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

ENCYCLOPÆDIA BRITANNICA

A New Survey of Universal Knowledge

Volume 6

COLEBROOKE to DAMASCIUS

THE UNIVERSITY OF CHICAGO

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Volume 6

COLEBROOKE to DAMASCIUS

COLEBROOKE, HENRY THOMAS (1765–1837), English orientalist, was born in London, June 15, 1765, and died March 18, 1837. He served in India as a civilian from 1782 to 1814, being a member of the Council of India for the last seven years of his service. After his return from India, he was a director of the Asiatic society. Colebrooke completed the translation of the *Digest of Hindu Laws*, begun by Sir William Jones, and wrote a *Sanskrit Grammar* (1805) and an *Essay on the Vedas* (1805), which was for a long time the standard work on the subject.

COLEMAN DU PONT ROAD, one of the most remarkable highways in the United States, conceived and built at his own expense and presented as a gift to the state of Delaware by Senator Coleman du Pont. It runs from Wilmington, Del. to the Maryland-Delaware state line at Selbyville, a distance of 98 mi. The original right-of-way, 200 ft. in width, was designed for a divided highway by-passing towns. This is believed to be the first highway to be built which was thus planned.

COLEMANITE, a hydrous calcium borate found in California as monoclinic crystals ($Ca_2B_6O_{11}5H_2O$). It contains 50.9% of boron trioxide, and is an important source of commercial borates and boracic acid. Beautifully developed crystals, up to two or three inches in length, encrust cavities in compact, white colemanite; they are colourless and transparent with brilliant lustre. There is a perfect cleavage parallel to the plane of symmetry of the crystals. Hardness 4–4½; sp. gr. 2.42. The mineral was first discovered in 1882 in Death valley, Inyo county, Calif., and in the following year it was found in greater abundance near Daggett, in San Bernardino county, Calif., forming with other borates and borosilicates a bed in sedimentary strata of sandstones and clays. *Priceite* and *pandermite* are hydrous calcium borates with very nearly the same composition as colemanite.

COLENSO, JOHN WILLIAM (1814–1883), English bishop of Natal, was born at St. Austell, Cornwall, on Jan. 24, 1814. In 1836 he was second wrangler and Smith's prizeman at Cambridge, and in 1837 he became fellow of St. John's. Two years later he went to Harrow as mathematical tutor, but the school was just then at the lowest ebb, and Colenso not only had few pupils, but lost most of his property by a fire. He went back to Cambridge, and in a short time paid off heavy debts by diligent tutoring and by the proceeds of his series of manuals of algebra (1841) and arithmetic (1843), which were adopted all over England. In 1846 he became rector of Forncett St. Mary, Norfolk, and in 1853 he was appointed bishop of Natal. He learned the Zulu language, of which he compiled a grammar and a dictionary, and translated the New Testament and other portions of Scripture into Zulu. He had already given evidence, in a volume of sermons dedicated to Maurice, that he was not satisfied with the traditional views about the Bible. The puzzling questions put to him by the Zulus strengthened him in this attitude and led him to make a critical examination of the Pentateuch. His conclusions, positive and negative, were published in a series of seven treatises on the Pentateuch, extending from 1862 to 1879, with the general title, *The Pentateuch and the Book of Joshua critically examined.*

While the controversy raged in England, the South African bishops, whose suspicions Colenso had already incurred by the liberality of his views respecting polygamy among native converts and by a commentary upon the Epistle to the Romans (1861), in which he combated the doctrine of eternal punishment, met, and pronounced his deposition (Dec. 1863). Colenso, who had refused to appear before their tribunal otherwise than as sending a protest by proxy, appealed to the privy council which pronounced that the metropolitan of Cape Town (Robert Gray) had no coercive jurisdiction and no authority to interfere with the bishop of Natal. No decision, therefore, was given upon the merits of the case. His adversaries, though unable to obtain his condemnation, succeeded in causing him to be generally inhibited from preaching in England, and Bishop Gray not only excommunicated him but consecrated a rival bishop for Natal (W. K. Macrorie), who, however, took his title from Maritzburg. Colenso returned to his diocese, and continued his work as a biblical commentator and translator. By his championship of the natives against Boer oppression and official encroachments he made more enemies among the colonists than he had ever made among the clergy. He died at Durban on June 20, 1883.

COLENSO, a village on the Tugela river in Natal, 16 mi. S. of Ladysmith, was the scene of a battle in the South African War (*q.v.*) on Dec. 15, 1899, between the Boers and the British force under Gen. Buller, which was endeavouring to relieve Ladysmith (*q.v.*). Buller, having assembled 20,000 men at Chieveley, moved forward, after two days' preliminary bombardment, to attack about an equal force of Boers under Louis Botha, who had entrenched themselves in a strong position on the north bank of the Tugela. Little was known by the British of the enemy positions or of the country they were to fight over. Two brigades were engaged, the one in a frontal attack at Colenso, the other 2 mi. farther west in what was intended to be a flank attack, but eventually also became frontal. The artillery supporting the right attack, coming into action within close range of the Boer positions, was quickly silenced; the infantry advance did not take place, and ten guns, despite repeated gallant attempts to bring them off, fell into Boer hands. The left brigade early lost direction and coming under concentric fire in a loop of the river suffered considerably and had to be withdrawn. Although little more than half his force had been engaged, Buller before mid-day issued orders to break off the action and return to camp. The so-called battle had, in fact, been little more than a reconnaissance in force, in which practically no loss had been inflicted on the Boers; but its moral effects, coming immediately after two other British defeats in the same week at Stormberg and Magersfontein, were considerable; Britain and the empire for the first time realized the true difficulty of effectively subduing the resistance of the South African republics, and were roused to efforts commensurate with the task. Pop. (1936) 1,123, including 443 whites.

COLEOPTERA, a term used in zoological classification for the true beetles which form one of the best defined and most natural orders of the Insecta. They vary very greatly in size and include some of the largest and also some of the most minute members of that class: thus *Dynastes hercules* attains a length of 155mm. (6in.) while there are members of the family Trichopterygidae that look like mere specks, less than ·5mm. long. The name (Gr. κολεός a sheath, and πτερά wings) is in allusion to the fore-wings which form horny or leathery sheaths or *elytra* which serve, when closed, to protect the membranous hind-wings which are folded beneath them. Their mouth-parts are adapted for biting and the prothorax is large and mobile. Beetles pass through a complete metamorphosis and their larvae are very varied in form, but generally possess legs or rudiments of them; only rarely are they footless. The above general definition will serve to recognize the majority of these insects of which approximately 180,000 species have been described. They form, it may be added, the largest single order in the whole animal kingdom: about 3,400 species occur in the British Isles and over 20,000 species are found in N. America. Perhaps the most characteristic feature of beetles is the solidarity of the integument exhibited in so many species, which is an important factor in protecting them against various enemies, and has evidently contributed much towards their dominance in the insect world. The habits of beetles are extremely varied, but they are more especially insects of the ground and either inhabit the soil or the various decaying animal and vegetable substances present. Consequently dung, carrion, vegetable refuse, rotting wood, and fungi all give sustenance to large numbers of these insects. On the other hand, many beetles, especially those of the metallic or other brilliant colours, are met with in association with growing vegetation and a considerable number are aquatic or sub-aquatic in habit.

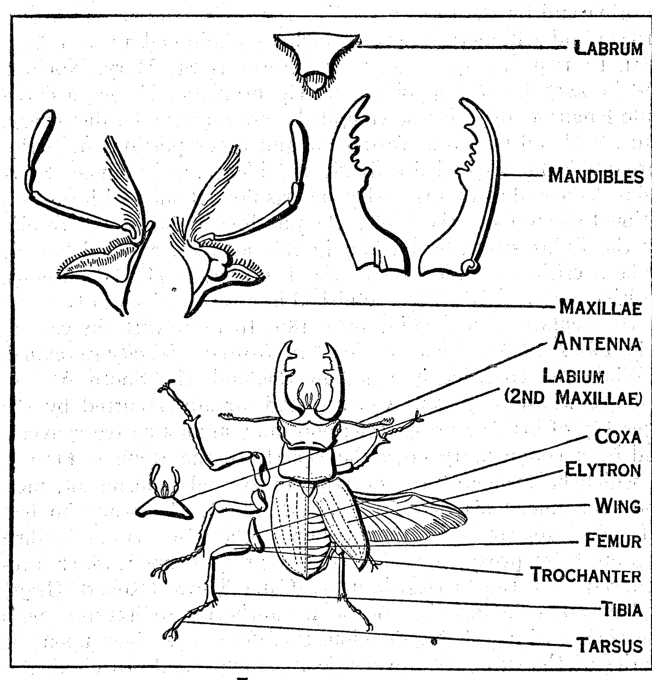


FIG. 1.—STAG BEETLE

The name is derived from the large, strong mandibles, found only in the male, which resemble horns of a stag

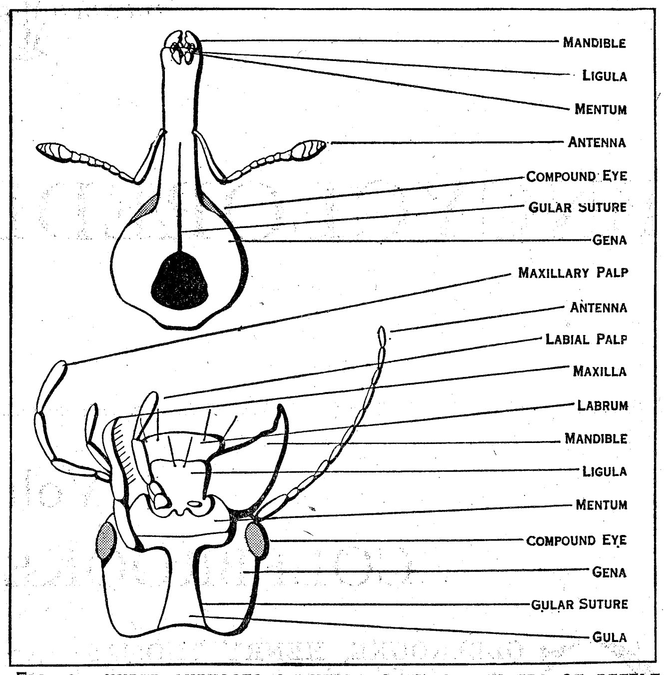


FIG. 2.—UNDER SURFACES OF HEADS OF TWO MEMBERS OF BEETLE FAMILY

Above, Weevil; below, Ground Beetle

General Structure.—The head is strongly chitinized and bears compound eyes but rarely ocelli: in most beetles a gular plate is present on the floor of the head, excepting weevils (fig. 2). The antennae vary greatly in character in different families: the mandibles are strong and very greatly developed in male stag-beetles (fig. 1) but as a rule they do not vary much in the two sexes: the maxillae consist of the typical parts, and the labium is characterized by its variability of form. The prothorax is a large shield forming the whole region between the head and the elytra, while the legs are generally adapted for running, more rarely for digging and, in water beetles, one or more pairs are flattened and oar-like for purposes of swimming. The elytra are the hardened, modified forewings and are protective rather than alary in function: they are variously sculptured and meet along the middle line of the body. The hind-wings (fig. 3) exhibit a characteristic venation which is of importance in classification: their most noteworthy feature is the presence or absence of a closed cell or oblongum. The number of segments in the abdomen is variable, ten being the maximum, and the first sternum is aborted: a true ovipositor is absent and the male genitalia are concealed.

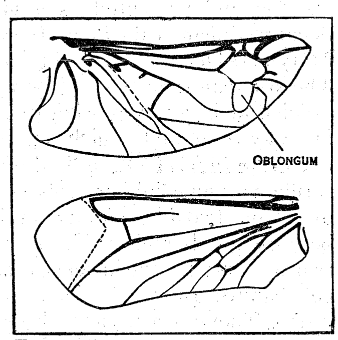


FIG. 3.—HIND-WING OF (ABOVE) WATER BEETLE, AND (BELOW), CLICK BEETLE, SHOWING DIFFERENCES IN THE ARRANGEMENT OF VEINS

Classification.—Many systems of classifying beetles have been proposed and one of the most satisfactory is that of Ganglbauer, who divides them into two main suborders and seven superfamilies, as below.

ADEPHAGA

Antennae usually thread-like: tarsi 5-jointed; hind wings with an oblongum and one or two cross-veins near middle (fig. 3): *first visible abdominal sternum completely divided by hind coxal cavities. Larvae predaceous, campodeiform* (fig. 23) *and usually with definite tarsi and paired claws.*

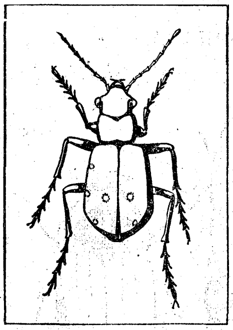


FIG. 4.—TIGER BEETLE
These beetles are fierce in nature, capturing other insects with their sharp mandibles

The Adephaga consist of a single superfamily, the *Caraboidea,* whose characters are as given above. Ten families are included here and the most important are as follows:

The *Cicindelidae* (fig. 4) are known as tiger beetles and rank among the most voracious of carnivorous insects. Their slender legs, acutely toothed mandibles, very prominent eyes and the presence of a jointed hook at the apex of the lacinia of the maxilla, are special distinguishing features. They are often brightly coloured and run and fly with great rapidity in sunshine. The species of *Cicindela* frequent sandy places, including the sea-shore, where their larvae construct deep burrows and feed upon other insects which they suddenly seize when near these retreats. About 1,800 species are known: four species inhabit the British Isles and 114 species occur in N. America, but the majority frequent hot countries.

The *Carabidae* (fig. 5) comprise the carnivorous ground beetles of which over 17,000 kinds are known. They are distinguished from the Cicindelidae by the absence of the jointed hook to the lacinia, and by the fact that the clypeus does not extend over the bases of the antennae. They mostly occur in the soil, under stones, in moss, under bark, etc., and are active runners: many species have hind wings reduced or absent, and the elytra soldered together. Since these beetles and their larvae prey upon other insects, worms, etc., they are distinctly useful to man: a few species may attack cereals and strawberries, but this is exceptional.

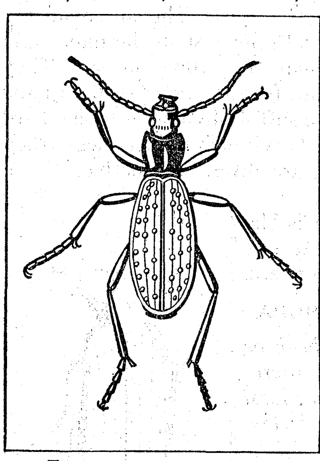


FIG. 5.—GROUND BEETLE
A member of the carnivorous family, *Carabidae;* ground beetles are found in the soil, under stones, or under bark

The *Dytiscidae* (fig. 6) are a large family of carnivorous water beetles. Their hind legs function as oars, being flattened and provided with long hairs. In the males of some genera three segments of the fore tarsi are expanded to form sucker pads which enable them to hold the females during pairing. Their larvae prey upon other forms of aquatic life including even tadpoles and small fish: their long sickle-like jaws are perforated by a fine canal through which the body-fluids of their victims are imbibed. The family is world-wide and includes about 2,200 species.

Other families include the *Gyrinidae* or whirligig beetles which swim on the surface of fresh water, and the curious *Paussidae* which inhabit ants' nests.

POLYPHAGA

Antennae and tarsi very variable: hind wings without cross-veins or oblongum (fig. 3): *first visible abdominal sternum not completely divided by hind coxal cavities. Larvae very variable in form and habit: tarsi wanting, claws single.*

SUPERFAMILY I. STAPHYLINOIDEA

Antennae simple or clubbed: venation of hind-wings without any closed cells, often greatly reduced. Larvae generally campodeiform.

The *Staphylinidae* (fig. 7) or rove-beetles amount to about 13,000 species, over 800 inhabiting the British Isles. They are easily distinguished by the very short elytra which usually leave

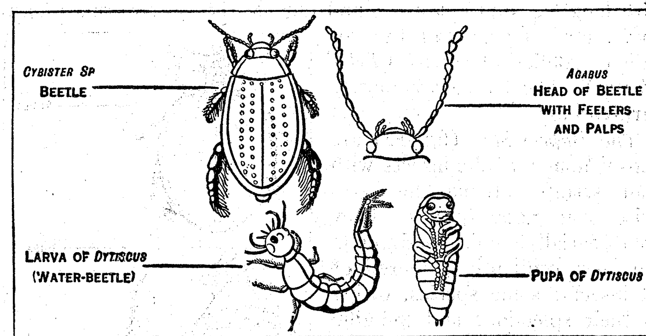


FIG. 6.—WATER BEETLE
In these aquatic beetles, the intermediate and hind legs are modified as swimming organs

the greater part of the abdomen uncovered. Both these beetles and their larvae inhabit the soil or decaying organic matter of many kinds: some are carnivorous and others feed on refuse.

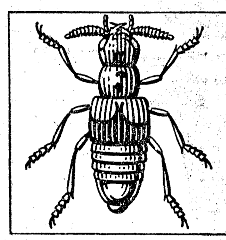


FIG. 7.—ROVE-BEETLE, A EUROPEAN MEMBER OF THE STAPHYLINIDAE GROUP

The *Silphidae* (fig. 8) include the carrion beetles and allies. The true burying beetles (*Necrophorus*) are large black or black and orange insects feeding upon small animal carcasses. The larvae of some species of *Silpha* prey upon snails or caterpillars, while those of *S. opaca* attack root crops.

The *Histeridae* are a large family of hard, shining beetles with elbowed, clubbed antennae: the elytra are shortened behind, leaving the last two body-segments exposed. *Hister* and its allies frequent dung and carrion while other genera live under bark. The larvae are carnivorous.

Among other families, mention must be made of the *Trichopterygidae* which are the most minute of all beetles.

SUPERFAMILY II. DIVERSICORNIA

Antennae generally clubbed or serrate: tarsi 1- to 5-jointed but not heteromerous. Larvae very varied.

This enormous division includes a great number of families and is to be regarded as a provisional group, including all those forms not belonging to other superfamilies: only a few of the important families can be mentioned here.

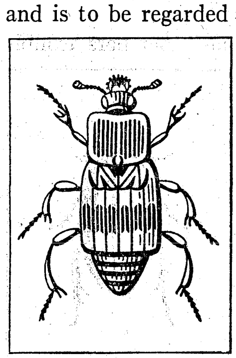


FIG. 8.—SEXTON BEETLE

The *Coccinellidae* (fig. 9) or ladybirds are rounded insects with the head concealed under the thorax: the antennae are feebly clubbed and the tarsi have three evident joints. Most of the species are brightly coloured and spotted, and since both the larvae and adults prey upon aphids and other soft-bodied insects, the family is highly beneficial to man. A small number, however, are injurious to vegetation, especially the squash-ladybird *Epilachna borealis* of the United States. More than 2,000 kinds of ladybirds are known and they occur in most parts of the world.

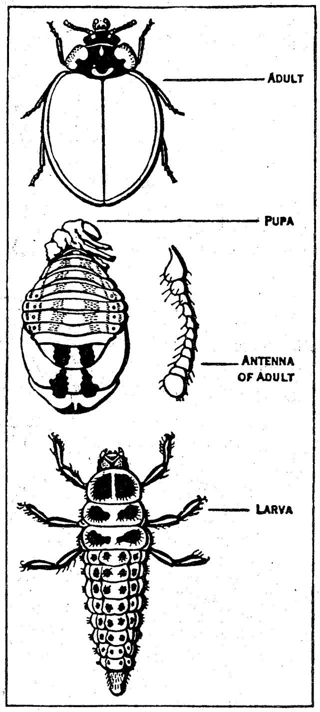
The *Dermestidae* are hard, dull-coloured insects with scaly or hairy elytra. Their larvae are active, hairy, with evident legs and feed upon dried animal matter, fur, hair, bacon, etc. Certain species have become widely spread through commerce and 16 occur in the British Isles.

The *Hydrophilidae* (fig. 10) are aquatic or sub-aquatic beetles numbering about 1,000 species. They are herbivorous in habit and can be recognized by the very long maxillary palpi which are often mistaken for antennae: the latter organs are very short and terminate in a hairy club. The large black *Hydrophilus piceus* when submerged, carries a supply of air beneath the elytra, and lays its eggs in a kind of cocoon attached to a leaf: its larva feeds upon other aquatic organisms.

The *Cantharidae* (fig. 11) are very soft-bodied elongate insects with long legs and antennae, and include the glow-worms (*Lampyris*, etc.) (*q.v.*) and the so-called soldier beetles (*Telephorus*). The larvae are mostly carnivorous.

The *Buprestidae* (fig. 12) are conspicuous metallic insects with short serrate antennae and comprise over 5,000 species. They are essentially tropical and among the most brilliantly coloured of all insects: some species, owing to their splendour and metallic lustre, are used in embroidery and jewellery. The beetles fly actively and inhabit forests where their larvae mostly live beneath the bark, wood and roots of trees.

The *Elateridae* or click beetles are a large and important family of wide distribution. By means of a peg and socket arrangement on the under side of the body, these insects are enabled to leap into the air with a clicking sound, hence their name. The larvae of certain species of *Agriotes*, and other genera, are known as wireworms (fig. 13) and are exceedingly destructive to cereals, grasses and root-crops, feeding actively on the underground parts of the plants. Included in this family are the "fire-flies" (*Pyrophorus*) of tropical America, which emit a bright light from localized areas on the thorax and the base of the abdomen.



AFTER WARLATT, BY COURTESY OF THE U.S. DEPARTMENT OF AGRICULTURE

FIG. 9.—LADYBIRD, SHOWING THE PUPA, LARVA, AND ADULT
The *Coccinellidae* family, to which the Ladybird belongs, lives mainly on plant lice

Among other families the *Anobiidae* or "death watch" beetles and the *Lyctidae* or powder post beetles should be mentioned.

SUPERFAMILY III. HETEROMERA

Fore- and middle tarsi 5-jointed, hind tarsi 4-jointed. Larvae campodeiform, or more usually an intermediate type.

The Heteromera include 17 families whose members exhibit great diversity of form and habit but all agree in the possession of the tarsal characters enumerated above. The two most important families are the following:

The *Tenebrionidae* are a very large group of beetles, variable in size and form, and number about 10,000 species. The familiar "black beetles" of the genus *Blaps* occur in cellars and outbuildings, and species of *Tenebrio* infest flour, meal and stored goods, their larvae being known as meal worms: most members of the family, however, occur on the ground, under stones and logs, or beneath bark.

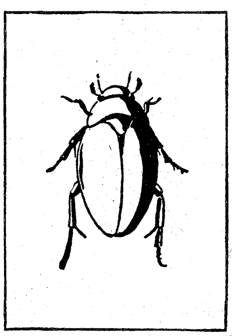


FIG. 10.—BLACK WATER BEETLE

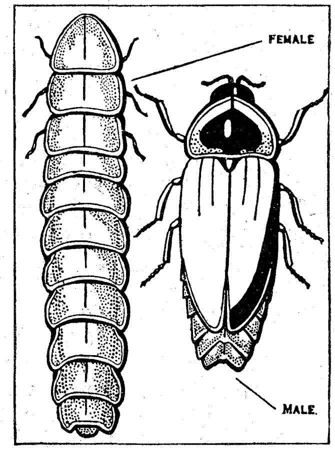
The *Melöidae* (fig. 14) comprise the blister beetles and oil beetles which are soft bodied insects with the elytra (often abbreviated) not fitting closely to the sides of the body, the head constricted behind forming a neck, and the claws of the feet cleft to the base. Their life-histories are very remarkable and the newly hatched larvae are active creatures known as triungulins. In *Melöe* and *Sitaris* these triungulins are dependent upon meeting certain wild bees, so, that they may be carried to their nests where they complete their development. Here they feed upon the eggs and stored honey or the latter only, and at each moult change their form and undergo a remarkable hypermetamorphosis (*see* INSECTS). The "spanish fly," *Lytta vesicatoria*, which yields cantharidin, is also a member of this family.

Mention should also be made of the *Rhipiphoridae* whose larvae are parasites of wasps, etc., and the *Pyrochroidae* which include the scarlet, or scarlet and black, cardinal beetles.

SUPERFAMILY IV. PHYTOPHAGA

Plant-feeding beetles with the antennae generally simple, less often pectinate or serrate: tarsi apparently 4-jointed, the 4th joint minute and concealed by the 3rd joint. Larvae eruciform with short or rudimentary legs.

The *Chrysomelidae* or leaf-beetles (fig. 15) number about 20,000 described species, being the second largest family of Coleoptera. These insects are usually bare and shining often with metallic colours, the antennae are of moderate length and are not embraced by the eyes around their points of origin from the head. Included in this family are such well known insects as the Colorado potato beetle and the asparagus beetle. In all cases the larvae and beetles feed on the leaves and other parts of plants: in the elongate metallic species of *Donacia* the larvae live submerged in the roots and stems of water plants.



FROM IMMS, "GENERAL TEXTBOOK OF ENTOMOLOGY" (METHUEN & CO.)

FIG. 11.—GLOW-WORM (LAMPROPHONUS TARDUS)

The *Cerambycidae* or longicorn beetles (fig. 16) are closely allied to the above family but are more rarely metallic and usually somewhat pubescent, elongate insects with the bases of the antennae more or less embraced by the eyes. The antennae are frequently elongate and slender, usually longest in the males and sometimes several times longer than the whole insect. They are mainly denizens of woods and forests, and about 13,000 species are known. Their larvae have soft fleshy bodies with a hard head and jaws, broad prothorax and very much reduced legs: they tunnel into the wood of trees and are often destructive. Some species live several years as larvae.

The other family of Phytophaga is the *Bruchidae* (or *Laridae*) whose larvae live in seeds, especially dried peas, beans, etc.

SUPERFAMILY V. RHYNCHOPHORA

Head generally produced into a beak or rostrum: gular plate absent and represented by a single mid-ventral suture: tarsi with four evident joints. Larvae legless and maggot-like.

The Rhynchophora are a vast assemblage of insects usually very easy to recognize and are all plant-feeders. They are divided into four main families of which the most important are the following:

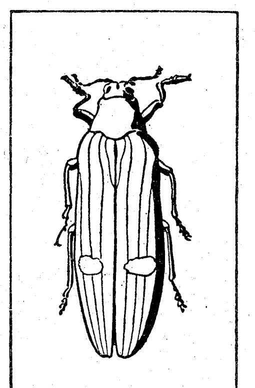


FIG. 12.—THE BUPRESTID BEETLE OF JAVA
The anterior wings of this beetle are used as ornaments of dress

The *Curculionidae* or weevils (figs. 17 and 2) include nearly 30,000 known species and great numbers still await discovery in tropical lands. They are usually recognized by the pronounced rostrum or beak, the clubbed elbowed antennae and the very reduced rigid palpi. The female often uses the rostrum as a boring instrument to prepare a place for egg-laying and the organ is usually longest in that sex. As a rule weevils (*q.v.*) are sombrely coloured but the tropical diamond beetles are beautiful insects. The family includes many destructive species including the cotton boll weevil, the grain weevils and the apple blossom weevil.

The *Scolytidae* (*Ipidae*) or bark beetles bore into the bark and wood of trees and are among the most serious enemies the forester has to contend with. They are hard, cylindrical insects devoid of a rostrum and with the tibiae armed with denticles (fig. 18). They construct galleries of very definite patterns beneath the bark, and their larvae closely resemble those of the weevils.

SUPERFAMILY VI. LAMELLICORNIA

Antennae clubbed, the club composed of plates or comb-like projections: legs stout and spiny, used for burrowing, tarsi 5-jointed. Larvae fleshy and crescentic with rather long legs.

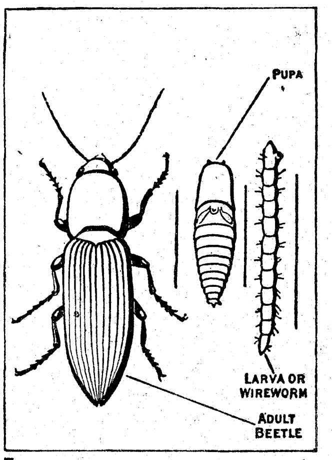


FIG. 13.—WIREWORM, THE LARVA OF CERTAIN CLICK BEETLES. IT IS DESTRUCTIVE TO ROOT CROPS

There are three families of Lamellicornia as follows:

The *Lucanidae* or stag beetles (fig. 19) are notable owing to the great development of the mandibles in the males, in which sex they are often antler-like in form: the use of these organs is problematical. The antennae are elbowed and the elytra cover the apex of the abdomen; their larvae inhabit decaying trees or their roots.

The *Passalidae* are confined to tropical forests: unlike the Lucanidae they have striated elytra and the jaws in the two sexes are alike. Their larvae live gregariously in wood and are tended by the parent beetles.

The *Scarabaeidae* (fig. 20) number over 14,000 species: the rose chafer, cockchafer and the "dor" beetles are familiar examples, while the sacred beetles or scarabs of ancient Egypt also find their place here. They are somewhat convex with very short antennae which are not elbowed, and the elytra do not cover the apex of the abdomen. The *Scarabaeus* has been studied by J. H. Fabre and the female beetles collect dung into balls which they roll along the ground and store in the earth as food for themselves and their larvae. The African goliath beetles (fig. 21) are among the largest of all insects. The larvae in this family feed upon dung, rotting wood, etc., or at the roots of plants: the latter habit prevails among cockchafers and great injury to crops may result.

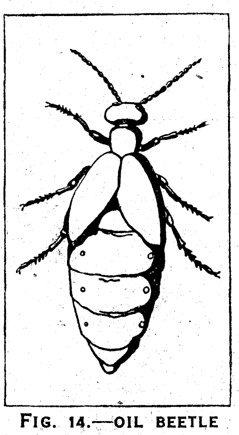


FIG. 14.—OIL BEETLE
The larvae of this group develop into mature growth only under nourishment derived from wild bees' eggs and honey

Reproduction and Development.—The eggs of beetles are laid in all kinds of places and most of them are ovoid without special features. Beetles are not very prolific and, although the oil beetles may lay several thousand eggs apiece, this is exceptional. By ladybirds the eggs are laid in batches on leaves, some water beetles enclose their eggs in a kind of cocoon, while many weevils lay them in deep holes, drilled by the rostrum of the female, in the food plants. All beetles undergo complete metamorphosis and their larvae vary greatly in character (fig. 22). They may be active and seek out their prey, as in the ground beetles, tiger beetles and ladybirds (figs. 22 and 23). Others, such as the chafers (fig. 22), have sluggish larvae, and live below ground or in rotting wood: although possessed of well formed legs they seldom seem to use them. In the weevils the larvae are legless maggots (fig. 22), remaining in close association with their food. When fully fed, beetle larvae transform into generally pale-coloured, very thin-skinned pupae which have the appendages free (fig. 17). Such pupae are commonly found without a special cocoon in the soil or in whatever material the larvae fed upon. In some cases earthen protective cells are constructed or a loose cocoon of wood or debris, while a few weevils form attractive net-like or seed-like cocoons attached to their food-plants.

As a general rule, beetles have a single generation in the year and many of them hibernate as adults under bark, in moss, etc. Some species, such as certain bean weevils and the cotton boll weevil, may complete their life-cycle in a few weeks, and there results a number of broods in the year: the same remark applies to certain beetles living under warm conditions in stored grain. On the other hand, the cockchafer and stag beetle require several years to complete their transformations. Certain beetles of parasitic habits undergo hypermetamorphosis (for definition *see* INSECTS). Thus, some of the Staphylinidae of the genus *Aleochara* hatch from the egg as active free larvae; which roam about and seek the puparia of certain kinds of flies. They bore their way into their hosts and transform into inert sluggish maggots with vestigial limbs. The same peculiarity is found in the Melöidae whose active newly hatched larvae are known as triungulins (*see* above).

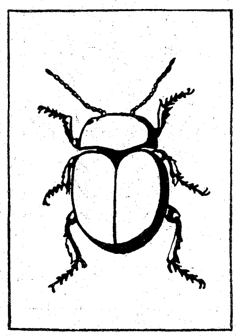


FIG. 15.—LEAF-BEETLE
These destructive beetles comprise about 20,000 species. The mandibles are strong, and adapted to a vegetable diet

Geographical Distribution. — Coleoptera are the most widely distributed of all large orders of insects and no other order has invaded the land, air and water to so great an extent. Many of the dominant families such as the Carabidae (ground beetles), Curculionidae (weevils) and Scarabaeidae (chafers) are almost as widely distributed as the order itself. On the other hand, the Dytiscidae (water beetles) are more abundant on the northern continents, while the Cicindelidae (tiger beetles), Buprestidae, Cerambycidae (longicorns) and Lucanidae (stag beetles) are essentially tropical families, becoming scarcer in more temperate zones. Some of the smaller families, however, are very restricted in their range, the Proterhinidae (closely allied to the weevils), for example, being almost confined to the Hawaiian Islands, and the aquatic family Amphizoidae only occurring in parts of N. America and Thibet. Certain species of beetles of diverse families appear more tolerant of climatic differences than others, and about 500 kinds are common to Europe, N. America and northern Asia. Many have become widely spread through the agency of man and over 100 species, more especially those affecting grain and other stored products, are now practically cosmopolitan. The study of island life yields some interesting features relative to the distribution of beetles. Thus, in the Madeira Islands, Wollaston found 580 species of Coleoptera, and of these, 266 kinds are peculiar to those islands, although allied to European species: in the Hawaiian Islands, Sharp mentions 428 species among which 352 species have not so far been found elsewhere. Thus the peculiar species must have formerly existed elsewhere, migrated to the islands mentioned, and since become extinct in their original homes, or they must have been evolved within the islands—the latter being the more probable.

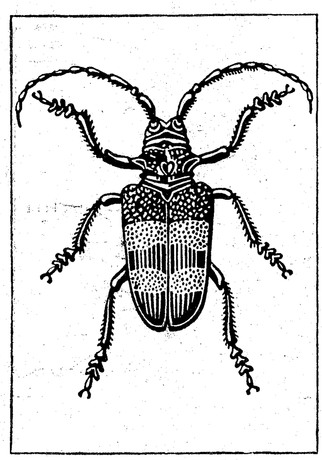
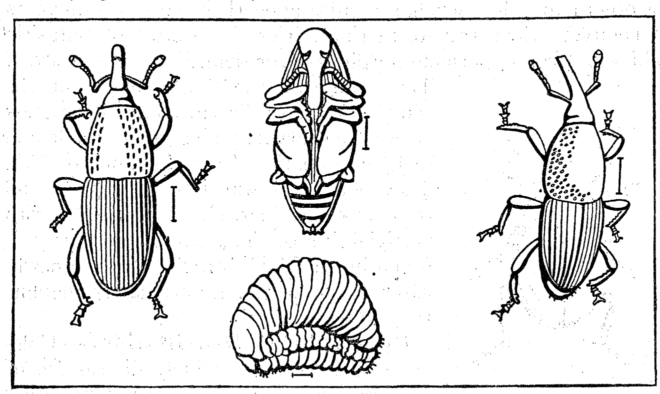


FIG. 16.—LONGICORN BEETLE, A MEMBER OF THE CERAMBYCIDAE FAMILY

Geological Distribution.—The oldest known fossil beetles come from the Upper Permian beds of New South Wales and consist of elytra only: these remains have been referred to special families, unrepresented at the present day, and certain of them show affinities with the existing family Hydrophilidae. A great number of fossil remains of beetles have been found in the Upper Trias of Ipswich, Queensland, and in the Trias of Switzerland. Some of these Triassic fossils are leaf-beetles and weevils, while the English Purbeck beds have yielded remains of bark beetles. In the Tertiary rocks of Colorado and Florissant and in the Prussian amber (Oligocene) many fossils referable to living genera have been found, including about 400 species of weevils.

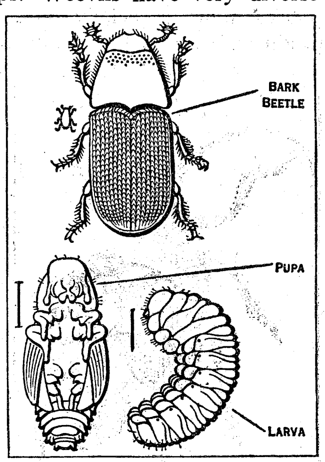
Natural History.—Beetles and their larvae live and feed in almost all the diverse ways found among insects. The carnivorous habit of seeking and devouring living prey occurs in the ground beetles, tiger beetles, ladybirds and in water-beetles of the family



BY COURTESY OF U.S. DEPT. OF AGRICULTURE, FROM CHITTENDEN, "YEARBOOK, 1894"

FIG. 17.—THE GRAIN WEEVIL, A SOURCE OF GREAT AGRICULTURAL LOSSES
Left: *Calandra granaria;* above, pupa; below, larva; right, *Calandra oryzae*

Dytiscidae. In these instances the beetles and their larvae have like habits. In certain rove beetles of the genus *Aleochara,* in the ground beetle *Lebia scapularis* and in the curious *Metaecus paradoxus* (fam. Rhipiphoridae) the larvae are true parasites and the beetles free-living—a habit that is rare among Coleoptera. The *Metaecus* occurs in Britain and its newly hatched larva is a minute black, active creature which, by some unknown means, finds its way into wasps' nests. Here it becomes an internal parasite of the wasp grub and subsequently bores its way out of its host, finally devouring the remains. A vast number of beetles and their larvae feed directly upon plants: this is the case with the whole family of the Chrysomelidae, or leaf beetles, and with the weevils. Others, such as the Cerambycidae (longicorns), Scolytidae (bark beetles) and Buprestidae, feed in the larval stages upon the wood or bark of trees. Wireworms, or injurious Elaterid larvae, and chafer larvae feed on the roots of various crops. Weevils have very diverse habits and no parts of plants from the roots to the seeds are exempt from the attacks of one or more species. There is again a great and diverse assembly of beetles, and more especially their larvae, which feed entirely upon decaying organic matter of various sorts. Thus the Silphidae include many carrion feeders and are well exemplified by the burying beetles; hosts of rove beetles frequent refuse of all kinds, and many Scarabaeidae live in dung. We have to add to these examples the many beetles and their larvae that live in grain and other stored products, and those attacking hides, furs, museum specimens, tobacco and drugs.



AFTER HOPKINS, BY COURTESY OF THE U.S. DEPARTMENT OF AGRICULTURE

FIG. 18.—BARK BEETLE
The adult beetle tunnels beneath the bark to deposit her eggs, and the young beetle, on emerging, cuts fresh galleries off the original passage

Apart from the more usual habits it is interesting to note certain exceptional modes of life found among beetles. There are genera and even whole families that live in the nests of ants or of termites. There are others that inhabit the extensive limestone caves of Europe and North America, while certain blind ground beetles are only met with beneath huge boulders deeply embedded in the earth. There are also species that inhabit the sea-shore and are submerged by the tides.

Means of protection against enemies are very varied among Coleoptera. Some are cryptically coloured and closely resemble their surroundings: thus in the African longicorn *Petrognatha gigas* the whole upper surface resembles dead velvety moss, and its irregular antennae are very like dried tendrils or twigs. Many weevils fall and feign death at the least alarm and, folding their limbs close around the body, look like seeds or particles of soil, thus escaping observation. There are again beetles, especially those living in ants' nests, that resemble ants, and the common wasp beetle of Europe, both in its movements and colouration, closely resembles a wasp (for further instances of this kind *see* the article MIMICRY). There are other beetles which obtain some measure of protection possibly from their repellent appearance, or from their property of emitting evil-smelling or distasteful secretions, either in the form of exudations of blood from definite parts of the body, or as the product of special foetid glands. The bombardier beetles (fam. Carabidae) have the property of secreting an evil-smelling defensive fluid from the anal end of the body. In some cases this fluid volatilizes into a gas which appears like a minute jet of smoke when it comes into contact with the air, and its caustic properties act as a repellent to other insects or foes. Finally a number of beetles secure protection in virtue of their general agility of movement—thus, many ground beetles and tiger beetles run rapidly and the latter also take to the wing with great readiness, while the flea-beetles have remarkable powers of leaping.

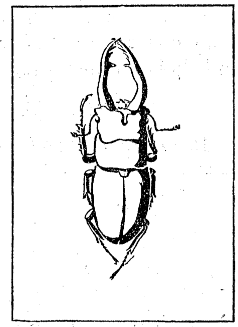


FIG. 19.—STAG BEETLE OF JAVA, SHOWING ANTLER-LIKE MANDIBLES

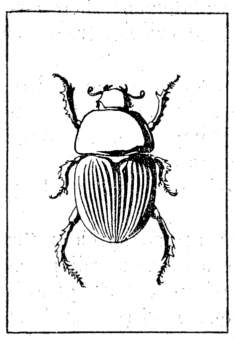


FIG. 20.—BRITISH "DOR" BEETLE
This member of the family *Scarabaeidae* flies in the evening with a loud humming flight, and its larva feeds upon dung

Many beetles are capable of sound-production which is usually brought about by the friction of one part of the body (the "scraper") against another part (the "file"). These stridulating organs have been studied by C. Darwin and more recently (1900) by C. J. Gahan: they are generally present in both sexes and probably serve for mutual sexual calling. In some beetles there is a file-like area on the head which is rasped by the anterior margin of the prothorax. Among the Cerambycidae (longicorns) the sound is produced either by rubbing the hind margin of the prothorax over a striated area on the mesothorax, or by rubbing the femora of the hind legs against the margins of the elytra. Stridulation, however, is not confined to adult beetles, but obtains in certain larvae also. Thus, in some larvae of the group Lamellicornia there is a series of ridges or tubercles on the coxae of the middle pair of legs and the hind legs are modified in various ways as rasping organs. In the cockchafer larva and larvae of other Scarabaeidae a ridged area on the mandible is rasped by a series of teeth on the maxillae. Stridulation in larvae is quite independent of sex and it has been suggested that it is to warn neighbouring larvae, inhabiting burrows in wood, etc., to avoid getting in each other's way.

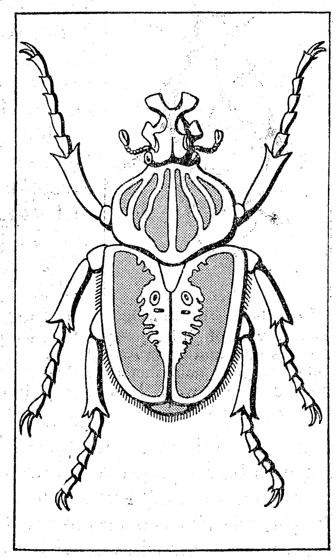
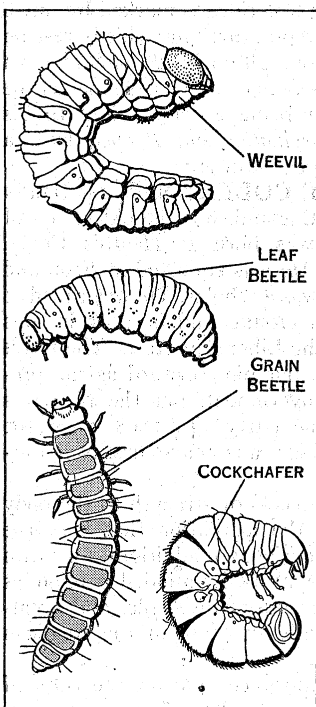


FIG. 21.—GOLIATH BEETLE

Apart from recognition by sound, some other beetles emit a bright light for the same purpose. The seat of the light is in special luminous organs which consist of an outer or light-producing layer, and an inner or reflector layer. The outer layer is supplied with oxygen by means of tracheae and the reflector layer contains many urate crystals which appear to act as a background, scattering the light and preventing its dispersion internally. The light is produced as the result of the oxidation of a compound *luciferin* in the presence of an enzyme-like substance *luciferase,* which takes place in the outer layer of the luminous organ. It has been suggested that this property does not reside in the actual cells of the tissue concerned, but is due to the presence therein of special luminous bacteria. Luminous beetles belong to the families Cantharidae and Elateridae and a familiar example of the first mentioned family is the common European glow-worm *Lampyris noctiluca,* whose wingless female emits a bright light near the hind end of the body: its winged male exhibits a much feebler luminosity. The luminous Elateridae include the fire-flies of the genera *Pyrophorus* and *Photophorus,* both sexes of which are winged and luminous.



FROM IMMS, "GENERAL TEXTBOOK OF ENTOMOLOGY" (METHUEN & CO.)

FIG. 22.—LARVAE OF VARIOUS SPECIES OF COLEOPTERA. ALL BEETLES UNDERGO COMPLETE METAMORPHOSIS

Economic Importance.—Beetles include among their species many that are injurious, either as larvae or often as adults also. Among those which attack farm crops, wireworms, or injurious larvae of certain click beetles are severe pests of the farmer. They are most prevalent in newly ploughed grassland and attack the supervening crops, particularly cereals and roots. Flea beetles (fam. Chrysomelidae) cause great injuries to plants of the turnip tribe, both the beetles and their larvae feeding upon the leaves and other parts. The asparagus beetle (*Crioceris asparagi*), belonging to the same family, is a familiar pest with growers of that vegetable in Europe and N. America (fig. 24). Related to it is the Colorado potato beetle (*Leptinotarsa decemlineata*) which is destructive to potato foliage in the eastern half of N. America: quite recently it has become established in the Bordeaux district of France. The Japanese beetle (*Popillia japonica*), one of the chafers, was accidentally introduced into New Jersey, from Japan, about 1916 and is extending its range in N. America where the beetle is injurious to the foliage of fruit and other trees, and its underground larvae damage lawns and golf greens. The common cockchafer (*Melolontha vulgaris*) and its allies are European pests whose larvae devour the roots of farm and other crops, the beetles feeding upon the foliage of trees. Many weevils are highly injurious: thus, the cotton boll weevil (*Anthonomus grandis*) is the most serious enemy of the American cotton crop. It entered Texas about 1892 from tropical America, subsequently infesting almost the whole cotton belt. In England, and other parts of Europe, its ally the apple blossom weevil (*A. pomorum*) prevents the formation of large quantities of fruit. The palm weevil (*Rhynchophorus ferrugineus*) infests toddy and cocoa-nut palms, and the pine weevil (*Hylobius abietis*) is extremely harmful to young conifers in Great Britain. Various members of the Scolytidae (bark beetles) are widespread pests of forest trees: one species (*Xyleborus fornicatus*) is the shot-hole borer of tea in Ceylon. Larvae of many Cerambycidae (longicorns) are also destructive to living and dead timber, while species of *Anobium* and *Xestobium* (death watch beetles) bore into furniture and the rafters of public buildings (fig. 25A): the powder-post beetles (Lyctidae) have very similar habits. Many beetles also attack stored grain, meal and other dried products, notably the granary weevils (*Calandra*) and the meal-worms and their allies (fam. Tenebrionidae).

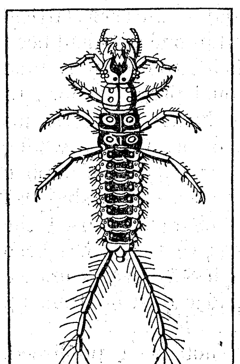

FROM CARPENTER, "INSECT TRANSFORMATION" (U.S. DEPT. AGR.)

FIG. 23.—THE LARVAE OF A GROUND BEETLE (CARABIDAE)

The larvae of ground beetles seek out their prey, while those of many other beetles are sluggish

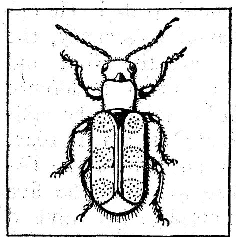


FIG. 24.—ASPARAGUS BEETLE, WHICH ATTACKS YOUNG ASPARAGUS SHOOTS, WHILE ITS LARVA DESTROYS THE SHOOTS, BERRIES AND SEEDS

The above remarks serve to show the many injurious species of Coleoptera; nevertheless, there are others which have been employed by man to his own benefit. The Australian ladybird (*Novius cardinalis*) has been imported into most citrus-growing countries of the world for the purpose of controlling the fluted scale which it attacks and destroys to a remarkable degree. Another Australian ladybird (*Cryptolaemus montrouzieri*) has a similar habit of preying upon mealy bugs (Coccidae), and its introduction into the Hawaiian Islands and California has achieved a remarkable degree of success. The European ground beetle *Calosoma sycophanta* has been introduced into N. America, where it preys upon the caterpillars of the gipsy moth and brown-tail moth. Mention must also be made of another type of useful beetle viz. the Spanish fly (*Lytta vesicatoria*) which yields cantharidin.

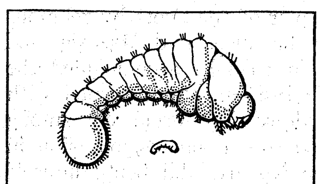
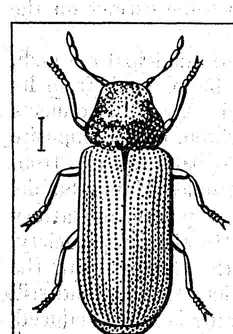

FROM C. J. GAHAN, "FURNITURE BEETLES" BY COURTESY OF TRUSTEES OF BRITISH MUSEUM

FIG. 25A.—LARVA OF COMMON FURNITURE BEETLE (ANOBIUM PUNCTATUM). NATURAL SIZE BELOW

BIBLIOGRAPHY.—In addition to information given in general textbooks of entomology (*see* INSECTS) the volume by W. W. Fowler in *Fauna of British India: Coleoptera—General Introduction* etc. (1912), should be consulted. Among continental authorities, L. Ganglbauer's *Käfer von Mitteleuropa* (1892–1904) is a standard work. British beetles are described and figured in W. W. Fowler, *Coleoptera of the British Islands,* (1887–1913); a less expensive work, valuable for the British species, is E. Reitter, *Fauna Germanica: Käfer* (1908–16). For the North American species, J. L. Leconte and G. H. Horn *Classification of the Coleoptera of N. America* (Smithsonian Misc. Coll. xxxviii., 1883), although old, is an important general work; a more recent book for the ordinary student is W. G. Blatchley, *Coleoptera of Indiana* (1910).

Catalogues of the species of Coleoptera include the *Catalogus Coleopterorum Europeae* (1906) by L. Heyden, E. Reitter and J. Weise; C. W. Leng, *Catalogue of the Coleoptera of America* (1920; with supplement, 1927); and E. A. Newberry and W. E. Sharp, *An Exchange List of British Coleoptera* (1915).

Works on the natural history of beetles include L. C. Miall, *Natural History of Aquatic Insects* (1902) and J. H. Fabre, *Souvenirs Entomologiques* (1879–91), many of the latter being available in English. The stridulating organs are described by C. J. Gahan in *Trans. Entomological Soc. London* (1900), and the luminous organs by E. N. Harvey, *Nature of Animal Light* (1920). The larvae of beetles are beautifully figured by J. C. Schiödte in a series of papers in *Naturh. Tidsskr,* i.–xiii., (1861–72), a journal to be found in leading scientific libraries. A standard anatomical and biological work, based upon a study of the water beetle *Dytiscus,* is E. Korschelt, *Der Gelbrand* (1923), which is a mine of information for the special student, with copious bibliographical references. (A. D. I.)



BY COURTESY OF TRUSTEES OF BRITISH MUSEUM FROM C. J. GAHAN, "FURNITURE BEETLES"

FIG. 25B.—THE ADULT FORM OF THE COMMON FURNITURE BEETLE

Attacks wood, from the larval stages

COLEPEPER, JOHN COLEPEPER (or CULPEPPER), 1st BARON (d. 1660), English statesman, was the only son of Sir John Colepeper, of Wigsell, Sussex. He was elected member for

Kent in the Long parliament, when he took the popular side, speaking against monopolies on Nov. 9, 1640, being entrusted with the impeachment of Sir Robert Berkeley on Feb. 12, 1641, supporting Strafford's attainder, and being appointed to the committee of defence on Aug. 12, 1641. He separated, however, from the popular party on the Church question, fearing the effect of the revolutionary changes which were now contemplated. He opposed the London petition for the abolition of episcopacy, the project of religious union with the Scots, and the Root and Branch Bill, and on Sept. 1 he moved a resolution in defence of the prayer-book. In the following session he opposed the militia bill and the Grand Remonstrance, and finally on Jan. 2, 1642, he joined the king's party, taking office as chancellor of the Exchequer. He highly disapproved of the attempt upon the five members, which was made without his knowledge, but advised the enterprise against Hull. On Aug. 25, 1642, he appeared at the bar of the House of Commons to deliver the king's final proposals for peace, and was afterwards present at Edgehill. In December he was made by Charles master of the rolls. He was a leading member of the Oxford parliament, and was said, in opposition to the general opinion, to have counselled considerable concessions to secure peace. He received a peerage in 1644.

Colepeper was despatched with Hyde in charge of the prince of Wales to the West in March 1645, and after Charles's final defeat, embarked with the prince for Scilly, and thence to France. He strongly advocated the gaining over of the Scots by religious concessions, a policy supported by the queen and Mazarin, and urged this course upon the king. In 1648 he accompanied the prince in his unsuccessful naval expedition, and returned with him to The Hague, where violent altercations broke out among the royalist leaders, Colepeper going so far, on one occasion in the council, as to challenge Prince Rupert, and being himself severely assaulted in the streets by Sir Robert Walsh. He continued after the execution of the king to press the acceptance on Charles II. of the Scottish proposals. He was sent to Russia in 1650, where he obtained a loan of 20,000 roubles from the tsar, and, soon after his return, to Holland, to procure military assistance. By the treaty, agreed to between Cromwell and Mazarin, of Aug. 1654, Colepeper was obliged to leave France, and he appears henceforth to have resided in Flanders. He accompanied Charles II. to the south of France in Sept. 1659, at the time of the treaty of the Pyrenees. At the Restoration he returned to England, but only survived a few weeks, dying on June 11, 1660.

THOMAS COLEPEPER (d. 1719), son of the former, became governor of Virginia from 1680–83; the title became extinct on the death of his brother Cheney in 1725.

COLERAINE, seaport, market town and municipal borough, Co. Londonderry, Northern Ireland, on the Bann, 4 mi. from its mouth. Pop. (1937) 9,180. Area, 1.6 sq.mi. A bridge connects the town with its suburb, Waterside or Killowen, on the opposite bank of the river. The main town on the east bank radiates from a central square—the Diamond. A rath occupies Mount Sandel 1 mi. S.E. of the town and there was once a priory, monastery and castle. Coleraine owed its importance to the Irish society, which was incorporated under James I as the Company for the New Plantation of Ulster in 1613. This society founded and still maintains schools in the town. The linen trade is much reduced, the staple industries being shirt and collar making, whiskey distilling, ironfounding and salmon fishing. The harbours were much improved by grants from the Irish Society of London and the River Bann Navigation act, 1879.

COLERIDGE, HARTLEY (1796–1849), English man of letters, eldest son of the poet Samuel Taylor Coleridge, was born on Sept. 19, 1796, near Bristol. In 1815 he went to Oxford, as scholar of Merton College. His university career, however, was unfortunate. He gained an Oriel fellowship, but at the close of the probationary year (1820) was judged to have forfeited it. Hartley Coleridge then spent two years in London, where he wrote short poems for the *London Magazine,* afterwards he became for a short time partner in a school at Ambleside, and in 1830 began to do hack work for a Leeds publisher, Mr. F. E. Bingley. Bingley also printed a volume of his poems in 1833, and Coleridge lived in his house until the contract came to an end through the bankruptcy of the publisher. From this time, except for two short periods in 1837 and 1838 when he acted as master at Sedbergh grammar school, he lived quietly at Grasmere and (1840–1849) Rydal, spending his time in study and wanderings about the countryside. In the year 1839 appeared his edition of Massinger and Ford, with biographies of both dramatists. He died on Jan. 6, 1849. The prose style of Hartley Coleridge is marked by much finish and vivacity; but his literary reputation must chiefly rest on the sanity of his criticisms, and above all on his *Prometheus,* an unfinished lyric drama, and on his sonnets. As a sonneteer he achieved real excellence, the form being exactly suited to his sensitive genius. *Essays and Marginalia,* and *Poems,* with a memoir by his brother Derwent, appeared in 1851.

COLERIDGE, JOHN DUKE COLERIDGE, 1st BARON (1820–1894), lord chief justice of England, was the eldest son of Sir John Taylor Coleridge. He was born at Heath's Court, Ottery St. Mary, on Dec. 3, 1820. He was educated at Eton and Balliol college, Oxford, of which he was a scholar. He was called to the bar in 1846, went the western circuit, and in 1865 he was returned as member for Exeter in the Liberal interest. The heads of his party determined in 1867 to put him forward as the protagonist of their attack on the Government, but the plan was frustrated by opposition within the party. In 1868 when the Liberals returned to power Coleridge was made first solicitor-general and then attorney-general.

His arrival in parliament was an access of strength to the body of Oxford men who had attacked the legislation that kept the university under ecclesiastical domination. In addition to his own talents he carried weight with the clerically-minded section as the son of Sir John Coleridge, the godson of Keble, and great-nephew of the man who was an indirect cause of the Anglican revival of 1833—Coleridge the poet.

The Tichborne trial was the most conspicuous feature of Coleridge's later years at the bar, and tasked his powers as an advocate to the uttermost, though he was assisted by Charles (afterwards Lord) Bowen. In November 1873 Coleridge succeeded Sir W. Bovill as chief justice of the common pleas, and was immediately afterwards raised to the peerage as Baron Coleridge of Ottery St. Mary. In 1880 he was made lord chief justice.

In jury cases his quickness in apprehending facts and his lucidity in arranging them were very remarkable indeed. He was not one of the most learned of lawyers, but he was a great deal more learned than many people thought, and as an ecclesiastical lawyer had few superiors. His fault—natural in one who had been so successful as an advocate—was that of being too prone to take one side, and he allowed political or personal prepossessions to colour the tone of his remarks from the bench. Latterly his health failed, and he became somewhat indolent. On the whole, he was not so strong a man in a judicial capacity as Campbell or Cockburn; but it must be admitted that his scholarship, his refinement, his power of oratory, and his character raised the tone of the bench during his occupancy, and that if it has been adorned by greater judicial abilities, it has hardly ever known a greater combination of varied merits. Coleridge died on June 14, 1894.

Coleridge's addresses and papers have not been published. One of the best and most eminently characteristic of the man, was his inaugural address to the Philosophical Institution at Edinburgh in 1870; another was a paper on Wordsworth (1873). He was an exceptionally good letter-writer. Of travel he had very little experience. He had hardly been to Paris; once, quite near the end of his career, he spent a few days in Holland, and came back a willing slave to the genius of Rembrandt; but his longest absence from England was a visit, of a representative legal character, to the United States. He had an extraordinary store of anecdotes, which were nearly always connected with Eton, Oxford, the bar or the bench. His exquisite voice, considerable power of mimicry, and perfect method of narration added greatly to the charm. John Duke Coleridge was sarcastic and critical, and at times over-sensitive. But his strongest characteristics were love of liberty and justice. By birth and connection Conservative, he was a Liberal by conviction, and loyal to his party and its great leader, Gladstone.

His *Life and Correspondence,* ed. by E. H. Coleridge, was published in 1904; *see* further E. Manson, *Builders of our Law* (1904); for the history of the Coleridge family *see* Lord Coleridge, *The Story of a Devonshire House* (1907).

COLERIDGE, SIR JOHN TAYLOR (1790–1876), English judge, the second son of Captain James Coleridge, and nephew of the poet S. T. Coleridge, was born at Tiverton, Devon, and was educated at Corpus Christi college, Oxford, where he had a brilliant career. He graduated in 1812 and was soon after made a fellow of Exeter; in 1819 he was called to the bar at the Middle Temple and practised for some years on the western circuit. In 1825 he published his excellent edition of *Blackstone's Commentaries,* and in 1832 he was made a serjeant-at-law and recorder of Exeter. He was one of the judges of the king's bench from 1835 to 1858. In 1869 he produced his *Memoir of the Rev. John Keble,* a third edition of which was issued within a year. He died on Feb. 11, 1876, at Ottery St. Mary, Devon, leaving two sons and a daughter; the eldest son, John Duke, 1st Baron Coleridge (*q.v.*), became lord chief justice of England. Sir John Taylor Coleridge's brothers, James Duke and Henry Nelson (husband of Sara Coleridge), are referred to in other articles; his brother Francis George was the father of Arthur Duke Coleridge (b. 1830), clerk of assizes on the midland circuit and author of *Eton in the Forties,* whose daughter Mary E. Coleridge (1861–1907), was poet, novelist and critic. Mary Coleridge's posthumous *Gathered Leaves* (1910) contains a notice of her work by Edith Sichel.

COLERIDGE, SAMUEL TAYLOR (1772–1834), English poet and philosopher, was born on Oct. 21, 1772, at his father's vicarage of Ottery St. Mary, Devonshire. His father, the Rev. John Coleridge (1719–1781), described by the poet as "a perfect Parson Adams," was known for his scholarship, simplicity of character, and affectionate interest in the pupils of the grammar school, of which he was appointed master a few months before becoming vicar of the parish (1760). The poet was the youngest child of his second wife, Anne Bowdon (d. 1809), a woman of great good sense, who saw to it that Samuel should be educated for the church as his father intended, and as three of his elder brothers had been before him. On the death of his father an old pupil of the latter secured for Samuel a presentation to Christ's Hospital, where he continued for eight years. Of these school-days Charles Lamb has given delightful glimpses in the *Essays of Elia.* Formerly a fretful and timorous child, Samuel became a comparatively happy schoolboy, though often ailing. The headmaster, Boyer, a severe disciplinarian, pushed him watchfully. Some of his compositions in English verse written at 16 give evidence of the influence of Bowles, to which he has testified in his *Biographia Literaria.*

In Feb. 1791 he was entered as a sizar at Jesus college, Cambridge, and went into residence in October. A schoolfellow who followed him to the university has told how in the evenings, in his rooms, he and his friends would put aside their work to discuss as they appeared, the new pamphlets of Burke, which Coleridge absorbed immediately. At that stage he was warmly democratic. William Frend, a fellow of Jesus, accused of sedition and Unitarianism, was at this time tried and banished, though not technically expelled from Cambridge. Coleridge had imbibed his sentiments, and joined the ranks of his partisans. He grew discontented with university life, and in 1793, pressed by debt, went to London. A poem in the *Morning Chronicle* brought him a guinea, and when that was spent he enlisted in the 15th Dragoons under the name of Silas Tomkyn Comberbacke, revealing at once an absolute unfitness for an army career. Shortly afterwards an old school-fellow (G. L. Tuckett) heard of his whereabouts, and by the intervention of his brother, Captain James Coleridge, his discharge was procured. He returned for a short time to Cambridge, but quitted the university without a degree in 1794. In the same year he visited Oxford, and after a short tour in Wales went to Bristol, where he met Southey. The French Revolution had captivated Southey, and Coleridge received with rapture his new friend's scheme of Pantisocracy. On the banks of the Susquehanna was to be founded a brotherly community, where selfishness was to be extinguished, and the virtues were to reign supreme. No funds were forthcoming; and in 1795, to the chagrin of Coleridge, who seems to have bitterly blamed Southey, the scheme was dropped. In 1794 appeared *The Fall of Robespierre,* of which Coleridge wrote the first act and Southey the other two. At Bristol Coleridge formed the acquaintance of Joseph Cottle, the bookseller, who offered him thirty guineas for a volume of poems. In October of 1795 Coleridge married Sarah Fricker, and took up his residence at Clevedon on the Bristol channel. A few weeks afterwards Southey married a sister of Mrs. Coleridge, and on the same day quitted England for Portugal.

Coleridge began to lecture in Bristol on politics and religion. He embodied the first two lectures, which contained much invective against Pitt, in his first prose publication, *Conciones ad Populum* (1795). The first volume of *Poems* was published by Cottle early in 1796. Coleridge projected a periodical called *The Watchman,* and in 1796 undertook a journey, well described in the *Biographia Literaria,* to enlist subscribers. *The Watchman* had a brief life of two months, and at this time Coleridge began to think of becoming a Unitarian preacher. Hazlitt has recorded his very favourable impression of a remarkable sermon delivered at Shrewsbury; but there are other accounts of Coleridge's preaching not so enthusiastic. In the summer of 1795 he met for the first time the brother poet with whose name his own will be for ever associated. Wordsworth and his sister had established themselves at Racedown in the Dorsetshire hills, and here Coleridge visited them in 1797. The gifted Dorothy Wordsworth described Coleridge as "thin and pale, the lower part of the face not good, wide mouth, thick lips, not very good teeth, longish, loose, half-curling, rough, black hair,"—but all was forgotten in the magic charm of his utterance. Wordsworth, who declared: "The only wonderful man I ever knew was Coleridge," seems at once to have desired to see more of his new friend. He and his sister removed in July 1797 to Alfoxden, near Nether Stowey, to be in Coleridge's neighbourhood, and in the most delightful and unrestrained intercourse the friends spent many happy days.

One evening at Watchett on the Bristol Channel, *The Ancient Mariner* first took shape. Coleridge was anxious to embody a dream of a friend, and the suggestion of the shooting of the albatross came from Wordsworth, who gained the idea from Shelvocke's *Voyage* (1726). A joint volume was planned. Wordsworth was to show the real poetry that lies hidden in commonplace subjects, while Coleridge was to treat supernatural subjects to illustrate the common emotions of humanity. From this sprang the *Lyrical Ballads,* to which Coleridge contributed *The Ancient Mariner,* the *Nightingale* and two scenes from *Osorio,* and after much cogitation the book was published in 1798 at Bristol by Cottle. A second edition of the *Lyrical Ballads* in 1800 included another poem by Coleridge—*Love,* to which subsequently the subtitle was given of *An Introduction to the Tale of the Dark Ladie.* To the Stowey period belong also the tragedy of *Osorio* (afterwards known as *Remorse*), *Kubla Khan,* and the first part of *Christabel.* In 1798 an annuity, granted him by the brothers Wedgwood, led Coleridge to abandon his reluctantly formed intention of becoming a Unitarian minister. For many years he had desired to see the continent, and in September 1798, in company with Wordsworth and his sister, he left England for Hamburg. *Satyrane's Letters* (republished in *Biog. Lit.* 1817) give an account of the tour.

A new period in Coleridge's life now began. He soon left the Wordsworths to spend four months at Ratzeburg, whence he removed to Göttingen to attend lectures. During his stay of nine months in Germany, he made himself master of the language to such purpose that the translation of *Wallenstein* was actually accomplished in six weeks. During these years he wrote many newspaper articles and some poems, among them "Fire, Famine and Slaughter," for the *Morning Post.* He had vehemently opposed Pitt's policy, but a change came over his way of thought, and he found himself separated from Fox on the question of a struggle with Napoleon. He had lost his admiration for the revolutionists, as his "Ode to France" shows (*Morning Post,* April 16, 1798). Like many other Whigs, he felt that all questions of domestic policy must at a time of European peril be postponed. In the year 1800 he left London for the Lakes, where he wrote the second part of *Christabel.* In 1803 Southey became a joint lodger with Coleridge at Greta Hall, Keswick, of which in 1812 Southey became sole tenant and occupier.

In 1801 begins the period of Coleridge's life during which he sank more and more under the dominion of opium, in which he may have first indulged at Cambridge. Few things are so sad to read as the letters in which he details the consequences of his obsession. He was occasionally seen in London during the first years of the century, and wherever he appeared he was the delight of admiring circles. He toured in Scotland with the Wordsworths in 1803, visited Malta in 1804, when for ten months he acted as secretary to the governor, and stayed nearly eight months at Naples and Rome in 1805–06. In Rome he received a hint that his articles in the *Morning Post* had been brought to Napoleon's notice, and he made the voyage from Leghorn in an American ship. On a visit to Somersetshire in 1807 he met De Quincey for the first time, and the younger man's admiration was shown by a gift of £300, "from an unknown friend." In 1809 he started a magazine called *The Friend,* which continued only for eight months. At the same time he began to contribute to the *Courier.* In 1808 he lectured at the Royal Institution, but with little success, and three years later he gave his lectures on Shakespeare and other poets. These lectures attracted great attention and were followed by two other series. In 1812 his income from the Wedgwoods was reduced, and he settled the remainder on his wife. His friends were generous in assisting him with money, and eventually, in 1824, some of them obtained a grant of £100 a year for him during the lifetime of George IV., as one of the royal associates of the Society of Literature, while his children shared Southey's home at Keswick. But between 1812 and 1817 Coleridge made a good deal by his work, and was able to send money to his wife in addition to the annuity she received. The tragedy of *Remorse* was produced at Drury Lane in 1813, and met with considerable success.

Three years after this, having failed to conquer the opium habit, he determined to enter the family of James Gillman, who lived at Highgate. For the rest of his life he hardly ever left this home. During his residence there, *Christabel,* written many years before, and known to a favoured few, was first published in a volume with *Kubla Khan* and the *Pains of Sleep* in 1816. In 1816 and the following year, he gave his Lay Sermons to the world. *Sibylline Leaves* appeared in 1817; the *Biographia Literaria* and a revised edition of *The Friend* soon followed. Eight years afterwards his most popular prose work—the *Aids to Reflection*—first appeared. His last publication, in 1830, was the work on *Church and State.* It was not till 1840 that his *Confessions of an Inquiring Spirit,* his most seminal work, was posthumously published. In 1833 he appeared at the meeting of the British Association at Cambridge, but he died in the following year (July 25, 1834), and was buried in the churchyard close to the house of Gillman, where he had enjoyed every consolation which friendship and love could render. Coleridge died in the communion of the Church of England, of whose polity and teaching he had been for many years a loving admirer. An interesting letter to his god-child, written twelve days before his death, sums up his spiritual experience in a most touching form.

To the extraordinary influence which he exercised in conversation there are many testimonies. Many of the most remarkable among the younger men of that period resorted to Highgate as to the shrine of an oracle; and although one or two disparaging judgments, such as that of Carlyle, have been recorded, there can be no doubt that since Samuel Johnson there had been no such intellectual power in England. His nephew, Henry Nelson Coleridge, gathered together many specimens of the *Table Talk* of the few last years. Four volumes of *Literary Remains* were published after his death, and these, along with the chapters on the poetry of Wordsworth in the *Biographia Literaria,* may be said to exhibit the full range of Coleridge's power as a critic of poetry. In this region he stands supreme, ranking as the creator in England of that higher criticism which had already in Germany accomplished so much in the hands of Lessing and Goethe. The fragmentary series of his Shakespearian criticisms gives evidence of the truest insight, and an original appreciation of the judicial "sanity" which raises the greatest name in literature above even the highest of the poets who approached him.

As a poet Coleridge's own place in the great gallery of English poets is secure. Of no one can it be more emphatically said that at his highest he was "of imagination all compact." The whole soul of the poet is reflected in the *Ode to Dejection.* The well-known lines—

> O Lady! we receive but what we give,
> And in our life alone does nature live;
> Ours is her wedding garment, ours her shroud,

with the passage which follows, express more vividly, perhaps, than anything which Coleridge had written, the shaping and colouring function which he assigns, in the *Biographia Literaria,* to imagination. *Christabel* and the *Ancient Mariner* have so completely taken possession of the highest place, that it is needless to do more than allude to them. The supernatural has never received such treatment as in these two wonderful productions of his genius, and though the first of them remains a torso, it is the loveliest torso in the gallery of English literature. Although Coleridge had, for many years before his death, almost entirely forsaken poetry, the few fragments of work which remain, written in later years, show little trace of weakness, although they are wanting in the unearthly melody which imparts such a charm to *Kubla Khan, Love* and *Youth and Age.*

It is chiefly as a personality and as a thinker that Coleridge has incurred disparaging criticism. The infirmity of will and the "sloth" to which he sadly confessed have been the subject of many homilies; and even eulogists have to avow that his works in mass are a "collection of fragments," to say nothing of a hundred large plans never fulfilled. But in the light of the biographical study of the last generation, he can be seen as the victim of heredity and malady, his rare powers and his inefficiencies being alike innate, and the opium-eating a fatal consequence. That he laboured under a vital cardiac weakness seems certain. In his vivid accounts of his childhood he has revealed himself as a "dreamer," living in the world of his strange imagination, and singularly responsive through that faculty to every stimulus received from his manifold reading. His poetry and his philosophy are thus alike to be seen as shaped at once by his bias and his culture.

In his youth he was poetically dominated by Bowles, because Bowles was the first of the modern innovating poets who had come in his way. Of Blake and Burns, and even of Cowper, at that stage he knew nothing. An American student has latterly revealed how the *Ancient Mariner* was coloured in diction and in conception by his reading, and then perfected by his fine critical faculty. His philosophy may be viewed in the same fashion. All the notable ideas which came to him took possession in turn of his imgination, only to be transformed continuously. As he truly said of himself, his mind was always "energic," as distinguished from "energetic." Save in his many hours of misery or utter lassitude, it was constantly at work creatively on the material of his reading, and its uncontrolled play has yielded a remarkable harvest of criticism and speculation, couched in a prose stamped at once with intensive feeling and skill of phrase. Hence the stirring quality of his influence.

In the latter part of his life, and for the generation which followed, Coleridge was ranked by many young English churchmen of liberal views as the greatest religious thinker of their time. Among those he thus fascinated was the abnormal Edward Irving. As Carlyle has told in his *Life of Sterling,* the poet's distinction, in the eyes of his audience, lay in his having recovered and preserved his Christian faith after having passed through periods of rationalism and Unitarianism, and faced the full results of German criticism and philosophy. His opinions, however, were at all periods mutable, and it would be difficult to state them in any form that would hold good for the whole even of his later writings. He was, indeed, too receptive of thought impressions of all kinds to be a consistent systematizer. From his early Unitarianism he gradually moved towards pantheism, a way of thought to which he had shown remarkable leanings when, as a schoolboy, he discoursed of Neoplatonism to Charles Lamb. Early in life, too, he met with the doctrines of Jacob Behmen, of whom, in the *Biographia Literaria*, he speaks with affection and gratitude as having given him vital philosophic guidance. In the *Aids to Reflection* he disparages him. Between pantheism and Unitarianism he seems to have balanced till his thirty-fifth year, always tending towards the former in virtue of the recoil from "anthropomorphism," which originally took him to Unitarianism. In 1796, when he named his first child David Hartley, but would not have him baptized, he held by the "Christian materialism" of the writer in question, whom in his *Religious Musings* he terms "wisest of mortal kind."

When, again, he met Wordsworth in 1797, the two poets sympathetically discussed Spinoza, for whom Coleridge always retained an admiration; and when in 1798 he gave up his Unitarian preaching, he named his second child Berkeley, signifying a new allegiance, but still without accepting Christian rites otherwise than passively. Shortly afterwards he went to Germany, where he began to study Kant, and was much impressed by Lessing. In the *Biographia* he avows that the writings of Kant "more than any other work, at once invigorated and disciplined my understanding." But after his stay at Malta, he announced to his friends that he had given up his "Socinianism" (of which ever afterwards he spoke with asperity), professing a return to Christian faith, though still putting on it a mystical construction, as when he told Crabb Robinson that "Jesus Christ was a Platonic philosopher." At this stage he was in sympathy with the historico-rationalistic criticism of the Old Testament, as carried on in Germany. From about 1810 onwards, however, he openly professed Christian orthodoxy, while privately indicating views which cannot be so described. And even his published speculations were such as to draw from J. H. Newman a protest that they took "a liberty which no Christian can tolerate," and carried him to "conclusions which were often heathen rather than Christian."

The explanation seems to be that while on Christian grounds he repeatedly denounced pantheism as being in all its forms equivalent to atheism, he was latterly much swayed by the thought of Schelling in the pantheistic direction which was natural to him. It would seem that, in the extreme spiritual vicissitudes of his life, conscious alternately of personal weakness and of the largest speculative grasp, he often threw himself entirely on the consolations of evangelical faith, and at times reconstructed the cosmos for himself in terms of Neo-Platonism and the philosophy of Schelling. So great were his variations, even in his latter years, that he could speak to his friend Allsop in a highly latitudinarian sense. From Schelling, whom he praised as having developed Kant where Fichte failed to do so, he borrowed much and often, not only in the metaphysical sections of the *Biographia* but in his aesthetic lectures, and further in the cosmic speculations of the posthumous *Theory of Life*. On the first score he makes but an equivocal acknowledgment, claiming to have thought on Schelling's lines before reading him; but it has been shown by Hamilton and Ferrier that besides transcribing much from Schelling without avowal he silently appropriated the learning of Maass on philosophical history. In other directions he laid under tribute Herder and Lessing; yet all the while he cast severe imputations of plagiarism upon Hume and others. His own plagiarisms were doubtless facilitated by the physiological effects of opium.

Inasmuch as his philosophy satisfied neither the logical needs appealed to by Hegel nor the new demand for naturalistic induction, Coleridge, after arousing a great amount of philosophic interest in his own country in the second quarter of the century, has ceased to "make a school." Thus his significance in intellectual history remains that of a great stimulator. He undoubtedly did much to deepen and liberalize Christian thought in England, his influence being specially marked in the school of F. D. Maurice, and in the lives of men like John Sterling.

Of Coleridge's four children, two (Hartley and Sara) are separately noticed. His second child, Berkeley, died in infancy. The third, Derwent (1800–1883), a distinguished scholar and author, was master of Helston school, Cornwall (1825–1841), first principal of St. Mark's college, Chelsea (1841–1864), and rector of Hanwell (1864–1880); and his daughter Christabel (b. 1843) and son Ernest Hartley, both became well known in the world of letters, the former as a novelist, the latter as a biographer, editor and critic.

After Coleridge's death several of his works were edited by his nephew, Henry Nelson Coleridge, the husband of Sara, the poet's only daughter. In 1847 Sara Coleridge published the *Biographia Literaria,* enriched with annotations and biographical supplement, begun by her husband and finished by her. Three volumes of Coleridge's political writings, entitled *Essays on his Own Times,* were also published by Sara Coleridge in 1850. The standard life of Coleridge is that by J. Dykes Campbell (1894); his letters were edited by E. H. Coleridge (1895). The *Anima Poetae,* edited by the latter (1895) is a compilation from Coleridge's notebooks. The *Biographia Epistolaris,* edited by A. Turnbull (2 vols., 1911) is a reprint of the Biog. Supp. to the *Biographia Literaria,* with additional letters and elucidations. Of monographs on Coleridge the most important are that of H. D. Traill ("English Men of Letters" series) and that of Joseph Aynard, *La Vie d'un Poète—Coleridge* (Paris, 1907). The work of J. L. Lowes, *The Road to Xanadu, a Study in the Ways of the Imagination* (1927), is an important research. *See* also J. Charpentier, *Coleridge, the Sublime Somnambulist* (1929). (J. M. R.)

COLERIDGE, SARA (1802–1852), English author, the fourth child and only daughter of Samuel Taylor Coleridge and his wife Sarah Fricker of Bristol, was born on Dec. 23, 1802, at Greta Hall, Keswick. Here, after 1803, the Coleridges, Southey and his wife (Mrs. Coleridge's sister), and Mrs. Lovell (another sister), widow of Robert Lovell, the Quaker poet, all lived together; but Coleridge was often away from home; and "Uncle Southey" was a *paterfamilias*. The Wordsworths at Grasmere were their neighbours. Wordsworth, in his poem, the *Triad,* has left us a description, or "poetical glorification," as Sara Coleridge calls it, of the three girls—his own daughter Dora, Edith Southey and Sara Coleridge, the "last of the three, though eldest born." Greta Hall was Sara Coleridge's home until her marriage; and the little Lake colony seems to have been her only school. Guided by Southey she read by herself the chief Greek and Latin classics, and before she was 25 had learnt French, German, Italian and Spanish.

In 1822 Sara Coleridge published *Account of the Abipones,* a translation in three large volumes of Dobrizhoffer, undertaken in connection with Southey's *Tales of Paraguay,* which had been suggested to him by Dobrizhoffer's volumes. In 1825 her second work appeared, a translation from the mediaeval French of the "Loyal Serviteur," *The Right Joyous and Pleasant History of the Feats, Jests, and Prowesses of the Chevalier Bayard, the Good Knight without Fear and without Reproach: By the Loyal Servant.*

In Sept. 1829, at Crosthwaite church, Keswick, after an engagement of seven years' duration, Sara Coleridge was married to her cousin, Henry Nelson Coleridge (1798–1843), younger son of Captain James Coleridge (1760–1836). He was then a chancery barrister in London. In 1834 Mrs. Coleridge published her *Pretty Lessons in Verse for Good Children; with some Lessons in Latin in Easy Rhyme.* These were originally written for the instruction of her own children, and became very popular. In 1837 appeared *Phantasmion, a Fairy Tale.*

In 1843 Henry Coleridge died, leaving to his widow the unfinished task of editing her father's works. To these she added some compositions of her own, among which are the *Essay on Rationalism, with a special application to the Doctrine of Baptismal Regeneration,* appended to Coleridge's *Aids to Reflection;* a Preface to the *Essays on his Own Times, by S. T. Coleridge,* and the Supplement to the *Biographia Literaria.* During the last few years of her life Sara Coleridge was a confirmed invalid. Shortly before she died she amused herself by writing a little autobiography for her daughter. This, which reaches only to her ninth year, was completed by her daughter, and published in 1873, together with some of her letters, under the title *Memoirs and Letters of Sara Coleridge.* She died in London on May 3, 1852.

Her son, HERBERT COLERIDGE (1830–61), won a double first class in classics and mathematics at Oxford in 1852. He was secretary to a committee appointed by the Philological Society to consider the project of a standard English dictionary, a scheme of which the *New English Dictionary,* published by the Clarendon Press, was the ultimate outcome. His personal researches into the subject were contained in his *Glossarial Index to the Printed English Literature of the Thirteenth Century* (1859).

COLERIDGE-TAYLOR, SAMUEL (1875–1912), composer, was born in London on Aug. 15, 1875, the son of a West African doctor of medicine and an English mother. He sang in a church choir at Croydon, and studied the violin and composition at the Royal College of Music. His first important work was a symphony given at St. James's hall in 1896, but his reputation rests on his picturesque and melodious choral work, the trilogy of *Hiawatha.* This work was succeeded by many other choral works, none of which had quite the same success. He wrote some excellent incidental music for plays by Stephen Phillips: *Herod* (1900), *Ulysses* (1902), *Nero* (1906), and *Faust* (1908); also occasional music for *Othello.*

See W. C. Berwick Savers, *Samuel Coleridge-Taylor, Musician. His Life and Letters* (1915).

COLET, JOHN (1467?–1519), English divine and educationist, the eldest son of Sir Henry Colet (twice mayor of London), was born in London and educated at Oxford, probably at Magdalen college. When he took his M.A. in 1490 he already held the rectory of St. Mary, Dennington, Suffolk, and the vicarage of St. Dunstan's, Stepney, and was now collated rector of St. Nicholas, Thurning, Hunts. In 1493 he went to Paris and thence to Italy, studying canon and civil law, patristics and Greek. During his residence abroad he became acquainted with Budaeus (Guillaume Budé) and Erasmus, and with the teaching of Savonarola. On his return to England in 1496 he took orders, and began his Oxford lectures on the Pauline epistles. In replacing the old scholastic methods by a study of the personality and times of St. Paul, he began a new epoch in Biblical exegesis and greatly influenced Erasmus, who visited Oxford in 1498. Since 1494 he had been prebendary of York and canon of St. Martin le Grand, London. In 1502 he became prebendary of Salisbury, in 1505 prebendary of St. Paul's, and immediately afterwards dean of the same cathedral, having previously taken the degree of doctor of divinity. Here he continued his innovating Biblical lectures. About 1508, having inherited his father's wealth, Colet re-founded St. Paul's school where a good Christian education together with Greek and Latin was to be given to the 153 scholars. The celebrated grammarian William Lilly was the first master, and the company of mercers were (in 1510) appointed trustees, the first example of non-clerical management in education. The dean's liberal religious opinions led the clergy to deem him little better than a heretic; but William Warham, the archbishop, refused to prosecute him. Similarly Henry VIII. held him in high esteem despite his sermons against the French wars. In 1514 he made the Canterbury pilgrimage with Erasmus, and in 1515 preached at Wolsey's installation as cardinal. Colet died on Sept. 16, 1519.

Though a staunch Catholic, Colet disapproved of the sale of bishoprics, the custom of pluralities, Church lawyers and the worldliness of churchmen. He was not a great scholar, but by introducing the humanist movement he helped to discredit mediaeval thought. Among his works, first collectively published in 1867–76, are *Absolutissimus de octo orationis partium constructione libellus* (Antwerp, 1530), *Rudimenta Grammatices* (London, 1539), *Daily Devotions, Monition to a Godly Life, Epistolae ad Erasmum,* and Biblical commentaries.

See F. Seebohm, *The Oxford Reformers* (1887); J. H. Lupton, *Life of John Colet,* 2nd ed. (1909); art. in *The Times,* July 7, 1909.

COLET, LOUISE (1810–1876), French poet and novelist, was born at Aix of a Provençal family named Revoil. In 1835 she came to Paris with her husband Hippolyte Colet (1808–51), a composer of music and professor of harmony and counterpoint at the conservatoire. Louise Colet is perhaps best known for her intimate connection with some of her famous contemporaries, Abel Villemain, Gustave Flaubert and Victor Cousin. Only one of her many volumes of prose and verse is now of interest—*Lui: roman contemporain* (1859), the novel in which she told the story of her life. (*See* also Flaubert.)

COLEUS, a genus of ornamental herbaceous or shrubby plants of the mint family, natives of the tropics of the old world. They are much cultivated as bedding plants for the colour of their exceedingly varied, and often brilliant leaves. They can be wintered over as room plants if the house is not too hot and dry.

COLFAX, SCHUYLER (1823–1885), American political leader, vice-president of the United States from 1869–73, was born in New York city on March 23, 1823. His father died before the son's birth, and his mother subsequently married a Mr. Matthews. The son attended the public schools of New York until he was ten, and then became a clerk in his step-father's store, removing in 1836 with his mother and step-father to New Carlisle, Ind. In 1841 he removed to South Bend, where for eight years he was deputy auditor (his step-father being auditor) of St. Joseph county; in 1842–44 he was assistant enrolling clerk of the State senate and senate reporter for the *Indiana State Journal.* In 1845 he established the *St. Joseph Valley Register,* which he published for 18 years and made an influential Whig and later Republican journal. In 1850 he was a member of the State Constitutional Convention, and in 1854 took an active part in organizing the "Anti-Nebraska men" (later called Republicans) of his State, and was by them sent to Congress. Here he served with distinction from 1855 until 1869, the last six years as speaker of the House. At the close of the Civil War he was a leading member of the radical wing of the Republican Party, advocating the disfranchisement of all who had been prominent in the service of the Confederacy, and declaring that "loyalty must govern what loyalty has preserved." In 1868 he had presidential aspirations, and was not without supporters. He accepted, however, the Republican nomination as vice-president on a ticket headed by Gen. Grant, and was elected; but he failed in 1872 to secure renomination. During the political campaign of 1872 he was accused, with other prominent politicians, of being implicated in corrupt transactions with the Crédit Mobilier, and a congressional investigation brought out the fact that he had agreed to take 20 shares from this concern, and had probably received dividends amounting to $1,200. It also leaked out during the investigation that he had received in 1868, as a campaign contribution, a gift of $4,000 from a contractor who had supplied the Government with envelopes while Colfax was chairman of the post-office committee of the House. At the close of his term Colfax returned to private life under a cloud, and during the remainder of his lifetime earned a livelihood by delivering popular lectures. His interest in moral and social reforms is best exemplified by his lifelong labours for the cause of temperance. He died at Mankato, Minn., on Jan. 13, 1885.

See E. W. Martin, *The Life and Public Services of Schuyler Colfax* (1868) and O. J. Hollister, *Life of Schuyler Colfax* (1887).

COLIC, a term in medicine used outside England for any paroxysmal abdominal pain, but generally limited in England to a sudden sharp pain having its origin in the pelvis of the kidney, the ureter, gall-bladder, bile-ducts or intestine. There is a tendency, however, to restrict use of the word to a pain produced by the contraction of the muscular walls of any hollow viscus of which the aperture has become more or less occluded, temporarily or otherwise. For renal and biliary colic, *see* Kidney Diseases and Liver, only intestinal colic being treated here.

In infants, usually those who are "bottle-fed," colic is exceedingly common, and is shown by the drawing up of their legs, their restlessness and their continuous cries.

Among adults one of the most serious causes is lead-poisoning (*see* Lead-Poisoning). In Germany a similar colic resulting from the absorption of copper occurs.

The simplest form of colic is that arising from habitual constipation or from ingestion of indigestible food such as apples, pears or nuts, heavy pastry, meat pies and puddings, etc. Often it is associated with diarrhoea. It may accompany any form of enteritis or an intestinal malignant growth, and certain forms of influenza (*q.v.*) are ushered in by severe colic.

Intestinal colic is paroxysmal, and the pain is generally referred to the neighbourhood of the umbilicus. It varies greatly in intensity and is usually relieved by pressure; this point aids in the differential diagnosis between simple colic and peritonitis, the pain of the latter being increased by pressure.

Treatment.—In simple colic the patient must be confined to bed, hot fomentations applied to the abdomen and a purge administered, a few drops of laudanum being added when the pain is exceptionally severe. But the whole difficulty lies in making the differential diagnosis. Acute intestinal obstruction, appendicitis, peritonitis, gallstone, renal stone and the gastric crises of locomotor ataxy, must all be excluded.

COLIGNY, GASPARD DE CHATILLON, COMTE (1519–1572), admiral of France and Protestant leader, was born at Châtillon-sur-Loing on Feb. 16, 1519, the son of Gaspard de Coligny, known as the maréchal de Châtillon (d. 1522), marshal of France in 1516. By his wife, Louise de Montmorency, the marshal had three sons: Odet, cardinal de Châtillon; Gaspard, the admiral; and Francis, seigneur d'Andelot, all of whom played an important part in the first period of the Wars of Religion. At 22 young Gaspard came to court, and there contracted a friendship with Francis of Guise. In the campaign of 1543 Coligny was wounded at the sieges of Montmédy and Bains. In 1544 he served in the Italian campaign under the duke of Enghien, and was knighted on the field of Ceresole. Appointed colonel-general of the infantry (April 1547), he exhibited great capacity and intelligence as a military reformer. He was made admiral on the death of d'Annebaut (1552). In 1557 he defended St. Quentin with great courage and resolution; but the place was taken, and he was imprisoned in the stronghold of L'Ecluse. On payment of a ransom of 50,000 crowns he recovered his liberty. He had by this time become a Huguenot, through the influence of his brother d'Andelot—the first letter which Calvin addressed to him is dated Sept. 4, 1558—and he busied himself secretly with protecting his co-religionists, a colony of whom he sent to Brazil, whence they were afterwards expelled by the Portuguese.

On the death of Henry II. he demanded, in concert with Louis, prince of Condé, religious toleration and certain other reforms. In 1560, at the assembly of notables at Fontainebleau, the hostility between Coligny and Francis of Guise was declared. When the civil wars began in 1562, Coligny decided to take arms only after long hesitation, and he was always ready to negotiate. In none of these wars did he show superior genius, but he acted throughout with great prudence and extraordinary tenacity; he was "le héros de la mauvaise fortune." In 1569 the defeat and death of the prince of Condé at Jarnac left him sole leader of the Protestant armies. Victorious at Arnay-le-Duc, he secured in 1570 the pacification of St. Germain. Returning to the court in 1571, he grew rapidly in favour with Charles IX. As a means of emancipating the king from the tutelage of his mother and the faction of the Guises, the admiral proposed to him a descent on Spanish Flanders, with an army drawn from both sects and commanded by Charles in person. The king's regard for the admiral, and the bold front of the Huguenots, alarmed the queen-mother; and the massacre of St. Bartholomew was the consequence. On Aug. 22, 1572, Coligny was wounded by Maurevel, a bravo in the pay of the queen-mother and Guise. The king visited him, but the queen-mother prevented all private intercourse between them. On Aug. 24, the night of the massacre, he was attacked in his house, and a servant of the duke of Guise, generally known as Besme, murdered him and threw the body from a window into the courtyard at his master's feet. His papers were seized and burned by the queen-mother; among them, according to Brantôme, was a history of the Civil War, "très-beau et très-bien faict, et digne d'estre imprimé." His correspondence was edited in 1858 by Bourquelot.

By his wife, Charlotte de Laval, Coligny had several children, among them being Louise, who married first Charles de Téligny and afterwards William the Silent, prince of Orange, and Francis, admiral of Guienne, who was one of the devoted servants of Henry IV. Gaspard de Coligny (1584–1646), son of Francis, was marshal of France during the reign of Louis XIII.

See L. J. Delaborde, *Gaspard de Coligny* (1879–82); Erich Marcks, *Gaspard von Coligny, sein Leben und das Frankreich seiner Zeit* (Stuttgart, 1892); H. Patry, "Coligny et la Papauté," in the *Bulletin du protestantisme français* (1902); A. W. Whitehead, *Gaspard de Coligny, Admiral of France* (1904); and C. Merki, *L'Amiral de Coligny* (1909).

COLIIDAE: *see* COLY.

COLIJN, HENDRICK (1869–1944), Dutch politician, was born at Haarlemmer Meer, the Netherlands. After serving as a government official in the Netherlands Indies he returned to the Netherlands in 1909 and became a member of the Second Chamber. From 1911 to 1913 he was minister for war. In 1914 he became manager of the Batavian Oil Co., and from 1919 to 1922 was managing director of the Asiatic Petroleum Co. and director of the Royal Dutch Shell and Anglo-Saxon companies. In 1922, after the death of Abraham Kuyper, Colijn led the anti-revolutionary party. He was minister of finance in 1923, retaining this portfolio in the short-lived cabinet formed by him in 1925. He became prime minister and minister for the colonies in 1933. Also in 1933 he was chairman of the World Economic conference in London. Colijn was imprisoned by the Germans in World War II. His death was reported Sept. 16, 1944.

COLIMA, a small Pacific coast state of Mexico, lying between Jalisco on the N.W. and N., and Michoacan on the E. Including the Revilla Gigédo islands its area is only 2,009 sq.mi., which thus makes it the second smallest of the Mexican states. Pop. (1940) 78,806. The larger part of its territory is within the narrow, flat coastal plain, beyond which it rises toward the northeast into the foothills of the Sierra Madre, the higher masses of the range, including the Colima volcano, lying outside the state. It is drained by the Ameria and Coahuayana rivers and their affluents, which are largely used for irrigation. There are tidewater lagoons and morasses on the coast which accentuate its malarious character. One of the largest of these, Cuitlán, immediately south of Manzanillo, is the centre of a large salt-producing industry.

The soil is generally fertile and productive, but lack of transportation facilities has been a serious obstacle to any production greatly exceeding local demands. The dry and rainy seasons are sharply defined. The climate is hot, humid and malarious, becoming drier and more healthful on the higher mountain slopes of the interior.

Stock raising is an important industry in the higher parts of the state, but the horses, mules and cattle raised have been limited to local demands. Agriculture, however, is the principal occupation of the state, the more important products being sugar, rice, Indian corn, palm oil and coffee. The "Caracolillo" coffee, produced on the slopes of the mountains culminating in the volcano of Colima, is reputed the best in Mexico.

There are important mineral deposits in the state, including iron, copper and lead. Palm-leaf hats, hides and deerskins are exported in large quantities. A narrow-gauge railway had been in operation between the capital and Manzanillo for many years, and in 1907 a branch of the Mexican Central was completed between Guadalajara and the capital, and the narrow-gauge line to the coast was widened to the standard gauge. The capital of the state is Colima, pop. (1940) 22,601; other cities, with 1940 populations are Manzanillo (6,831); Tecomán (3,295); and Comala, 5 mi. from the capital (2,842).

COLIMA, a city of Mexico and capital of a state of the same name, 570 mi. (direct) W. by S. of Mexico City and about 36 mi. inland from the Pacific coast. Pop. (1940) 22,601. Colima is picturesquely situated on the Colima river, in a large fertile valley about 1,650 ft. above the sea, and lies in the midst of fine mountain scenery. About 30 mi. to the northeast the volcano of Colima, in the state of Jalisco, rises to an elevation of 12,685 ft.; it is the most westerly of the active volcanoes of Mexico. Colima enjoys a moderately cool and healthful climate, especially in the dry season (November to June). The city is regularly laid out and is in great part well built, with good public buildings, several churches, a theatre, two hospitals and a handsome market, completed in 1905. Tramways connect the central *plaza* with the railway station, cemetery, and the suburb of Villa de Alvarez, 2½ mi. distant. The local industries include cotton mills, an ice plant, corn-grinding mill and cigarette factories. The city is on the line of the Mexican National railway which connects Guadalajara with the port of Manzanillo. Colima was founded in 1522 by Gonzalo de Sandoval. It has not played a very prominent part in Mexican history because of its inaccessibility, and for the same reason has suffered less from revolutionary violence.

COLIN, ALEXANDRE (1526–1612), Flemish sculptor, was born at Malines. In 1563 he went, at the invitation of the Emperor Ferdinand I., to Innsbruck, to work on the magnificent monument which was being erected to Maximilian I. in the nave of the Franciscan church. Of the 24 marble alti-rilievi, representing the emperor's principal acts and victories, which adorn the sides of this tomb, 20 were executed by Colin, apparently in three years.

Colin, who was sculptor in ordinary both to the emperor and to his son, the Archduke Ferdinand of Tirol, did a great deal of work for his patrons at Innsbruck and in its neighbourhood, including the sepulchres of the archduke and his first wife, Philippine Welser, both in the same church as the Maximilian monument, and of Bishop Jean Nas.

COLISEUM: *see* COLOSSEUM.

COLL ISLAND: *see* HEBRIDES.

COLLAERT, HANS, Flemish engraver, son of Adrian Collaert, a draughtsman and engraver of repute, was born at Antwerp about 1545. After working some years in his father's studio, he went to Rome to perfect himself in his art. His engravings after Rubens are very highly esteemed. He left many works: among the best may be mentioned a "Life of St. Francis," 16 prints; a "Last Judgment," folio; "Monilium, Bullarum, Inauriumque Artificiosissimae Icones," 10 prints (1581); "The Dead Christ in his Mother's Lap"; "Marcus Curtius"; "Moses Striking the Rock," and "The Resurrection of Lazarus," after Lambert Lombard; "The Fathers of the Desert"; and "Biblia Sacra and the History of the Church," after Rubens.

COLLAPSE: *see* SHOCK AND COLLAPSE.

COLLAR, something worn or fastened round the neck, particularly a band of linen, lace or other material, which, under various shapes at different periods, has been worn by men and women to serve as a completion or finish to the neckband of a garment (*see* DRESS); also a chain, worn as a personal ornament, a badge of livery, a symbol of office or as part of the insignia of an order of knighthood, an application of the term with which the present article deals. The word is also applied to that part of the draught-harness of a horse which fits over the animal's neck, to which the traces are attached, and against which the strain of the drawing of the vehicle is exercised, and to a circular piece of metal passed round the joints of a rod or pipe, to prevent movement or to make the joint steam- or water-tight.

Necklaces with beads and jewels threaded thereon or the plain laces with a hanging ornament are among the common braveries of all times and countries. From these come the collar and the neck-chain. Torques or twisted collars of metal are found in burying-places of the barbarous people of northern Europe. British chiefs wore them, and gold torques were around the necks of the leaders of the first of the Saxon invaders of Britain, among whose descendants, however, the fashion seems to have languished. Edward the Confessor was buried with a neck-chain of gold 2ft. long, fastened with a jewelled locket and carrying an enamelled crucifix.

The extravagant age of Richard II. saw a great revival of the neck-chain, heavy links twisted of gold or silver. From this time onward neck chains, with or without pendant devices, were commonly worn by men and women of the richer sort. The men abandoned them in the time of Charles I.

Closely allied to the chain are the livery collars which appeared in the 14th century, worn by those who thus displayed their alliances or their fealty. Thus Charles V. of France in 1378 granted to his chamberlain Geoffrey de Belleville the right of bearing in all feasts and in all companies the collar of the *Cosse de Geneste* or Broomcod, a collar which was accepted and worn even by the English kings, Charles VI. sending such collars to Richard II. and to his three uncles. This French collar, a chain of couples of broom-cods linked by jewels, is seen in the contemporary portrait of Richard II. at Wilton. The like collar was worn by Henry IV. on the way to his crowning. Livery collars of the king of France, of Queen Anne and of the dukes of York and Lancaster are numbered with the royal plate and jewels which in the first year of Henry IV. had come to the king's hands. The inventory shows that Queen Anne's collar was made up of sprigs of rosemary garnished with pearls. The York collar had falcons and fetter-locks, and the Lancaster collar was doubtless that collar of Esses (or SS) used by the duke's son, Henry of Bolingbroke, as an earl, duke and king. This famous livery collar, which has never passed out of use, takes many forms, its Esses being sometimes linked together chainwise, and sometimes, in early examples, bestowed as the ornamental bosses of a garter-shaped strap-collar. The oldest effigy bearing it is that in Spratton church of Sir John Swinford (d. 1371). Swinford was a follower of John of Gaunt, and the date of his death easily disposes of the fancy that the Esses were devised by Henry IV. to stand for his motto or "word" of *Soverayne.* Many explanations are given of the origin of these letters, but none has as yet been established with sufficient proof. During the reigns of Henry IV., his son and grandson, the collar of Esses was a royal badge of the Lancastrian house and party, the white swan being its pendant. In one of Henry VI.'s own collars the S was joined to the Broomcod of the French device, thus symbolizing the king's claim to the two kingdoms.

The kings of the house of York and their chief followers wore the Yorkist collar of suns and roses, with the white lion of March, the Clare bull or Richard's white boar for a pendant device. Henry VII. brought back the collar of Esses, a portcullis or a rose hanging from it, although in a portrait of this king, now possessed by the Society of Antiquaries, his neck bears the *rose en soleil* alternating with knots, and his son, when young, had a collar of roses red and white. Besides these royal collars, the 14th and 15th centuries show many of private devices. A brass at Mildenhall shows a knight whose badge of a dog or wolf circled by a crown hangs from a collar with edges suggesting a pruned bough or the ragged staff. Thomas of Markenfield (d. *c.* 1415) on his effigy has a strange collar of park palings with a badge of a hart in a park, and the Lord Berkeley (d. 1392) wears one set with mermaids.

Collars of various devices are now worn by the grand crosses of the European orders of knighthood. The custom was begun by Philip of Burgundy, who gave his knights of the Golden Fleece, an order founded on Feb. 10, 1429–30, badges of a golden fleece hung from that collar of flints, steels and sparks which is seen in so many old Flemish portraits. To this day it remains the most beautiful of all the collars, keeping in the main the lines of its Flemish designer, although a vulgar fancy sometimes destroys the symbolism of the golden fleece by changing it for an unmeaning fleece of diamonds. Following this new fashion, Louis XI. of France, when instituting his order of St. Michael in 1469, gave the knights collars of scallop shells linked on a chain. The chain was doubled by Charles VIII., and the pattern suffered other changes before the order lapsed in 1830. Until the reign of Henry VIII., the Garter, most ancient of the great knightly orders, had no collar. But the Tudor king must needs match in all things with Continental sovereigns, and the present collar of the Garter knights, with its golden knots and its buckled garters enclosing white roses set on red roses, has its origin in the Tudor age. The collar of the Thistle with the thistles and rue-sprigs is as old as the reign of James II. The Bath collar, in its first form of white knots linking closed crowns to roses and thistles issuing from sceptres, dates from 1725, up to which time the knights of the Bath had hung their medallion from a ribbon. (*See* KNIGHTHOOD AND CHIVALRY.)

Founding the order of the Saint Esprit in 1578, Henry III. of France devised a collar of enflamed fleur-de-lis and cyphers of H and L, a fashion which was soon afterwards varied by Henry his successor. Elephants have been always borne on the collar of the Elephant founded in Denmark in 1478, the other links of which have taken many shapes. Another Danish order, the Dan-ne-brog, said to be "re-instituted" by Christian V. in 1671, has a collar of crosses formy alternating with the crowned letters C and W, the latter standing for Waldemar the Victorious, whom a legend of no value described as founding the order in 1219. Of other European orders, that of St Andrew, founded by Peter of Russia in 1698, had eagles and Andrew crosses and cyphers, while the Black Eagle of Prussia had the Prussian eagle with thunderbolts in its claws beside roundels charged with ciphers of the letters F.R.

Plain collars of Esses are now worn in Great Britain by kings-of-arms, heralds and serjeants-at-arms. Certain legal dignitaries have worn them since the 16th century, the collar of the lord chief-justice having knots and roses between the letters. Henry IV.'s parliament in his second year restricted the free use of the king's livery collar to his sons and to all dukes, earls, barons and bannerets, while simple knights and squires might use it when in the royal presence or in going to and from the hostel of the king. The giving of a livery collar by the king made a squire of a man even as the stroke of the royal sword made him a knight. Collars of Esses are sometimes seen on the necks of ladies.

Since 1545 the lord mayor of London has worn a royal livery collar of Esses. This collar, however, has its origin in no royal favour, Sir John Alen, thrice a lord mayor, having bequeathed it to the then lord mayor and his successors "to use and occupie yerely at and uppon principall and festivall dayes." It was enlarged in 1567, and in its present shape has 28 Esses alternating with knots and roses and joined with a portcullis. Lord mayors of York use a plain gold chain of a triple row of links given in 1670; this chain, since the day when certain links were found wanting, is weighed on its return by the outgoing mayor. In Ireland the lord mayor of Dublin wears a collar given by Charles II., while Cork's mayor has another which the Cork council bought of a silversmith in 1755, stipulating that it should be like the Dublin one. The lady mayoress of York wears a plain chain given with that of the lord mayor in 1670, and, like his, weighed on its return to official keeping. For some 230 years the mayoress of Kingston-on-Hull enjoyed a like ornament until a thrifty council in 1835 sold her chain as a useless thing. (O. B.; X.)

COLLARDS or **COLLARD,** (*Brassica oleracea* form *acephala*) bears the same botanical name as kale, from which it differs only in leaf characters. The leaves are like those of common cabbage, forming a large, prolific rosette like a cabbage plant that is approaching the formation of a head, but never forming a true head. Even when fully grown the plants may be left unprotected in the garden, through the winter, in the southern half of the United States. The larger leaves may be removed for use singly as the stem elongates, or the entire rosette may be harvested. The plant is a prolific source of nutritionally important minerals, and vitamins A and C. It is widely adapted, easily grown, and is probably the least exacting of any of the Crucifers in its requirements for successful seed production. Seed is sown in August or September and the plants thinned to stand about 1 ft. apart in rows 2 to 3 ft. apart. (*See* CABBAGE.) (V. R. B.)

COLLATERAL, a term used in law in several senses. *Collateral relationship* means the relationship between persons who are descended from the same stock or ancestor, but in a different line; as opposed to *lineal,* which is the relationship between ascendants and descendants in a direct line, as between father and son, grandfather and grandson. A *collateral agreement* is an agreement made contemporaneously with a written contract as part of the transaction, but without being incorporated with it. *Collateral facts,* in evidence, are those facts which do not bear directly on the matters in dispute. *Collateral security* is an additional security for the safety of the mortgagee, *e.g.,* a deed of guaranty, or property deposited, to secure the fulfilment of an obligation.

Collateral, in banking is the security which a borrower gives over to a lender as a pledge to guarantee the payment of the debt. If the debt is paid when and as agreed upon, the collateral is returned to the borrower but if default in payment is made the lender has the right to sell the collateral and from the proceeds retain the amount due for principal and interest, returning the remainder, if any, to the borrower. Almost any kind of property which is saleable may be used as collateral but as a matter of practice only certain types are generally acceptable to the lending banks.

The "financial type" of collateral is one of the greatest in importance. Certificates of stock in business corporations are accepted as collateral if they are marketable and give evidence that they will remain so till the expiration of the time of the loan. Corporate, municipal or government bonds are acceptable if they are sound and marketable. Securities which are listed on the Stock Exchange are much preferred as collateral over unlisted and outside market securities because of their exceptional marketability. The borrower usually has the privilege of substituting other collateral for that already pledged provided the new collateral is satisfactory to the lender. This privilege of exchanging collateral is especially important and necessary in the case of the investment banker who is constantly buying and selling and thus changing his securities, and in the case of the stock-broker who is continuously dealing for his clients. The "merchandise type" of collateral consists of negotiable warehouse receipts, negotiable bills of lading and trust receipts. Other collateral may be classed as "personal type," under which are included deeds, deeds of trust, mortgages, leases and similar rights in good real estate; deeds, deeds of trust, bills of sale and similar rights in movable goods capable of transfer, such as portable machinery, furniture, livestock, crops and many similar things. Savings bank pass-books, which serve as vouchers or receipts for deposits made, and without the presentation of which withdrawals cannot be made, are often assigned to a bank as collateral for loans. Banks will demand that the market value of the collateral exceed the amount of the loan so as to safeguard the bank in case of possible shrinkage of the value of the collateral. The excess margin usually required is about 20%, and when, through decrease in value of collateral, it falls below this percentage the bank can, under its customary agreement, require the borrower to deposit additional collateral equal in value to the decline, or to pay off a part of the loan so that the present collateral will again supply the required margin. On a large loan bankers demand "mixed collateral," consisting probably of railroad, industrial and other securities, rather than "straight collateral," consisting of securities of only one class. Likewise they do not grant too many small loans, each secured by the same type of collateral. Extremely high-priced stocks with wide market fluctuations are not considered desirable. Odd lots, *i.e.,* batches of less than 100 shares of any stock, are unpopular because they are harder to keep track of and rather troublesome to market if a sale becomes necessary. Where corporate securities are used as collateral they should be conservative, rather than speculative issues; active on the market rather than inactive; and should have good delivery, that is, be negotiable in form and indorsed in blank by the borrower. Property other than securities is not acceptable unless it has a determinable value and a potential market.

COLLATIA, an ancient town of Latium, 10m. E. by N. of Rome, by the Via Collatina. Later it became a mere village. It is the legendary scene of the rape of Lucretia. The site is on the hill now occupied by the large mediaeval fortified farmhouse of Lunghezza, immediately south of the Anio.

COLLATION, the bringing together of things for the purpose of comparison, and thus the critical examination of the texts of documents or mss. (Lat. *collatio* from *conferre,* to bring together or compare); also used in printing and bookbinding for the register of the "signatures," the number of quires and leaves in each quire of a book or ms. In Roman and Scots law "collation" answers to the English law term "hotch-pot" (*q.v.*). From another meaning of the Latin word, a consultation or conference, and so a treatise, comes the title of a work of Johannes Cassianus (*q.v.*), the *Conferences of the Fathers* (*Collationes Patrum*). Readings from such works were customary in monasteries. By the rule of St. Benedict it is ordered that after supper *collationes,* passages from the lives of the Fathers, etc., should be read. On fast days it was usual in monasteries to have a light meal after the *Collatio,* hence the meal itself came to be called "collation," a term now used of any light repast.

COLLÉ, CHARLES (1709–1783), French dramatist and song-writer, the son of a notary, was born in Paris. In 1729 he became a member of the famous "Caveau," which numbered among its members Helvétius, Charles Duclos, Pierre Joseph Bernard, called Gentil-Bernard, Jean Philippe Rameau, Alexis Piron and the two Crébillons. The society was dissolved in 1739, and was not reconstituted till 20 years afterwards. His first comedy, *La Vérité dans le vin,* appeared in 1747. The greater part of his genre pieces, *Théâtre de Société* (3 vols., 1777) were composed for the regent, Orleans, who was a good comedy actor, especially in low life parts. In 1774 appeared *La Partie de chasse de Henri Quatre* (partly taken from Dodsley's *King and the Miller of Mansfield*), Collé's last and best play. From 1748 to 1772, besides these and a multitude of songs, Collé was writing his *Journal,* a curious collection of literary and personal strictures on his boon companions as well as on their enemies, on Piron as on Voltaire, on La Harpe as on Corneille. The subjects of his lyrics are love and wine; occasionally, however, as in the famous lyric (1756) on the capture of Port Mahon, for which the author received a pension, the note of patriotism is struck.

See H. Bonhomme's edition (1868) of the *Journal et Mémoires* (1748–72); Grimm's *Correspondance;* and C. A. Sainte-Beuve, *Nouveaux lundis,* vol. vii.

COLLECTIVISM, a theory that society and industry should be based upon the collective, or national, ownership of land and capital, *i.e.,* of the means of production, distribution and exchange. Under such a system, the private ownership of capital would be abolished, but private property in personal goods would remain. Thus, the cotton-mills would be owned collectively by the nation, and the products of the cotton mills would be dealt in collectively by the nation, but the consumer who bought the collectively produced cotton products would own them as his inalienable personal property. Collectivism is thus not the common ownership of wealth, but the common ownership of the means of producing wealth. For a full discussion of the points involved *see* SOCIALISM.

COLLECTOR, a term used for various officials, and particularly in India for the chief administrative official of a district. The title is confined to the regulation provinces; in the non-regulation provinces the same duties are discharged by the deputy-commissioner (*see* COMMISSIONER).

COLLEGE (*Collegium*), in Roman law, a number of persons associated together by the possession of common functions—a body of colleagues; in many respects the collegium was what we should now call a corporation (*q.v.*). Collegia might exist for purposes of trade like the English gilds, or for religious purposes (*e.g.,* the college of augurs, etc.), or for political purposes; *e.g., tribunorum plebis collegia.* By the Roman law a collegium must have at least three members. The name is now usually applied to educational corporations, such as the colleges of Oxford and Cambridge, with which, in the numerous English statutes relating to colleges, the colleges of Winchester and Eton are usually associated. These colleges are in the eye of the law eleemosynary corporations. In some of the earlier statutes of Elizabeth they are spoken of as having an ecclesiastical character, but the doctrine of the common law since the Reformation has been that they are purely lay corporations, notwithstanding that most or all of their members may be persons in priest's orders.

Colleges appear to have grown out of the voluntary association of students and teachers at the university. According to some accounts these must at one time have been numerous and flourishing beyond anything we are now acquainted with. We are told, for example, of 300 halls or societies at Oxford, and 30,000 students. In early times there seems to have been a strong desire to confine the scholars to certain licensed houses beyond the influence of the townspeople. Men of wealth and culture, and notably the political bishops and chancellors of England, obtained charters from the Crown for the incorporation of societies of scholars, and these in time became exclusively the places of abode for students attending the university. At the same time the corporations thus founded were not necessarily attached to the locality of the university. The early statutes of Merton college, for example, allow the residence of the college to be shifted as occasion required; and the foundations of Wolsey at Oxford and Ipswich seem to have been the same in intention. In later times (until the introduction of non-collegiate students) the university and the colleges became coextensive; every member of the university had to attach himself to some college or hall, and every person admitted to a college or hall was obliged to matriculate himself in the university.

The fellowships, scholarships, etc., of colleges were until a comparatively recent date subject to various restrictions. Birth in a particular county, education at a particular school, relationship to the founder and holy orders, are amongst the most usual of the conditions giving a preferential or conclusive claim to the emoluments. Most of these restrictions have been swept away.

The American college has no exact counterpart in the educational system of other countries. It was developed from the European systems and particularly from the British Universities. While the older colleges such as Harvard, Princeton and Yale are in primary form of organization quite similar to the Universities of Oxford and Cambridge, the representative American college is an institution with adaptations widely different from the older schools. The three commonly accepted divisions of education in the United States, primary, secondary and higher stages, are fully recognized but are not rigorously followed. The typical American college is a composite institution, in part secondary and in part higher in its organization. It normally consists of a four-year course of study leading to a bachelor's degree. The many tendencies at present existing in American institutions of higher education are discussed under UNIVERSITIES; EDUCATION; SCHOOLS.

The term "college" (like "academy") is also applied to various institutions; *e.g.,* to colleges of physicians and surgeons, and to the electoral college in the United States presidential elections, etc.

For the Sacred College, *see* CARDINAL.

COL LEGNO (It.), "with the wood," a direction in music signifying that the notes so marked are to be played, not in the usual way, but by striking the strings with the stick of the bow.

COLLEONI, BARTOLOMMEO (1400–1475), Italian soldier of fortune, served the Venetian republic for many years under Gonzaga and Francesco Sforza. He defeated the Milanese at the battles of Brescia, Verona and on Lake Garda. He transferred his services to the Milanese in 1443, but the suspicious nature of Visconti was awakened by his conduct, and he was imprisoned at Monza until the duke died in 1447. He left the Milanese service in 1448, and returned to that of Venice; but dissatisfied at not having been appointed captain-general he again entered the Milanese service.

The offer of increased pay brought him back once more to Venice, and in 1455 he was appointed captain-general for life. He died in 1475.

BIBLIOGRAPHY.—For an account of Colleoni's wars, S. Romanin, *Storia documentata di Venezia* vol. iv. (Venice, 1855), and other histories of Venice; *see* also G. M. Bonomi, *Il Castello di Caverrago e i conti Martinengo Colleoni* (Bergamo, 1884); O. Browning, *Life of Bartolommeo Colleoni* (1891); B. Belotti, *La Vita di Bartolommeo Colleoni* (Bergamo, 1923).

COLLETTA, PIETRO (1775–1831), Neapolitan general and historian, served in the Neapolitan artillery against the French in 1798. He adhered to the Parthenopean republic, and on the surrender of Naples was imprisoned, but, more fortunate than many of his comrades, he was pardoned. When Joseph Bonaparte seized the Neapolitan throne in 1806, Colletta was reinstated in his rank and in 1812 he was promoted general. On the return of Ferdinand, Colletta not only retained his rank, but was given command of a division. When the revolution broke out in 1820, Colletta put down the separatist movement in Sicily with great severity. On the re-establishment of autocracy (1821) he was exiled to Brunn in Moravia, but two years later he returned to Florence, where he wrote his *Storia del reame di Napoli* (1st ed. Capolago, 1834). This work, which deals with the period 1734–1825, is still the standard history of the subject, despite its manifest bias.

See Gino Capponi's memoir in *Storia del reame di Napoli* (2nd ed. Florence, 1848).

COLLEY, SIR GEORGE POMEROY (1835–1881), British general, third son of George Pomeroy Colley, of Rathangan, Co. Kildare, Ireland, was born on Nov. 1, 1835. Entering the 2nd Queen's Regiment in 1852, he served in South Africa (1854–60), and in the Anglo-French expedition to China (1860). In 1870 he went to the War Office to assist in the preparation of Lord Cardwell's measures of army reform, and in 1871 was appointed professor of military administration at the Staff college. Joining Sir Garnet Wolseley at the Gold Coast in 1873, he took charge of the transport in the Ashanti expedition. On his return from Natal where he had accompanied Wolseley in 1875 he was appointed military secretary, and in 1877 private secretary, to Lord Lytton, governor-general of India. In 1879 he joined Wolseley as chief of the staff and brigadier-general in south-east Africa, but on the murder of Cavagnari at Kabul, returned to India. In 1880 he succeeded Wolseley in south-east Africa as high commissioner, and conducted the operations against the rebel Boers. Defeated at Laing's Nek and at the Ingogo river, he was killed at Majuba hill on Feb. 27, 1881.

See W. F. Butler, *Life of Sir George Pomeroy Colley* (1899).

COLLIER, ARTHUR (1680–1732), English philosopher, was born at the rectory of Steeple Langford, Wiltshire, and educated at Oxford. In 1704 he was presented to the family living of Langford Magna and held it to his death. His philosophical opinions grew out of a diligent study of Descartes and Malebranche. He makes no reference to Locke, and shows no knowledge of his works. His chief work appeared in 1713, under the title *Clavis Universalis,* or a *New Inquiry after Truth,* being a *Demonstration of the Non-Existence or Impossibility of an External World* (printed privately, Edinburgh, 1836, and reprinted in *Metaphysical Tracts* [1837] edited by Sam. Parr).

His views are grounded on two presuppositions: first, the utter aversion of common sense to any theory of representative perception; second, the opinion shared with Berkeley, that the difference between imagination and sense perception is only one of degree. The former is the basis of the negative part of his argument; the latter supplies him with all the positive account he has to give, and that is meagre enough. The *Clavis* consists of two parts. After explaining that he will use the term "external world" in the sense of absolute, self-existent, independent matter, he attempts in the first part to prove that the visible world is not external, by showing—first, that the seeming externality of a visible object is no proof of real externality; and second, that a visible object, as such, is not external. The second part of the book is taken up with a number of metaphysical arguments to prove the impossibility of an external world. From the hypothesis of an external world a series of contradictions are deduced, such as that the world is both finite and infinite, is movable and immovable, etc.; and finally, Aristotle and various other philosophers are quoted, to show that the external matter they dealt with, as mere potentiality, is just nothing at all. As cause of our sensations and ground of our belief in externality, Collier substituted for an unintelligible material substance an equally unintelligible operation of divine power. In philosophy he is a curiosity, and nothing more.

In theology Collier was an adherent of the High Church party, though his views were by no means orthodox. In the Jacobite *Mist's Journal* he attacked Bishop Hoadly's defence of sincere errors. His views on the problems of Arianism, and his attempt to reconcile it with orthodox theology, are contained in *A Specimen of True Philosophy* (1730, reprinted in *Metaphysical Tracts,* 1837) and *Logology, or a Treatise on the Logos in Seven Sermons on John i.* 1, 2, 3, 14 (1732, analysed in *Metaph. Tracts*). These may be compared with Berkeley's *Siris.*

See Robt. Benson, *Memoirs of the Life and Writings of Arthur Collier* (1837); Sir W. Hamilton, *Discussions* (1852); A. C. Fraser, ed. of *Berkeley's Works* (1871); G. Lyon, "Un Idealiste anglais au XVIIIe siècle," in *Rev. philos.* (1880), x. 375.

COLLIER, JEREMY (1650–1726), English nonjuring divine, was born at Stow-with-Quy, Cambridgeshire, on Sept. 23 1650. He was educated at Ipswich free school, of which his father was master, and at Caius college, Cambridge, He was appointed in 1679 to the small rectory of Ampton, near Bury St. Edmunds, and in 1685 he was made lecturer of Gray's Inn. He was a nonjuror, and at the Revolution he was sent to Newgate for writing in favour of James II. a tract entitled *The Desertion discuss'd in a Letter to a Country Gentleman* (1688), in answer to Bishop Burnet's defence of King William's position. He was released after some months of imprisonment, without trial, but in 1692 he was again in prison under suspicion of treasonable correspondence with James. His scruples forbade him to acknowledge the jurisdiction of the court by accepting bail, but he was soon released. In 1696 for his boldness in granting absolution on the scaffold to Sir John Friend and Sir William Parkyns, who had attempted to assassinate William, he was obliged to flee, and for the rest of his life continued under sentence of outlawry.

When the storm had blown over, he returned to London. In 1697 appeared the first volume of his *Essays on Several Moral Subjects,* to which a second was added in 1705, and a third in 1709. In 1698 Collier produced his famous *Short View of the Immorality and Profaneness of the English Stage. . . .* He attacked the immorality of the contemporary stage, supporting his contentions by references to the comparative decency of Latin and Greek drama, the profane language of the plays, the abuse of the clergy common in the drama, the encouragement of vice by representing the vicious characters as admirable and successful; and supported his general position by the analysis of particular plays, Dryden's *Amphitryon,* Vanbrugh's *Relapse* and D'Urfey's *Don Quixote.* Collier had no artistic appreciation of the subject he discussed, and he mistook cause for effect in asserting that the decline in public morality was the result of the flagrant indecency of the stage. He owed a good deal to Thomas Rymer's *Tragedies of the Lost Age* printed 20 years before. Dryden contented himself with protesting against Collier's insolence; but Congreve made an angry reply; Vanbrugh and others followed. Collier defended himself in numerous tracts: a *Defence* (1699), a *Second Defence* (1700), and *Mr. Collier's Dissuasive from the Playhouse, in a Letter to a Person of Quality* (1703), and a *Further Vindication* (1708). The fight lasted in all about ten years. The actual effect on the stage of Collier's onslaught has been much exaggerated by historians. The dramatists were incensed, but they did not mend their ways.

From 1701 to 1721 Collier was employed on his *Great Historical, Geographical, Genealogical, and Poetical Dictionary,* founded on, and partly translated from, Louis Moréri's *Dictionnaire historique,* and in the compilation and issue of the two volumes folio of his own *Ecclesiastical History of Great Britain from the first planting of Christianity to the end of the reign of Charles II.* (1708–14). The latter work was attacked by Burnet and others, but the author showed himself as keen a controversialist as ever. Many attempts were made to shake his fidelity to the lost cause of the Stuarts, but he continued indomitable to the end. In 1712 George Hickes was the only survivor of the nonjuring bishops, and in the next year Collier was consecrated. He had a share in an attempt made towards union with the Greek Church. He had a long correspondence with the Orthodox authorities, his last letters on the subject being written in 1725. Collier preferred the version of the *Book of Common Prayer* issued in 1549, and regretted that certain practices and petitions there enjoined were omitted in later editions. His first tract on the subject, *Reasons for Restoring some Prayers* (1717), was followed by others. In 1718 was published a new *Communion Office taken partly from Primitive Liturgies and partly from the first English Reformed Common Prayer Book . . .* which embodied the changes desired by Collier. The controversy that ensued made a split in the nonjuring communion. His last work was a volume of *Practical Discourses,* published in 1725. He died April 26 1726.

Bibliography.—There is an excellent account of Collier in A. Kippis's *Biographia Britannica,* vol. iv. (1789), where some sensible observations by the editor are added to the original biography. A full list of Collier's writings is given by the Rev. William Hunt in the article in the *Dictionary of National Biography.* For particulars of Collier's history as a nonjuring bishop, *see* Thomas Lathbury, *A History of the Nonjurors . . .* (1845). There is an excellent account of the *Short View* and the controversy arising from it in A. Beljame's *Le Public et les hommes de lettres en Angleterre au XVIIIe siècle* (2nd ed., 1897), pp. 244–263.

COLLIER, HON. JOHN (1850–1934), British painter, son of the 1st Lord Monkswell, was born in London on Jan. 27, 1850, and educated at Eton. He studied painting at the Slade school, London, and in Paris, Heidelberg and Munich. He enjoyed great popularity with the public as a painter of what were styled "problem pictures" or pictures depicting some highly dramatic incident; but his best work was done in portraiture. His portraits include "His Majesty the King when Duke of York" (1901), "Professor E. Ray Lankester" (1906), "Professor Huxley" (1891) and "H. Pelissier" (1909).

COLLIER, JOHN PAYNE (1789–1883), English Shakespearian critic, was born in London, on Jan. 11, 1789. The son of a journalist, he was on the staff of the *Morning Chronicle* and then of *The Times* for some time. He entered the Middle Temple in 1811, but was not called to the bar until 1829. The delay was partly due to his indiscretion in publishing the *Criticisms on the Bar* (1819) by "Amicus Curiae." Collier's first important work for the English drama was a new edition of Dodsley's *Old Plays* (1825–27), and a supplementary volume, *Five Old Plays* (1833). In 1831 appeared his *History of English Dramatic Poetry and Annals of the Stage to the Restoration.* He then became librarian to the duke of Devonshire, and gained access to the chief collections of early English literature throughout the kingdom, especially to the treasures of Bridgewater House. From 1835 to 1839 he published *New Facts, New Particulars and Further Particulars* respecting Shakespeare, and in 1852 the famous *Perkins Folio,* a copy of the second folio (1632), so-called from a name written on the title page. On this book were numerous Ms. emendations of Shakespeare said by Collier to be from the hand of "an old corrector." He published these corrections as *Notes and Emendations to the Text of Shakespeare* (1852), and incorporated them in his edition (1853) of Shakespeare. Their authenticity was disputed by S. W. Singer in *The Text of Shakespeare Vindicated* (1853) and by E. A. Brae in *Literary Cookery* (1855) on internal evidence; and when in 1859 the folio was submitted by its owner, the duke of Devonshire, to experts at the British museum, the emendations were incontestably proved to be forgeries of modern date. Collier was exposed by Mr. Nicholas Hamilton in his *Inquiry* (1860). The point whether he was deceiver or deceived was left undecided, but the falsifications of which he was unquestionably guilty among the Mss. at Dulwich college have left little doubt. He forged the name of Shakespeare in a genuine letter at Dulwich, and the spurious entries in Edward Alleyn's *Diary* were proved to be by Collier's hand when the sale of his library in 1884 gave access to a transcript he had made of the *Diary* with interlineations corresponding with the Dulwich forgeries. No statement of his can be accepted without verification, and no manuscript he has handled without careful examination, but he did much useful work. He compiled a valuable *Bibliographical and Critical Account of the Rarest Books in the English Language* (1865); he reprinted a great number of early English tracts of extreme rarity. His *Old Man's Diary* (1871–72) is an interesting record. He died at Maidenhead on Sept. 17, 1883.

For an account of the discussion raised by Collier's emendations *see* C. M. Ingleby, *Complete View of the Shakespeare Controversy* (1861). *See* also H. B. Wheatley, *Life of J. P. Collier* (London, 1884).

COLLIER: see HEWER.

COLLIMATOR, a lens (*q.v.*) placed at a distance equal to its focal length from the luminous object under examination; the rays proceeding from the lens are thus rendered parallel, which is equivalent to the removal of the luminous object under examination to an infinite distance, without the loss of light intensity which such a procedure entails.

In measurements in geometrical and physical optics and spectroscopy (*q.v.*) certain technical advantages require this collimation of the light. In these cases the collimator is usually a telescope with a slit at the principal focal length from the lens. Light from the luminous source is focused on this slit by a lens of similar focal length and the slit then serves as the luminous object of the optical system.

COLLIN, HEINRICH JOSEPH VON (1771–1811), Austrian dramatist, was born in Vienna on Dec. 26, 1771. In 1805 and in 1809, when Austria was under the heel of Napoleon, Collin, who was a civil servant, was entrusted with important political missions. He died on July 28, 1811. His tragedy, *Regulus* (1801), was written in strict classical form in conformity with French taste. But in his later dramas, *Coriolan* (1804), the overture to which was composed by Beethoven, *Polyxena* (1804), *Balboa* (1806), *Bianca della Porta* (1808), he made some attempt to reconcile the pseudo-classic type of tragedy with that of Shakespeare and the German romanticists. As a lyric poet (*Gedichte,* collected 1812), Collin has left a collection of stirring *Wehrmannslieder* for the fighters in the cause of Austrian freedom, as well as some excellent ballads (*Kaiser Max auf der Martinswand, Herzog Leupold vor Solothurn*). His younger brother Matthaüs von Collin (1779–1824) was in sympathy with the Romantic movement, and as editor of the *Wiener Jahrbücher für Literatur,* was a potent force in the literary life of Vienna. His dramas on themes from Austrian national history (*Belas Krieg mit dem Vater,* 1808, *Der Tod Friedrichs des Streitbaren,* 1813) may be regarded as the precursors of Franz Grillparzer's historical tragedies.

H. J. von Collin's *Gesammelte Werke* appeared in 6 vols. (1812–14). *See* an excellent monograph by F. Laban (1879); also A. Hauffen, *Das Drama der klassischen Periode,* ii, 2 (1891).

Matthaüs von Collin's *Dramatische Dichtungen* were published in 4 vols. (1815–17); his *Nachgelassene Schriften,* edited by J. von Hammer, in 2 vols. (1827). A study of his life and work by J. Wihan will be found in *Euphorion,* Ergänzungsheft (1901).

COLLIN D'HARLEVILLE, JEAN FRANÇOIS (1755–1806), French dramatist, was born at Mévoisins, near Maintenon (Eure-et-Loire), on May 30, 1755. His best plays are *L'Optimiste, ou l'homme toujours content* (1788), and *Le Vieux Célibataire* (1793). Collin was one of the original members of the Institute of France, and died in Paris on Feb. 24, 1806.

The 1822 edition of his *Théâtre et poésies fugitives* contains a notice by his friend the dramatist Andrieux. His *Théâtre* was also edited by L. Moland in 1876; and by Édouard Thierry in 1882.

COLLING, ROBERT (1749–1820), and **CHARLES** (1751–1836), English stock breeders, famous for their improvement of the Shorthorn breed of cattle, were the sons of Charles Colling, a farmer of Ketton, near Darlington, where Charles continued to farm, while Robert took a farm at Barmpton. An animal which Robert bought on Charles' advice for £8 and afterward sold to his brother, became known as the celebrated "Hubback," a bull which formed the basis of both the Ketton and Barmpton herds. The two brothers pursued the same system of "in and in" breeding which they had learned from Robert Bakewell (*q.v.*), and both the Ketton and the Barmpton herds were sold by auction in the autumn of 1810. Robert Colling died at Barmpton on March 7, 1820. Charles Colling died on Jan. 16, 1836. (*See* AGRICULTURE: A GENERAL SURVEY; CATTLE.)

COLLINGS, JESSE (1831–1920), British politician, was born at Littleham, Exmouth, Devon, on Jan. 9, 1831. In 1866 he settled in Birmingham, where he was intimately associated with Joseph Chamberlain, and in 1878 was elected mayor of Birmingham. In 1880 he entered parliament as Liberal member for Ipswich, and became a famous advocate of the Radical land policy, associated with the phrase "three acres and a cow." In 1886 he became parliamentary secretary to the local government board, but resigned with Chamberlain over William Gladstone's home rule policy. In 1895 Collings became under-secretary to the home office, retaining the post till 1902. He resigned his seat in parliament in 1918, and died at Edgbaston on Nov. 20, 1920. He was the founder (1872) of the Rural Labourers' league. His works are: *Land Reform* (1906); *The Colonisation of Rural Britain* (1914, 2 vols.); and *Autobiography* (1920).

COLLINGSWOOD, a borough of Camden county (N.J.), U.S.A., 3 mi. S.E. of Camden on the Pennsylvania railroad. It has some manufactures, including loom works and printing, but is primarily a suburban residence town, with a population of 8,714 in 1920, and 12,685 (federal census) in 1940. A commission form of government was adopted in 1917.

COLLINGWOOD, CUTHBERT COLLINGWOOD, BARON (1750–1810), British naval commander, was born at Newcastle-on-Tyne on Sept. 26, 1750, educated at a grammar school, and when eleven years old was sent to sea in the frigate *Shannon* in the care of his cousin, Captain Braithwaite. He served for some years on the home station with this officer and also under Admiral Roddam. In 1774 he served on the North American station under Admiral Graves, and was in the naval brigade that saw service at the battle of Bunker's Hill, here winning his lieutenancy (June 17, 1775). In the following year he was lieutenant of the sloop *Hornet* in the West Indies, and thereafter began his close association with Nelson whose proximity generally seems to have inspired him to his most brilliant work. He followed Nelson as first lieutenant of the *Lowestoft,* as Commander of the *Badger,* and post-captain of the frigate *Hinchinbrook* (March 1780). Immediately afterwards he was one of those employed under Nelson in the San Juan expedition which failed owing to the appalling climate which killed nine-tenths of the personnel. After commanding another frigate and the *Sampson* Collingwood found himself again with Nelson in the West Indies, this time in the frigate *Mediator.* He remained there three years and was present during the quarrel between Nelson and the commander-in-chief concerning the severity with which the navigation laws ought to be enforced against the late American colonists, agreeing with Nelson, with whom he was by now on most intimate terms, that no leniency should be exercised.

In 1786 Collingwood returned home and, with the exception of one brief command, remained there till 1792, marrying in 1791 the grand-daughter of one of his old commanders, Admiral Roddam. On the outbreak of war, he was appointed Flag-Captain to Rear-Admiral Bowyer in the *Prince,* and with him he shifted to the *Barfleur* and took part in Howe's victory on the "Glorious 1st of June," 1794. In August 1795 he was appointed to the *Excellent* for his first experience of the Mediterranean station; he was engaged in the blockade of Toulon and took a conspicuous part in Jervis's great victory off St. Vincent (Feb. 1797). As Jervis pierced the Spanish line, the *Excellent* was the rearmost ship in his fleet and when Nelson had, without orders, taken his ship from the line to oppose the Spaniards that seemed likely to escape, it was to Collingwood that Jervis signalled orders to go to his friend's assistance. He and Nelson thus found themselves greatly outnumbered until other ships, in the ordinary course, arrived to help,—a situation offering scope for heroic deeds of which both took full advantage. The Spanish flight was held up and two ships struck to the *Excellent.* In 1799 Collingwood became Rear-Admiral, and he was at sea in the *Triumph* and other ships until the peace of Amiens gave him some respite.

On the renewal of war in 1803, Collingwood was at once employed, and he continued in active service until his death. He began in the Channel fleet under Cornwallis which was blockading Brest. He remained there until May 1805 (having in the meantime been promoted to Vice-Admiral in May 1804), when he was given command of a small squadron which was intended to reinforce the Mediterranean fleet under Nelson. He placed himself off Cadiz when Villeneuve, after his return from the West Indies, made that port, and there he was joined by Nelson, so becoming second-in-command at Trafalgar. In this battle he carried out brilliantly the part assigned to him by the commander-in-chief. With 15 ships he was to attack the rear 11 of the enemy, breaking through and fighting from to leeward so as to prevent their escape, Nelson with 12 ships undertaking that the enemy's van and centre should not interfere with him. Collingwood carried his detachment into action in line of bearing—his own contribution to the tactics of the battle—but, owing to the irregularity of the allied line, became engaged with 16, instead of 11, ships. As, however, he demolished them with ease, this was positively a gain. His own ship, the *Royal Sovereign,* being a very fast sailer, was in action some 20 minutes before the rest of his detachment, and was consequently surrounded by enemies, but she got free and caused the Spanish flagship to strike to her. On Nelson's death, the command passed to Collingwood, and he had the difficult task of conserving the fleet and its prizes during the storm which followed. For his services in the battle he was created Baron Collingwood of Coldburne and Heathpool, and granted a pension of £2000 a year.

The very completeness of Trafalgar prevented Nelson's immediate followers from achieving any comparable success. Collingwood received the Mediterranean command and held it, with distinction, till his death, but the French were not easily induced to leave port, and on the only occasion that he had a chance of catching them he was hampered by lack of intelligence of their movements. Collingwood was not only a distinguished officer in the ordinary sense, he was also a gunnery expert, a man of great political insight and diplomatic ability, a humanist, objecting strongly to the cruder methods of maintaining discipline customary in his time, and a letter-writer of the first class. He died while on the way home, on March 7, 1810. His health had long been declining, but the Admiralty had been loath to dispense with the services of such a popular and versatile officer. He was, very fittingly, laid to rest in St. Paul's by Nelson's side.

See G. C. M. Collingwood, *Selection from the Public and Private Correspondence of Lord Collingwood* (1828); W. Clark Russell, *Life of Admiral Collingwood* (1891); Admiralty Committee Report, *Evidence relating to the Tactics employed by Nelson at the Battle of Trafalgar* (1913). (G. A. R. C.; J. G. B.)

COLLINGWOOD, a city of Bourke county, Victoria, Australia, a suburb of Melbourne on the N.E., on the Yarra river. Pop. (1933) was 30,665. It was the first town in Victoria incorporated after Melbourne and Geelong. It is now well within Greater Melbourne, and less than 2 mi. from the centre.

COLLINGWOOD, a town of Simcoe county, Ontario, Canada, 90m. N.N.W. of Toronto, on Georgian bay, and on the Canadian National railway. Pop. (1941) 6,270. It has steamer communication with all Lake and St. Lawrence ports. It contains a large stone dry-dock and shipyard, pork factory, and saw and planing mills, and has a large lumber, grain and produce export trade, besides a shipbuilding plant and steel works.

COLLINS, ANTHONY (1676–1729), English deist, was born at Heston, near Hounslow in Middlesex, on June 21, 1676. He was educated at Eton and King's college, Cambridge. The most interesting episode of his life was his intimacy with Locke, who in his letters speaks of him with affection and admiration. He died at his house in Harley street, London, on Dec. 13, 1729.

His writings are important as gathering together the results of previous English Freethinkers. In spite of unorthodoxy Collins was not an atheist or even an agnostic. In his own words, "Ignorance is the foundation of atheism and freethinking the cure of it" (*Discourse of Freethinking,* 105).

His first work of note was his *Essay concerning the Use of Reason in Propositions the Evidence whereof depends on Human Testimony* (1707), in which he rejected the distinction between *above* reason and *contrary to* reason, and demanded that revelation should conform to man's natural ideas of God. Like all his works, it was published anonymously. Six years later appeared his chief work, *A Discourse of Freethinking, occasioned by the Rise and Growth of a Sect called Freethinkers* (1713). In spite of its indiscriminate attack on the priests, the book contends for no more than every Protestant must allow. In England this essay, which was regarded and treated as a plea for deism, made a great sensation, calling forth several replies, among others from William Whiston, Bishop Hare, Bishop Hoadly, and Richard Bentley. Swift, also, being satirically referred to in the book, made it the subject of a caricature.

In 1724 Collins published his *Discourse of the Grounds and Reasons of the Christian Religion,* with *An Apology for Free Debate and Liberty of Writing* prefixed. Ostensibly, it is written in opposition to Whiston's attempt to show that the books of the Old Testament did originally contain prophecies of events in the New Testament, which had been eliminated or corrupted by the Jews, and to prove that the fulfilment of prophecy by the events of Christ's life is all "secondary, secret, allegorical and mystical," since the original and literal reference is always to some other fact. Since, further, according to him the fulfilment of prophecy is the only valid proof of Christianity, he thus secretly aims a blow at Christianity as a revelation. No less than 35 answers were directed against this book, the most noteworthy of which were those of Bishop Edward Chandler, Arthur Sykes and Samuel Clarke. To these Collins replied by his *Scheme of Literal Prophecy Considered* (1727). An appendix contends against Whiston that the book of *Daniel* was forged in the time of Antiochus Epiphanes (*see* DEISM).

In philosophy, Collins, is a defender of Necessitarianism. His brief *Inquiry Concerning Human Liberty* (1715) has not been excelled, at all events in its main outlines, as a statement of the determinist standpoint. Attacked by Samuel Clarke he replied after Clarke's death with *Liberty and Necessity* (1729).

Besides these works he wrote *A Letter to Mr. Dodwell,* arguing that it is conceivable that the soul may be material, and, secondly, that if the soul be immaterial it does not follow, as Clarke had contended, that it is immortal; *Vindication of the Divine Attributes* (1710); *Priestcraft in Perfection* (1709).

See Kippis, *Biographia Britannica;* G. Lechler, *Geschichte des englischen Deismus* (1841); J. Hunt, *Religious Thought in England,* ii. (1871); Leslie Stephen, *English Thought in the 18th Century,* i. (1881); A. W. Benn, *Hist. of English Rationalism in the 19th Century* (1906); J. M. Robertson, *Short History of Freethought* (1906); and *Deism.*

COLLINS, JOHN CHURTON (1848–1908), English literary critic, was born March 26 1848 at Bourton on the Water, Gloucestershire, and died at Lowestoft Sept. 15 1908. He was educated at King Edward's school, Birmingham, and Balliol college, Oxford. In 1904 he was appointed professor of English literature at Birmingham.

His works include: *Bolingbroke and Voltaire in England* (1886), a *Study of English Literature* (1891), a study of *Dean Swift* (1893), *Essays and Studies* (1895), *Ephemera Critica* (1901), *Essays in Poetry and Criticism* (1905), and *Rousseau and Voltaire* (1908), his original essays being sharply controversial in tone, but full of knowledge.

COLLINS, MICHAEL (1890–1922), Irish politician, was born near Clonakilty in County Cork, the eighth child of John Collins, a prosperous farmer who, at 62, married Kate O'Brien, his junior by 40 years. Michael Collins entered the second division of the British civil service and went to London as a junior postal clerk in 1907. After two years he left the civil service to be clerk in an accountant's office. During this period he joined the Irish Republican brotherhood.

At the beginning of 1916 Collins returned to Ireland, joined the Irish volunteers in Dublin, and was one of those who fought under Pearse in the general post office during Easter week. He escaped being taken under arms, but later was arrested and sent with the great body of suspects to the detention camp at Frongoch. Released with the rest in July 1917, he was returned at the general election in Dec. 1918 as Sinn Fein member for County Cork. Out of 73 elected only 29 were present when they met in the Mansion house and declared for the Irish Republic. E. de Valera, their elected president, was in gaol, so was the vice-president, Arthur Griffith. All effective decisions were taken by the men who were clever enough to avoid arrest. These were Collins, Cathal Brugha and the headquarter staff of the Irish volunteers.

Brugha (Charles Burgess), as minister of defence in de Valera's Republican Ministry, was head of the Irish volunteers, known later as the I.R.A. (Irish Republican Army). In this military organization Collins was head of the intelligence department; but in the administration as a whole he was minister of finance. In this dual capacity Collins controlled the entire correspondence of the movement. All enterprises were considered, financed, and many were carried out by him. In March 1919 he and Harry Boland arranged the escape of de Valera from Lincoln gaol. How far he was responsible for the spread of the guerrilla war cannot now be ascertained. But by 1920 his name, first gradually and then universally, had become known as that of the man most wanted by the British authorities. A reward of £10,000 was offered for his arrest, and pictures of him were published. Yet he used no disguise, went about Dublin alone on a bicycle and frequently made appointments for an interview in the public streets. He demoralized the British secret service and created a most effective spy system of his own.

At the close of 1920 secret negotiations, conducted through the Australian Archbishop Clune, were held with Collins, who afterwards maintained that all the concessions obtained six months later could have been secured then but for the action of a county council which called for cessation of hostilities. This, he held, encouraged the British to insist on a surrender of arms, upon which demand the negotiations broke down. In July 1921 when the truce with Britain was proclaimed, Collins for the first time became directly known to the Irish public. No other figure was so popular. When the negotiations between de Valera and Lloyd George failed to reach any conclusion, Griffith, Collins and three others were appointed to renew the attempt. Collins, by his genial personality, undoubtedly smoothed over many of the difficulties, and though in principle a republican he knew when the utmost possible had been gained. Griffith alone could not have forced the Dail to accept the treaty against de Valera's opposition; this achievement was mainly due to the magnetic personality of the younger man. When the result of the voting showed the narrow margin of seven for acceptance, Collins instantly rose and gravely warned the assembly of the anarchy that might follow dissension. He proposed a joint committee of public order, but the proposal was rejected. In the debate he had declared that he accepted the treaty as a stepping stone to a republic, but he was careful both in his speech and his published volume, *The Path to Freedom,* to disavow any desire to force a separation which would injure Britain or leave her exposed. In his opinion, the Dominions were destined to detach themselves naturally and without a wrench, like ripened fruit.

The first result of the Dail's decision was confusion. Griffith was elected president, not of the Free State but of the Irish Republic. Collins was appointed chairman of the provisional Government. But administration in the ordinary sense was impossible. Civil life had been destroyed in the guerrilla war; the police were now necessarily disbanded, since the struggle had left a blood feud between them and the people; the British garrison was evacuating the country, and the Irish army, still considered the army of the Republic, was deeply disaffected.

Collins's first object was to reach a settlement with Ulster. He therefore entered into personal negotiations with Sir James Craig, (Lord Craigavon) premier of Northern Ireland. No settlement was reached, largely because of the imminence of civil war in the South. Mutiny broke out in the army, and Collins, hoping against hope to avoid civil strife, refrained from drastic action. He was instrumental in postponing the general election (stipulated for under the treaty), and when at last a date for it was fixed in June he entered at the eleventh hour into a compact with de Valera by which he and the Republican leader agreed to appeal for the unopposed return of candidates jointly nominated by them. This would have given a very large representation to opponents of the treaty. But when independent candidates were put forward, Collins at the last moment advised his countrymen to vote as they wished. This he knew would mean the acceptance of the treaty. At the elections the republicans were heavily beaten and the Irish Government, challenged by force even in the capital, decided to use force in return.

Civil war began; and Collins, assuming chief command, flung himself into the struggle with all his energy. Opposition was crushed in Dublin and all the large towns. Suddenly, on Aug. 12, Griffith fell dead and Collins became at once head of the State and of the army. The newly enrolled forces needed impetus and he went down to give it to them by his presence in Munster, where the chief resistance lay. On Aug. 22, 1922, motoring with a strong escort from Skibbereen to Cork, his party was ambushed, and in the skirmish he was shot through the head. No man since Parnell had so caught the imagination of Ireland. Perhaps the moment of his death was fortunate, for he died when victory was more apparent than real, and he was spared the task of executing those who had been his comrades. But his work stands, and he emerges from the struggle with a reputation less tarnished than some of his contemporaries. (S. G.)

COLLINS, MORTIMER (1827–1876), English writer, was born in Plymouth June 29 1827, and died July 28 1876. His longest and best sustained poem is *The British Birds, a Com-*

munication from the Ghost of Aristophanes* (1872). He also wrote several novels, the best of which is perhaps *Sweet Anne Page* (1868).

COLLINS, WILLIAM (1721–1759), English poet, was born on Dec. 25, 1721. He divides with Gray the glory of being the greatest English lyrist of the 18th century. After some childish studies in Chichester, of which his father, a rich hatter, was the mayor, he was sent, in Jan. 1733, to Winchester college, where Whitehead and Joseph Warton were his school-fellows.

In 1734 the young poet published his first verses, in a sixpenny pamphlet, on *The Royal Nuptials,* of which, however, no copy has come down to us; another poem, probably satiric, called *The Battle of the Schoolbooks,* was written about this time, and has also been lost. Fired by his poetic fellows to further feats in verse, Collins produced, in his 17th year, those *Persian Eclogues* which were the only writings of his that were valued by the world during his own lifetime. They were not printed for some years, and meanwhile Collins sent, in Oct. 1739, some verses to the *Gentleman's Magazine,* which attracted the notice and admiration of Johnson, then still young and uninfluential. In March 1740 he was admitted a commoner of Queen's college, Oxford, but did not go up to Oxford until July 1741, when he obtained a demyship at Magdalen college. At Oxford he continued his affectionate intimacy with the Wartons, and gained the friendship of Gilbert White. Early in 1742 the *Persian Eclogues* appeared in London. They were four in number, and formed a modest pamphlet of not more than 300 lines in all. In a later edition, of 1759, the title was changed to *Oriental Eclogues.*

A few days after taking his degree in 1743 Collins published his second work, *Verses humbly addressed to Sir Thomas Hanmer.* This poem, written in heroic couplets, shows a great advance in individuality, and resembles, in its habit of personifying qualities of the mind, the riper lyrics of its author. For the rest, it is an enthusiastic review of poetry, culminating in a laudation of Shakespeare. A second edition of it, differing considerably from the first, was published in the following year. To this edition was added the *Song from Cymbeline* in its original form, which was not strictly adhered to by the editor, Cave, when he published it in the *Gentleman's Magazine* for Oct. 1749. Collins's indolence, which had been no less marked at the university than his genius, combined with a fatal irresolution to make it extremely difficult to choose for him a path in life. The army and the church were successively suggested and rejected; and he finally arrived in London, bent on enjoying a small property as an independent man about town. He made the acquaintance of Johnson and others, and was urged by those friends to undertake various important writings—a *History of the Revival of Learning,* several tragedies and a version of Aristotle's *Poetics,* among others—all of which he began but lacked force of will to continue. He soon squandered his means, plunging, with most disastrous effects, into profligate excesses.

It was at this time, however, that he composed his matchless *Odes*—12 in number—which appeared on Dec. 12, 1746, dated 1747. Collins's little volume fell dead from the press, but it won him the admiration and friendship of the poet Thomson, with whom, until the death of the latter in 1748, he lived on terms of affectionate intimacy. In 1749 Collins was raised beyond the fear of poverty by the death of his uncle, Colonel Martyn, who left him about £2,000, and he left London to settle in his native city. He had hardly begun to taste the sweets of a life devoted to literature and quiet, before the weakness of his will began to develop in the direction of insanity, and he hurried abroad to attempt to dispel the gathering gloom by travel. In the interval he had published a short piece of consummate grace and beauty—the *Elegy on Thomson,* in 1749. In the beginning of 1750 he composed the *Ode on the Popular Superstitions of the Highlands,* which was dedicated to the author of *Douglas,* and not printed till long after the death of Collins, and an *Ode on the Music of the Grecian Theatre,* which no longer exists. With this poem his literary career closes, although he lingered in great misery for nearly nine years. From Gilbert White, who jotted down some pages of invaluable recollections of Collins in 1781, and from other friends, we learn that his madness was occasionally violent, and that he was confined for a time in an asylum at Oxford. But for the most part he resided at Chichester, suffering from extreme debility of body when the mind was clear, and incapable of any regular occupation. In this miserable condition he passed out of sight of all his friends, and in 1756 it was supposed, even by Johnson, that he was dead; in point of fact, however, his sufferings did not cease until June 12, 1759. No journal or magazine recorded the death of the forgotten poet, though Goldsmith, only two months before, had begun the laudation which was soon to become universal.

No English poet so great as Collins has left so small a bulk of writings. Not more than 1,500 lines of his have been handed down to us. His odes are the most sculpturesque and faultless in the language. They lack fire, but in charm and precision of diction, exquisite propriety of form and lofty poetic suggestion, they stand unrivalled. The ode named *The Passions* is the most popular; that *To Evening* is the classical example of perfect unrhymed verse. In this, and the *Ode to Simplicity,* one seems to be handling an antique vase of matchless delicacy and elegance. In his descriptions of nature it is unquestionable that he owed something to the influence of Thomson. Distinction may be said to be the crowning grace of the style of Collins; its leading peculiarity is the incessant personification of some quality of the character. In the *Ode on Popular Superstitions* he produced a still nobler work; this poem, the most considerable in size which has been preserved, contains passages which are beyond question unrivalled for rich melancholy fullness, in the literature between Milton and Keats.

See his life in Johnson's *Lives of the Poets* and the biography by M. Thomas (1853). There is a bibliography of his writings in *Seven 18th Century Bibliographies* by I. A. Williams (1924). (E. G.)

COLLINS, WILLIAM WILKIE (1824–1889), English novelist, elder son of William Collins, R.A. (1787–1847), the landscape painter, was born in London on Jan. 8, 1824, and died there on Sept. 23, 1889. He was educated at a private school in Highbury, and when only a small boy of twelve was taken by his parents to Italy, where the family lived three years. On his return he was articled to a firm in the tea trade, but later abandoned that business for the law, and was entered at Lincoln's Inn in 1846, being called to the Bar three years later. He took little interest, however, in his new career. On his father's death in 1847, Collins made his first essay in literature with *The Life of William Collins* (1848). In 1850 he published his first novel, *Antonina, or The Fall of Rome,* which was clearly inspired by his life in Italy. *Basil* appeared in 1852, and *Hide and Seek* in 1854. About this time Collins made the acquaintance of Charles Dickens, and began to contribute to *Household Words,* where *After Dark* (1856) and *The Dead Secret* (1857) ran serially. Among his most successful subsequent books were *The Woman in White* (1860), *No Name* (1862), *Armadale* (1866), and *The Moonstone* (1868). After *The New Magdalen* (1873) his ingenuity seemed to become exhausted.

Collins' popularity was great in his own day. He subsequently shared the temporary eclipse of most of the Victorian authors, but regained some of his vogue through the increasing popularity of mystery stories in the early years of the twentieth century. His style approximates, at its worst, to the melodramatic, and he sometimes exhibits all the violence and crudity of the "penny gaff." But he was undeniably a first-class story-teller, a master of situation and effect. His method of telling a story through the mouths of several characters, though sometimes criticised, has been imitated with success by subsequent writers of similar stories, such as Bram Stoker in *Dracula,* and is certainly well adapted to the progressive elucidation of a mystery. Some of his characters are not only real but uncommon. Later admirers of "Professor Moriarty" and "Arsène Lupin" could find a peer and in many respects a superior to these and similar personages in Count Fosco in *The Woman in White,* who is the spiritual parent of scores of subtly humorous sardonic villains.

COLLINSVILLE, a city of south-western Illinois, U.S.A., on the Pennsylvania Railroad, 12m. E.N.E. of St. Louis. The population in 1930 was 9,235; 1940, 9,767 by the federal census. It is in a coal-mining and farming region; has a dress factory, flour mills, a large poster-printing plant, a tomato products factory, and manufactures pressed bricks and cowbells. It was settled about 1810 and incorporated as a city in 1873.

COLLODION, a colourless, viscid fluid, made by dissolving gun-cotton and the other varieties of pyroxylin in a mixture of alcohol and ether. It was discovered in 1846 by Louis Nicolas Ménard in Paris, and independently in 1848 by Dr. J. Parkers Maynard in Boston. The quality of collodion differs according to the proportions of alcohol and ether and the nature of the pyroxylin it contains. Collodion in which there is a great excess of ether gives by its evaporation a very tough film; the film left by collodion containing a large quantity of alcohol is soft and easily torn. Under the microscope, the film produced by collodion of good quality appears translucent and colourless. To preserve collodion it should be kept cool and out of the action of the light. For the iodizing of collodion, ammonium bromide and iodide, and the iodides of calcium and cadmium are the agents employed. (*See* PHOTOGRAPHY.) Collodion is used in surgery since, when painted on the skin, it rapidly dries to a thin contractile film, affording both pressure and protection. Flexible collodion, containing Canada balsam and castor oil, does not crack, but, on the other hand, does not contract. M. E. Gripon found (*Compt. rend.,* 1875) that collodion membranes, like glass, reflect light and polarize it both by refraction and reflection; they also transmit a very much larger proportion of radiant heat, for the study of which they are preferable to mica.

BIBLIOGRAPHY.—Medical uses of collodion: W. H. Martindale & W. W. Westcott, *Extra Pharmacopeia* (1924, 1925; 19th ed. vol. i., 1928); Photographic use of collodion: T. E. Thorpe, *Dictionary of Applied Chemistry,* vol. v. (1924).

COLLOIDS. In a paper entitled "Liquid Diffusion applied to Analysis" published in 1861 in the *Philosophical Transactions,* Thomas Graham (*q.v.*) described the results of an investigation carried out with very simple means. Aqueous solutions were placed in a cylindrical vessel the bottom of which was formed by a piece of animal membrane, like pig's bladder, or by the recently invented parchment paper, and the membrane immersed in water. The amount of dissolved substance which diffused into the outer water was determined from time to time. Graham found that the numerous substances examined fell into two classes: those which diffused in appreciable amounts and those which hardly passed through the membrane in perceptible quantities. The former were without exception substances known to crystallize from their solutions, like various salts or sugar, while the latter, among which were albumin, gum arabic or gelatin, had never been known as crystals. Graham accordingly called the first class *crystalloids* and the second class *colloids* (from *colla,* glue).

Graham made the further discovery that a number of substances known to be insoluble in water could, by appropriate procedure, be brought into a state of solution. Thus prussian blue, the well-known pigment, is quite insoluble in water, but dissolves in a solution of oxalic acid. If such a solution is placed in Graham's apparatus, the oxalic acid diffuses into the outside water and the prussian blue remains behind, but still forms what appears a perfectly clear solution, and thus behaves like Graham's other colloids. He called this method of separating crystalloid from colloid constituents *"dialysis"* and the apparatus used for it a *"dialyser,"* terms still in use.

Graham studied by the same method a number of similar preparations, one of which only need be mentioned. If a dilute solution of sodium silicate (the "waterglass" of commerce) is poured into dilute hydrochloric acid, silicic acid and sodium chloride are formed. If this mixture is now dialysed, the sodium chloride passes out and a perfectly clear and colourless solution of silicic acid remains in the dialyser, although this substance, which occurs in great quantities in nature, is almost completely insoluble in water. Both this solution and that of prussian blue, however, exhibit very striking differences from ordinary solutions of crystalloids beyond the fundamental one of not passing through the dialysing membrane. On addition of a few drops of any acid or salt solution the prussian blue is immediately coagulated and in a short while settles out as a flocculent precipitate, leaving the liquid quite clear and colourless. The silicic acid solution even undergoes a spontaneous change on keeping: it gradually becomes more and more viscous, develops a bluish opalescence and finally sets to a jelly; the change can be enormously accelerated by the addition of a few drops of ammonia or even by bubbling carbon dioxide gas through the solution. Both these transformations are *irreversible:* neither the precipitate of prussian blue nor the jelly of silicic acid can be re-transformed into the original solution by washing or the like.

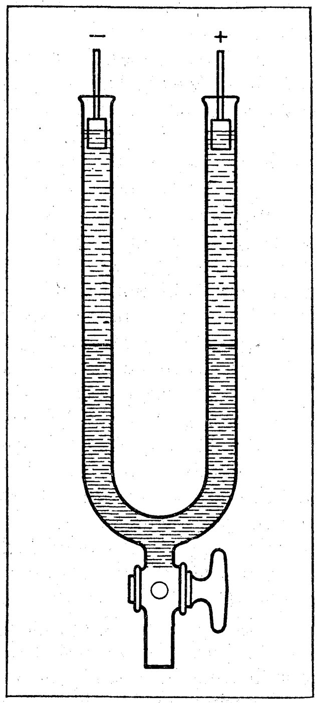


FIG. 1.—CATAPHORESIS TUBE FOR COLLOIDAL SOLUTIONS DEMONSTRATING THAT THE BOUNDARY BETWEEN COLLOIDAL SOLUTION AND WATER MOVES TOWARDS THE POLE WITH THE OPPOSITE SIGN TO THAT OF THE ELECTRIC CHARGE ON THE COLLOIDAL PARTICLES

Graham gave the convenient name of *sol* to a solution which did not dialyse, and the name of *gel* to its product of transformation; both terms have come into general use and will be employed in the rest of this article.

Earlier Observations.—Graham's method of preparing sols or colloidal solutions of many substances known to be insoluble was new and fundamental, but numbers of such apparent solutions had been observed long before him. Berzelius (*q.v.*) had already noticed that silicic acid, sulphur and several metallic sulphides formed such solutions in certain conditions; Francesco Selmi (1817–81) had investigated prussian blue and sulphur sols and expressed very modern views on the constitution of these "pseudo-solutions," as he called them, and many other isolated observations are on record.

Of particular interest is the first systematic investigation of what is now called colloidal gold or gold sol, a preparation which has been of immense importance in the study of colloids. It was known already to the alchemists of the 17th century that very dilute gold chloride solutions, when treated with reducing agents, turned red or purple. In a paper entitled "On the experimental relations of gold (and other metals) to light" published in the *Philosophical Transactions* in 1857, Faraday described such ruby and purple fluids obtained with various reducing agents and gave an extremely complete account of their properties. They were at once turned blue and eventually precipitated by traces of electrolytes; this change, which was irreversible, was even produced after a time by the minute amount of matter dissolved out of the glass vessels. Faraday expressed the definite view that the gold in these liquids was present in the form of extremely minute particles, much too small to be visible in the microscope; their presence could, however, be made evident "by gathering the rays of the sun into a cone by a lens and sending the part of the cone near the focus into the fluid"; the cone becomes visible which it would not be in a liquid entirely free from suspended particles.

This method of illumination was later used extensively by Tyndall and is generally known as the *Tyndall cone;* it has become one of the most delicate means of making small particles collectively visible in liquids or gases.

The Invention of the Ultra-Microscope.—Faraday's paper was almost completely overlooked for about fifty years. Towards the end of the last century R. Zsigmondy (now professor at Göttingen) prepared "ruby liquids" similar to those of Faraday by a new method of reduction, which he at first described as "aqueous solutions of metallic gold." The question of their constitution—and that of most other sols—was however eventually solved by means of the "Ultra-microscope" (*see* MICROSCOPE), designed by Zsigmondy and H. Siedentopf (the scientific adviser of the firm of Carl Zeiss) in 1903. In this instrument a small, but extremely intense, Tyndall cone is projected into the liquid and is viewed at a right angle to its axis with a microscope. Particles which, for reasons inherent in the formation of microscopic images, cannot be seen in the ordinary microscope on account of their small size, become visible in the ultra-microscope as bright discs on a dark ground. The apparent size of the discs is no measure of the actual size of the particles which can, however, be calculated from the number counted in a known volume of illuminated liquid and from the known concentration.

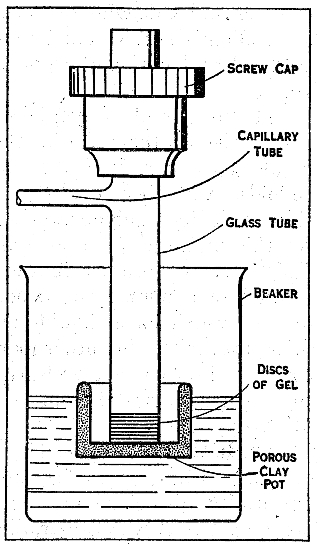


FIG. 2.—APPARATUS FOR DETERMINING THE DEGREE OF SWELLING OF INDIA RUBBER IN VARIOUS SOLVENTS

A very large number of sols have been examined with the ultra-microscope since its invention and have been found to contain particles of very various sizes, the *upper limit* of which is roughly 100–150$\mu\mu$ ($\mu\mu$= one-millionth of a millimetre; this is the usual unit of ultra-microscopic measurements). The lower limit of visibility depends, apart from the intensity of the illumination, on the size of the particle and on the optical difference between its substance and that of the liquid; the difference is greatest with metallic particles, and, with sunlight as the source of illumination, gold particles of about 5 $\mu\mu$ can just be made visible.

The presence of particles within the range described and thus very much larger than even complicated molecules is the characteristic of all colloidal solutions. Some substances, like albumin, gum arabic in cold and gelatin in warm water, are spontaneously *dispersed,* as the usual term is, into particles of such size; inorganic compounds such as have been mentioned, and very many others, must be produced by reactions which, by suitable choice of concentration, temperature and other factors, are so controlled that the particles formed cannot grow beyond the limit of colloïdal sizes. This result has now been achieved in many hundreds of cases, and it is clear that Graham's distinction between colloids and crystalloids as two different *kinds* of matter is no longer tenable. Sulphur crystallizes from solution in carbon disulphide, while common salt does so from aqueous solution; sols of sulphur in water and of salt in several organic liquids can, however, be prepared by a variety of methods. Although the term "colloid" is used for convenience, it now means, not a peculiar type of matter, but merely matter which is, or can be made to appear in, a particular state of subdivision. Some substances, which were among those investigated by Graham, invariably and spontaneously assume this state when brought into contact with a suitable liquid, while others have to be produced in conditions so controlled that the required subdivision is brought about.

Brownian Movement and Stability.—When particles can be observed at all they are always seen to be in constant motion of a very peculiar kind; they quiver and describe irregular paths, the distances traversed by small particles sometimes amounting to several times their diameter. The motion is not confined to ultra-microscopic particles, but was first observed in 1827 by Robert Brown, the botanist, with microscopic particles (pollen grains). The motion, which is called the *Brownian movement* (*q.v.*) is now known to be caused by the impact of the molecules of the surrounding liquid on the particle, and its amplitude increases as the size of the particle decreases. The impacts take place in all directions and the fraction of component which acts vertically upwards is sufficient to counteract gravity and to keep the particles from settling out in the course of time; in the absence of the Brownian movement even ultra-microscopic particles would shew appreciable sedimentation within a few hours or days.

Although the particles move in all directions they never, in a stable sol, are observed to collide with one another. Since there is nothing in the nature of the movement itself to render such collisions impossible, there must be something in the particles themselves which prevents collision. What this factor is will become clear when we have considered the classification of sols.

Classification of Sols.—In spite of the great diversity of behaviour exhibited by individual sols two main types can be clearly distinguished, one resembling the Prussian Blue or the gold sol, the other the gum arabic or albumin sol. The first type is generally very dilute and strikingly sensitive to small concentrations of electrolytes, which produce immediate coagulation followed by settling out of the dispersed substance. The coagulum in the great majority of cases cannot be made to pass into colloidal solution again. On the other hand sols of the second type, *e.g.* of albumin, are not perceptibly affected by small electrolyte concentrations; very high concentrations, such as saturation with ammonium sulphate, cause coagulation, but with this and some other salts the coagulation is reversible and the albumin disperses again when the salt is removed by dialysis. A somewhat similar effect is produced by alcohol or acetone, organic liquids which strongly attract water.

Colloids of the first class are called *lyophobic* and those of the second *lyophilic, i.e.,* translated literally, such as hate and such as like the state of solution, the classification of Prof. Herbert Freundlich (1880–1941) and many authors. Prof. Wolfgang Ostwald of Leipzig distinguished *suspensoids* and *emulsoids;* these classes coincide roughly, though not quite exactly, with the lyophobic and lyophilic respectively. These terms imply that the one class resembles suspensions, the usual description of a liquid in which solid particles are distributed, while the other resembles emulsions, which contain globules of one liquid distributed in another. The assumption that the particles in this class are liquid rests on inferences which are not generally accepted.

The **Lyophobic** or suspensoid sols shew a much more uniform behaviour than the lyophilic ones and may therefore be described first. They are all fairly dilute, concentrations of a few per cent being rarely exceeded, clear or slightly opalescent; their colour may vary widely for a given substance: thus gold sols may be red, purple or blue, and silver sols any colour from blue through purple and red to yellow. Their common and most striking characteristic, the sensitiveness to electrolytes, has already been mentioned repeatedly. A further property common to all of them, whatever the chemical nature of the dispersed substance, is the existence of a difference of electric potential between the surface of the particles and the surrounding liquid. The consequence is that in an electric field they move towards one pole, as was first shewn (for arsenic trisulphide sol) by S. Linder and H. Picton, working in Ramsay's laboratory in 1892. This phenomenon, known as *cataphoresis,* is demonstrated in the simple apparatus illustrated in Fig. 1. The lower portion of the U-tube is filled with the sol to be investigated, while the limbs contain distilled water, into which dip two electrodes. When these are connected to an electric supply, the particles move towards the electrode of the sign opposite to that on their surface, and, if the sol is coloured, the boundary between it and the water above can be seen to move accordingly. It can now be shewn that the existence of the charge at the surface of the particles is necessary for the stability of the sol. By careful addition of electrolyte in small amounts the charge on the particles can be neutralized, which shews itself by their no longer travelling in the electric field; when this point is reached, or even before the potential difference is quite reduced to zero, the sol becomes unstable and eventually precipitates. The particles which, notwithstanding the Brownian movement, did not collide while charged, now come into collision, adhere to one another and finally form aggregates sufficiently large to settle out.

Many theories, which cannot be discussed here, have been advanced to explain the origin of the potential difference, why it prevents collision is still obscure, although the facts are clearly established.

The great majority of lyophobic sols, like those of sulphur, the sulphides, ferrocyanides, gold, silver, platinum, etc. contain particles which are negatively charged towards the liquid and travel to the anode; the particles of a number of oxide sols, like those of iron, chromium, aluminium and cerium, are positive and travel to the cathode.

Electrolyte Coagulation.—The concentration of electrolytes required to bring about coagulation of a lyophobic sol (arsenic trisulphide) was investigated for the first time by Hans Schulze in 1882. He found that the concentration of salt depended on the nature of its metal or, as we now say, its cation and to a very marked degree on its valency. Potassium salts, with a univalent cation, had to be used in concentrations 40–50 times as great as the corresponding salts of bivalent cations like magnesium or barium, and in concentrations about 500 times as great as the corresponding salts of a tervalent cation like aluminium. The coagulation of the arsenic trisulphide sol, with negative particles, was again studied with great thoroughness by Linder and Picton, who confirmed Schulze's results and extended his rule by examining the ferric oxide sol, the particles of which are positive. They found that in this case the valency of the acid or anion was the determining factor. A very considerable amount of study has since been devoted to the phenomenon, which substantially confirms the findings of the pioneer workers; the valency of the ion of the sign opposite to that of the sol particles determines the concentration required to produce coagulation, but the ion which has the same sign makes itself felt by a slight antagonistic effect: thus potassium chloride or nitrate will coagulate a negative sol in somewhat lower concentration than potassium sulphate or citrate.

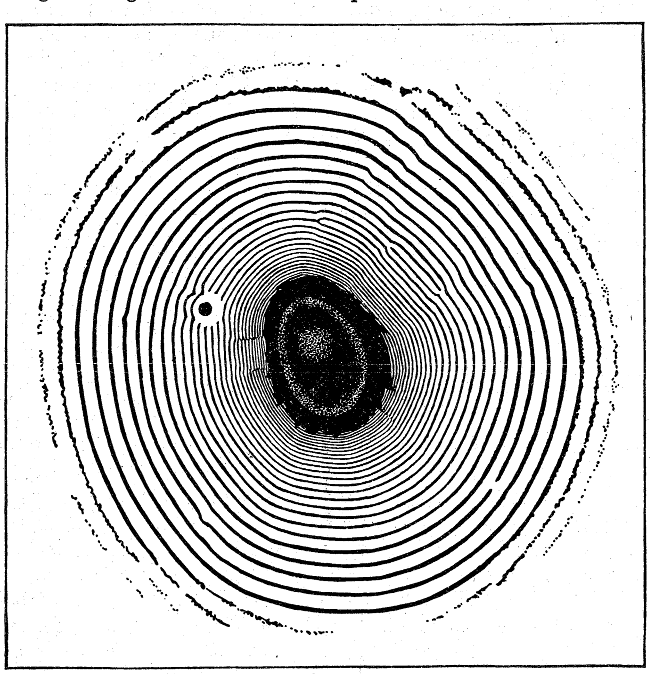


FIG. 3.—LIESEGANG RINGS OF SILVER CHROMATE WHICH STRIKINGLY RESEMBLE THE BANDING IN MANY MINERALS, SUCH AS AGATE, AND ARE BELIEVED TO EXPLAIN ITS FORMATION

It has been mentioned as one of the chief characteristics of the second or lyophilic class of colloids that they are little affected by low electrolyte concentrations. If a lyophilic colloid in small amount is added to a lyophobic sol it imparts to it this enhanced resistance to electrolytes or, as it is usually called, "protects" it. This protective action had been observed already by Faraday, who noticed that the addition of "a little jelly" made his ruby fluids much more stable. Gelatin is, indeed, one of the most effective protective agents for gold sols; a few milligrammes per litre prevent coagulation by salt concentrations many times higher than those which precipitate the unprotected sol. Gum arabic, albumin and its products of decomposition as well as tannin act in the same way. Various body fluids contain mixtures of proteins which act as protective colloids; in the cerebro-spinal fluid the protective effect is altered by various diseases and a diagnosis can be made by coagulating, by a standard sodium chloride solution, mixtures of the fluid with standard gold sol and noting the colour change produced (Lange's test, 1912).

The suspensoid of lyophobic sols are all laboratory products and, while of the greatest theoretical interest, do not play as important a part in nature or in the arts as do the lyophilic colloids. A number of sols, *e.g.* of ferric oxide, manganese dioxide, silver, selenium, sulphur, etc., are used in medicine; all sols made for this purpose are protected. Sols of graphite in water or oil find extensive use as lubricants. Coagulation by electrolytes is used in a number of processes to precipitate finely divided matter suspended in liquids and, indeed, occurs on a huge scale in nature; clay and other particles carried down by rivers are coagulated on contact with salt water and are deposited to form such deltas as are present at the mouths of the Nile and the Mississippi.

Lyophilic Colloids.—The lyophobic colloids, however different their chemical constitution, shew on the whole a remarkable uniformity of behaviour. The lyophilic colloids, on the other hand, exhibit very considerable variety and have no such striking feature in common as the electrolyte coagulation characteristic of all lyophobic sols. Nevertheless a fundamental similarity can be perceived when the properties of a few representatives of the group are surveyed and compared.

Albumin.—White of egg is a mixture of several proteins (*q.v.*) the most important of which, albumin, can be isolated by a simple procedure. The white is beaten to a froth, the clear liquid which drains from it suitably diluted, and sufficient ammonium sulphate is added to form a half-saturated solution. A precipitate forms, consisting of globulin, another protein, while the liquid contains albumin and ammonium sulphate, which can be removed by dialysis. The remaining sol of natural albumin can be shewn to contain negatively charged particles; on the gradual addition of acid it loses the charge and at a fairly constant acid concentration becomes neutral or "iso-electric" (Hardy, 1900).

Addition of neutral salts produces coagulation, but the concentrations required are enormously greater than those required for the precipitation of lyophobic sols, and in many cases, *e.g.* ammonium sulphate, amount to saturation. Salts fall into three classes according to their cation: salts of the alkalis form reversible coagula, which on dilution or dialysing out the salt disperse again; salts of the alkaline earths in about the same concentrations produce precipitates which are at first reversible but soon become permanently insoluble, while, finally, salts of the heavy metals produce irreversible precipitates in much smaller concentrations.

If salts of the first class with the same cation, say potassium or ammonium, are compared, it is found that the concentration required to precipitate or, as it is often called, "salt out" natural albumin depends markedly on the anion or acid. If the salts are arranged in increasing order of the concentrations required to produce coagulation, *i.e.* in decreasing order of their efficacy, the following sequence of anions is found:

Citrate—Tartrate—Sulphate—Acetate—Chloride—
Nitrate—Chlorate—(Iodide—Thiocyanate)

The salts of the two anions in parenthesis do not salt out even in saturated solutions. This sequence, which is of fundamental importance in the theory of lyophilic sols, was found by Hofmeister (Professor at Strasbourg) in 1888 and is generally called after him.

Albumin, like the majority of aqueous lyophilic sols, is also precipitated by alcohol; the concentration required is smallest at the iso-electric point, a significant fact to which reference will be made again.

Albumin finally undergoes a specific change familiar to everyone when heated for some time above 65° C: it coagulates irreversibly. When concentrated it forms a stiff white gel (boiled white of egg), when dilute an opalescent sol which has distinctly lyophobic character and is precipitated by low electrolyte concentrations.

Another protein, glutin, is the principal constituent of a lyophilic colloid well known to most people, gelatin. If the sheet or powder, as which it occurs in commerce, is placed in cold water, it swells until it has taken up six to ten times its weight of water. On warming to about 30° the gel disperses to form a faintly turbid sol which remains liquid above about 25° and on cooling "sets" to a jelly, the change being completely reversible.

High salt concentrations produce a stringy coagulum from the sol, and alcohol also precipitates gelatin. The most striking effect of salts, however, is shown in the viscosity of the sol and in the sol-gel transformation or setting. Here the Hofmeister series of anions appears again quite unmistakably: the salts at the beginning of the series make the sol more viscous, favour setting so that it takes place at higher temperature, and produce a stiffer jelly; these effects decrease towards the end of the series and the last members, iodide and thiocyanate, lower the viscosity of the sol, retard setting and, in sufficient concentrations, even prevent it altogether.

A substance shewing a behaviour quite parallel to that of gelatin, though differing from it profoundly in chemical constitution, is agar, much used as a culture medium in bacteriology. It is prepared from a number of Japanese seaweeds and occurs in commerce as shreds or powder, the principal constituent of which is a carbohydrate (*q.v.*). In cold water the substance swells and on heating to boiling point forms a sol, which on cooling to about 30° sets to a jelly at concentrations as low as 0·2%. The effect of the Hofmeister series is again exactly the same as on gelatin, which excludes the possibility of ascribing it to any sort of chemical action; the anions at the beginning favour setting, while those at the end retard or prevent it.

At sufficiently low concentrations the agar sol does not set to a jelly, and such dilute sols have been the subject of theoretical investigations of much importance (by Prof. Kruyt of Utrecht and his pupils) which afford an insight into the character of lyophilic sols in general.

Agar sol, like many others of this class, is an almost clear liquid and shews no particles in the ultra-microscope, but only a diffuse cone of light. It has already been emphasized that two factors determine the possibility of making ultra-microscopic particles visible, sufficient intensity of illumination being assumed: the size and the optical difference between particles and medium. It is the latter which is small in lyophilic sols, in which however the existence of particles falling within the colloidal range can be demonstrated, and their size estimated, by indirect methods which cannot be discussed here. A starch sol, *e.g.*, which in many respects resembles the agar sol closely, contains particles of about $14\mu\mu$ diameter. From the number of particles and the known quantity of *dry* starch used in making the sol it can however be calculated that this would account for particles of about $6\mu\mu$ diameter only, so that we must conclude the starch to be somehow associated with sufficient water to make up the larger volume, *i.e.* one part of starch with about eleven of water. Such hydrated—as the usual term is—particles are present in all lyophilic sols.

The particles of the agar sol are negatively charged, and the charge can be neutralized by small additions of electrolytes of the same order of concentration as are necessary for the coagulation of lyophobic sols. The agar sol however shews no perceptible change when this has been done, so that there must be some factor other than, or additional to, the electric charge which keeps it stable. This factor is the hydration or water associated with the particles, as can be shewn by adding some liquid which strongly attracts water, such as alcohol or acetone, to the sol which has been rendered electrically neutral by small electrolyte concentrations: coagulation takes place as soon as sufficient alcohol has been added to produce dehydration, *i.e.* withdrawal of water from the particles. The inverse order of procedure confirms the result just described; on addition of alcohol to agar sol without electrolyte the clear liquid becomes opalescent and shews copious particles in the ultra-microscope. The withdrawal of water from them increases the optical difference between them and the surrounding liquid, so that, although smaller, they become visible. The sol has, in fact, been transformed into a lyophobic sol, but is still stable because it retains its electric charge; this can be neutralized in the usual way by small additions of electrolytes, which again bring about coagulation.

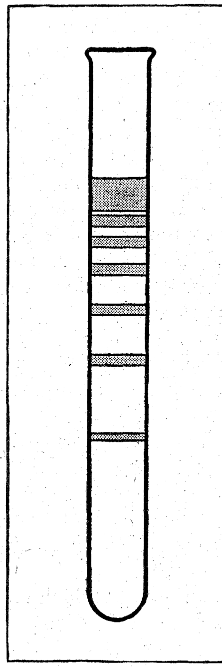


FIG. 4.—STRATIFICATION OF MAGNESIUM HYDROXIDE, SHOWING THE CLEAR SPACES BETWEEN THE STRATA

There are thus two factors which maintain the stability of the lyophilic sols, electric charge and hydration, and both have to be removed to bring about precipitation. Removal of the charge alone or dehydration alone alters the character of the sol but leaves the altered sols stable.

These considerations also elucidate satisfactorily the meaning of the Hofmeister series, which has been mentioned several times. The action of salts in *e.g.* salting out albumin is twofold: the first small addition neutralizes the charge, while the further large amounts required for coagulation act, like alcohol, by reducing the hydration of the particles. It is well known that the ions, into which the salts dissociate, are themselves hydrated, *i.e.* attach water molecules to themselves, to very different degrees and in proportion to this degree of hydration withdraw water from the colloid particles. The ions also have an effect on the water, to which brief reference only is possible: water at ordinary temperature is known to contain multiple or associated molecules, and its solvent properties are dependent on the proportion of those of the "degree of association." The degree of association itself is proved to be affected by the presence of the ions of the Hofmeister series.

We have so far spoken of lyophilic colloids in water only, and experimental investigation has, until recent times, been largely confined to them and more particularly to the proteins. The reason is the enormous importance of the proteins in living organisms; to take a single example, blood or, more exactly, the serum in which the red and white corpuscles are suspended, is a sol containing a mixture of several proteins with different properties which have been gradually elucidated by the methods of colloid chemistry. There are however many lyophilic sols of the greatest importance in the arts, in which the medium is not water but an organic liquid or a whole group of such. Thus india rubber forms sols in many hydrocarbons like petroleum ether, benzene or toluene, and also in substituted hydrocarbons like carbon tetrachloride or tetrachloro-ethane; the rubber solution used for mending tyres is a familiar example. Cellulose nitrates (one of which is gun-cotton) form sols in many organic solvents, such as acetone, glacial acetic acid, amyl acetate and in a mixture of ether and alcohol, though not in either of them separately. Cellulose acetate likewise forms sols in organic solvents and is now one of the materials for the manufacture of artificial silk, as is another derivative of cellulose, viscose or cellulose xanthate. It may be of interest to mention in this connection that cellulose itself, though not dispersed either by water alone or by any organic solvent, forms sols in various concentrated salt solutions when digested under pressure.

The most striking and obvious characteristic of the lyophilic sols in organic solvents is undoubtedly their very high viscosity at low concentrations. A sol containing 1 gm. of rubber in 100 cc. of benzene may have a viscosity 50–80 times as high as that of the solvent, while sols of certain brands of cellulose nitrate in acetone at the same concentration have viscosities many hundred times that of the solvent. For comparison it may be worth mentioning that a 40% sugar solution has a viscosity only 7·47 times as high as that of water at 15°. As there is generally a whole series of organic solvents available for every colloid of this class, it is possible to compare the viscosities produced by equal concentrations in a number of them, when it is found that they vary considerably in different liquids, a fact the significance of which will be discussed below.

The conditions which determine the stability of sols in organic solvents have not been studied to the same extent as those in aqueous sols. It is however fairly certain that electric charges, if present at all, do not play any great part, and that the principal or only factor is solvation, *i.e.* some sort of combination with the liquid, by which a great portion of it is held by the particles just as water is held by the agar or starch particles. No particles can be seen in benzene-rubber sol, but they become visible after the addition of alcohol, which withdraws benzene from them as it withdraws water from agar particles.

Gels.—Reference has already been made to the products of—reversible or irreversible—transformation of sols, to which Graham gave the name of *gels*. The gels of the lyophilic sols, to which the term has now become more or less confined, are of particular interest and importance; one of the typical forms is the gel of gelatin, familiar to everyone in the shape of table jellies. These contain 5–6% of the dry substance and thus exhibit at once the most striking characteristic of gels: that they retain their shape and behave up to a point like solids, although consisting very largely of liquid.

Gelatin gel is reversible: on warming it "melts" to sol, which on cooling sets again to gel. If the temperature is not raised above the melting point it can be dried without passing through the sol state until it contains in ordinary atmospheric conditions about 15% of water; the sheets or powder of commerce are such dry gel. A piece of this dry gel, placed in cold water, takes it up and swells, until the quantity taken up reaches 8–10 times its own weight, when the process stops. In thus swelling, the gel exerts considerable force, which can be measured by placing it in an enclosure permeable to water, but impermeable to the gel. An apparatus of this description (Posnjak, 1912) is shewn in sectional elevation in fig. 2. A cylindrical glass tube is luted at the lower end into a porous clay pot, while the upper end is closed by a screw cap. Discs of the gel to be examined, of exactly the same diameter as the inside of the tube, are placed on the bottom of the porous pot, and the whole tube is then filled with mercury, which reaches into the calibrated capillary tube. This is connected to a pressure gauge and a steel bottle containing compressed gas, by means of which any desired pressure up to about 6 atmospheres can be put on the mercury and through it on the gel. The lower end of the tube is placed in a vessel containing water, which passes through the porous clay cell to the gel, and the increase in volume of the latter can be calculated from the displacement of the mercury column in the capillary. In this way it has been found that gelatin, in taking up about half its weight of water, can overcome a pressure of about 5 atmospheres; in other words, this pressure has to be exerted on it to prevent it from swelling further. The first portions of water have the greatest effect, but when the gel has taken up over twice its weight of water it still exerts a pressure of about 0·5 atmospheres.

The swelling of gelatin is very greatly affected by electrolytes; all acids in low concentrations increase it markedly, but have the opposite effect when an optimum concentration has been exceeded. The effect of salts is still more complicated and cannot be briefly summarized here.

It may be mentioned here in parenthesis that a large number of organic tissues share with simple gels the property of swelling in water; the swelling of wood even in moist air, that of dry peas in water, etc. and the great forces exerted in these processes are everyday examples. The proper water content (or degree of swelling) of such living tissues as consist of proteins depends, like that of gelatin, on the electrolyte content and especially on the reaction, which healthy organisms regulate within very narrow limits.

As mentioned, gelatin gels containing as little as 5% of dry substance retain their shape, while those of 10–15% are sufficiently strong to permit a study of their elastic properties. Their Young's modulus has been determined by several observers and has been found to be of the order of grammes per sq. cm. and roughly proportional to the square of the gelatin content. Further investigation shews that the gel combines in a curious way the properties of the solid and liquid state. The volume remains almost exactly constant during deformation, a behaviour caused by the low compressibility of the liquid portion; if the deformation is maintained beyond a short time, the gel yields and the force required to maintain a given deformation, say a given elongation in a stretched rod, becomes less and less with time. Gels free from strain are, like liquids, optically isotropic, but when strained become double refracting (*see* LIGHT), as is revealed by examination in polarized light. When the stress is applied for a considerable time, and especially if the gel is dried while stressed, the double refraction remains permanent; it is a curious and significant fact that many structural elements of organisms, which consist of gels or mixtures of such, always exhibit double refraction.

A gel very similar to gelatin gel is that of agar, which has received comparatively little study so far. The gelatinizing properties of agar are much more marked than those of gelatin: a concentration of 1% is sufficient to form a fairly stiff gel. Owing to this property and to its being tasteless, as well as difficult to detect by chemical tests, agar has been much used for adulterating jams and jellies.

Lyophilic gels in which the liquid constituent is an organic solvent are also numerous and interesting. Cellulose acetate and benzyl alcohol behave exactly like gelatin and water: the acetate swells in the cols solvent, disperses on warming to about 40° to form a sol, which on cooling sets to a jelly resembling gelatin gel in appearance and elastic properties. Both natural and vulcanized rubber swell in hydrocarbons, although the latter does not form sols. The volumes of liquid taken up and the pressures generated are much greater than with gelatin: rubber, when it has taken up about 3.5 times its weight of benzene, still exerts a pressure of over 5 atmospheres. Rubber swells in a great number of organic liquids, but to very different degrees, which have been determined by several observers, who find that *e.g.* the quantity of carbon tetrachloride or of chloroform taken up is almost double that of benzene or toluene. Here a remarkable parallelism with the viscosity of sols shews itself: sols of equal concentration in carbon tetrachloride or chloroform are much more viscous than those in benzene. The inference is natural that the sol particles themselves are more "swollen" in the solvents containing chlorin than in the simple hydrocarbons, which would explain the higher viscosity of the sols in the former.

The gels described so far dry without the formation of any pores or voids; at no stage will they imbibe liquids other than those which have the specific effect of causing swelling. No organic liquid will penetrate into dry gelatin, nor water or aqueous solutions into dry rubber. A different behaviour is shewn by a number of gels, the most important representative of which is that of silicic acid. It has already been mentioned that this gel forms, spontaneously or on addition of electrolytes, from the sol and that it is a transparent or translucent mass with bluish opalescence. Unlike gelatin gel it cannot be deformed, but is brittle. Gels containing about 90% of water can be handled and keep their shape; on drying they shrink considerably and finally turn to a perfectly transparent mass resembling glass, but much lighter. If the gel is placed in water during any stage of the drying process it does not take up water and swell; it is therefore generally described as a *rigid* gel, in contradistinction to the type represented by gelatin and rubber, which are known as *elastic* gels.

When the gel has reached the glassy stage it still contains some water, which can be removed over concentrated sulphuric acid or at higher temperature; in this final drying, however, the volume undergoes no further reduction. The gel has now become a porous mass and the last stage of drying merely removes water contained in the pores. The existence of the pores can be easily demonstrated by immersing the gel in a liquid: air bubbles escape and the gel imbibes the liquid, of course without change of volume. The pores can be shewn by methods which cannot be described here to be of ultra-microscopic diameter. A gel resembling these artificially prepared ones is found in the internodial spaces of the bamboo; the optical properties of this substance, which is known as tabasheer and credited with curative properties, were investigated by Sir David Brewster (1819). Various forms of silica found in nature, such as opal and agate, probably originated from gels dehydrated under considerable pressure. Moist silicic acid gel has been found in fissures during the construction of the Simplon tunnel, and in mining operations in Australia.

Gelatin gel can be transformed into a rigid gel by the action of various agents, the most energetic of which is formaldehyde. The gel thus treated is quite brittle and no longer swells in water, nor disperses when the temperature is raised.

Diffusion and Reactions in Gels.—A further property of gels traceable to their high content of liquid is the small resistance which they offer to the diffusion of dissolved substances. This can be shewn by half filling test tubes with say 5% gelatin, allowing it to set and then pouring on the gel solutions of coloured salts or some of the simpler dyes, like fuchsin or fluorescein; the colour will be seen to penetrate fairly rapidly into the jelly. Graham, who carried out the first quantitative investigations on the rate of diffusion of a number of substances, found that it was not much lower in dilute gels than in the pure solvent and many measurements have been carried out in such, as the difficulties arising from vibration and convection are eliminated. In more concentrated gels, however, the rate of diffusion is markedly reduced. Colloidal solutions, which do not pass through membranes, do not diffuse into gels either, and the simple test described above can therefore be used—instead of dialysis—for deciding whether a given solution is colloidal. If a gold or other coloured sol is placed on the gelatin gel, no trace of colour shews in the latter even after days.

Since dissolved substances diffuse readily into gels, it is possible to allow reactions between two of them to proceed in such media either by letting the two solutions diffuse into a cylinder of the gel from opposite directions, or else by dissolving one of the substances in the gel itself and placing an aqueous solution of the other on it. The results are of considerable interest when one of the products of the reaction is an insoluble precipitate: as the solutions mix very gradually and as the first particles of precipitate are held fixed by the gel, thus acting as nuclei for further material, the conditions are favourable for the formation of large crystals. Many substances which are precipitated from aqueous solutions as microscopic particles only, can be obtained as large crystals when the reaction is produced in a gel, especially that of silicic acid; even metals can be obtained in well developed crystals of several mm. *e.g.* as glistening tetrahedra and gold as brilliant hexagonal plates.

The Liesegang Phenomenon.—An extremely curious phenomenon, generally called after its discoverer, R. E. Liesegang (Frankfurt), is observed with certain reactions. The original experiment is as follows: a thin layer of gelatin gel containing a little potassium dichromate is prepared on a glass plate, and a drop of strong silver nitrate solution placed in the centre. The silver nitrate at once diffuses into the gel and reacts with the dichromate, forming dark red, insoluble silver chromate and potassium nitrate. Diffusion proceeds continuously and it would seem that the precipitation of silver chromate should likewise be continuous and should lead to the formation of a gradually widening band of precipitate round the original drop. What actually happens, however, is that the chromate appears in a number of concentric rings separated by clear intervals, which become wider as the distance from the centre increases. (Fig. 3.) Similar results can be obtained by placing gel containing one substance in the lower half of test tubes and pouring the solution of the other substance on it, in which case parallel strata of precipitate are formed at increasing distances from each other. Fig. 4 shews diagrammatically the position of strata of magnesium hydroxide produced by letting a solution of ammonia diffuse into a gelatin gel containing magnesium chloride; the spaces between the strata are perfectly clear.

Many other reactions have been found, in carefully adjusted concentrations, to give similar stratifications, and investigation has also shewn that the gel does not take a passive part only, by securing quiet diffusion and fixing the precipitate where it is formed, but has a specific effect. Thus lead iodide and lead chromate form beautiful stratifications in agar, but not in gelatin, while on the other hand silver chromate forms them in gelatin, but not in agar.

Various interesting theories have been propounded to explain the phenomenon, none of which has found general acceptance or covers all the facts; in particular, most of them fail to explain the very marked specific effect of the gel.

Syneresis.—All gels at certain concentrations, specific for each substance, shew a characteristic phenomenon: they spontaneously contract with exudation of liquid. Graham, who first described this behaviour, called it *syneresis* (from the same Greek root as heresy, a separation or splitting off). Silicic acid shows it at high concentrations; sols can be prepared which set within a minute to gels apparently dry on the surface and adhering to the vessel. After about ten minutes the surface is covered with minute drops of liquid and in an hour so much liquid has exuded between the walls of the vessel and the gel that the latter can be tipped out. Gelatin and agar, on the other hand, exhibit syneresis at low concentrations only; so do some gels with organic solvents, like that of vulcanized india rubber, which contracts to 1/10 of its volume in a few days. The syneretic liquid is not pure solvent but always contains some colloid.

The Sol-Gel Transformation.—The formation of a gel, with some of the properties of a solid, from a sol which may contain as little as 0·5% of dry matter (agar) is an extremely striking change, which has very naturally been the subject of much speculation. Most gels are not differentiated in the ultra-microscope, so that theory has to rely on inferences from their known properties. The most generally received opinion is that the particles somehow join up to form chains and a network, or "ramifying aggregates," which some investigators (McBain) assume to be, to some extent, present already in the sol and to account for its viscosity. It is also probable that such a linking-up is accompanied by some change in the hydration of the particles. In any case, there must almost certainly be continuous liquid paths through a gel, to account for the ease with which diffusion proceeds through it.

Colloids in Nature and the Arts.—This necessarily brief account of the chief properties of a few typical colloids would be incomplete without a few words on the part played by colloids in nature and in the arts. Their importance in nature it is impossible to exaggerate: all organisms consist very largely of colloidal material, or more precisely of complicated mixtures and intricate structures composed of such. While the simple sols and gels of the laboratory are but the crudest models of even the simplest organic structures, the knowledge gained from their study is providing, if not a solution, new and promising methods of attack on problems which have proved intractable by the methods of physical chemistry. The selective permeability of cell membranes, *e.g.* to different ions is one of these problems, which any theory of solutions fails to explain, but for which known properties of colloidal systems provide at least a parallel.

As regards the arts, many of the oldest, like bread making, tanning, ceramics or dyeing, employ typically colloidal material and have empirically attained a high degree of perfection. In these the part of science is to find rational explanations of methods discovered by accident and improved by trial and error, and colloid science is playing this part successfully. The study of gelatin has thrown a great deal of light on obscure features of the tanning process; a study of the electric charges on dye particles and fibres has elucidated methods of dyeing, and so on. The industries just mentioned are of prehistoric origin, but even the processes which go on in so modern and astonishingly perfect a product as the photographic dry plate remained very obscure until the behaviour of colloidal silver and silver compounds embedded in a gel received systematic investigation.

More recent industries, the rise of which has coincided with the modern development of colloid chemistry, like the artificial silk and the rubber industry, have benefited much more directly. Some of the most important new developments, especially in the manufacture of rubber goods, are direct applications of theoretical knowledge. It may be mentioned that a recently published work dealing with colloids in the arts runs to over a thousand pages.

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Journals. Two monthly journals are devoted exclusively to Colloids: *Kolloid-Zeitschrift* (Dresden, Theodor Steinkopff) and *Revue Generale des Colloides* (Paris, Dunod). (E. H.)

COLLOT D'HERBOIS, JEAN MARIE (1750–1796), French revolutionist, was a Parisian by birth and an actor by profession. He became director of the playhouse at Geneva. By the publication of *L'Almanach du Père Gérard* (1791), a little book setting forth, in homely style, the advantages of a constitutional monarchy, he suddenly acquired fame. He intervened on behalf of the Swiss of the Château-Vieux regiment, condemned to the galleys for mutiny at Nancy, and secured their liberation. He was a member of the Commune of Paris on Aug. 10, 1792, and was elected deputy for Paris to the convention, where he was the first to demand the abolition of royalty (on Sept. 21, 1792), and he voted the death of Louis XVI. *"sans sursis."* After the *coup d'état* of May 31, 1793, he made himself conspicuous by his pitiless pursuit of the defeated Girondins. In June he was made president of the convention; and in September became a member of the committee of public safety. The convention sent him, on Oct. 30, 1793, to suppress the revolt of Lyons. There he introduced the Terror in its most terrible form.

In May 1794 an attempt was made to assassinate Collot; but it only increased his popularity, and this won him the hatred of Robespierre, against whom he took sides on the 9th Thermidor, when he presided over the convention during a part of the session. During the Thermidorian reaction he was one of the first to be accused of complicity with the fallen leader but was acquitted. Denounced a second time, he defended himself by pleading that he had acted for the cause of the Revolution but was condemned to transportation to Cayenne (March 1795), where he died on Jan. 8, 1796. Collot d'Herbois wrote and adapted from the English and Spanish many plays, one of which, *Le Paysan magistrat,* kept the stage for several years.

See F. A. Aulard, *Les Orateurs de la Législative et de la Convention,* t. ii pp. 501–512 (1885–86). The principal documents relative to the trial of Collot d'Herbois, Barère, and Billaud-Varenne are indicated in Aulard, *Recueil des actes du comité de salut public,* t. i pp. 5 and 6.

COLLOTYPE. A photomechanical printing process for reproducing illustration copy with fine detail, practical only for runs of limited quantity. It is a planographic process, derived from the application of photography to lithographic printing. It was first developed on a practical scale in France, about 1865, by T. du Motay and C. R. Maréchal. The first collotype printing in the U.S. was done by Ernest Edwards in Boston in 1872.

Collotype differs from other reproductive processes in that the image is not broken up by any form of screen. From the original copy is made a continuous tone photographic negative with the image reversed by a prism. From the negatives are made blueprint proofs, which are pasted up to show their position on the sheet. Printing areas are cut out of a mask of opaque paper and the negatives mounted on this mask in position.

The printing plate for flatbed printing is a sheet of plate glass about ½ in. thick, which is first coated with a substratum solution with a high affinity for glass. The plates are dried in an oven, levelled and preheated to the temperature of the sensitized coating solution. This latter, made up of gelatin, water and a bichromate sensitizer, is flowed onto the plate and drawn across the surface. The plate is then subjected to higher heat in the oven, until all moisture is driven off. As the coating dries it becomes sensitive to light. The assembled masked negatives are then printed down on the plate. Light coming through the negatives reduces the capacity of the gelatin film to absorb moisture. After exposure to light, the plate is washed to remove the remaining sensitizing agent, the surface hardened with an alum solution, and then soaked in a water and glycerine solution. The gelatin film absorbs this solution selectively in proportion to the exposure, which causes the plate to accept or reject printing ink in proportion to the amount of solution absorbed. The plate is clamped to the bed of a flatbed press, similar to a stone lithographic press. The inking rollers which pass first over the plate, applying a stiff, greasy ink, are of leather with the flesh side out. Composition rollers follow to smooth out the image.

As sheets come off the press, they are slipsheeted, because of the heavy film of an ink which dries slowly. The speed of flatbed collotype printing is slow, about 200 impressions per hour. An average day's product on a press will not much exceed 1,000 sheets. The cost of platemaking, however, is low, making the process economical for relatively short runs of fine illustrations. For greater production metal sheets can be coated with the gelatin emulsion and printed on a direct rotary or offset press.

Fine colour printing by the collotype process has been done in England and Austria. Excellent single-colour full-tone reproductions are made in the U. S. Other names by which the process is known are albertype, autotype, phototype, heliotype, Lichtdruck, photocollotype, photogelatin, or simply gelatin printing. (D. C. McM.)

COLLUSION. In judicial proceedings, and particularly in matrimonial causes (*see* DIVORCE), collusion is a deceitful agreement between two or more persons, or between one of them and a third party, to bring an action against the other and obtain a judicial remedy which would not otherwise have been obtainable.

COLMAN, SAINT (d. 676), bishop of Lindisfarne (661), was an Irish monk at Iona. He attended the synod of Whitby in 664, when the dispute between the Roman and the Celtic parties on the date of Easter was considered. He upheld the Celtic usages, but King Oswy decided against him. After this event Colman returned to Iona, and then with many of the Columban clergy went to Ireland. He settled on Inishbofin, where he built a monastery and where he died on Aug. 8, 676.

Colman must be distinguished from St. Colman of Cloyne (*c.* 522–600), an Irish saint, who became a Christian about 570; and also from another Irishman, St. Colman Ela (553–610), a kinsman of St. Columba.

COLMAN, GEORGE (1732–1794), English dramatist and essayist, usually called "the Elder," and sometimes "George the First," to distinguish him from his son, was born in 1732 at Florence, where his father was resident at the court of the grand duke of Tuscany. Colman's father died within a year of his son's birth, and the boy's education was undertaken by William Pulteney, afterwards Lord Bath, whose wife was Mrs. Colman's sister. He was sent to Westminster school and then to Christ Church, Oxford. Here he made the acquaintance of Bonnell Thornton, the parodist, and founded *The Connoisseur* (1754–56), a periodical which reached its 140th number. He left Oxford in 1755 and was called to the bar at Lincoln's Inn in 1757.

In 1760 he produced his first play, *Polly Honeycomb,* which mocked at the sentimentalities of the popular novel. In 1761 *The Jealous Wife,* a comedy partly founded on *Tom Jones,* made

Colman famous. *The Jealous Wife* is one of the earliest instances of the successful dramatisation of a novelist's material, and is genuine comedy. The death of Lord Bath in 1764 placed Colman in possession of independent means. In 1765 appeared his metrical translation of the plays of Terence, and in 1766 he produced *The Clandestine Marriage,* jointly with Garrick. In the next year he purchased a fourth share in the Covent Garden theatre. Colman was acting manager of Covent Garden for seven years, and during that period he produced many pieces of his own and several "adapted" plays of Shakespeare. In 1774 he sold his share in the playhouse, which had involved him in much litigation with his partners, to Leake; and three years later he purchased of Samuel Foote, then broken in health and spirits, the little theatre in the Haymarket. He was attacked with paralysis in 1785; in 1789 his brain became affected, and he died on Aug. 14, 1794. Besides the works already cited, Colman was author of adaptations of Beaumont and Fletcher's *Bonduca,* Ben Jonson's *Epicoene,* Milton's *Comus,* and of other plays. He also produced an edition of the works of Beaumont and Fletcher (1778), a version of the *Ars Poëtica* of Horace, an excellent translation from the *Mercator* of Plautus for Bonnell Thornton's edition (1769–72), some thirty plays, many parodies and occasional pieces. An incomplete edition of his dramatic works was published in 1777 in four volumes.

COLMAN, GEORGE (1762–1836), "the Younger," son of the above, was born on Oct. 21, 1762. He passed from Westminster school to Christ Church, Oxford, and King's college, Aberdeen, and was finally entered as a student at Lincoln's Inn, London. In 1782 he produced, at his father's playhouse in the Haymarket, his first play, *The Female Dramatist,* for which Smollett's *Roderick Random* supplied the material. It was unanimously condemned, but *Two to One* (1784) was entirely successful. It was followed by *Turk and no Turk* (1785), a musical comedy; *Inkle and Yarico* (1787), an opera; *Ways and Means* (1788); *The Iron Chest* (1796), taken from William Godwin's *Adventures of Caleb Williams; The Poor Gentleman* (1802); *John Bull, or an Englishman's Fireside* (1803), his most successful piece; *The Heir at Law* (1808), which enriched the stage with one immortal character, "Dr. Pangloss," and numerous other pieces, many of them adapted from the French.

The failing health of the elder Colman obliged him to relinquish the management of the Haymarket theatre in 1789, when the younger George succeeded him, at a yearly salary of £600. On the death of his father, he was involved in litigation with Thomas Harris, and was forced to take sanctuary within the Rules of the King's Bench. Here he resided for many years continuing to direct the affairs of his theatre. Released at last through the kindness of George IV., who had appointed him exon of the Yeomen of the Guard, he was made examiner of plays by the duke of Montrose, then lord chamberlain.

Colman died in Brompton, London, on Oct. 17, 1836. He had, as early as 1784, contracted a runaway marriage with an actress, Clara Morris, to whose brother, David Morris, he eventually disposed of his share in the Haymarket theatre. Many of the leading parts in his plays were written especially for Mrs. Gibbs (*née* Logan), whom he was said to have married secretly after the death of his first wife.

See the second George Colman's memoirs of his early life, entitled *Random Records* (1830) and R. B. Peake, *Memoirs of the Colman Family* (1842).

COLMAN, SAMUEL (1832–1920), American landscape painter, was born at Portland (Me.), March 4, 1832. He was a pupil of Ashur B. Durand in New York, and in 1860–62 studied in Spain, Italy, France, and England. In 1871–76 he was again in Europe. In 1860, with James D. Smilie, he founded the American Water Colour Society, and became its first president (1866–67), his own water-colour paintings being particularly fine. He was elected a member of the National Academy of Design in 1862. Among his works are "The Ships of the Western Plains," in the Union League Club, New York; and "The Spanish Peaks, Colorado," in the Metropolitan Museum, New York. He died in New York city, March 27, 1920.

COLMAR, a town of France, capital of the department of Haut-Rhin, on the Logelbach and Lauch, tributaries of the Ill, 40 m. S.S.W. of Strasbourg on the main railway to Basle. Population (1936) 49,041.

Colmar (probably the *columbarium* of the Romans) is first mentioned, as a royal *villa,* in a charter of 823. It was raised to the status of a town and surrounded with walls by Wölfelin, advocate (*Landvogt*) of the emperor Frederick II in Alsace. In 1226 it became an imperial city, and the civic rights (*Stadtrecht*) conferred on it in 1274 by Rudolph of Habsburg became the model for those of many other cities. A long struggle between democratic gilds and aristocratic "families" ended in 1347 in the inclusion of the former in the governing body, and in the 17th century in the complete exclusion of the latter. In 1255 Colmar joined the league of Rhenish cities, and in 1476 and 1477 took a vigorous share in the struggle against Charles the Bold. It suffered in the wars of the 17th century, was formally annexed to France in 1681, and to Germany in 1871, and again became a part of France in 1919.

The Roman Catholic parish church (*Münster*) of St. Martin dates from the 13th and 14th centuries. Other notable buildings are the Lutheran parish church (15th century); the former Dominican monastery (1232–1289), known as "Unterlinden" and now used as a museum; the Kaufhaus (trade-hall) of the 15th century. Colmar is the centre of considerable textile industries, comprising wool, cotton and silk-weaving, and has important manufactures of sewing thread, starch, sugar and machinery. Bleaching and brewing are also carried on, and the neighbourhood is rich in vineyards and fruit-gardens.

COLNE, a municipal borough in north-east Lancashire, England, $34\frac{1}{2}$ mi. northeast from Manchester by the L.M.S.R. Pop. (1938) 21,960. Area, 9.3 sq.mi. It stands above a small affluent of the river Calder. Nelson and Colne are towns along a crossway between the Aire valley at Skipton and the Calder valley at Burnley followed by the Leeds and Liverpool canal. Roman coins have been found on the site. As early as the 14th century it was the seat of woollen manufacture. The church of St. Bartholomew retains some Norman work. There is a cloth hall or piece hall, originally used as an exchange when woollens were the staple of the town. The grammar school dates from Reformation times. Textile workers and weavers form a considerable proportion of the population. In the neighbourhood are several limestone and slate quarries. The town was incorporated in 1895 and is in the Nelson and Colne Parliamentary Borough.

COLOCYNTH, COLOQUINTIDA or **BITTER APPLE,** *Citrullus colocynthis,* a plant of the family Cucurbitaceae. The flowers are unisexual; the male blossoms have five stamens with sinuous anthers, the female have reniform stigmas, and an ovary with three large fleshy placentas. The fruit is round, and about the size of an orange; it has a thick yellowish rind, and a light, spongy and very bitter pulp, which yields the colocynth of druggists. The seeds, which number from 200 to 300, and are disposed in vertical rows on the three parietal placentas of the fruit, are flat and ovoid and dark-brown; they are used as food by some of the tribes of the Sahara, and a coarse oil is expressed from them. The foliage resembles that of the cucumber, and the root is perennial. The plant has a wide range, being found in Ceylon, India, Iran, Arabia, Syria, north Africa, the Grecian Archipelago, the Cape Verde islands and the southeast of Spain.

The commercial colocynth consists of the peeled and dried fruits. In the preparation of the drug the seeds are always removed from the pulp. Its active principle is an intensely bitter amorphous or crystalline glucoside, colocynthin, $C_{56}H_{84}O_{23}$, soluble in water, ether and alcohol, and decomposable by acids.

COLOGNE (Ger. *Köln*), a fortified town, archiepiscopal see and third city of the German Reich, in the Prussian Rhine province. Pop. (1939), 768,426. It lies in the form of a vast semicircle on the left bank of the Rhine, 44 m. by rail north-east from Aachen, 24 south-east from Düsseldorf and 57 north-northwest from Coblenz.

Its situation (1) as an important port on the Rhine (2) at the

Rhine crossing of the great natural highway from Paris via the valleys of the Oise, Sambre and Meuse along the north-western margin of the Ardennes and (3) at the emergence of roads along the Rhine from the incised section of that river has made it one of the chief cities in western Europe. The value of the site on the Rhine frontier was realized by the Romans and very little alteration in the town plan had taken place by the days of Archbishop Hildebold in the 9th century. The city was still contained within the rectangle formed by its Roman walls. Trading facilities during the 11th century caused a great increase in the size of the town and early in the 12th century the suburbs of Oversburg, Niederich and St. Aposteln were included. These were later enclosed by a rampart, fortified by walls and gates, some of which survived until the 19th century. Within the crescent formed by these fortifications flourished the mediaeval city—a capital of a third of the Hanseatic league. This mediaeval section of the city still has its tortuous, narrow and dark streets. The long Hohe-Strasse of this section is the city's chief business centre. The mediaeval walls and ditches were dismantled between 1881 and 1885, and the site of the old fortifications, bought from the government by the municipality, were converted into a fine boulevard, the Ring, nearly 4 m. long.

Beyond the Ring, about ½ m. farther out, a new line of fortifications was built and 1,000 acres, now occupied by handsome streets, squares and two public parks, were thus added concentrically to the inner town. Still later extensions have been in the form of "spurs" forming suburbs projecting as it were from the central core. Among the most important suburbs are Bayenthal, Lindenthal, Ehrenfeld, Nippes, Sülz, Bickendorf, Merheim, Niehl, and those on the opposite bank of the Rhine. Cologne is connected with Deutz by bridges. Mulheim, Meiheim and Worringen were incorporated in the city in 1914. Of the former city gates four have been retained, restored and converted into museums: the Severin gate, on the south, contains the geological section of the natural history museum; the Hahnen gate, on the west, is fitted as the historical and antiquarian museum of the city; and the Eigelstein gate, on the north, accommodates the zoological section of the natural history museum.

The most important squares are the Domhof, the Heumarkt, Neumarkt, Alte Markt and Waidmarkt in the old inner, and the Hansa-platz in the new inner town.

The Cathedral and Other Churches.—The cathedral or Dom stands on the site of a church begun in the 9th century by Hildebold, metropolitan of Cologne, and finished under Willibert in 873. This structure was ruined by the Normans, was rebuilt, but destroyed in 1248 by fire. The foundation of the present cathedral was then laid by Conrad of Hochstaden (archbishop from 1238 to 1261). The original plan has been attributed to Gerhard von Rile (d. *c.* 1295). In 1322 the new choir was consecrated. After Conrad's death the work of building advanced but slowly, and in the 19th century the building was finally finished. It contains the shrine of the Magi. The oldest church in the city is St. Maria im Kapitol, situated within the Roman nucleus. It was dedicated in 1049 by Pope Leo IX., though a church built on the old Roman foundation was in existence as early as 696. It is Romanesque in style and is noted for its crypt. A ring of churches surrounded the Roman section of the city, among them are St. Gereon, St. Ursula, St. Severin and St. Kunibert. St. Gereon's was built in the 11th century and shows Romanesque and Gothic features. It was erected on a Roman rotunda and has a square front hall. The crypt has fine mosaics in stone dating from the 11th century. The church has some fine painted glass. St. Kunibert is in the Byzantine-Moorish style, completed in 1248. There are also the church of St. Peter with the famous altar-piece of Rubens; St. Martin's built between the 12th and 13th centuries; the Minorite church built in the same year as the cathedral was begun with the tomb of Duns Scotus; St. Pantaleon, a 13th century structure; St. Cecilia's; the church of the Apostles and that of St. Andrew (1220 and 1414) with the tomb of Albertus Magnus.

Historic Buildings.—The Gürzenich, Rathaus, Tempelhaus and other buildings tell of the rise of the great merchant classes and of their struggle for power against the church and the nobility. The Gürzenich was a former meeting-place of the diets of the Holy Roman empire and built between 1441 and 1447. The ground floor was in 1875 converted into a stock exchange, and the upper hall utilized for public festivities. The Rathaus (13th century) has beautiful Gobelin tapestries. The Tempelhaus, the seat of the patrician family of Overstolzens, is a building of the 13th century, now the chamber of commerce. There is also the Wallraf-Richartz museum, with a collection of paintings by Italian and Dutch masters; the Zeughaus, built on Roman foundations; and the municipal library and archives. The Wolkenburg, a Gothic house of the 15th century, was restored in 1874. Near the cathedral is a museum of church antiquities. Cologne has numerous educational institutions. The municipal theatre (Stadttheater) is famed for its operatic productions. Many of Cologne's famous buildings were destroyed by British bombs in the great raid of May 30, 1942, and subsequent attacks. The British announced in June 1942, however, that the cathedral had escaped serious damage.

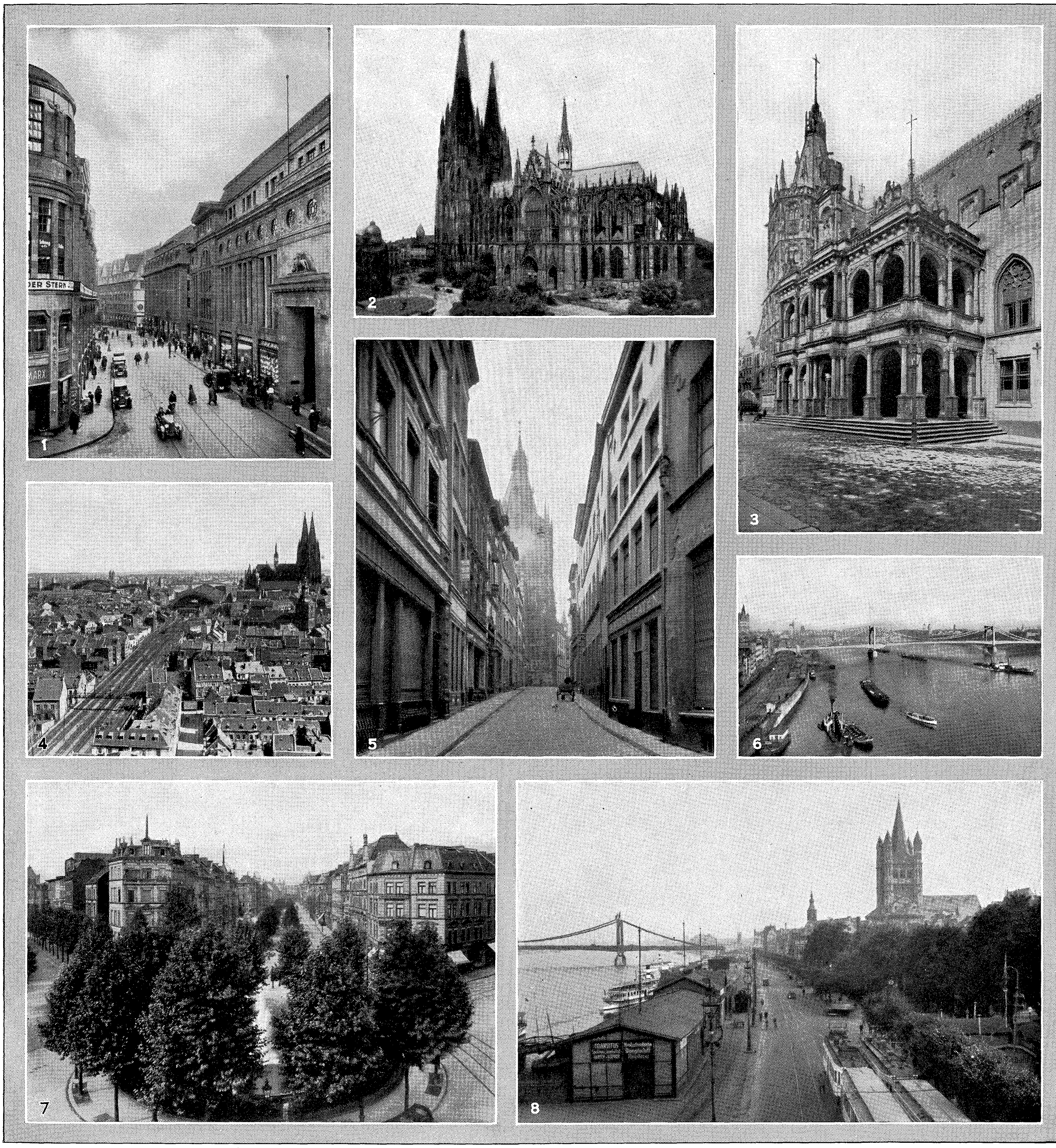
Commercially, Cologne is the retail town for the industrial cities of Rhineland and Westphalia, and has a very important trade in corn, wine, mineral ores, coals, drugs, dyes, manufactured wares, groceries, leather and hides, timber, porcelain and many other commodities. The docks are to the south of the city. Cologne manufactures sugar, chocolate, tobacco and cigars; the most famous product is the perfume known as *eau de Cologne* (*q.v.*) (*Kölnisches Wasser, i.e.,* Cologne-water).

HISTORY

Cologne occupies the site of *Oppidum Ubiorum,* the chief town of the Ubii, and here in A.D. 50 a Roman colony, *Colonia,* was planted by the emperor Claudius, at the request of his wife Agrippina, who was born in the place. After her it was named Colonia Agrippina or Agrippinensis. Cologne rose to be the chief town of Germania Secunda and had the privilege of the Jus Italicum. About 330 the city was taken by the Franks but was not permanently occupied by them till the 5th century, becoming in 475 the residence of the Frankish king Childeric. Counts of Cologne are mentioned in the 9th century.

The succession of bishops in Cologne is traceable, except for a gap covering the 5th century, from A.D. 313, when the see was founded. It was made the metropolitan see for the bishoprics of the Lower Rhine and part of Westphalia by Charlemagne, the first archbishop being Hildebold, who occupied the see from 785 to his death in 819. Of his successors one of the most illustrious was Bruno (*q.v.*), archbishop from 953 to 965, who was the first of the archbishops to exercise temporal jurisdiction, and was also "archduke" of Lorraine. The territorial power of the archbishops was already great when, in 1180, on the partition of the Saxon duchy, the duchy of Westphalia was assigned to them. In the 11th century they became *ex-officio* arch-chancellors of Italy (*see* ARCHCHANCELLOR), and by the Golden Bull of 1356 they were finally created electors of the empire. With Cologne itself, a free imperial city, the archbishop-electors were at perpetual feud; in 1262 the archiepiscopal see was transferred to Brühl and in 1273 to Bonn; and the quarrel was not finally adjusted until 1671. The archbishopric was secularized in 1801, all its territories on the left bank of the Rhine being annexed to France; in 1803 those on the right bank were divided up among various German states, and in 1815, by the congress of Vienna, the whole was assigned to Prussia. The last archbishop-elector, Maximilian of Austria, died in 1801.

The municipal history of Cologne follows in general the same lines as that of other cities of Lower Germany and the Netherlands. At first the bishop ruled through his burgrave, advocate, and nominated jurats. Then, as the trading classes grew in wealth, his jurisdiction began to be disputed. Peculiar to Cologne, however, was the *Richerzeche* (*rigirzegheide*), a corporation of all the wealthy patricians, which gradually absorbed in its hands the direction of the city's government. In the 13th century the archbishops made repeated efforts to reassert their authority, and in 1259 Archbishop Conrad of Hochstaden, by appealing to the democratic element of the population, succeeded in overthrowing the Richerzeche and driving its members into exile. His succes-



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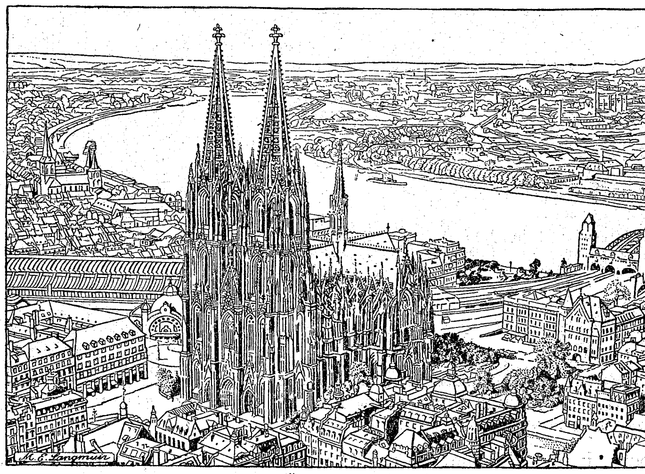
GENERAL VIEWS OF THE CITY OF COLOGNE

1. Gurzenich street, running along the south side of the Gurzenich (a mediaeval building used for municipal celebrations). This thoroughfare, built in 1914, starts from the suspension bridge and intersects the old town east and west. Much of Cologne was destroyed during World War II by British air raids
2. The cathedral or Dom, considered the finest example of decorated Gothic in Germany, situated 60 ft. above the Rhine, near the Hohenzollern bridge, in the oldest part of the city. Its towers, 515 ft. high, are a distinguishing feature of Cologne and may be seen from a great distance
3. The City Hall, standing on the site of the old Roman walls. The central portion, with the five-storied tower, dates from the 14th century; the ornate portico in the Renaissance style was built in 1569. The carillon was added in 1913
4. General view of centre of old city, showing the station, cathedral towers and, in the distance, the Rhine, with the Hohenzollern and suspension bridges
5. A street in the old town, showing the City Hall in the distance. The old town is situated in a broad semicircle on the Rhine within the new town. Some of its streets date from the 13th and 14th centuries
6. The suspension bridge opposite the Heymarkt, built in 1913–15 from plans of K. Moritz, to replace the old pontoon bridge. Its central opening has a span of 605 feet
7. Barbarossa place, an open square in the new city, showing the Hohenstauffer Ring, one of the broad new boulevards encircling the old city
8. A street along the Rhine, showing the Romanesque church of S. Martin and the suspension bridge, which crosses the river here to Deutz

sor, Engelbert II., however, attempted to overthrow the democratic constitution, with the result that in 1262 the brotherhoods combined with the patricians against the archbishop, and the Richerzeche returned to share its authority with the elected "great council." As yet, however, none of the trade or craft gilds, as such, had a share in the government, which continued in the hands of the patrician families, until long after the battle of



BY COURTESY OF THE REICHSZENTRALE FÜR DEUTSCHE VEREHRSWERBUNG

COLOGNE CATHEDRAL

This, the largest Gothic cathedral in northern Europe, begun in the 13th century, was not completed until the 19th century. The towers were completed in 1880, five and one-half centuries after the choir was consecrated

Worringen (1288) had secured for the city full self-government, and the archbishops had ceased to reside within its walls. In the 14th century a narrow patrician council selected from the Richerzeche, with two burgomasters, was supreme; but in 1396, the rule of the patricians having been weakened by internal dissensions, a bloodless revolution established a comparatively democratic constitution, based on the organization of the trade and craft gilds, which lasted until the French Revolution.

The expulsion of the Jews in 1414, and still more the exclusion of Protestants from the citizenship and magistracy, deeply affected the prosperity of Cologne. New trade routes, the decay of the gilds and many prolonged periods of warfare further contributed to its decay; and when, in 1794, Cologne was occupied by the French it was a poor city of some 40,000 inhabitants, of whom only 6,000 possessed civic rights. Incorporated in France in 1801 it was not then important enough to be more than the chief town of an arrondissement. On the death of the last elector in 1801 the archiepiscopal see was left vacant. With the assignment of the city to Prussia by the congress of Vienna in 1815 a new era of prosperity began. Cologne university, indeed, was definitively established at Bonn, but the archbishopric was restored (1821) as part of the new ecclesiastical organization of Prussia, and the city became the seat of the president of a governmental district.

Its prosperity rapidly increased; when railways were introduced it became the meeting-place of several lines, and in 1881 its growth necessitated the pushing outward of the circle of fortifications.

Cologne, together with a bridge head of 18 sq.m., was occupied in Dec. 1918 by the Allies under the terms of the Armistice. It was made the head-quarters of the British army of occupation and was not evacuated until Jan. 30, 1926.

During World War II Cologne was bombed by the British repeatedly and very heavily. One of the most catastrophic raids was on the night of May 30, 1942, when 1,130 planes dropped full loads of explosive and incendiary bombs in 90 minutes. Six great city areas, totalling about 5,000 acres and including the central part of the city and railway station but not the cathedral, were destroyed or severely damaged in this single raid.

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COLOMB, PHILIP HOWARD (1831–1899), British vice-admiral, historian, critic and inventor, the son of Gen. G. T. Colomb, was born in Scotland, on May 29, 1831. He entered the navy in 1846, and served first at sea off Portugal in 1847; afterwards, in 1848, in the Mediterranean, and from 1848 to 1851 in operations against piracy in Chinese waters; during the Burmese War of 1852–53; in the Arctic Expedition of 1854; and in the Baltic during the Russian War, taking part in the attack on Sveaborg. From 1859 to 1863 he served as flag-lieutenant to Rear-Admiral Sir Thomas Pasley at Devonport. Between 1858 and 1868 he was employed in home waters on a variety of special services, chiefly connected with gunnery, signalling and the tactical characteristics and capacities of steam warships. From 1868 to 1870 he commanded the "Dryad," and was engaged in the suppression of the slave trade. In 1874, while captain of the "Audacious" he served for three years as flag-captain to Vice-Admiral Ryder in China; and finally he was appointed, in 1880, to command the "Thunderer" in the Mediterranean. Next year he was appointed captain of the steam reserve at Portsmouth; and after serving three years in that capacity, he remained at Portsmouth as flag-captain to the commander-in-chief until 1886, when he was retired by superannuation before he had attained flag rank. Subsequently he became rear-admiral, and finally vice-admiral on the retired list.

Colomb was one of the first sailors to perceive the vast changes which must ensue from the introduction of steam into the navy, which would necessitate a new system of signals and a new method of tactics. He set himself to devise the former as far back as 1858, but his system of signals was not adopted by the navy until 1867.

What he had done for signals Colomb next did for tactics. Having first determined by experiment—for which he was given special facilities by the Admiralty—what are the manoeuvring powers of ships propelled by steam under varying conditions of speed and helm, he proceeded to devise a system of tactics based on these data. In the sequel he prepared a new evolutionary signal-book, which was adopted by the British navy. His conclusions on the chief causes of collisions at sea, though stoutly combated in many quarters at the outset, were ultimately embodied in the international code of regulations adopted by the leading maritime nations on the recommendations of a conference at Washington in 1889.

Colomb helped to initiate an equally momentous change in the popular, and even the professional, way of regarding sea-power and its conditions in his book on *Naval Warfare* (1891). The central idea of his teaching was that naval supremacy is the condition precedent of all vigorous military offensive across the sea, and, conversely, that no vigorous military offensive can be undertaken across the seas until the naval force of the enemy has been accounted for—either destroyed or defeated and compelled to withdraw to the shelter of its own ports, or at least driven from the seas by the menace of a force it dare not encounter in the open. He worked quite independently of Admiral Mahan, and his chief conclusions were published before Admiral Mahan's works appeared.

He died on Oct. 13, 1899, at Steeple Court, Botley, Hants.

His younger brother, SIR JOHN COLOMB (1838–1909), entered the Royal Marines in 1854, and retired in 1869. His books on *Colonial Defence and Colonial Opinions* (1873), *The Defence of*

Great and Greater Britain (1879), *Naval Intelligence and the Protection of Commerce* (1881), *The Use and the Application of Marine Forces* (1883), *Imperial Federation: Naval and Military* (1887), followed later by other similar works, made him well known among the rising school of Imperialists, and he was returned to parliament (1886–92) as Conservative member for Bow, and afterwards (1895–1906) for Great Yarmouth. In 1887 he was created C.M.G., and in 1888 K.C.M.G. He died in London on May 27, 1909. In Kerry, Ireland, he was a large landowner, and became a member of the Irish Privy Council (1903), and in 1906 sat on the royal commission dealing with congested areas.

See H. d'Egville, *Imperial Defence and Closer Union: record of the life-work of Colomb* (1913).

COLOMBES, a town of France, in the department of Seine, arrondissement of St. Denis, 7 mi. N.N.W. of Paris. Pop. (1936) 61,944. It has a 16th-century church with 12th-century tower, a race-course, and numerous villas and boarding-schools. Manufactures include oil, vinegar and measuring-instruments.

COLOMBEY, a village of Lorraine, 4 mi. E. of Metz, famous as the scene of a battle between the Germans and the French, fought on Aug. 14, 1870. It is often called the battle of Borny, from another village 2½ mi. E. of Metz. (*See* METZ and FRANCO-GERMAN WAR.)

COLOMBIA is a republic occupying the north-western angle of South America. It is bounded on the north by the Caribbean sea and Venezuela, on the east by Venezuela and Brazil, on the south by Brazil, Peru and Ecuador, and on the west by Ecuador, the Pacific ocean, Panama and the Caribbean sea. The republic has an extreme length from north to south of 1,050 mi. and an extreme width of 860 miles. The area is 439,714 square miles.

Physical Geography.—The western and north-western portions of Colombia are occupied by the terminal ranges of the great Andean system. The two closely parallel ranges of northern Ecuador unite to form the Macizo de Pasto as they enter southern Colombia. From this great mountain knot, in turn, the Western and Central Cordilleras of the triple-spurred Colombian Andes emerge and stretch away side by side toward the north. The Eastern Cordillera originates in a secondary knot in the central range not far north of the Pasto *macizo,* and crosses the country in a north-easterly direction until it in turn splits asunder, sending one spur north into the Caribbean to form the Goajira Peninsula, and the other to the east to form the Sierra de Mérida south of Lake Maracaibo in western Venezuela.

The Eastern Cordillera sharply divides the mountainous district of northern and western Colombia from the torrid, low-lying plains of the interior which comprise slightly more than half the total area. To the south, a region covered by nearly impenetrable jungle growth is drained by the tributaries of the Amazon. Except along the principal rivers it is largely unexplored and inhabited mostly by uncivilized tribes of Indians. The northern part of these transmontane low-lands, the so-called llanos, is a region of open tropical plains, alternately flooded and parched with the changing seasons, and drained by tributaries of the Orinoco. The approximate length of this region is 640m. and the average width 320 miles.

The Western Cordillera roughly follows the line of the Pacific coast, terminating in three low, wooded spurs which merge into the Caribbean coastal plain in the southern part of Bolívar department. A short transverse range connects it with the Cordillera de Baudó, which extends from the mouth of the San Juan river north to form the highlands of Panama. The Western Cordillera is covered with vegetation, and its Pacific slopes are precipitous and humid. Its highest elevation, the Punta de Mallama, is 13,780 feet.

The Central Cordillera, also called the Quindío, is separated from the eastern and western Andean ranges by the Magdalena river on one side and its principal tributary, the Cauca, on the other. It terminates in low hills near the confluence of the two rivers. The Central Cordillera has a series of lofty volcanoes, some of them perpetually snow-capped. Its highest elevation is the Nevado del Huila (18,701ft.), the highest point in the republic.

The Eastern Cordillera is the region of densest population and is distinguished by its large area of plateau and elevated valley lying within the limits of the vertical temperate zone. The "sabana" of Bogotá (8,661ft.) with an area of 2,000 sq.mi., is a good illustration of the higher of these plateaux. Mild in temperature and fertile, it has the varied production of the temperate zone.

The Pacific coast line, omitting minor convolutions, is about

THATCHED NATIVE HUTS SHADOWED BY DROOPING PALMS, IN THE WESTERN PORTION OF COLOMBIA

500m. in length; that of the Caribbean is about 700 miles. The Caribbean ports are Barranquilla, Cartagena, Santa Marta, and Río Hacha. There are two commercial ports on the west coast, Buenaventura and Tumaco. Because of its unhealthful character and the high mountain barriers, the Pacific coast has played only a slight role in the country's development. The Caribbean plain is hot and low except in the northwestern section of Magdalena department, where the surface is elevated in the Sierra Nevada de Santa Marta, whose lofty, snow-covered peaks reach 17,389ft. in altitude.

Rivers.—For convenience of description the rivers may be divided into three general classes: those which find outlet in the Pacific, those which flow into the Caribbean and those whose waters reach the Atlantic through the Orinoco and the Amazon. The most important rivers in Colombia are the Magdalena and its principal tributary, the Cauca. Both rise in the high plateau of the Andes adjoining Ecuador. The Magdalena empties into the Caribbean sea near Barranquilla. It is about 1,000m. long and traverses 9° of latitude—nearly the entire country. In the lower reaches, throughout perhaps half its course, the waters of the Magdalena are dissipated over a wide area of swamp, lagoons and lakes, and its course is continually changing through the wearing away of its alluvial banks. The Cauca unites with the Magdalena about 200m. from the sea through several channels. The Cauca is navigable in two widely separated stretches of 200m. each. Both the Atrato and Sinú rivers flow to the north coast and are navigable by small steamers.

The rivers of the Pacific coast are numerous. They have short, precipitous courses with comparatively short navigable channels. The waters of the rivers of the great eastern plains pass to the Atlantic through the Orinoco and Amazon rivers. Some of them are navigable, which fact may be of great importance to the future development of this region, which is as yet only partially explored.

Geology.—The Andes reach their northern end in Colombia, where they are divided into three principal ranges, of which the central one is the highest. This range, the Cordillera Central, which is separated from the western one by the valley of the Cauca and from the eastern one by the valley of the Magdalena, includes peaks that rise to heights of more than 18,000 feet. The highest of these, Tolima (18,438 ft.) and Huila (18,701 ft.), are volcanic. The cores of all the ranges consist of old granite, gneiss and schist, which are generally overlain, on the east and west flanks, by folded and contorted beds of sandstone, shale, slate and limestone of Cretaceous age, with which are interbedded sheets and masses of volcanic rock, chiefly porphyry and porphyrite. The western chain, the Cordillera Occidental, extends northward from

Ecuador nearly to the Caribbean sea. In its southern part it is flanked on its west side by steeply tilted Palaeozoic beds; in its northern part on both sides by Mesozoic beds. The eastern Andean range, known as the Cordillera Oriental, or the Cordillera of Sumapaz, is composed mainly of folded Cretaceous beds. The Cordillera Central, which is the continuation of the Cordillera Oriental of Ecuador, consists chiefly of beds of Cretaceous sandstone and porphyritic rocks. The axes of folding in all these ranges conform in direction with the trend of the ranges. Along the Pacific coast of Colombia there is a lower range, composed mainly of Tertiary volcanic rocks, which are covered in places with soft Quaternary sandstones and marls containing the remains of species of marine animals such as inhabit the neighbouring ocean. The Magdalena valley is a structural trough 600 m. long and 9 to 45 m. wide, outlined by faults and filled with Tertiary clay and sandstone, which unconformably overlie Cretaceous beds. The Cúcuta basin, which is a south-westward continuation of the Maracaibo basin of Venezuela, is occupied by Cretaceous and Tertiary formations related to those in the Maracaibo basin. The beds in these basins are wrinkled by small folds that trend north-north-east. The foothills east of the Cordillera Oriental are composed of marine Cretaceous and marine and fresh-water Tertiary beds, which are folded and faulted along lines parallel to the trend of the Andes. In the part of Colombia that lies east and south-east of the Andes the surface deposits are mainly Tertiary and Quaternary sand, loam and gravel.

Colombia produces about half the platinum mined in the world. The emerald mines of Muzo in the eastern Andes are world famous. Gold is found in both lodes and placers. Many of the mines are in the department of Antioquia. Some silver, copper, iron, and coal are mined. Oil, nitre, lead, tin, and mercury are also produced.

Climate.—Colombia lies almost entirely in the north torrid zone. The heat of the tropics is, however, modified throughout a large part of the area by the elevation of the surface and the action of winds. In general torrid heat prevails within the lower areas, including the coastal plains and the valleys of the larger rivers. These regions are characterized by excessive moisture and dense forests, and are in general unhealthy, except in communities where development of modern sanitation and medicine have reduced the dangers attendant upon tropical environment. Above the tropical zone in the mountainous area are found all gradations of cooler climate. The subtropical districts comprise the valleys and slopes lying between 1,500 and 7,500ft. of elevation. Some of them are among the most fertile and productive areas of the country. The temperate zone lies between 7,500 and 10,000ft. of elevation, and the cold, bleak *páramos* at from 10,000 to 15,000. Above these are wastes of ice and snow. Most of the principal cities are situated in the vertical temperate zone.

In general, the year is divided into a wet season (called *invierno,* or winter) and a dry season (called *verano,* or summer). In some sections there are two wet and two dry seasons. The time when these seasons occur and their duration vary greatly, however, in the different regions and even vary from year to year in the same location.

Fauna.—The fauna is essentially tropical, though species characteristic of temperate countries are found in the higher regions, such as the bear, fox, skunk, weasel, squirrel and deer. In the forested lowlands and the lower mountain slopes there are many species of monkeys. The puma, the jaguar and the ocelot are widely distributed and are numerous in the Magdalena valley. The peccary and the tapir are found in many regions of the lowlands and lower forest zones. Among the other commonly known animals are the sloth, armadillo, nutria, porcupine and opossum. There are many varieties of rats, some of them partly amphibious. Lizards are abundant in most parts of the country in many different species, some of them brilliantly coloured. The alligator is common along the banks of the larger rivers, though in some places, especially along the Magdalena, it is becoming scarcer because of the activities of the hide hunters. The large rivers and lakes are plentifully stocked with fish and turtles, of which there are many edible varieties. The shell of one of the varieties of turtle is known as the tortoise-shell of commerce. Snakes abound in many regions.

The condor inhabits the higher Cordilleras. Others of this order are the eagle, osprey, buzzard, kite and hawk. Parrots and parakeets are numerous everywhere in tropical and subtropical regions, also the macaw and toucan. A vast number of waterfowl throng the shallow lagoons and river beaches at certain seasons. These are largely migratory and include the crane, heron, egret, roseate spoonbill, stork, bittern and many species of duck. There is an infinite variety of insect life in Colombia and the country is considered one of the best fields for students and collectors. The varieties include butterflies, spiders, beetles and ants. Practically all the low country swarms with mosquitoes and other insect pests, but there are no mosquitoes on the high plateaux.

Flora.—The Colombian flora is very rich, ranging as it does through all varieties from those of the tropics to the Alpine species of the highest plateaux. A luxuriant forest growth covers a large part of the republic, including the foothills, slopes and valleys of the Cordilleras, a large part of the plains adjacent to the north coast, the entire surface of the Western Cordillera and coast and the southern section of the eastern plains. There are many varieties of forest products, including vanilla and medicinal plants such as quinine, ipecac, sarsaparilla, gums and balsams, also rubber, tanning agents and dyewoods, and the tagua-nut, known as vegetable ivory. These forest products form a potential source of wealth as yet little exploited. Up to an altitude of 10,000ft. the palm is very abundant and varied, with incredibly numerous uses. There are extensive groves of the coco-palm on the Caribbean coast. Orchids are abundant in the forests, and many valuable varieties have been secured in Colombia.

As the surface of the land rises the character of the vegetation changes. From 1,500ft. to 4,500ft. there is a great variety of semi-tropical fruits. The temperate zone commences at 6,000ft. and is the finest agricultural region. Here practically all the cereals, vegetables and fruits commonly found in the United States are produced. Above 10,000ft. are the *páramos* with stunted vegetation. Farther up only Alpine species are found. Colombia is especially rich in fine woods, but very little use has been made of this resource so far. The varieties include mahogany, lignum vitae, Brazil-wood, pine, walnut, cedar, oak and many others. One of the most useful trees of the temperate zone today is the eucalyptus introduced from Australia.

GOVERNMENT AND ADMINISTRATION

Population.—The census of 1938 showed a population of 8,701,816. The population is made up of white, Indian, and Negro, and their mixtures, in the following proportions: pure whites, 35%; pure Negroes, 5%; Indians, 2%; mixed, 58%. The whites are mainly descendants of Spanish settlers; the Negroes were originally imported as slaves. In general the mixture of Indian and white blood predominates in the higher regions, where there is little or no trace of African blood. On the coast and in the river valleys the predominating mixture is the Negro and white, with very few pure whites.

Population of Colombia by Departments. Census of 1938.

Department	*Population*	*Capital City*	*Population*
Antioquia	1,188,587	Medellín	143,952
Atlántico	268,409	Barranquilla	150,395
Bolívar	765,194	Cartagena	72,767
Boyacá	737,368	Tunja	16,597
Caldas	769,968	Manizales	51,025
Cauca	356,040	Popayán	18,292
Cundinamarca	1,174,607	Bogotá	325,658
Huila	216,676	Neiva	15,096
Magdalena	342,322	Santa Marta	25,113
Nariño	465,868	Pasto	27,564
Santander del Norte	346,181	Cúcuta	37,323
Santander del Sur	615,710	Bucaramanga	41,714
Tolima	547,796	Ibagué	27,448
Valle del Cauca	613,230	Cali	88,366
Intendencies			
Amazonas	6,414	Leticia	1,674
Chocó	111,216	Quibdó	5,278
Meta	51,674	Villavicencio	6,074
San Andrés y Providencia	6,528	San Andrés	4,261
Comisarias (territories)	118,028		
	8,701,816		

Of the aboriginal or Indian inhabitants there remain some scattered tribes in a savage state. Their number is estimated at about

160,000, and they are found principally on the eastern plains, also in the Río Hacha, Valle de Upar, and Santa Marta districts, and in the Atrato river basin. There are also civilized Indian communities which to some extent retain their own language and customs. According to one authority nearly 100 native languages are spoken in Colombia, but these belong principally to small and isolated communities, and the traveller in the country hears nothing but Spanish along the ordinary routes of travel.

The principal cities are: Bogotá, the capital; Medellín, the centre of commercial activity; Barranquilla, starting point of steamship service on the Magdalena, which has recently replaced Puerto Colombia as a port of call; Cali, centre of a rich agricultural district; and the Pacific coast port of Buenaventura.

Health.—In general, the coast and lower river valleys are unhealthy but there are regions which form exceptions. Among the latter are the cities of Barranquilla and Santa Marta on the Caribbean coast, where health conditions are reported reasonably good, due largely to improved sanitation. In the low country malaria and dysentery are very prevalent. The Magdalena valley is particularly unhealthy because of the vast swamp areas and the resultant mosquitoes. Hookworm is common in a large part of the country. The Rockefeller Foundation of New York has been carrying on an extensive campaign against disease in cooperation with the Colombian Government, devoting itself especially to the treatment of hookworm and the prevention of yellow fever. Very important results are being obtained.

In general, the higher altitudes are healthy. Many of the Colombian cities were lacking in proper water supply, sewage disposal, street paving, etc., but in most communities this situation is rapidly being corrected. Admirable new water supply systems in Bogotá, Cali, Cartagena, and other cities are indicative of this trend. The ports are generally free from yellow fever and similar diseases.

Immigration.—The law provides some inducements to immigrants such as the grant of agricultural land, but so far there has been little movement of foreign workers into the country. The settlement of Jewish refugees from European anti-Semitic persecution in Colombia has been minimized by the difficulty such persons encounter in complying with the Government's requirement that they settle on the land.

Social Classes.—The settlements of the Spaniards were mainly in the interior elevated sections. Due to the fact that adequate communications with the outside world have only recently been established, communities long remained in great isolation, and the result has been to preserve the language, manners, and physical characteristics of the early colonists with less variation than is found in any other Spanish-American state. The white race, numerically superior, has retained a certain social and economic dominance with respect to the Indians and Negroes, but the process of race mixture has progressed so far that, except for the comparatively few tribal Indians and limited numbers of predominantly pure Negroes, the country is rapidly attaining racial homogeneity. Upper class whites in Colombia, as elsewhere, disdain manual labour. The mestizos of Indian stock are in the main sturdy and patient and furnish the labour of the plateau districts. In the cities they are artisans, domestics and day labourers and in the country farm workers and herders. In the hot low country where the Negro strain is strongest the labour is less efficient than in the elevated sections. Though the men of wealth and position in all sections of the country are generally white, there are numerous exceptions to this rule. There is little colour antagonism, as such, against those of Indian and Negro lineage, and individuals of these races sometimes rise to important positions.

Government.—The Government is that of a centralized republic. The executive branch is formed by the president and nine cabinet ministers and the governors of the departments, who are appointed by the president, as well as other administrative authorities directly or indirectly controlled by him. The president is elected by the people for a term of four years. Attached to the president is a consulting body known as the Council of State, which is composed of seven members. The national loan board has jurisdiction over all borrowing done by the Government.

The legislative power is vested in Congress, consisting of the senate and the house of representatives. The senate is composed of 35 members elected for four years by electoral councils appointed by the departmental assemblies. The house of representatives is elected directly by the people for a period of two years. All male Colombians, 21 years of age or over, who exercise a lawful occupation, are citizens and entitled to vote.

The judicial power is vested in the supreme court of 12 members at Bogotá and a superior court in each judicial district. The supreme court has appellate jurisdiction in judicial matters and original jurisdiction in impeachment trials and in matters involving constitutional interpretation. There are various inferior courts.

Education.—The Constitution provides that public education shall be organized and directed in agreement with the Catholic religion and that primary education, paid for out of the public funds, shall be free but not obligatory. Primary education is under the control of the departments, and the status of education varies in the different departments. At the end of the last century the proportion of illiterates was authoritatively estimated at 90%. On the basis of the 1918 census the proportion of illiterates in the adult civilized population was about 50%. Colombia has, however, made great progress in education, and the percentage has been very considerably reduced, although no statistics have been published on the subject. The education of the majority, however, does not extend beyond the most elementary branches.

The following chart indicates the educational system of Colombia in 1937. Included among the primary schools are 190 Roman Catholic missions in the national territories. The National university at Bogotá, founded in 1572, and the School of Mines at Medellín are under the national Government. Four other universities are departmental; the universities of Antioquia (at Medellín), Cartagena, Popayán, and Pasto. The Government maintains a conservatory of music and a school of fine arts in Bogotá.

Education in Colombia in 1937

Type of School	Total of Official Schools	Total of All Schools	Teaching Staff	Enrolment
Infant	95	326	485	15,112
Primary	8,015	8,714	12,495	573,617
Vocational	127	163	380	7,512
Evening	199	213	340	12,265
Secondary and normal	75	361	3,367	32,585
Commercial	10	100	653	8,337
Superior (preparatory)	19	27	599	3,324
Arts and crafts	19	37	297	3,691
Agricultural	7	9	32	426
Art	3	6	73	684
Military	10	10	—	—
Religious	0	27	211	1,504
Nursing	1	1	5	15
Abnormals	4	5	59	243
Unclassified	7	7	40	539
Total	8,491	10,081	19,037	639,854

Religion.—The Roman Catholic faith was introduced into Colombia by the Spanish conquerors and up to 1853 was the only religion permitted to Colombians. Until amended in 1936, the Constitution provided that Roman Catholicism should be the national religion protected by the State, but a complete disestablishment was effected in that year. During the colonial period many churches were built and religious communities established, and the Church was wealthy and powerful. Although under President Mosquera (1861) most of the church property was transferred to the State, the influence of the Church is still quite strong. Its influence in matters of education was materially decreased by the policies followed under President López (1934–1938). Ecclesiastically the republic is divided into four archdioceses and eleven episcopal dioceses. The people of Colombia are overwhelmingly Roman Catholic in religion.

Finances.—Many elements have contributed to the marked improvement which has taken place during the last few years in the economic situation of the country and in the finances of the Government. Of these the most far-reaching has been the great increase in the value of coffee exports, which has materially increased the wealth of the country, and only to a less degree the development of the nation's petroleum resources. The initial impetus to more orderly finances may be said to have been the payment by the United States of $25,000,000 in five yearly instalments, from 1922 to 1926 inclusive, in settlement of claims arising out of the secession of Panama in 1903, and the financial and monetary reforms of the Kemmerer commission in 1923. These reforms included the establishment of a new and sound budget régime, the reorganization of the currency on a gold basis and establishment of a national bank of issue, the reorganization of the administration and collection of the national revenues and the national accounting, and the creation of a department for the general supervision of expenditures.

Revenue and Expenditure.—A sudden freshet of borrowed money from the United States in 1927 and 1928 enabled the budgets for those years to reach record heights, but by 1929 a deficit brought financial difficulties and necessitated short term borrowings in the following year. The indebtednesses thus incurred have loaded the country with a debt from whose effects it is but slowly recovering.

In 1932 the ordinary revenues reached the lowest total for a decade, but since that time they have mounted steadily, as have expenditures.

Ordinary Revenues and Expenditures, 1932–1939
(in thousands of pesos)

	1932	1933	1934	1935	1936	1937	1938	1939
Revenues	35,346	39,787	53,361	57,360	70,063	82,606	83,773	89,200
Expenditures	35,458	31,810	49,365	57,670	65,301	71,892	81,237	89,800

Revenues come principally from import and export duties, which normally account for approximately half the total, especially since adoption of a high tariff policy in 1930. The income tax now supplies around 10,000,000 pesos annually. The largest single item of expenditure in the 1938 budget, which totalled 81,567,979 pesos, was public works (15,216,541 pesos), with national defence (13,050,000 pesos) and public debt (10,825,174 pesos) next in order. Education was allotted 6,840,903 pesos.

Public Debt.—The external debt of Colombia, including that of departments and municipalities, and of institutional indebtedness guaranteed by the Government, aggregated $146,265,930 and £2,666,290 in 1939. Most of this is in complete default, with accrued interest on the dollar loans approximating $53,304,000. In Feb. 1940, however, an agreement was made for temporary resumption of service on the national government's $53,839,530 obligations. Internal indebtedness as of Jan. 1, 1939, was officially reported as 109,418,146.04 pesos.

Money and Banking.—The monetary unit is the peso, which through exchange control has been maintained at approximately 57¢ U.S. This is maintained through the Banco de la República, which is also the sole bank of issue in the country.

Weights and Measures.—The metric system of weights and measures is obligatory for official business and is used in international trade. In the interior, however, the old Spanish weights and measures are still used to a considerable extent in domestic transactions, including the *libra* of 1·102 lb. avoirdupois, the *arroba* of 25 *libras* (12½kg.), the *quintal* of 100 *libras* (50kg.), the *carga* of 250 *libras* (125kg.), the *vara* of 80cm. and the *fanega*. The litre is the standard liquid measure.

National Defence.—Military service is obligatory under the law and all males are eligible. The standing army numbers about 6,000. The naval and aerial equipment for national defence is very limited.

ECONOMICS AND TRADE

Agriculture.—The larger part of the population live by farming and cattle herding. Coffee production is the principal source of wealth, there being no other that approaches it in importance. Agricultural statistics for the most part do not exist. Only a small part of the land is under cultivation, and there are still vast tracts of virgin land in all the departments. The largest proportion of cultivated land is in the temperate zone of the elevated areas. Modern agricultural methods are unknown; there are very few ploughs in use, and other agricultural machinery is practically unknown. There is little or no use of fertilizers. The most common method of preparing land for cultivation is to burn it over, and in the aggregate a large area of good timber land is burned off every year for planting. There are in general use only a few crude implements, of which the most important is the *machete* (heavy knife). Most of the cultivation given the coffee shrubs is done with this.

Coffee is grown principally in the zone between 3,000 and 6,000ft. in elevation. Production has increased greatly in the last quarter century. In 1926 exportation totalled 2,454,288 bags of 132lb. (60 kg.), more than 60% in excess of the average for the preceding 5 years. Except for 1927, when the total was 97% of that figure, exports have been consistently higher ever since, and in 1937 aggregated 165% of the 1926 total, or 4,059,642 bags (4,262,366 bags in 1938). No statistics were published for domestic consumption until 1935, in which year it was estimated at 350,000 bags (400,000 in 1937). The 1937 crop was approximately 10·7% of the world's total, making Colombia second only to Brazil (25,944,000 bags) in world production.

In 1937 16·54% of world consumption (in contrast to production) was of Colombian coffee (Brazil, 52·89%). The United States is the heaviest purchaser of Colombian coffee, which supplied 21·72% of her needs in 1937. Colombian coffee is known in the world's markets as mild, and is blended with stronger grades. It is grown under shade-trees, and a large part of it on mountain slopes. The departments of Caldas (31·56% in 1937), Antioquia (16·45%), Tolima (13·71%), Cundinamarca (11·78%), and Valle del Cauca (10·87%) are the principal producing regions, but coffee is also produced in five other departments. Coffee exports in 1938 represented 55·8% of export values. Although the total volume was 5% greater, value declined 5·1% from 99,172,496 pesos in 1937 to 94,160,136 pesos in 1938.

Bananas grow extensively in nearly all regions of the torrid and temperate zones in a great number of varieties and are one of the principal foods of the people. The production for export is practically all in the region about Santa Marta on the Caribbean coast. Other agricultural products exported are cotton, rubber, tobacco and tagua. Their export value, however, is insignificant. Other agricultural production is mainly food for home consumption. The torrid zone produces rubber, coco-nuts, tobacco, bananas, sugar-cane, corn, cotton, cocoa, beans, rice, etc. The subtropical zone, in addition to coffee, produces a great variety of fruits such as banana, pineapple, mango, papaya, alligator-pear and citrus fruits. The temperate zone is the most favourable for agriculture and produces wheat, barley, potatoes, oats, corn and practically all the fruits and vegetables known in the United States.

Bananas aggregate around 5% of total exports, averaging around 7,500,000 stems annually (6,685,192 in 1937).

Production and extent of cultivation of some of the other leading agricultural products were as follows in 1937:

	Hectares under cultivation	Production in metric tons
Cacao	12,316,451 (trees)	11,359
Corn	556,147	490,505
Sugar	272,818	43,428
Wheat	199,627	90,768
Beans	72,496	36,096
Potatoes	67,546	285,547
Rice	67,170	74,645
Cotton	43,294	18,842
Tobacco	15,087	14,829

Cattle-raising.—Cattle-raising and crop farming sustain the bulk of the population. The largest rural properties are those devoted to cattle, and in both the tropical and the temperate zone there are vast areas suitable for this industry. It is estimated that the country could support 50,000,000 head. The number of head of cattle and other livestock in 1937 was: cattle, 7,592,000; sheep, 830,807; swine, 1,544,617; goats, 517,510; mules, 453,232; asses, 288,455; horses, 925,733.

The only export which has developed is that of hides. In 1938, the exportation of hides was valued at 3,871,000 pesos.

An attempt to establish a meat-packing industry shortly after the close of the War of 1914–1918 failed, and the plant was abandoned.

An important import trade in cattle from Venezuela helps supply domestic demands.

Mineral Wealth.—Gold, formerly the principal source of mineral wealth, has been supplanted by petroleum. Colombia, with a current production of about half that of Mexico, is the third most important petroleum producer among the Hispanic American countries. Concessions are exploited by foreign companies, of whom only one, the Tropical Oil Company, a subsidiary of the Standard Oil Company (N.J.), was actively producing, and the value accruing to the country is in the royalties on production and in special taxes. Under the terms of the Tropical Oil Company grant, 10% of crude production (after deduction of petroleum used in drilling) goes to the State. Between 1921 and June 1937, the nation (and the department of Santander del Sur) received approximately 14,500,000 pesos as its royalty, the amount being paid in money, not oil. Annual production averaged almost 19,000,000bbl. between 1928 and 1939 inclusive. In 1939 it was 22,998,000 barrels.

Production of gold was valued at $15,447,700 (U.S.) in 1937, and $18,225,095 in 1938 with a production of 442,222 fine ounces, the highest on record. Silver production was 167,971 fine ounces, platinum, 29,315 fine ounces. Slightly over half the gold and over 60% of the silver is mined in Antioquia.

There are abundant resources of coal, which have been exploited particularly since 1934. Production over the four-year period 1934–1937 averaged approximately 335,000 metric tons annually. Salt production is a Government monopoly. Total annual output averages three million pesos.

Manufacturing.—Manufacturing was formerly confined to low grade articles of everyday use, but has made great strides under a protective tariff policy since 1930. Textile mills, sugar mills, breweries, and cement plants are the most important industrial enterprises. Practically all the output is for domestic consumption. In 1937, 31,192 persons were employed in factories, 10,009 of them in textile mills. The departments of Cundinamarca, Atlántico, and Antioquia are the principal centres of industrial activity.

Foreign Trade.—Colombia, by reason of her geography and topography, has an almost bewildering range of potential exports, but nevertheless her export trade is confined into such narrow limits as to put her on the edge of the one-crop country group. The following chart shows the percentages of each of the principal commodities exported in 1937, 1938 and 1939 (including gold):

(In thousands of pesos, i.e. add 000)

Commodity	1937	% of total	1938	% of total	1939	% of total
Coffee	99,172	53·8	94,160	55·8	87,125	49·2
Petroleum	35,079	19·0	37,206	22·1	31,903	18·0
Gold (to U. S.)	32,019	17·4	18,780	11·1	40,582	22·9
Bananas	6,983	3·8	8,684	5·2	8,679	4·9
Cattle hides	5,034	2·7	3,876	2·3	3,638	2·0
Platinum	2,666	1·5	1,651	1·0	1,126	0·6
Tobacco	400	0·3	1,027	0·6	....	...
Others	2,834	1·5	3,253	1·9	4,001	2·4
Total exports	184,187	100·0	168,637	100·0	177,054	100·0

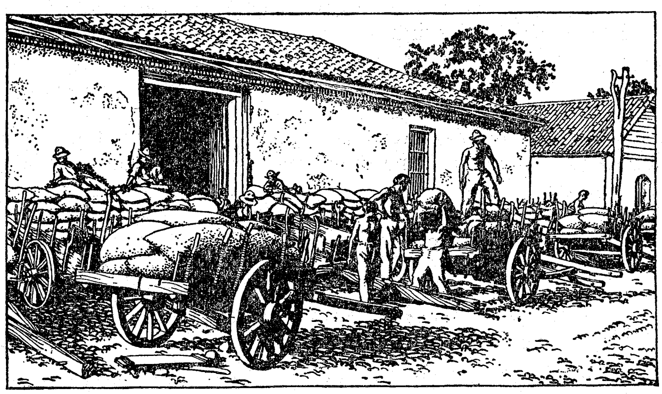
If gold were deducted from the above totals, coffee alone would total 61% of all exports. The United States takes around 60% of the total of Colombia's exports, including, in recent years, all the gold and over 75% of the coffee. Until the outbreak of the European war in 1939, Germany was taking between 10% and 15% annually. Around 12%, representing petroleum for refining, goes to Curaçao.

Imports are textiles, machinery, and miscellaneous manufactured goods. Approximately 50% of imports are supplied by the United States. In recent years Germany, with 13·4% in 1937 and 17·3% in 1938, and Great Britain, with 18·82% in 1937 and 12·3% in 1938, have stood second and third. Imports and exports in recent years have been as follows (not including exports of gold bullion):

Colombian Foreign Trade, 1932–38 (in thousands of pesos)

	1932	1933	1934	1935	1936	1937	1938	1939
Imports	34,327	55,627	98,066	119,677	134,441	169,682	159,259	183,461
Exports	67,109	67,586	123,891	123,602	136,844	152,169	149,857	177,054

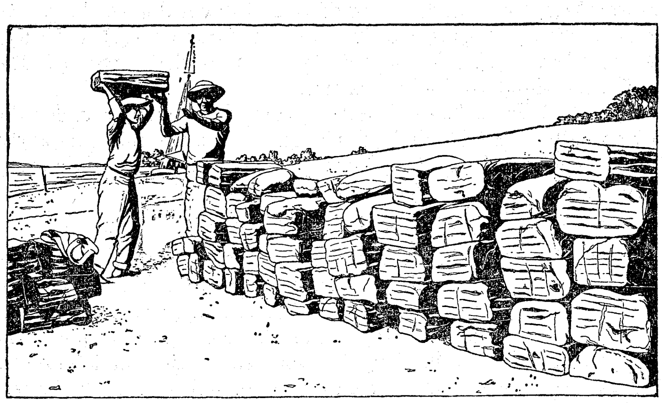
In 1939, exports (not including 40,582,000 pesos value of gold to the United States) were valued at 136,472,000 pesos, going chiefly to the United States (58·9%), Germany (9·5%), France (4·1%), Great Britain (1·8%), Italy (1·7%). During the first 8 months Germany purchased 13·7%, but after Sept. 1, 1939, only 0·3%. Imports of 129,807,000 pesos were chiefly from the United States (55·6%), Germany (12·8%), Great Britain (10·5%). German sales dropped from 16·6% in the first 8 months to 3·5% in the last 4 months.



COFFEE BEING LOADED ONTO CRUDE CARTS

Communications.—The transportation problem in Colombia is one of peculiar difficulty. With few exceptions, the more densely populated districts are in the interior, isolated from the coast by mountain chains, and despite steady and rapid progress in the last few years, communication is still inadequate. This is especially true of Bogotá, although development of aviation has materially alleviated the difficulties. There is no continuous rail or road communication from the interior to the coast. Instead, the Magdalena river is the main artery of traffic. Most of the railroads run from it to interior points. Its navigation is slow and is open only to vessels of small draft, necessitating transhipment at Barranquilla, whose harbour has been recently improved by extensive port works.

In 1921 the country had 1,511km. of railways in operation, but since that time the length has been more than doubled, reaching 3,197km. in 1937. Most of the railways are Government-owned. The National Railway Council administers six lines (1,513km.) of nationally owned railroads and one principally owned by the department of Cundinamarca. Two nationally owned lines (172km.) are operated separately. Five lines (783km.) are owned by departments. The total of railway mileage owned by the nation or by departments is 2,468 kilometres. In addition, 9



NATIVE RUBBER MOULDED INTO BLOCKS, BEING STACKED FOR SHIPPING BY MULE OR CANOE separate privately owned railways (729km.) are in operation.

Highway development has received especial stress in recent years. During the four years ending in 1937, some 3,000km. of highway were added. In that year there were 11,952km. of highways in the country, and an additional 11,614km. in project. National highways aggregated 6,866km. in operation, and 8,172km. in project. Between 1932 and 1936 the number of automobiles in the country increased by 69% (to 19,435), and was estimated at 21,000 in 1937. About half were in the department of Cundinamarca, that is, in and around the national capital.

A peculiar feature of Colombian transportation is the use of aerial cables for handling merchandise and passengers. Three of these, with a total length of 142km., are in operation between Gamarra and Ocaña, Manizales and Mariquita, and in the department of Caldas. The distance between stations on the first named averages 4,700 metres.

Aviation.—Colombia was the first South American country to take up air travel on a commercial scale. In 1920 a concession was granted to the German-Colombian company "Sociedad Colombiana Alemana de Transportes Aéreos," familiarly known as "Scadta" from its initials. This company and some others connect various parts of the country with one another and with the outside. The longest non-stop run, from Barranquilla to Bogotá, some 500 miles, takes $2\frac{1}{2}$ hours by plane, and a minimum of 6 days by rail and river. Between 1934 and 1937 inclusive, passenger and freight traffic quadrupled. Through the internal air transport system, regular and frequent connection with foreign air services is available. Barranquilla, at the mouth of the Magdalena, is the country's largest port. Other ports are Cartagena and Santa Marta on the Caribbean, and Buenaventura on the Pacific. Frequent and regular steamer service by several lines is available to Panama, to New York and New Orleans, and to European ports.

Telephone, Telegraph, Etc.—Both telegraph and radio systems are Government-operated. In 1937 there were 35,990km. of telegraph line and 898 offices. The larger cities have local telephone service owned by private companies or the municipalities. The national Government owns long-distance telephone lines connecting most of the larger cities. External cable communication is through Buenaventura and Cartagena. (L. W. Be.; J. F. Ki.)

ARCHAEOLOGY

From the archaeological point of view the large expanse of territory represented to-day by the Republic of Colombia must be considered separately. But investigation is so incomplete that only the main lines of the prevailing culture can be indicated. The fine technique of the pottery and gold-work of certain regions, and also the traditional history of a few tribes, bring the area into relation with the more organized cultural developments both to the north and south. Large portions of the country were peopled by tribes living under primitive conditions, and the manifestations of higher culture are confined, so far as is known, to the Cauca valley and the plateau of Bogotá.

Historical tradition, as preserved, relates principally to the tribes of the Bogotá plateau, where, at the time of the Spanish invasion, political conditions seem to have been much the same as those of central Peru at the beginning of the rise of the Inca. The expansion of tribes of kindred culture, ruled by paramount chiefs, led inevitably to collision, and the Chibcha people had established a supremacy over their neighbours, which, given time for development, might well have resulted in an "empire" on Inca lines. Far less is known from traditional sources of the people of the Cauca valley, among whom the Quimbaya tribe stand pre-eminent as potters and gold-workers. Existing evidence would place culture of the more advanced peoples of Colombia in exactly that position which their geographical situation suggests. There is undoubtedly a close connection with Panama, and remoter Peruvian and Mexican influence. Influence from the south is a natural assumption, but, owing to the difficulties of travel by land, due to the forested area of eastern Panama, sparsely peopled by tribes of low culture, the very close relationship between the Colombians and the Talamancans appears at first sight surprising. But clearly there was a regular "port-to-port" trade down the western coast, which was so continuous that Vasco Núñez de Balboa received from the Panamanian chief, Tumaco, an itinerary by sea to Peru, as yet undiscovered, together with a description of the llama.

Like the Talamancans, the inhabitants of Colombia did not practise stone-building, with one notable exception. This is the prehistoric site of San Agustín, on the upper Magdalena, where sculptures have been found in a style obviously connected with the art of the Peruvian Chimú. The pottery, especially in ornamentation by means of the "lost-colour" process (the reservation of designs in the ground-colour by means of wax or resin painting before the second slip was applied) shows a close relationship with Talamancan technique, while the forms and paste display near relationship to the ware of the Ecuadorian highlands. The gold-work, produced by the *cire-perdue* process of casting, with soldered details, or by hammering is, as far as the province of Antioquia (the Quimbaya area) is concerned, almost indistinguishable from the Talamancan. But the Chibcha produced castings, of very inferior quality, in a peculiar style of their own, which is easily recognizable. Gold was common in the Colombian region, and was employed for divine offerings, either in the form of dust or of manufactured articles. At certain ceremonies, practised in common by the tribes of the Bogotá plateau, rich offerings of this metal were thrown into certain sacred lakes (especially Lake Guatavitá) or deposited on the banks. The particular rite of investiture of the ruler of Guatavitá, in accordance with which, plastered with gold-dust, he plunged into the lake, gave rise to the many stories of "El Dorado" found in the pages of the early chroniclers. Religion, so far as can be ascertained, was expressed in the worship of various powers of nature, the sun, moon, rain and lakes. Creator-gods and culture-heroes were also included in the pantheon. In outline, religion seems to have corresponded to that of the early Peruvian tribes, but much of the ritual shows a very close correspondence with that of the later Mexicans, especially in the extent, and methods, of human sacrifice. Nahuatl influence extended into the Talamancan area, and certain features of Nahuatl ritual may have been introduced into Colombia together with Talamancan methods of pottery decoration and gold-technique. Human sacrifice, if it existed under the Inca régime in Peru, was rare, and was only practised on special occasions. In this respect Colombian religion approximates very closely to the Mexican. For chronology *see* chronological table, Central America: *Archaeology*. (T. A. J.)

HISTORY

The coast of Colombia was one of the first parts of the American continent visited by the Spanish navigators. There, too, at Darien, was located the first permanent European settlement on the American mainland (1510). In 1525 Rodrigo de Bástidas founded Santa Marta, from which stemmed colonial New Granada (as Colombia was known until 1861). From Santa Marta, in April 1536, Gonzalo Jiménez de Quesada pushed inland and founded Bogotá (Aug. 6, 1538). Soon there were several well established, growing communities on the coast and in the interior highlands, among the former the great fortress city of Cartagena, focal point of foreign attacks throughout the Spanish era. Until the early 18th century, New Granada was governed by the Viceroy of Peru. In 1718 (temporarily) and definitely in 1740, however, New Granada was erected into a viceroyalty which included under its jurisdiction not only the present Colombia, but what is now Panama, Ecuador, and Venezuela as well. Throughout the colonial era geographically isolated New Granada was neglected by Spain, and toward the close of the 18th century, rumblings of discontent were manifest.

In 1811 insurrection against Spanish domination was formally commenced, and almost incessant warfare was carried on with the mother country until 1824. Simón Bolívar, the great national hero, headed the struggle. In 1831 the republic of New Granada was founded, which included the territory at present known as Colombia and Panama, and a Constitution was promulgated. From then up to 1903 the country was carrying on intermittent civil war. Under President Tomás de Mosquera in 1861 the power of the

Church was reduced and its property appropriated by the nation. In 1861 the name The United States of Colombia was adopted.

Through the many years of strife the conciliation of warring factors was effected, the unity of the country consolidated, and the way laid for permanent peace. There was, however, a constant drain on the manhood and resources of the country, and the intervals of peace were too short to permit of the development of the natural resources or progress in transportation. Colombia entered the 20th century as a country in which the principal centres of population were scattered over a vast territory more or less isolated from each other. A life of considerable comfort and culture developed in the various cities, but the country as a whole remained in a backward state. In 1903 peace was attained, which has proved to be lasting.

Perhaps the most important event of the 20th century has been the loss of Panama, which seceded in 1903 (*see* PANAMA). The differences between Colombia and the United States over the secession of Panama were adjusted by the Thompson-Urrutia Treaty, which was finally ratified by the Colombian senate in Dec. 1921. Among other conditions this provided for the payment of $25,000,000 indemnity to Colombia for the loss of Panama in five yearly payments, Colombia engaging to recognize the independence of Panama.

Under Gen. Pedro Nel Ospina, who became president in Aug. 1922, an impetus was given to the construction of public works, especially roads and railroads. For this purpose loans to the amount of $25,000,000 in July, 1927, and $34,000,000 in March, 1928, were concluded in New York; particular projects involved included a railway giving Bogotá direct connection with the Pacific and another extending from Bogotá northward to connect with the existing line in the lower Magdalena valley. In 1926 Dr. Miguel Abadia Méndez was elected to the presidency for a four-year term. A treaty with Nicaragua, signed March 24, 1928, settled several century-old territorial disputes between the two countries by awarding the Mosquito Coast and the Great and Little Corn Islands to Nicaragua and islands of the Andrés Archipelago to Colombia. In Feb. 1930, Dr. Enrique Olaya Herrera was elected president, the first Liberal in several decades. The financial crisis forced the Conservative majority in Congress to provide checks on the export of gold, regulation of exports and imports, a virtual suspension of debt payments, a system of agricultural credits, and appropriations for public works. The Conservatives sought by voting war preparations to magnify a minor Peruvian invasion of Leticia, Sept. 1931, into a major issue; only the friendly agency of Brazil, the U.S.A., and the League of Nations secured the interposition of a League Commission to administer the province while a Protocol favorable to Colombia was negotiated; Conservative opposition delayed ratification until 1935. Meanwhile the Liberals captured control over Congress and reopened their attack on the favoured position of the Catholic Church. In the presidential election of 1934, boycotted by the Conservatives, Dr. Alfonso López, advocate of a "New Deal," easily won over his Communist rival. A series of constitutional and other reforms featured his administration, an eight-hour day law, the guarantee of labour's right to strike, and the disestablishment of the Roman Catholic Church being the most outstanding. A reaction set in by 1937, however, and the more moderate Liberals were able to nominate the relatively conservative Eduardo Santos, a prominent newspaper publisher, as the party candidate, and to elect him in Feb. 1938. The new president's policy was, in general, one of progressive but not radical action. Meanwhile, in international affairs, Colombia continued to work in close harmony with the United States.

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(L. W. BE.; J. F. KI.)

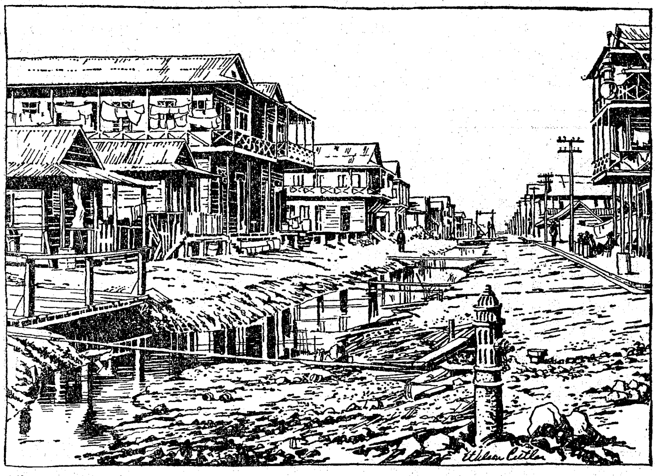
COLOMBO, the capital and principal seaport of Ceylon, situated on the west coast. Pop. (1931), 284,155; est. 1943, 345,000. Near the mouth of the Kelani river, the environs of the town are low-lying and wide areas are liable to inundations against which considerable protective works have been constructed. Galle, 70 mi. S. by rail, was Ceylon's principal port of call until harbour works were undertaken at Colombo between 1874 and 1886. The large artificial harbour has an area of 643 ac. at low water. An area of 246 ac. has been dredged to a low-water depth of 36 ft. and over, 140 ac. to a depth varying between 36 ft. and 34 ft. and 106 ac. to between 33 ft. and 30 ft.; the remaining 151 ac. have a depth of less than 30 ft. Vessels drawing 34 ft. can enter by the western channel (630 ft. wide), and vessels drawing 29 ft. by the northern channel (550 ft. wide). Berthing accommodation, exclusive of the graving docks, guide pier and oil jetties, is available for 35 vessels in the N.E. monsoon and 38 vessels in the S.W. monsoon. The outer graving dock has a length of 695 ft., and the inner, completed in 1938, 350 ft. The Beira lake, and the canal connecting to the harbour, is an integral part of the port of Colombo. The canal is navigable by 40-ton barges, and the lakeside barge yards relieve congestion in the harbour where hitherto they had been moored.

The business part of Colombo is known as the Fort; it occupies the site of the old fortified area, the defenses of which were demolished by Lord Rosmead (then Sir Hercules Robinson) in 1869. Here are also Queen's House, the official residence of the governor, and the main block of government offices. The law courts are built on a site in the suburb known as Hultsdorf, which, during the Dutch period, formed with Wolfendahl the principal European quarter. Colombo has few buildings of any architectural interest or value, but mention may be made of the Dutch church at Wolfendahl and the Buddhist temple at Kotāhena. Ceylon University college, established 1921, prepared students for the examinations of the University of London, and Ceylon Medical college, founded 1870, provides instruction of such standard that it has been recognized by the General Medical Council of the United Kingdom since 1887. These two institutions, by legislation enacted in 1942, were merged to constitute the University of Ceylon. Colombo has a general hospital with 935 beds and an ophthalmic hospital, hospitals for women and for children, a Pasteur institute and bacteriological, dental and anti-tuberculosis institutes.

Colombo is a municipal town. It is administered by a municipal council, the members (of either sex) being elected by the ratepayers; the mayor is elected annually from among the councillors. The town is not only the administrative capital of the colony but is by far the greatest business centre. All the principal firms doing business in Ceylon have their offices in Colombo, and by means of visiting agents attached to some of these firms the management of most of the tea and rubber plantations in the island is controlled. The principal open spaces are the Victoria park, in the suburb that still bears the name of the Cinnamon Gardens, the Galle Face esplanade, the Havelock racecourse, Havelock park and the Ridgeway golf links. There are numerous cricket fields, several of which are of exceptional quality. The climate is warm and humid, but the town is healthy and has always been singularly free from malaria, in spite of its somewhat low-lying and waterlogged situation. The mean temperature is 80.8° F., and the mean annual rainfall 91 in. The hotel at Mount Lavinia, a few miles to the south of Colombo, originally built as a residence for the governor without colonial office authorization and promptly sold, is a favourite sea-bathing and pleasure resort. Cotta, a suburb distant some 5 mi. from the port, was the original capital of the Sinhalese kings in the neighbourhood. The Kelani river is spanned by the Victoria bridge, from the head of which roads lead northward to Negombo and Chilaw, and east by north to Kandy. South of the Kelani river, main roads lead southward along the coast to Hambantota and up the Kelani valley to Avisawella. From these points main roads branch off to every part of the island.

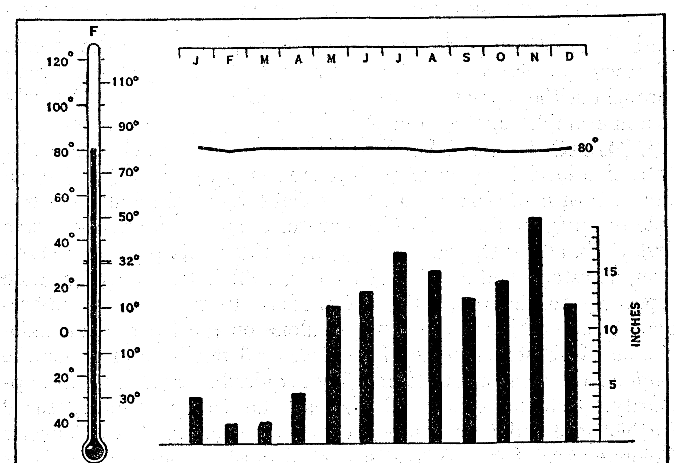
COLÓN, a town of Matanzas province, Cuba, on the railway between Matanzas and Santa Clara, and the centre of a productive cattle, sugar and tobacco region. Population (1943 census) 11,534 (city); 25,052 (*municipio*).

COLÓN, the second city of the Republic of Panamá, and the northern gateway to the Panama canal. The American town of Cristóbal, which is within the Canal Zone, adjoins Colón and is virtually a part of it. The great port works and docks built by the American government at Cristóbal make Colón one of the most important ports of the Caribbean sea, a considerable portion of the freight for neighbouring coastal points in Central America and northern South America being transshipped there and other goods being unloaded for storage in the large bonded warehouses within the Canal Zone. Colón has a population (1940) of 44,393, not including the residents of the Canal Zone. It is the northern terminus of the Panama railroad, 48 mi. from the city of Panamá. It is the capital of the province of Colón, the seat of a Panaman custom-house and of consuls of various countries.



BY COURTESY OF U.S. WAR DEPARTMENT
"D" STREET IN COLÓN, BEFORE CONSTRUCTION OF PANAMA CANAL

Colón is now one of the busiest tourist centres in the world, its streets lined with shops owned by natives of every land under the sun, and selling the varied products of the world. The native population is largely Negro, chiefly descendants of labourers, imported from the British West Indies during the various periods of construction on the Panama canal, and the rule of the road is to keep to the left, one of the few cities of importance in Latin America following the British custom. The town was founded in 1850, at the Atlantic terminus of the original Panama railway, and was first called Aspinwall, after William H. Aspinwall (1807–75), one of the builders of the railway. The present name, Colón, is the Spanish form of Columbus, as the twin city of Cristóbal is the Spanish of his Christian name. On the completion of the railway in 1855, Colón attained outstanding importance as compared with the older Caribbean ports of Panamá, and with the first plans for the isthmian canal, took on additional prestige. Prior to the beginning of work on the American canal, in 1903, Colón was notoriously unhealthy, and one of the provisions of the Canal treaty of 1903, giving the United States full sanitary control over the cities of Panamá, was to enable it to clean up Colón before the work of construction was begun. Much of the work of Gen. Gorgas (*q.v.*), the sanitary genius of the canal construction, was done in and about Colón, which was given a new system of waterworks and sewerage as well as a complete drainage of the surrounding swamps in the triumphant fight against yellow fever and malaria. Colón is one of the most healthful tropical cities in the world. The Hotel Washington, operated by the U.S. government, is the popular resort of the Canal Zone. (W. THO.; X.)



WEATHER GRAPH OF COLÓN. THE THERMOMETER REGISTERS THE ANNUAL MEAN TEMPERATURE. THE CURVE SHOWS THE MONTHLY MEAN TEMPERATURE. COLUMNS INDICATE NORMAL PRECIPITATION FOR EACH MONTH

COLON. (1) In anatomy, part of the greater intestine (Gr. κόλον, from κόλος, curtailed) (*see* ALIMENTARY CANAL). (2) Originally in Greek rhetoric a short clause, hence a mark (:) in punctuation, used to show a break greater than that marked by the semicolon (;), and less than that marked by the full stop (Gr. κῶλον, a member, or part). Applied in palaeography to a unit of measure in mss., amounting in length to a hexameter line.

COLONEL, the superior officer of a regiment of infantry or cavalry (derived either from Lat. *columna*, Fr. *colonne*, column, or Lat. *corona*, a crown); also an officer of corresponding rank in the general army list. The colonelcy of a regiment formerly implied a proprietary right in it. Whether the colonel commanded it directly in the field or not, he always superintended its finance and interior economy, and the emoluments of the office, in the 18th century, were often the only form of pay drawn by general officers. The general officers of the 17th and 18th centuries were invariably colonels of regiments, and in this case the active command was exercised by the lieutenant-colonels. At the present day, British general officers are often, though not always, given the colonelcy of a regiment, which has become almost purely an honorary office. The sovereign, foreign sovereigns, royal princes and others, hold honorary colonelcies, as colonels-in-chief or honorary colonels of many regiments. In other armies, the regiment being a fighting unit—usually of three battalions, the colonel is its active commander; in the British army the battalions of a regiment serve separately—normally one abroad and one at home in peace—and are organized in brigades composed of battalions of different regiments. Thus 18th century practice has become the modern regulation, and a lieutenant-colonel is the commanding officer of the battalion of infantry and regiment of cavalry. Colonels are actively employed in the army at large in staff appointments, brigade commands, etc., extra-regimentally. Colonel-general, a rank formerly used in many armies, still survives in the German service, a colonel-general (*General-Oberst*) ranking between a general of infantry, cavalry or artillery, and a general field marshal (*General-Feld-marschall*). Colonels-general are usually given the honorary rank of general field marshal.

The United States.—The colonel in the U.S. army is the highest rank to which officers are promoted by seniority. His appropriate command is the regiment. Colonels are assigned to duty as chief of staff of divisions, assistant chiefs of staff in the larger units, and as assistants in the administrative and supply services. The insignia of rank of the colonel is the silver eagle worn on the shoulder strap of the uniform.

COLONIAL OFFICE: *see* GOVERNMENT DEPARTMENTS.

COLONIAL PREFERENCE: *see* IMPERIAL PREFERENCE.

COLONIAL STYLE, in architecture, a term loosely applied to any style developed by colonizers; *e.g.*, the French colonial architecture of Morocco, the colonial architecture of Bermuda, etc. When used without a qualifying adjective, the term denotes specifically the architecture of the English colonies of the North American continent during the 17th and 18th centuries; and also, by extension, the continuation and development of that style after the Revolution, down to the coming of the classic revivals, 1800–30 (*see* MODERN ARCHITECTURE, 18TH AND 19TH CENTURIES). The peculiar characteristics of any colonial architecture result from the attempt to reproduce as closely as possible the architecture of the mother country in places where labour may be limited or untrained or influenced by native tradition, materials may be different and climate and environment may be unfamiliar.

COLONNA, a noble Roman family, second only to the Gaetani di Sermoneta in antiquity, and first of all the Roman houses in importance. The popes Marcellinus, Sixtus III., Stephen IV. and Adrian III. are said to have been members of it, but the authentic pedigree of the family begins with Pietro, lord of Columna, Palestrina and Paliano (about 1100), probably a brother of Pope Benedict IX. His great grandson Giovanni had two sons, respectively the founders of the Colonna di Paliano and Colonna di Sciarra lines. The third, or Colonna-Romano line, is descended from Federigo Colonna (1223). In the 12th century we find the Colonna as counts of Tusculum, and the family was then famous as one of the most powerful and turbulent of the great Roman clans; its feuds with the Orsini and the Gaetani are a characteristic feature of mediaeval Rome and the Campagna; like the other great nobles of the Campagna, the Colonna plundered travellers and cities and did not even spare the pope himself if they felt themselves injured by him. Boniface VIII. attempted to break their power, excommunicated them in 1297, and confiscated their estates. He proclaimed a crusade against them and captured Palestrina, but they afterwards revenged themselves by besieging him at Anagni, and Sciarra Colonna laid violent hands on His Holiness, being with difficulty restrained from actually murdering him (1303). In 1347 the Colonna, at that time almost an independent power, were defeated by Cola di Rienzi, but soon recovered. Pope Martin V. (1417–1431) was a Colonna, and conferred immense estates on his family, including Marino, Frascati, Rocca di Papa, Nettuno, Palinao, etc., in the Campagna, and other fiefs in Romagna and Umbria. Their goods were frequently confiscated and frequently given back, and the house was subject to many changes of fortune; during the reign of Pope Alexander VI. they were again humbled; but they always remained powerful and important, and members of the family rose to eminence as generals, prelates and statesmen in the service of the Church or other powers. In the war of 1522 between France and Spain there were Colonna on both sides, and at the battle of Lepanto (1571) Marc Antonio Colonna, who commanded the papal contingent, greatly distinguished himself. A detailed record of the Colonna family would be a history of Rome. To-day there are three lines of Colonna: (1) Colonna di Paliano, with two branches, the princes and dukes of Paliano, and the princes of Stigliano; (2) Colonna di Sciarra, with two branches, Colonna di Sciarra, princes of Carbagnano, and Barberini-Colonna, princes of Palestrina; and (3) Colonna-Romano. The Colonna palace, one of the finest in Rome, was begun by Martin V. and contains a valuable gallery.

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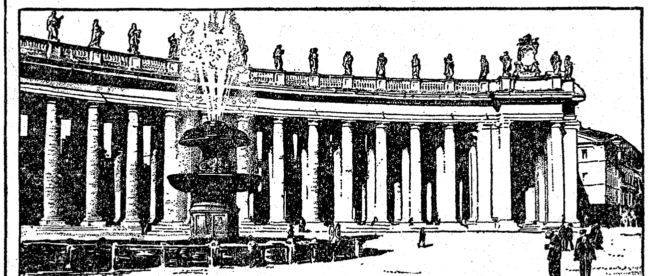
COLONNA, VITTORIA (1490–1547), marchioness of Pescara, Italian poetess, daughter of Fabrizio Colonna, grand constable of the kingdom of Naples and of Anna da Montefeltro, was born at Marino, a fief of the Colonna family. She married at 19 Ferrante de Avalos, marquis of Pescara, who was subsequently a noted captain of Charles V., and who died of wounds at Milan in 1525. During their long separation they corresponded with each other in passionate terms in prose and verse. After her husband's death, Vittoria lived at Ischia where she composed the first of the *Rime spirituali* that are a characteristic feature of her poetic genius. In 1539 she was living in Rome, and was the object of a romantic friendship on the part of the ageing Michelangelo. Among her other friends were Cardinal Reginald Pole, Contarini, Cardinal Bembo and Baldassare Castiglione. Her amatory and elegiac poems were printed at Parma in 1538; a third edition, containing 16 of her *Rime spirituali*, was published at Florence soon afterwards; and a fourth was printed at Venice in 1544.

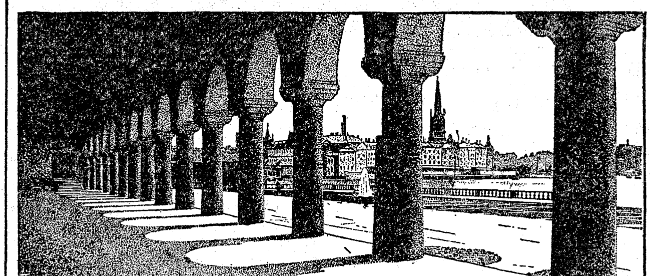
BIBLIOGRAPHY.—A great deal has been written about Vittoria Colonna, but perhaps the best account of her life is A. Luzio, "Vittoria Colonna" in the *Rivista Storica Mantovana*, vol. i. (Mantua, 1885); A. von Reumont, *Vittoria Colonna Vita, fede e poesia*, (Italian revised ed., Turin, 1883), and Amy A. Bernardy, *La vita e l'opere di Vittoria Colonna* (Florence, 1927) are also excellent. For English readers M. Roscoe, *Vittoria Colonna* (1868) and the biography by M. F. Jerrold (London, 1906) may be recommended. The best edition of her *Rime e lettere* is by G. E. Saltini (Florence, 1860). *See* also D. Tordi and G. Sassi, "Michelangelo e Vittoria Colonna," *Nuova Rivista Storica*, X, 478 ff. (1926).

COLONNADE, in architecture, a row of columns. When a colonnade completely surrounds a building or a court-yard, it is known as a peristyle (*q.v.*). When it projects as a separate motif or as an entrance porch, it is called a portico (*q.v.*). Colonnades



BERNINI, ARCHITECT

FORECOURT OF ST. PETER'S, ROME, 17TH CENTURY



RAGNAR ÖSTBERG, ARCHITECT

IN TOWN HALL, STOCKHOLM, SWEDEN, 20TH CENTURY

BY COURTESY OF (A) ARCHITECTURAL FORUM; (B) SWEDISH STATE RAILWAYS

TWO EXAMPLES OF THE COLONNADE SHOWING (ABOVE) THE PURELY DECORATIVE TYPE AND (BELOW) ITS USE AS COVERED PASSAGEWAY

were frequently used in the Hellenistic period to line the streets of towns in Syria and Asia Minor, and this custom spread throughout the Roman empire; the city of Rome was particularly rich in examples of this usage.

COLONNE, EDOUARD (1838–1910), French conductor of Italian origin, was born at Bordeaux on July 23, 1838. He began to earn his living when he was eight years old, but later was able to study at the Paris Conservatoire, and from 1858–67 was first violin at the Opéra. In 1873, with the music publisher Hartman, he established a series of concerts which were devoted more especially to the production of modern French works. Subsequently he continued the concerts alone on the basis of an association of artists supported by the general public, and under the name of the Concerts Colonne they acquired great fame and popularity. Colonne conducted also at the Opéra, and appeared further in London and other European centres. The Concerts Colonne were of great value to French music because of the large number of new works by Lalo, Dubois, Franck, Reyer, and other modern French composers which were given at them for the first time. Much attention was given also in their programmes to Berlioz, whose works were frequently performed, in many cases after long-continued neglect. Colonne died in Paris on March 28, 1910.

COLONSAY: *see* HEBRIDES.

COLONY, a term denoting the settlement of the subjects of a State beyond its territorial limits. It is applied by usage to a group of the subjects of one sovereign State living within the bounds of another, and, in this sense, most of the European countries have "colonies" in London. By a variant of this usage the term is applied also to groups of persons of one original nationality admitted as denizens to another State. Thus in the United States there are many "colonies" or emigrants from European powers. More strictly the term refers to (a) the settlement of the subjects of a State in an area outside its geographical boundaries, but within its administrative sphere; or (b) a territorial unit outside the limits of a State but closely associated with it by ties of nationality, administration, economic interest or sentiment. The first finds examples in the Teutonic colonies settled in the Baltic provinces and in colonies of similar type but different nationalities in the Balkan peninsula. The second and more general definition covers all the variations of colony connected with those States which are commonly described as "colonial powers."

Early Period.—The history of colonization in the European sphere is generally opened with the activities of the Phoenicians on the Mediterranean sea-board. At first from Tyre, and later also from Carthage, the Phoenicians founded a series of settlements among the islands and along the North African coast. Their establishment was due to the necessities of trade expansion, and they remained trading-posts of the type which became general in a later age in the history of European contact with the East.

The next colonizing power in this region was Greece. In this case the character of the colonies and the motives of their establishment were more diverse, and present many points of comparison with modern colonization. Some were, like the Phoenician colonies, outposts for trade; but desire for adventure, political discontent and the pressure of population all contributed to the exodus from the city-states, as they did later to emigration from Britain. The system of government in these colonies was of a kind less familiar in modern times. All the Greek colonies, except those founded by Athens, were independent of the parent State, bound to it only by economic or military advantage or by sentiment; and this independence was, moreover, assumed from the beginning, in contrast to the slow growth of autonomy in the British dominions.

The Roman colony was again of a different type. The expansion of Rome was by land, and its method was by conquest, and its modern parallel is to be found in the Balkans or the Baltic rather than among the colonies of "colonizing powers." The Roman colonies of Imperial Rome were settlements within a province, with certain characteristics and privileges, and were primarily centres for the spread of Roman influences in civilization and culture.

Between the downfall of Rome and the great expansion of Europe in the 15th and 16th centuries, the chief exponents of colonization were the city-states of the Italian sea-board. Both Genoa and Venice planted colonies in the 12th and 13th centuries along the Spanish and Barbary coasts, in Dalmatia and among the Greek islands. Like the Phoenician settlements these were mainly out-posts for trade, though the grant of land to the great Venetian families in Dalmatia and the islands offers a closer approximation to modern colonizing methods.

The Period of World Colonization.—These Italian settlements ended the period of colonization in which the Mediterranean was the centre. Henceforth the history of colonization pivoting about the Atlantic, Indian and (later) Pacific Oceans, came to imply the spread of European influence in the non-European world. Before the end of the first half of the 16th century, the Spanish empire had grown up in Central and South America, at Cuba and Hispaniola among the islands and in New Spain and Peru on the mainland. By that time too Portugal had established her claim to Brazil, and had set her mark on the west coast of India and in the Spice islands. France, England and the Dutch followed close upon them, wresting from Spain and Portugal their early monopoly and founding new colonies in North America and the West Indies and trading settlements on the African coast and in the East. The Danes and the Swedes took part also in this wave of expansion, but the west European powers kept their leadership throughout the 17th and 18th centuries.

The motives of colonization in this period included most of those which had led to earlier activities. The increase of trade was perhaps the most important factor, but desire for adventure and the force of religious or political discontent explained much of the emigration. The proselytizing zeal of Portugal and Spain was also of some importance, while the whole movement gained strength and persistence from international rivalries. Colonies changed hands as the result of European wars; the Dutch succeeded Portugal in the Spice islands, and England struggled with France for trading predominance on the African coast and in India, while the French colonies of Canada and certain West Indian islands passed to English control. Trade was the most important consideration for all these colonizing powers, and all followed the lead of Spain and Portugal in seeking a monopoly of their colonial products. They met with varying success. Both the competition and the colonies grew rapidly in the 17th century, and two factors came to determine the measure of the success of the parent State: sea-power was needed to ward off interloping rivals, and cargoes of manufactured goods to supply the colonists' demands. Spain lacked both in the 17th century; Holland could not compete with France or England, and these two were left as the chief protagonists in the colonial struggle.

The government of the colonies had another feature in common besides the principle of trade monopoly, for the tendency in all States was to reproduce in their outlying parts their own constitutional system. This was less marked in the case of Spain than in that of France or England; but while the Spanish king ruled the Indies, as he did Spain, as part of a medley of dominions which had little uniformity of government, yet in many details he followed Spanish procedure. France introduced into Canada the system of legislation by royal edict registered in local *parlements* and the reliance on *intendants* for maintaining local government; while the English colonies possessed legislative assemblies which reproduced the spirit and the forms of Stuart parliaments.

The 19th and 20th Centuries.—This period of colonization ends with the close of the 18th century. The economic changes which formed the Industrial Revolution (*q.v.*) destroyed the economic basis of the colonial system, and the revolutionary era in Europe was accompanied by a movement for colonial freedom. The United States started the change, and were followed by the revolt of Central and South America and the ruin of the empires of Spain and Portugal.

Alone among the colonizing powers Britain carried forward some of her colonial traditions to the new age. The early years of the 19th century saw the expansion of Canada and the growth of new colonies in Australia, South Africa and New Zealand. The great emigration of the middle years of the century, and the increasing demand of industrial England for food-stuffs and raw materials transformed these colonies into great dominions who could support a quasi-national status. At the same time trading interests led to the expansion of control in tropical and semi-tropical regions and the establishment of new "crown colonies" under the administration of the Colonial Office. International rivalry re-appeared in the last quarter of the 19th century. French colonization on the south side of the Mediterranean and inland penetration from the west coast led to the growth of French control over a large part of North Africa, while Spain and Italy later extended their interests in the same region. At the end of the century Germany started her colonial period. The partition of Africa followed, with its welter of delimiting treaties and its multiplication of the types of colony, protected areas, and spheres of influence. The struggle for Pacific islands and trading posts in China accompanied this process, and the United States appeared as a colonizing power. The World War brought some readjustment in the distribution of colonies, and added the new class of "mandated territories" to the existing types.

The developments of the last 50 years seem to be leading to a new limitation of the word "colony," at least in Britain. The great dominions have acquired most of the characteristics of independent States and have to a great extent abandoned the use of the term "colony" as applicable to themselves. It is being restricted, therefore, in general use to those regions to which rights of self-government have not yet been granted. (*See* also BRITISH EMPIRE; AFRICA; MANDATE.) (L. M. P.)

COLOPHON, an ancient city of Ionia, situated inland about 15 m. N. of Ephesus. Its port was at Notium or New Colophon. The site, now called *Tracha,* lies near Diermendere, 5 m. S. of Develikeui. Excavations, commenced during 1922, were interrupted by the Turkish reconquest of Asia Minor. Colophon was a very flourishing city in the great period of Ionia. It was the mother-city of Smyrna; it was ruled by a timocracy (oligarchy of wealth) which provided a famous troop of cavalry. It was famous for its luxury, imitated from the Lydians. It claimed to have produced Homer, but its greatest genuine literary names were Xenophanes and Mimnermus. The first shock to its prosperity was the sack by Gyges of Lydia in 665 B.C. It declined in favour of Notium until in 287 Lysimachus transferred a part of the population to his new city at Ephesus.

Notium contained the important shrine of the Clarian Apollo.

COLOPHON, a final paragraph in some manuscripts and many early printed books (*see* BOOKS), giving particulars as to authorship, date and place of production, and sometimes expressing the thankfulness of the author, scribe or printer on the completion of his task. Thus the Guillermus, who made a famous collection of sermons on the gospels for Sundays and saints' days, records its completion in 1437 and submits it to the correction of charitable readers, and Sir Thomas Malory notes that his *Morte d'Arthur* "was ended in the ix yere of the reygne of Kyng Edward the fourth," and bids his readers "praye for me whyle I am on lyue that God sende me good delyuerance, and whan I am deed I praye you all praye for my soule." The earliest printed paragraph of this kind is that which Fust and Schoeffer printed at the end of their famous psalter of 1457 in red ink: *Presens spalmorum* (*sic* for *psalmorum*) *codex venustate capitalium decoratus Rubricationibusque sufficienter distinctus, Adinuentione artificiosa imprimendi ac caracterizandi absque calami vlla exaracione sic effigiatus, Et ad eusebiam dei industrie est consummatus, Per Iohannem fust ciuem maguntinum, Et Petrum Schoffer de Gernszheim Anno domini Millesimo. cccc. lvii. in vigilia Assumpcionis.* In the Vienna copy of this and in their Latin Bible of 1462 they added a device of two shields at the end of the paragraph, and this addition was widely copied. When a leaf or page was added to the title of a book at its beginning the importance of these final paragraphs slowly diminished, and the information they gave was gradually transferred to the title-page. Complete title-pages bearing the date and name of the publishers are found in most books printed after 1520, and the final paragraph, if retained at all, was gradually reduced to information as to the printer and date. From the use of the word in the sense of a "finishing stroke" (from the story that the final charge of the cavalry of Colophon was always decisive) such a final paragraph as has been described is called by bibliographers a "colophon," but this name for it is quite possibly not earlier than the 18th century. (A. W. P.)

COLORADO, known as the "Centennial State" because of its entrance into the Union in 1876, 100 years after the Declaration of Independence, is a State of the United States of America, situated between 37° and 41° N. lat. and 102° and 109° W. longitude. The State is bounded on the north by Wyoming and Nebraska, on the east by Nebraska and Kansas, on the south by Oklahoma and New Mexico and on the west by Utah. It is the seventh largest State in the Union, having an area of 104,247 sq.mi., of which 280 are water surface and 103,967 land.

Physiography.—Colorado embraces in its area a great variety of plains, mountains and plateaux. It lies at the junction of the Great Plains—which in their upward slant to the westward attain an average elevation of about 4,000 ft. along the eastern boundary —with the Rocky mountains, to the west of which is a portion of the Colorado plateau. These are the three physiographic provinces of the State. The Colorado plateau includes a number of lofty plateaux—the Roan or Book, Uncompahgre, etc., which form the eastern continuation of the high plateaux of Utah and cover the western quarter of the State. Its eastern third consists of rich, unbroken plains.

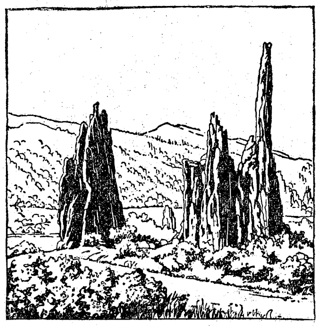
On the western edge of these plains lies an abrupt, massive and strangely uniform chain of mountains, known in the neighbourhood of Colorado Springs as the Rampart range, and in the extreme north as the Front range, and often denominated as a whole by the latter name. The upturning of the rocks of the Great Plains at the foot of the Front range develops an interesting topography, the harder layers weathering into grotesquely curious forms, as seen in the famous Garden of the Gods at the foot of Pikes peak. Behind this barrier the whole country is elevated about 2,000 ft. above the level of the plains region. In its lowest portions just behind the front ranges are the natural "parks"—great plateaux enclosed by superb ranges. To the west of these and between them, and covering the remainder of the State east of the plateau region, is an entanglement of mountains, tier above tier, running from north to south, buttressed laterally with splendid spurs, cut by river valleys and divided by mesas and plateaux. These various chains are known by a multitude of local names. Among the finest of the chains are the Rampart, Sangre de Cristo, San Juan, Sawatch (Saguache) and Elk ranges. The first, like the other ranges abutting from north to south upon the region of the prairie, rises abruptly from the plain and has a fine, bold outline. It contains a number of fine summits dominated by Pikes peak (14,110 ft.). Much more beautiful as a whole is the Sangre de Cristo range. At its southern end are Blanca peak (14,363 ft.) and Old Baldy (14,125 ft.), both in Costilla county. The mountains of the San Juan ranges of the south-west are particularly abrupt and jagged. Most magnificent of all the mountains of Colorado, however, are the Sawatch and adjoining ranges in the centre of the State. The former (the name is used a little loosely) consists of almost a solid mass of granite, has an average elevation of probably 13,000 ft., presents a broad and massive outline and has a mean breadth of 15 to 20 miles. Mt. Ouray (13,955 ft.), in Chaffee county, may be taken as the southern end, and the splendid Mount of the Holy Cross (13,978 ft.), in Eagle county—so named from the figure of its snow-filled ravines—as the northern. Between the two lie numerous high peaks including Mt. Elbert (14,431 ft.), the highest peak in the State. The Elk range is geologically interesting for the almost unexampled displacement of the strata of which it is composed and the apparent confusion which has thence arisen. The most remarkable of its separate summits, which rise superbly in a crescent about Aspen, is North Italian peak (13,225 ft.), displaying the red, white and green of Italy's national colours. A few miles to the north and north-east of the Mount of the Holy Cross are Torrey peak (14,264 ft.) and Grays peak (14,274 ft.), in Summit county; Mt. Evans (14,259 ft.), in Clear Creek county; and Rosalie peak (13,574 ft.), in Park county; a little farther north, in Gilpin, Grand and Clear Creek counties, James peak (13,259 ft.), and, in Boulder county, Longs peak (14,255 feet). Altogether there are at least 600 summits exceeding 12,000

BY COURTESY OF THE CHAMBER OF COMMERCE, COLORADO SPRINGS

THE SWITCHBACKS, PIKES PEAK, SHOWING THE MODERN MOTOR HIGHWAY TO THE SUMMIT OF THE MOUNTAIN, 14,110 FT. ABOVE SEA LEVEL ft. in altitude, 300 above 13,000 and 50 above 14,000.

Cirques, valley troughs, numberless beautiful cascades, sharpened alpine peaks and ridges, glacial lakes and valley moraines offer everywhere abundant evidence of glacial action, which has modified profoundly practically all the ranges. The Park range, east of Leadville, and the Sawatch range are particularly fine examples. Much of the grandest scenery is due to glaciation.

Among the most remarkable orographical features of the State are the great mountain "parks"—North, Estes, Middle, South and San Luis—extending from the northern to the southern border of the State, and lying (with the exception of Middle park) just east of the continental divide. These "parks" are great plateaux, not all of them level, lying below the barriers of surrounding mountain chains. North park, the highest of all, is a lovely country of meadow and forest. Middle park is not level, but is traversed thickly by low ranges like the Alleghenies; in the bordering mountain rim are several of the grandest mountain peaks and some of the most magnificent scenery of the State. Estes park is small, only 20 m. long and never more than 2 m. broad; it is in fact the valley of Thompson creek. By many it is accounted among the loveliest of Colorado valleys. Seven ranges lie between it and the plains. South park is similarly quiet and charming in character. Much greater than these is San Luis park. The surface is nearly as flat as a lake, and it was probably at one time the bed of an inland sea. In the centre there is a long narrow lake fed by many streams. It has no visible outlet, but is fresh. The San Luis park, which runs into New Mexico, is traversed by the Rio Grande del Norte and more than a dozen of its mountain tributaries. These parks are frequented by great quantities of large game, and—especially the North and Middle—are famous hunting-grounds. They are fertile, too, and their combined area is something like 13,000 sq. miles.

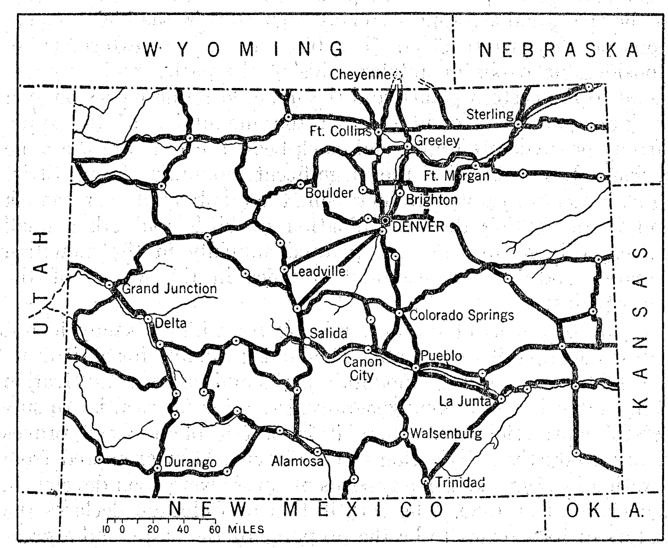


BY COURTESY OF THE CHAMBER OF COMMERCE, COLORADO SPRINGS

CATHEDRAL SPIRES OF ROCK IN THE GARDEN OF THE GODS, PART OF THE MUNICIPAL PARK SYSTEM IN COLORADO SPRINGS

The drainage system of the State is complicated. Eleven topographical and climatic divisions are recognized by the United States Weather Bureau within its borders, including the several parks, the continental divide and various river valleys. Of the rivers, the North Platte has its sources in North park; the Colorado (the Grand branch), in Middle park; the South Platte, in South park; the Arkansas, in Lake county; and the Rio Grande in San Luis park. Four of these flow east and south-east to the Missouri, the Mississippi and the gulf; but the waters of the Colorado system flow to the south-west into the Gulf of California. Among the other streams, almost countless in number among the mountains, the San Juan, Dolores, White and Yampa, all in the west, are of primary importance. The scenery on the head-waters of the White and Bear, the upper tributaries of the Gunnison and on many of the minor rivers of the south-west, is wonderfully beautiful. The South Platte falls 4,830 ft. in the 139 m. above Denver; the Grand, 3,600 ft. in the 224 m. between the mouth of the Gunnison and the Forks; the Gunnison, 6,477 ft. in the 200 m. to its mouth (except for 16 m., never with a gradient of less than 10 ft.); the Arkansas, 7,000 ft. in its 338 m. west of the Kansas line. Of the smaller streams the Uncompahgre falls 2,700 ft. in 134 m., the Las Animas 7,100 ft. in 113 m., the Los Pinos 4,920 ft. in 75 m., the Roaring Fork 5,923 ft. in 64 m., the Mancos 5,000 ft. in 62 m., the La Plata 3,103 ft. in 43 m., the Eagle 4,293 ft. in 62 m., the San Juan 3,785 ft. in 303 m., the Lake Fork of the Gunnison 6,047 ft. in 59 miles. The canyons formed in the mountains by these streams are among the glories of Colorado and of America. The grandest are the Toltec gorge near the southern boundary line, traversed by the railway 1,500 ft. above the bottom; the Red gorge and Rouge canyon of the Upper Grand, and a splendid gorge 16 m. long below the mouth of the Eagle, with walls 2,000–2,500 ft. in height; the Grand canyon of the Arkansas (8 mi.) above Canon City, with granite walls towering 2,600 ft. above the boiling river at the Royal gorge; and the superb Black canyon (15 m.) of the Gunnison and the Cimarron. But there are scores of others which, though less grand, are hardly less beautiful. The exquisite colour contrasts of the Cheyenne canyons near Colorado Springs, Boulder canyon near the city of the same name, Red Cliff and Eagle River canyons near Red Cliff, Clear Creek canyon near Denver—with walls at places 1,000 ft. in height—the Granite canyon (11 m.) of the South Platte west of Florissant, and the fine gorge of the Rio de las Animas (1,500 ft.), would be considered wonderful in any State less rich in still more marvellous scenery. Among the peculiar features of the mountain landscapes are the mines. In districts like that of Cripple Creek their enormous ore "dumps" dot the mountain flanks like scores of vast ant-hills; and in Eagle River canyon their mouths, like dormer windows into the granite mountain roof, may be seen 2,000 ft. above the railway. More than a dozen mountain passes lie above 10,000 feet. Argentine pass (13,132 ft.), near Grays peak, is one of the highest wagon roads of the world; just east of Silverton is Rio Grande pass, about 12,400 ft. above sea level, and in the Elk mountains between Gunnison and Pitkin counties is Pearl pass (12,715 feet). Many passes are traversed by the railways, especially the splendid scenic route of the Denver and Rio Grande Western, with a water-level route through the Royal gorge of the Arkansas river. Among the higher passes are Hoosier pass (10,780 ft.) in the Park range; Hayden Divide (10,780) and La Veta pass (9,378), both of these across the Sangre de Cristo range; the crossing of the San Miguel chain at Lizard Head pass (10,250) near Rico; of the Uncompahgre at Dallas Divide (8,977) near Ouray; of the Elk and Sawatch ranges at Fremont (11,320), Tennessee (10,424) and Breckenridge (11,503) passes, and the Busk tunnel, all near Leadville; and Monarch pass (11,302) above Salida.

The climate of Colorado is exceptional for regularity and salubrity. The mean annual temperature for the State is about 45° F. Owing to the complex orography of the State, few climatic generalizations can be made. It may be said, however, that the south-east is the warmest portion, lying as it does outside the mountains; that the north-central region is usually coldest; that the normal yearly rainfall for the entire State is about 16·38 in., with great local variations (rarely above 27 in.). Winds are constant and rather high (5 to 10 m.), and for many persons are the most trying feature of the climate. Very intense cold prevails in winter in the mountains, and intense heat (110° F or more in the shade) is often experienced in summer, temperatures above 90° being very common. Nevertheless, the climate of Colorado is not to be judged severe, and that of the plains region is in



MAP OF THE MAIN ROADS OF COLORADO

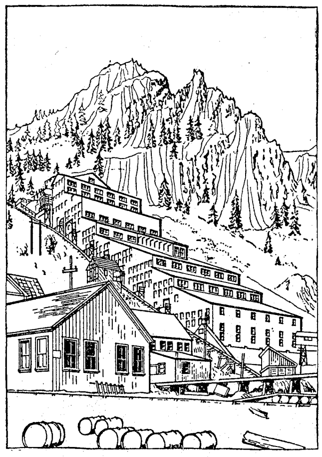
many ways ideal. In the lowlands the snow is always slight and it disappears almost immediately, even in the very foothills of the mountains, as at Denver or Colorado Springs. However hot the summer day, its night is always cool and dewless. Between July and October there is little rain, day after day bringing a bright and cloudless sky. Humidity is moderate (annual averages for Grand Junction, Pueblo, Denver and Cheyenne, Wyo., for 6 A.M., about 50 to 66; for 6 P.M., 33 to 50). Sunshine is almost continuous; for the whole state the average of perfectly "clear" days is normally above 50%. Colorado, because of its lowness of humidity and clarity of atmosphere, has many famous arid health resorts.

The wide variation in climatic conditions is explained by the fact that the altitude of the state varies from 3,385 ft. in the bed of the Arkansas river at the Kansas line to 14,431 ft. at the summit of Mt. Elbert.

Flora and Fauna.—The life zones of Colorado are simple in arrangement. The boreal embraces the highest mountain altitudes; the transition belts it on both sides of the continental divide; the upper Sonoran takes in about the eastern half of the plains region east of the mountains, and is represented further by two small valley penetrations from Utah. Timber is confined almost wholly to the high mountain sides, the mountain valleys and the parks being for the most part bare. Nowhere is the timber large or dense. The timber-line on the mountains is at about 10,000 ft., and the snow line at about 11,000 feet. It is supposed that the forests were much richer before the settlement of the state, which was followed by reckless consumption and waste and the more terrible ravages of fire. In 1872–76 the wooded area was estimated at 32% of the state's area. It is certainly much less now. The principal trees, after the yellow and lodgepole pines, are the red fir, so-called hemlock and cedar, the Engelmann spruce, the cottonwood and the aspen (*Populus tremuloides*). In 1899 Federal forest reserves had been created aggregating 4,849 sq.mi. in extent, and by 1940 this had been increased to 21,300 sq. miles. These national forests cover altitudes of 7,000 to 14,000 feet.

Large game is still found in limited numbers west of the continental divide. The great parks are a favourite range and shelter. Deer and elk frequent the mountains of the entire western part of the state, and are almost equally numerous in the higher elevations on the eastern slope. The bison have been exterminated. Considerable bands of antelope live in the parks, and even descend to the eastern plains, and the mule deer, the most common of large game, is found through the mountains of the state. Grizzly or silver-tip, brown and black bears are found in the same regions. Rarest of all is the magnificent mountain sheep. Strict game laws have resulted in increasing the numbers of deer and elk and in preventing the extermination of birds and other small game. Millions of trout are planted annually in the mountain streams, and bass, catfish and crappies in the waters of the lower plains.

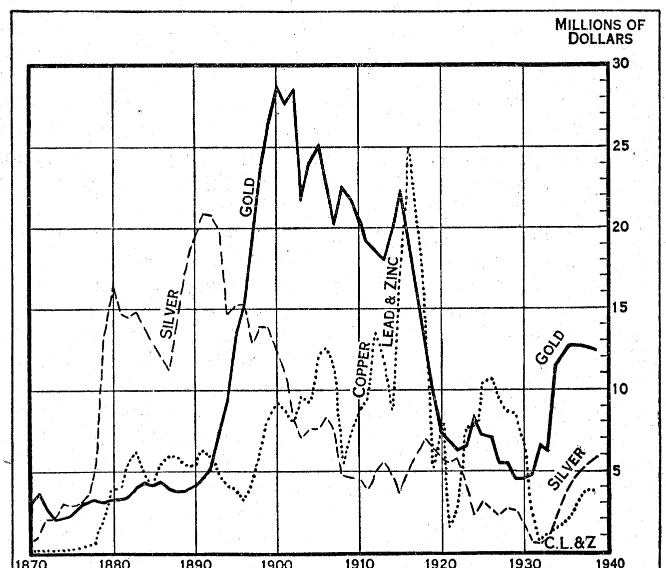
Soil.—The soils of the lowlands are prevailingly sandy loams, with a covering of rich mould. The lands available for agriculture are the lowlands and the mountain parks and valleys. Cultivation is not intensive. Speaking generally, irrigation is essential to successful cultivation, and where it is practicable the soil proves richly productive. Irrigation ditches having been exempted from taxation in 1872, extensive systems of canals were soon developed, especially after 1880. The constitution of Colorado declares the waters of its streams to be the property of the state, and a great body of irrigation law and practice has grown up about this provision. The riparian doctrine does not obtain in Colorado. In no other part of the semi-arid region of the country are the irrigation problems so diverse and difficult. In 1940 investments in irrigation works for 3,400,000 ac. totalled $100,000,000. There are irrigated lands in most of the counties. Except for the fact that quantities of water diverted for irrigation return to the streams through underground channels, both the Arkansas and the South Platte would be dry at the state line. To end litigation and secure the best possible use of available waters, Colorado has compacts with some of the neighbouring states for a division of river waters, similar to the compact between the United States and Mexico covering the Rio Grande river. Most important among recent irrigation developments is the construction of a 13-mi. tunnel under the continental divide, which will bring annually to the valley of the South Platte, most intensively farmed area in the state, 320,000 ac.ft. from the headwaters of the Colorado river at Grand lake. This tunnel, with accompanying compensatory storage and power plants, totals $50,000,000 in cost. Its effect will be to bring security to a rich, irrigated area without injuring the region from which the water is taken, and to provide firm and cheap electric power. Colorado has two large federal reclamation projects—the Grand valley and the Uncompahgre, both on the western slope. The parks and mountain valleys are largely given over to ranges. The native grasses are especially adapted for fodder. The grama, buffalo, and bunch varieties cure on the stem and furnish throughout the winter an excellent range food. These native grasses, even the thin bunch varieties of dry hills, are surprisingly nutritious, comparing very favourably with cultivated grasses. Large areas temporarily devoted to cultivation with poor success, and later allowed to revert to ranges, have become prosperous and even noted as stock country. This is true of the sand-hill region of eastern Colorado. The grass flora of the lowlands is not so rich in variety nor so abundant in quality as that of high altitudes.



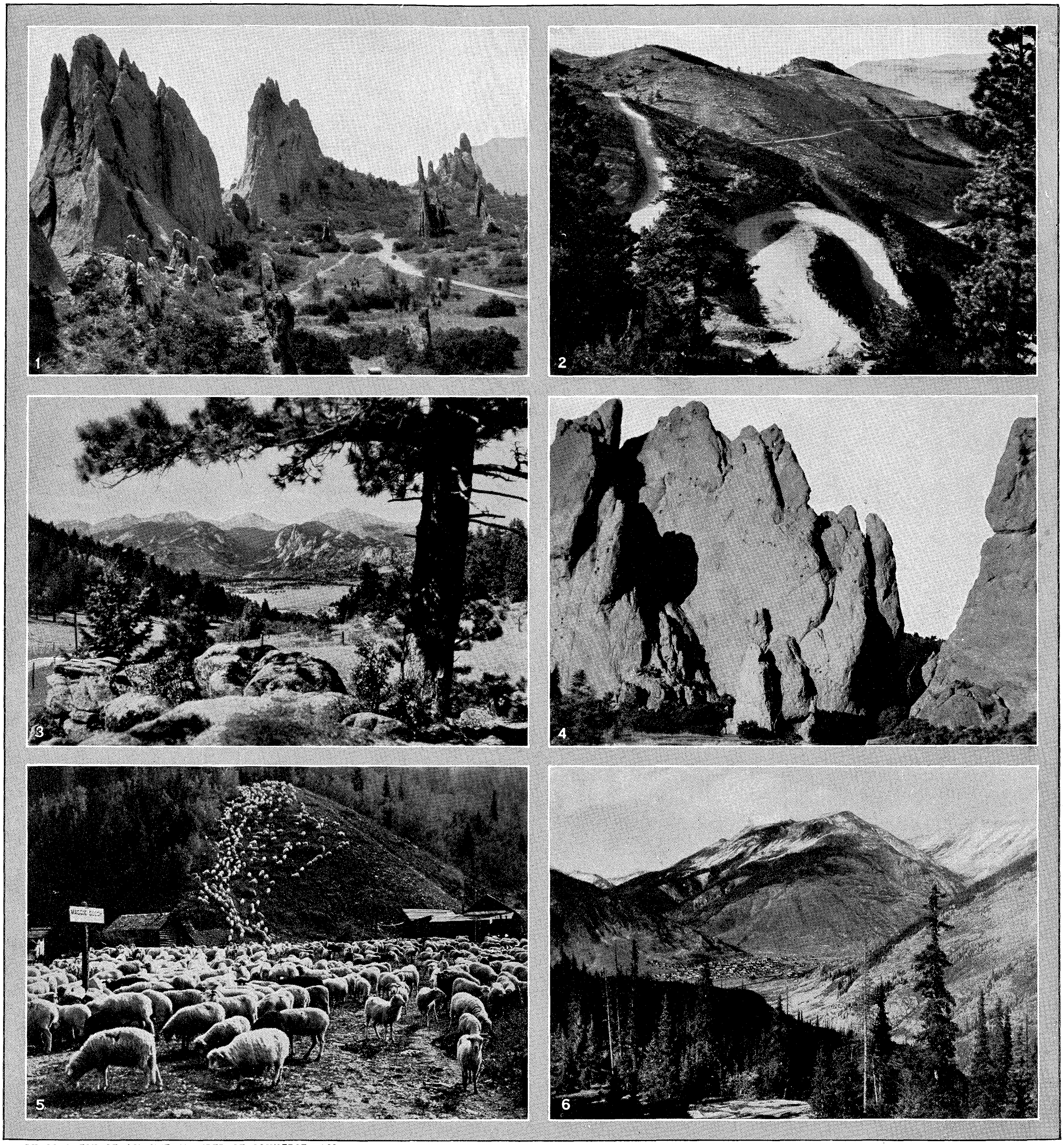
BY COURTESY OF E. GALLOWAY

SUNNYSIDE GOLD MINING PLANT NEAR SILVERTON, COLORADO

Minerals.—Colorado was primarily a mineral region, and to this fact it owes its colonization. It possesses unlimited supplies, as yet not greatly exploited, of fine building stones, some oil and asphalt and related bituminous products, a few precious and semi-precious stones (especially tourmalines, beryls and aquamarines found near Canon City and the Royal gorge of the Arkansas river), rare opalized and jasperized wood (in the eastern part of El Paso county), considerable wealth of lead and copper, enormous fields of bituminous coal and great wealth of the precious metals. In the exploitation of the last there have been three periods: That before the discovery of the lead-carbonate silver ores of Leadville in 1879, in which period gold-mining was predominant; the succeeding years until 1894, in which silver-



GRAPH OF THE VALUE OF GOLD, SILVER AND COPPER, LEAD AND ZINC PRODUCED IN COLORADO FROM 1870 TO 1939



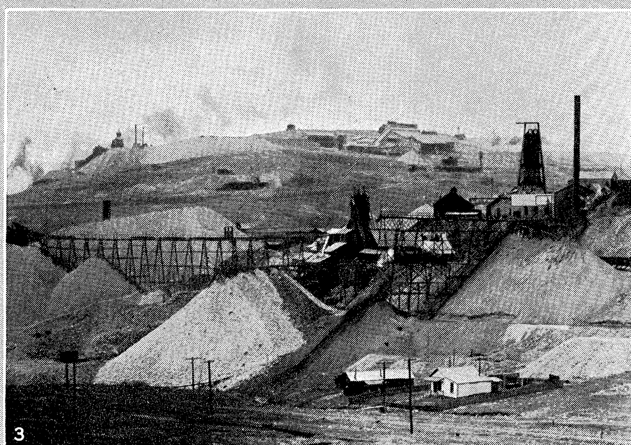
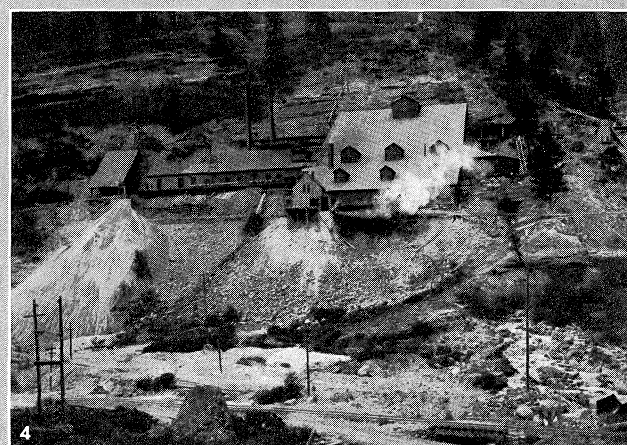
BY COURTESY OF (4) THE CHAMBER OF COMMERCE, COLORADO SPRINGS; PHOTOGRAPHS, (1, 2, 5) EWING GALLOWAY, (3) PUBLISHERS PHOTO SERVICE, (6) UNDERWOOD AND UNDERWOOD

SCENES IN THE COLORADO ROCKY MOUNTAINS

1. Sandstone spires, in the Garden of the Gods, near Colorado Springs, 70 m. south of Denver. This tract, owned by the city of Colorado Springs, includes some 500 acres of ridges and grotesque shapes of brightly coloured sandstone
2. Lariat Trail, so called from its lariat-like twists and turns. The trail ascends to the crest of Lookout Mountain, near Denver
3. Looking into the valley of Estes Park, at the eastern entrance to the Rocky Mountain Park, about 70 m. northwest of Denver
4. The Gateway Rocks, which form the entrance to the Garden of the Gods. Near top, at left, the "Kissing Camels"
5. Herd of sheep returning to corral. The Maggie Gulch sheep ranch, in the Rocky Mountains, near Silverton
6. Silverton, about 200 m. southwest of Denver. It has been noted for its lead and silver production. Entirely surrounded by mountains, it is popular for winter and summer sports

COLORADO



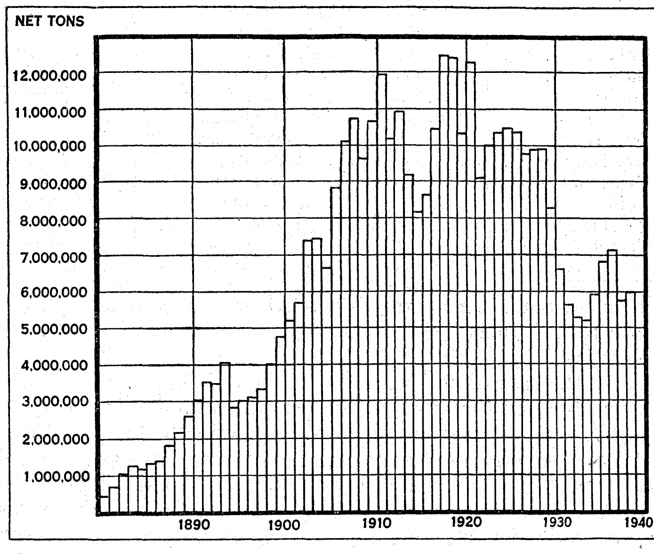



PHOTOGRAPHS, (1) O. ROACH, DENVER, (2) INTERNATIONAL NEWSREEL, (3, 4, 5, 6) EWING GALLOWAY

CITIES AND MINING CENTRES OF COLORADO

1. From the state capitol, Denver, Colorado, looking across the civic centre toward the Rocky mountains
2. Air view of Denver, capital of the state
3. Gold mines at Cripple Creek, at the geographical centre of Colorado. Gold was first discovered there in 1891
4. Gold mine and stamp-mill, near Telluride, about 200 mi. S.W. of Denver
5. A street in Black Hawk, 55 mi. west of Denver. Founded during the great immigration of 1859, it is one of the oldest mining towns of Colorado
6. View of Telluride. Since the comparative exhaustion of Alaskan sources of gold supply, the mines of Colorado have become especially valuable

mining was predominant; and the period since 1894, in which gold has attained the primacy. The two metals are found in more than 50 counties, San Miguel, Boulder, Eagle, Clear Creek, Park, San Juan and Teller being the leading producers. The Cripple Creek field in the last-named county was one of the most wonderful mining districts of America. Leadville, in Lake county, was another. The district about Silverton (product 1870–1939 about $108,250,000, principally silver and lead, and mostly after 1881) also had a remarkable development; and Creede, in the years of its brief prosperity, was a phenomenal silver-field.



GRAPH OF COAL MINED IN COLORADO FROM 1880 TO 1939. THE RECORDED PRODUCTION BEGINS IN 1864 WITH 500 TONS FROM THE MAIN COAL AREAS

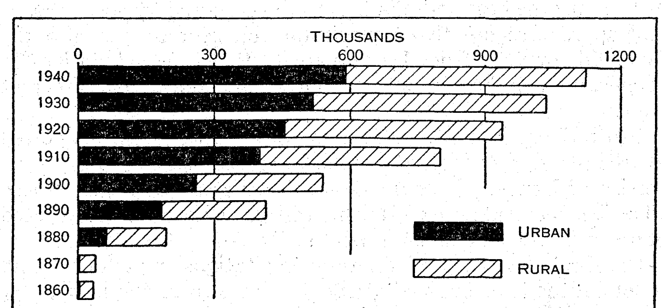
The stratified rocks of the Great Plains, the parks and the plateaus contain enormous quantities of coal. The coal-bearing rocks are confined to the Upper Cretaceous, and almost wholly to the Laramie formation. The main areas are on the two flanks of the Rockies, with two smaller fields in the parks. The east group includes the fields of Canon City (whose product is the ideal domestic coal of the western states), Raton and the South Platte; the park group includes the Cones field and the Middle park; the west group includes the Yampa, La Plata and Grand river fields. The total includes every variety from typical lignite to typical anthracite. The aggregate area of beds is estimated by the United States Geological Survey at 19,750 sq.mi. (seventh in rank of the states of the union). The industry began in 1864. Production reached its peak in 1918, when 12,658,000 tons were produced, but natural gas and other factors brought about a gradual reduction to about 6,000,000 tons in 1939.

Mineral springs are numerous and occur in various parts of the state. The most important are at Buena Vista, Ouray, Wagon Wheel Gap, Poncha or Poncha Springs (80°–168° F.), Canon City, Manitou, Idaho Springs and Glenwood Springs (106°–125° F., highly mineralized). The last three places, all beautifully situated—the first at the base of Pikes peak, the second in the Clear creek canyon, and the third at the junction of the Roaring Fork with the Grand river—have an especially high repute.

Government.—The first and only state constitution of Colorado was adopted in the year 1876. It requires a separate popular vote on any amendment—though as many as six may be (since 1900) voted on at one election. Amendments have been rather freely adopted. The general assemblies are biennial, sessions not limited, average about 110 days; state and county elections are held at the same time (since 1902). A declared intention to become a United States citizen ceased in 1902 to be sufficient qualification for voters, full citizenship (with residence qualifications) being made requisite. An act of 1909 provides that election campaign expenses shall be borne "only by the state and by the candidates" and authorizes appropriations for this purpose. Full woman suffrage was adopted in 1893 (by a majority of about 6,000 votes). Women have served in the legislature and in many minor offices. The governor may veto any separate item in an appropriation bill. The state treasurer and auditor may not hold office for two consecutive terms. Popular initiative and referendum were introduced in 1910, recall of officials in 1912. County government is of the commissioner type.

By constitutional amendment in 1902 the city and county of Denver were established, with authority in the electorate to establish by charter such form of government as they desired. Following many experiments, the present government provides for a mayor with broad powers, four appointed departmental managers and a council with legislative authority, only the auditor and the school authorities being elected independently.

Population.—The population of Colorado in 1860 was 34,277; in 1880, 194,327; in 1910, 799,024; and in 1940, 1,123,296. This last figure represents an increase of 8·4% over the population in 1930. The population per square mile was 10·8, as compared with 44·2 for the United States as a whole. Of the 1940 population, 590,756, or 52·6%, lived in urban places; that is, in cities of 2,500 or more. The number of occupied dwelling units returned in the housing census of 1940 was 316,112, which is approximately the same as the number of families. The average population per family (occupied dwelling unit) declined from 3·9 in 1930 to 3·6 in 1940. The white population of Colorado (including Mexicans) formed 98·5% of the total in 1940. The population of the state and of its principal cities is summarized for recent censuses in the following table:



BY COURTESY OF THE U.S. BUREAU OF THE CENSUS

URBAN AND RURAL POPULATION OF COLORADO, 1860–1940

Area	Population			Percent of increase	
	1940	1930	1920	1930–40	1920–30
The State	1,123,296	1,035,791	939,629	8·4	10·2
Urban	590,756	519,882	453,259	13·6	14·7
Rural	532,540	515,909	486,370	3·2	6·1
Percent urban	52·6	50·2	48·2	. .	. .
Principal cities:					
Denver	322,412	287,861	256,491	12·0	12·2
Pueblo	52,162	50,096	43,050	4·1	16·4
Colorado Springs	36,789	33,237	30,105	10·7	10·4

Finance and Education.—The general assessment valuation of taxable property in 1939 was $1,114,278,000, on which there was a state levy of 4·4 mills, including 1·18 mills levied in 1937 for a 10-year period for new buildings at state institutions. Principal sources of revenue in addition to property taxes include taxes on sales, services, incomes, liquors, inheritances, corporations and motor fuel, and federal aid. State disbursements for public welfare, including old-age pensions and direct relief, were $20,000,000 in 1940. Colorado has the highest old-age pension program in the United States. Disbursements for highway construction in 1939, including federal aid, were $12,200,000. Total bonded indebtedness of the state and its subdivisions at the beginning of 1940 was as follows: state, $3,257,700; Moffat tunnel district, $15,470,000; counties, $1,758,000; cities and towns—general, $49,124,000; special, $9,572,000; school districts, $21,528,000.

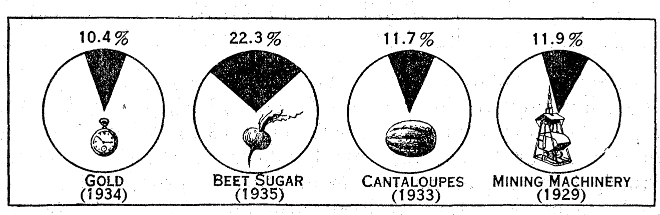
The public-school system of Colorado dates from 1861, when a school law was passed by the territorial legislature; this law was superseded by that of 1876, which with subsequent amendments is still in force. In expenditure for the public schools per head of total population, Colorado is sixth in rank of the 48 States. The school population in 1938 was 312,845, of whom 233,141 attended school. The total number of teachers was 9,590, and of school buildings 2,905. The average number of days attended per year per pupil enrolled was, in 1938, 138·3, an increase from 93·4 in 1900. The total expenditure for public schools in 1938 was $23,017,216, $98.72 per head. The income of the permanent school fund, derived from federal land grants, is annually apportioned among the districts. The remainder of the school funds, and by far the greater amount, is raised by local taxation. Only 2·8% of the population ten years of age and over were listed as illiterate in the census of 1930. The percentage of illiterates among the native whites was 0·8; among the foreign-born white, 8·6; and among the Negroes 3·9. The state institutions are: The University of Colorado, at Boulder (opened 1877); the School of Mines, at Golden (1874); State College of Agriculture and Mechanic Arts, at Fort Collins (1879); State College of Education, at Greeley (1889); Western State college, at Gunnison (1909); Adams State Teachers college, at Alamosa (1925); and a school at Colorado Springs for the deaf and blind. All are supported by special taxes and appropriations—the Agricultural college receiving also the usual aid from the federal government. Experimental stations in connection with the Agricultural college are maintained at different points.

Institutions of higher education, other than those supported by the state, are: Colorado college at Colorado Springs; University of Denver, Colorado Woman's college, and Regis college, all at Denver; and Loretto Heights college at Loretto. The United States maintains an Indian school at Towaoc.

Of charitable and reformatory institutions, a soldiers' and sailors' home is maintained at Monte Vista, an insane hospital at Pueblo, a home for dependent and neglected children at Denver, homes for mental defectives at Ridge and Grand Junction, an industrial school for girls near Morrison, and for boys at Golden, a reformatory at Buena Vista and a penitentiary at Canon City. Denver was one of the earlier cities in the country to institute special courts for juvenile offenders, a reform that is widening in influence and promise.

The parole system is in force in the state reformatory, and in the industrial school at Golden (for youthful offenders) no locks, bars or cells are used, the theory being to treat the inmates as "students." The state has a parole law and an indeterminate-sentence law for convicts.

Industry, Trade and Transport.—In the decade 1910–20 agriculture displaced mining as Colorado's most important industry. The number of farms in 1935 amounted to 63,644; their total area amounted to 29,978,472 acres, and their average size increased by 1935 to 471·2 acres. The value of all farm lands and buildings amounted to $418,757,555. Reports for 1935 indi-



GRAPH SHOWING PERCENTAGE PRODUCED IN COLORADO OF THE TOTAL OUTPUT OF CERTAIN COMMODITIES IN THE UNITED STATES

cated increased numbers of farms but decreased acreage in farms, capital valuations and values of products, as compared with the 1930 figures. The farm population decreased between the years 1930 and 1935 from 282,827 to 276,198. Less than one-half of the farms are operated by managers or tenants. Irrigation is extensively used throughout the main agricultural areas. The acres actually irrigated increased from 2,792,032 in 1910 to 3,393,619 in 1930. Organized drainage enterprises, most of them having been rendered necessary by faulty irrigation, had affected, in 1930 366,719 ac., at a cost of $4,358,866. According to the 1935 census of agriculture, 4,961,000 ac. of the farms were in crops; the remaining acreage was in pasture or idle under provisions of the Agricultural Adjustment administration. The severe drought in 1934 caused production of crops to fall to the lowest point in 25 years; only 3,947,390 acres were harvested. The principal 1935 farm crops were:

Crops	Acreage	Production	Farm Value
			$
All Crops	4,961,000	. .	62,693,000
Corn	1,266,000	10,761,000 bu.	7,102,000
Wheat	553,000	6,532,000 bu.	5,885,000
Oats	160,000	4,480,000 bu.	1,532,000
Barley	321,000	6,420,000 bu.	2,825,000
Potatoes	100,000	18,000,000 bu.	9,540,000
Tame Hay	1,069,000	1,712,000 tons	11,128,000
Wild Hay	354,000	354,000 tons	2,124,000
Dry Beans	435,000	117,400,000 lbs.	3,003,000
Cantaloupes	6,240	1,030,000 crates	772,000
Apples	. .	1,590,000 bu.	1,097,000
Peaches	. .	1,276,000 bu.	1,021,000
Cherries	. .	4,662 tons	233,000
Sugar Beets	140,000	1,826,000 short tons	10,609,000

On Jan. 1, 1935, there were 312,000 horses; 22,000 mules; 1,439,000 cattle; 2,736,000 sheep and 273,000 swine on the farms of Colorado.

As in the case of agriculture, the mining industry in Colorado was hard hit by the economic depression beginning in 1929; by 1934, however, a marked revival of production had set in. Colorado, with mineral products valued at $60,403,000 in 1938 ranked 15th among the states, producing 1·52% of the total value for the United States. Colorado, which ranks seventh among the states in coal production, had an output in 1939 of 5,991,022 tons, worth approximately $15,816,000. Coal has long been the state's most valuable mineral product. In 1938 with an output valued at $13,136,100, Colorado ranked fifth among the states in gold production. It was third for silver, with output worth $5,046,000, and seventh for lead and for zinc. The production of lead and of zinc in 1938 had dropped to $869,800 and $437,100, respectively. Petroleum production dropped from 2,750,060 bbl. in 1928 to 908,504 in 1933; by 1938 it had picked up to 1,448,600 bbl. valued at $1,594,700. Brick and other clay products in 1935 had a value of $1,393,000.

A marked influence on Colorado's economic life is found in the existence of large forested and mountain areas and the consequent establishment of forest reserves and national parks. There were in 1940, 13,638,381 ac. in national forests, and there were two national parks and six national monuments. Timber supplies, grazing for stock, irrigation and hydro-electric power are important. The tourist business is a leading industry of the state.

From 1900 to 1920 the number of manufacturing establishments in Colorado nearly doubled, the number of persons engaged more than doubled, and the capital invested increased 225%. In 1937 there were, according to the U.S. census of manufactures, 1,233 industrial establishments, employing 25,932 wage earners, with products valued at $237,838,370. Beet-sugar manufacturing has been the chief industry since 1914. There were 16 operating plants in 1937, which manufactured sugar amounting to 303,000 short tons. Other important industries were: Slaughtering and meat packing $39,806,000; flour and other grain-mill products $10,299,600; construction and repairs in steam railway shops $5,890,209; butter, cheese and condensed milk products $8,890,100; bakery products $11,844,000; and printing and publishing newspapers and periodicals $9,471,500. Denver, the chief industrial centre, had 610 manufacturing establishments and products valued at $115,847,600.

The state is well supplied with railway mileage in spite of its rugged topography. In the year 1939 there were 4,868 mi. of main line railways in operation—a decline from the 5,724 mi. in operation in 1915. The Denver Pacific, built from Cheyenne, Wyo., reached Denver in June 1870, and the Kansas Pacific, from Kansas City, in August of the same year. Then followed the building of the Denver and Rio Grande (1871), to which the earlier development of the state is largely due. The Santa Fe (1873), Burlington (1882), Missouri Pacific (1887) and Rock

Island (1888) systems reached Pueblo, Denver and Colorado Springs successively from the east. The Colorado and Southern, a consolidation of roads connecting Colorado with the south, and the Denver and Salt Lake have also become important. The electric railway systems, operated by eight companies, had in 1937 a total of 267 mi. of track.

There were 12,202 mi. of highway in the State system at the end of 1939. Of this amount 8,272 mi. were surfaced; there were also 8,466 mi. of surfaced county roads. The total number of motor vehicles registered in the year 1939 was 344,838, of which 312,847 were passenger cars, buses and taxis. Motor licence fees and a gasoline tax of five cents per gallon are the chief sources of highway revenue.

HISTORY

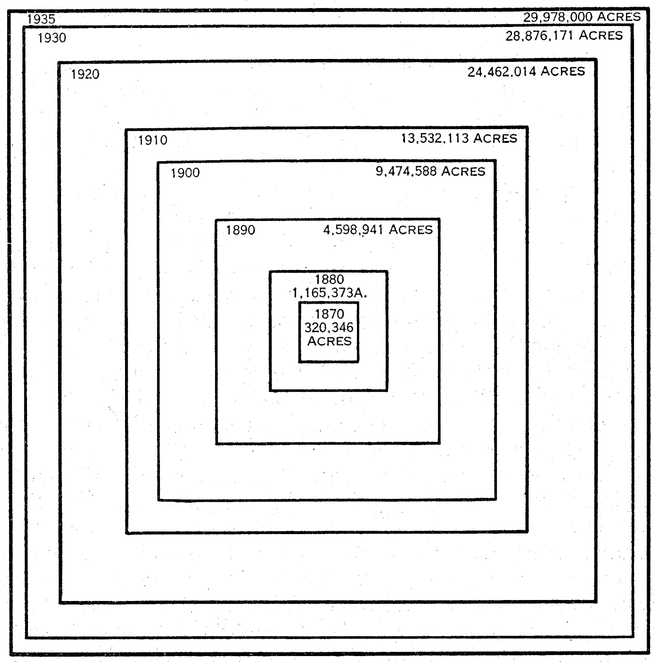
Colorado was acquired by the United States in three successive waves of westward expansion. The portion north of the Arkansas river and east of the meridian of its head was acquired by the Louisiana Purchase (*q.v.*) in 1803, but its exact boundary was not established until 1819, when the western boundary of the United States was incorporated in the treaty with Spain. The boundary of the United States was extended farther westward in 1845, with the admission of Texas. By a boundary adjustment between that State and the Federal Government in 1850, a strip of territory between the Rio Grande river and the present boundaries of Texas became a part of the public domain. The territory west of the Rio Grande was included in the Mexican cession of 1848.

Before the coming of the white men two types of Indians inhabited the country. The southern and south-western parts of the State were occupied by the cliff-dwellers, a sedentary, agricultural people. On the plains and to the northward dwelt the Utes and other nomadic, hunting tribes. Only a few of the pueblos and cave dwellings remain to commemorate the Indian culture of the south-west.

Early Explorers and Fur-traders.—The first Europeans to enter the bounds of the State were Spaniards who came in from Mexico to seek their fortune or to christianize the savages. It is tolerably certain that Coronado entered Colorado territory in 1540 in search of the fabled "Seven Cities of Cibola." Almost a decade before the founding of the first English settlement in America, a Spanish adventurer, Juan de Oñate, planted a colony on the Rio Grande, and seven years later founded Santa Fe (*q.v.*), the second oldest city in the United States. Through the 17th century expeditions were made by small bands of Spaniards in almost every direction from the settlements on the Rio Grande, and the mountains of Colorado must have become a familiar sight to them. The next explorer supposed to have entered the country was Juan Maria Rivera, who, with several companions, prospected on the Rio San Juan and is thought to have gone as far west and north as the valley of the Gunnison. There are meagre records of indisputable Spanish exploration in 1776, in what is now the southern part of the State, by the friars Escalante and Dominguez who were in search of a route to northern California. Fur traders were the next to enter the country. In 1799 Jean de la Maisonneuve and a Swiss named Preneloupe, while trading on the Upper Missouri, decided to visit the mountain country to the west and on July 20, 1799, arrived at the present site of Denver. It was also the fur trade that took the first American, James Purcell, into the Colorado region in 1803. In 1806 Zebulon M. Pike, mapping the Arkansas and Red rivers of the Louisiana territory for the U.S. Government, followed the Arkansas into Colorado, incidentally discovering the famous peak that bears his name. In 1819–20 Maj. S. H. Long explored the valleys of the South Platte and Arkansas, pronouncing them uninhabited and uncultivable (as he also did the valley of the Missouri, whence the idea of the "Great American Desert"). His name is also commemorated by a famous summit of the Rockies. There is nothing more of importance in Colorado annals until 1858. From 1804 to 1854 the whole or parts of Colorado were included, nominally, in some half-dozen territories carved successively out of the trans-Mississippi country; but not one of these had any practical significance for an uninhabited land. From 1828 to 1832 a fortified trading post was maintained near La Junta in the Arkansas valley on the Santa Fe trail; in 1834–36 several private forts were erected on the Platte; in 1841 the first overland emigrants to the Pacific coast crossed the State, and in 1846–47 the Mormons settled temporarily at the old Mexican town of Pueblo. John C. Frémont had explored the region in 1842–43 and 1845 (and unofficially in later years for railway routes), and gave more trustworthy reports of the country to the world than had his predecessors. Commerce in these years centred in the (New) Mexican town of Taos.

Colorado Becomes a State.—Colorado was practically an unknown country when in 1858 gold was discovered in the plains, on the tributaries of the South Platte, near Denver. In 1859 various discoveries were made in the mountains. The history of Denver dates from the gold rush in 1858. Julesburg, in the extreme north-east corner, at the intersection of the Platte valley and the overland wagon route, became transiently important during the rush of settlers that followed. Emigration from the east was stimulated by the panic, and hard times following 1857. During 1860–62 there was a continuous stream of immigration. Denver (under its present name), Black Hawk, Golden, Central City, Mount Vernon and Nevada City were all founded in 1859; Breckenridge, Empire, Gold Hill, Georgetown and Mill City in 1860 and 1861. The political development of the next few years was complicated. "Arapahoe county," including all Colorado, was organized as a part of Kansas territory in 1858; but a delegate was also sent to Congress to work for the admission of an independent territory (called "Jefferson"). At about the same time, early in 1860, a movement for Statehood was inaugurated, a Constitution being framed and submitted to the people, who rejected it, adopting later in the year a Constitution of territorial government. Accordingly the territory of Jefferson arose, claiming to extend over 6° of latitude (37°–43°) and 8° of longitude (102°–110°). Then there was the Kansas territorial Government also, under which a full county organization was maintained. Finally peoples' courts, acting wholly without reference to Kansas, and with little reference to the local "provisional" legislature, secured justice in the mining country. The provisional legislature of the territory of Jefferson maintained an illegal but rather creditable existence somewhat precariously and ineffectively until 1861. Its acts had slight importance. Some, such as the first charter of Denver, were later re-enacted under the legal territorial Government, organized by the United States in Feb. 1861. Colorado City, the first capital, was replaced by Golden in 1862. In 1868 Denver was made the seat of government (in 1881 permanently, by vote of the people). In 1862 some Texas forces were defeated by Colorado forces in an attempt to occupy the territory for the Confederacy. From 1864 to 1870 there was trouble with the Cheyenne and Arapahoe Indians. A sanguinary attack on an Indian camp in Kiowa county in 1864 is known as the Sand Creek Massacre. In 1867 the Republican Party had prepared for the admission of Colorado as a State, but the enabling act was vetoed by President Johnson, and Statehood was not gained until 1876. Finally, under a Congressional enabling act of March 3, 1875, a Constitution was framed by a convention at Denver (Dec. 20, 1875 to March 14, 1876) and adopted by the people July 1, 1876. The admission of Colorado to the Union was thereupon proclaimed on Aug. 1, 1876.

Labour Troubles.—For a considerable time after this the history of the State was identified with that of her great mining camps. After 1890 industrial conditions were confused and development retarded by strikes and lock-outs in the mines, particularly in 1894, 1896–97 and 1903–04, when martial law was several times necessary. Questions of railways, franchises, union wage scales, and sheep and cattle interests entered into the political and economic troubles of these years. The Colorado "labour wars" were among the most important struggles between labour and capital, and afforded one of the most sensational episodes in the story of all labour troubles in the United States in these years. A State board of arbitration was created in 1896, but its usefulness was impaired by an opinion of the State attorney-general (in 1901) that it could not enforce subpoenas, compel testimony or enforce decisions. A law establishing an eight-hour day for underground miners and smelter employees (1899) was unanimously voided by the state supreme court, but in 1902 the people amended the constitution and ordered the general assembly to re-enact the law for labourers in mines, smelters and dangerous employments. Following the repeal of the Sherman law in 1893, the silver question became the dominant issue in politics, resulting in the success of the Populist-Democratic fusion party in three



GRAPH SHOWING THE INCREASE IN THE AMOUNT OF LAND IN FARMS AND RANCHES IN COLORADO, 1870 TO 1935

successive elections, and permanently and greatly altering prior party organizations. In recent years the two major parties have been so equally balanced in strength that the state administration has been at times Republican and at times Democratic.

Colorado was a great cattle country until about 1890, when the free range began to pass away because of fencing for agricultural enterprises. The cattlemen had to adjust themselves to the new situation by providing winter forage, and this led to the cultivation of alfalfa and other hays. Later, with the introduction of the sugar-beet industry, Colorado regained some of its former importance as a meat-producing state. Lambs and cattle are fattened on the hay crops, and sheep and cattle consume the by-products of the sugar-beet industry.

Constitutional Reforms.—A constitutional amendment adopting initiative and referendum was ratified in Nov. 1910. In the same year a primary election law provided for direct nominations by the people of candidates for the U.S. senate, representatives in congress, and all elective state, district, county, ward and precinct officers, as well as members of the state legislature. The expense of candidates in such primary elections was limited by the act, and severe penalties were provided for violations. In 1911 an act was passed providing for registration of voters for all elections to be held in the state except school elections, and providing severe penalties for false registration and other violations of the act. In Nov. 1912 the people approved amendments to the state constitution providing for the recall of elective officials and, in certain cases, for the recall of judicial decisions. An act, proposed by initiative, was passed at the same time, providing for a ballot without party headings. The voters adopted in Nov. 1914 an amendment to the state constitution, prohibiting the sale and manufacture of intoxicating liquor, which became effective on Jan. 1, 1916; and the prohibition amendment to the federal constitution was ratified by the Colorado legislature in regular session on Jan. 15, 1919. Following the repeal of national prohibition, Colorado, in 1934, gave up state prohibition. The law of 1935 allowed the sale of liquor by the glass and in bulk.

The legislature in 1919 passed an act providing for a budget system in making appropriations and creating a state budget and efficiency commissioner. The first budget prepared under this act was presented to the legislature in 1921. In 1920 the voters adopted an initiated constitutional amendment raising the limit on state tax levy from four mills to five, the additional revenue being limited to the use of state educational institutions. In 1921 a proposed amendment to extend the tenure of office of state and county officers was defeated. Proposals for a convention to revise the state constitution were rejected in 1921 and 1930. In 1921 inheritance tax laws were strengthened by raising the rates thereof. Persistent advocacy by the governor secured the passage of laws for the re-establishment of a national guard and for a Department of Safety, with a body of rangers as a state police force; the latter was disbanded in 1923. The legislature in 1922 voted a $6,700,000 bond issue to finance the Moffat tunnel, and before it was completed in 1934 a total issue of $18,000,000 had been authorized. A loan of $3,850,000 from the Reconstruction Finance corporation enabled the Denver and Rio Grande railroad to build its strategic Dotsero cut-off connecting Denver with Salt Lake City. Serious labour disturbances occurred beginning with the depression in 1930 as coal production fell off 45%, petroleum 50%, and the major crops even more precipitously. Democrats strengthened by the party's national ascendancy swept state and national elections in 1932, 1934 and 1936. In 1931 Colorado ratified the national child labour amendment. Under pressure of necessity laws for prohibition repeal, closer supervision of insurance and banking companies, and grants to aid the destitute were passed in 1934. A 2% emergency retail sales tax was passed in 1935 supplemented by the 2% professional service tax in 1937. In 1936 a $45 per month old age pension was ratified by popular vote.

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COLORADO DESERT, a name applied to that arid region of southeastern California which extends from San Gorgonio pass south-eastward to the Gulf of California, and includes the depression (248·7 ft. below sea level) known as "Salton sink." It is separated from the Mohave desert (*q.v.*) by the San Bernardino, Cottonwood, Chuckwalla and Chocolate mountains. The Colorado desert is about 200 m. in length and attains a maximum width of 50 miles. The northwestern portion consists chiefly of shifting sand dunes but farther southeast, below the sea level, the valley floor is silt-covered and fertile; the soil of the Imperial valley (*q.v.*) is highly productive when irrigated. The rainfall varies considerably from year to year, but the average is between 3 and 4 in. yearly. During the five summer months the mean daily temperature is high, about 90° F, and occasionally an extreme of 125° or more in the shade is reached.

See W. C. Mendenhall, *Ground Waters of the Indio Region, California with a sketch of the Colorado Desert,* and *Some Desert Watering Places in South-eastern California and South-western Nevada.* These are U.S. Geological Survey *Water Supply Papers,* nos. 225 and 224, respectively. *See* also J. Smeaton Chase, *California Desert Trails* (1919).

COLORADO NATIONAL MONUMENT, a tract of 13,883 ac. in central Colorado, U.S.A., near the west boundary, set apart by the Government as a reservation in 1911. It is notable for its enormous sandstone monoliths which have been grotesquely formed by erosion. One of the largest of these is Independence rock; its base is 250 ft. by 100 ft. and it rises to a height of 500 feet. Another, Fisherman's Head, is over 400 ft. high and is topped by the semblance of a human face.

COLORADO POTATO BEETLE, a chrysomelid beetle (*Leptinotarsa decemlineata,* Say), native to the western United States. This leaf-beetle, first named and described by Say in 1824, fed originally on a wild solanaceous plant, *Solanum rostratum,* abounding in the Rocky Mountain region. With the westward advance of civilization, the cultivation of potatoes was brought to its neighbourhood, and the insect at once took to the cultivated plant and began an eastward spread. By 1864 or 1865 it had crossed the Mississippi river in Illinois. By 1869 it reached Ohio. In 1874 it reached the Atlantic seaboard. In its spread across the country, it flourished best in what is known as the Upper Austral life zone. It did not readily accommodate itself to the severe winters of the far north nor to the hot summers of the far south. As it progressed, certain predatory insects and certain birds became accustomed to it, and as early as 1869 Paris green began to be used against it; so that by the time the beetle reached the Atlantic, potato growers in the mid-west were able to control it in their fields.

Great alarm was expressed in Europe. The German Government, early in 1875, issued a decree against the importation of American potatoes, and was followed the same year by Belgium, Spain, France, Russia, Italy, Hungary and Austria, and by Portugal and Sweden the following year. In spite of the German decree, the beetle was discovered in a potato field near Hamburg, but was exterminated by radical measures. It is quite likely that the insect has been imported by accident into European countries since that date, but in no case has it been established except that shortly after the War of 1914–18 it was found to have been introduced near Bordeaux in France in a region where there had been large bodies of American troops. From that region it has since spread, rather slowly, into surrounding departments, but the French Government, having adopted American methods, feels that it can well be kept in check. It is now known to be established in France, Belgium, Holland, Luxembourg, Germany, and Switzerland. It has been found sporadically in England but repressive measures are believed to have exterminated the species.

Both the adult beetles and the larvae feed upon the foliage of the potato plant. In the early days it not only caused the loss of entire crops but sometimes destroyed the potato yield of whole counties and of large portions of some States. It materially affected the market price of potatoes. The extensive work of the insect on the foliage affected the quality of the tuber, and at one time it was difficult to obtain potatoes that were not watery when cooked. The adult beetles pass the winter underground, and in the spring lay their eggs upon the plants. There are two generations each year, the leaf-feeding larva descending to the ground to turn to pupa. The insect feeds on nearly all solanaceous plants, including eggplant, tomato and tobacco among the cultivated species. The tender-leaved varieties of potato are most affected. The insect is held in check by the application of arsenicals. In the U.S. one formula is, one part Paris green to 10 to 20 parts of flour, sifted land plaster or fresh air-slaked lime. Another is, 1 lb. Paris green to 75 to 125 gal. of water, 1 lb. of quicklime being added to prevent scorching of the foliage by the arsenical.

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(L. O. H.)

COLORADO RIVER, a stream in the south of the Argentine Republic. It has its sources on the eastern slopes of the Andes in the latitude of the Chilean volcano Tinguiririca (about 34° 48′ S.), and pursues a general east-south-east course to the Atlantic, where it discharges through several channels of a delta extending from lat. 39° 30′ to 39° 50′ S. Its total length is about 620 m., of which about 200 m. from the coast up to Pichemahuida is navigable for vessels of 7 ft. draught. It has been usually described as being formed by the confluence of the Grande and Barrancas, but as the latter is only a small stream compared with the Grande it is better described as a tributary, and the Grande as a part of the main river under another name. After leaving the vicinity of the Andes the Colorado flows through a barren, arid territory and receives no tributary of note except the Curaco, which has its sources in the Pampa territory and is considered to be part of the ancient outlet of the now closed lacustrine basin of southern Mendoza. The bottom lands of the Colorado in its course across Patagonia are fertile and wooded, but their area is too limited to support more than a small, scattered population.

COLORADO RIVER. The Colorado river and its upper tributaries rise in the mountains of Wyoming, Colorado and Utah, where precipitation, especially in the form of snow, is heavy. Including the Green river, the Colorado river is about 1,700m. long. Its drainage basin covers 244,000sq.m. or $\frac{1}{13}$ of the area of the United States, and includes parts of seven States—Wyoming, Colorado, Utah, New Mexico, Nevada, Arizona and California. The river forms for 17m. the boundary between Arizona and Mexico and then flows 80m. through the Republic of Mexico to the Gulf of California. Its discharge varies from about 3,000 second-feet at low water to a flood discharge of more than 200,000cu.ft. per second. Its water supply, with storage, is estimated to be equivalent to a uniform flow of 19,300 second-feet at Lees Ferry, 22,600 second-feet at the lower end of Black Canyon, and 21,100 second-feet at Parker. When development in the upper basin is completed and the canyon section and the lower river are developed these quantities will be reduced. With an average annual flow at Yuma of 17,000,000 acre-feet at the present time and an average silt content of 0·62% by volume, the annual load of silt brought to the delta region by the Colorado and Gila averages 105,000 acre-feet, or 170,000,000 cubic yards.

The region traversed by the Colorado and its tributaries is for many reasons of intense interest to the people of the United States. Here was the home of that forgotten people of which there is almost no record except the hieroglyphics on the rocks, the ruins of their irrigation systems, and the cliff dwellings by which they are most widely known; in this region were Spanish missions whose history extends back nearly to the days of Balboa and Cortez; here is the Grand Canyon, whose grandeur cannot be described; and here are the greatest known natural bridges, so remote and inaccessible that they have only recently been discovered.

For more than 1,000m. along its course the Colorado has cut for itself a deep, narrow gorge or canyon, but at some points where lateral streams join it the canyon is broken and these narrow transverse valleys divide it into a series of canyons. Virgin, Kanab, Paria, Escalante, Fremont, San Rafael, Price and Duchesne rivers on the west, and the Little Colorado, San Juan, Grand, White and Yampa on the east have also cut out for themselves narrow, winding gorges or deep canyons. Each river entering these has cut another canyon; each lateral creek has cut a canyon; and each brook runs in a canyon; so that much of the upper part of the basin of the Colorado is traversed by a labyrinth of these deep gorges. The longest unbroken canyon through which the Colorado runs is that known as the Grand Canyon between the mouth of the Paria and the Grand Wash.

The Grand Canyon is 278m. long and at one place is 13m.

wide and nearly 6,000ft. deep. All the scenic features of this canyon are on a grand scale. Low plateaux, dry and treeless, stretch back from the brink of the canyon. In some places rock is composed of richly coloured and variegated marls, and here the surface is a bed of loose, disintegrated material through which one walks as though in a bed of ashes. In other places the rock is a soft sandstone, the disintegration of which has left broad stretches of drifting sand, white, golden and vermilion. Where this sandstone is a conglomerate, a paving of pebbles has been left—a mosaic of many colours, polished by the drifting sands, glistening in the sunlight.

On the California side of the lower portion of the river in the United States a vast desert, which has been known as the Colorado desert and more recently as the Salton basin, stretches north-westward from the head of the Gulf of California, a distance of 150 miles. At one time in the geological history of this country, the Gulf of California extended a long distance farther to the north-west, above the point where the Colorado now enters it, but this stream brought its mud from the mountains and hills above and bore it into the gulf, across which it gradually erected a vast dam until the waters on the north were separated from those on the south. Then the Colorado cut a channel into the lower gulf. The upper waters, being cut off from the sea, gradually evaporated. The bottom of this ancient upper gulf has come to be known as the Salton sink. It is now land about 278ft. below the level of the sea. On the Arizona side of the river there are similar desert plains, but these are interrupted by mountains.

In the year 1905 there occurred, about 3m. below the California-Mexico line, a break which diverted all the waters of the Colorado into the Salton sink and created the Salton sea, with a maximum depth of 76ft., a length of 50m. and a width of 10m. to 15m., a total water area of 445 square miles. The break threatened inundation of the entire Imperial valley and permanent blocking of the Southern Pacific route. Because of this latter danger the Southern Pacific company stopped the crevasse and completed, in 1907, a line of protective levees, the whole involving a deal of engineering skill and an outlay of $2,000,000.

The Colorado problem is international. Under existing treaties neither the United States nor Mexico can take action along the common boundary line which might impede navigation in the Colorado river. The language of the treaties does not, however, appear to prevent the taking of water for navigation purposes from the Rio Grande in the United States above the point where it forms the boundary line between the two countries.

Colorado river is one of the remarkable rivers of the world in its value for irrigation and water-power. It combines, in proper sequence for complete use, a large quantity of water, great concentrations of fall, reservoir sites for the control of flow, sites for power plants, and several million acres of irrigable land below the stretch where power may be developed. Over 5,000,000 prime h.p. can be developed. The flood menace is a serious one; the silt brought down annually to Yuma produces dangerous meandering in the leveed sections in the delta and causes the river to seek new outlets. These threats necessitate large expenditures for revetment and the steady raising of levees to prevent further disasters such as occurred in 1905.

For the purposes of controlling floods and regulating the flow of the lower Colorado river and for interception of silt, providing for storage and delivery of water for irrigation purposes and for the generation of power, Congress has provided for the construction of a dam in the Colorado river at Black canyon or Boulder canyon. As the project entailed an adjustment of the water rights claimed by Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming, a commission comprised of representatives of each of these States and of the United States prepared, in 1922, a plan for the distribution of the waters, giving 7,500,000ac.ft. annually to the upper States (Colorado, New Mexico, Utah and Wyoming), and 8,500,000 to the lower States. A disagreement between Arizona and California delayed ratification of this compact until 1928 when all but Arizona ratified by agreeing to an amendment that the ratification of any six of the States would make it effective. Congress followed by passing the Boulder Canyon Project Act on Dec. 21, 1928 and President Hoover issued a proclamation the following June authorizing construction. Construction was not formally begun until Sept. 17, 1930, but the rapid completion of four huge diversion tunnels, each 56ft. in diameter, during the next three years, providing a dry bed on which to construct the dam at the boulder, and the erection of a modern city to house 600 workers high above the waters of the projected dam, and the construction of 53 miles of railway and 40 miles of improved highway completed the early stages of the project and attracted national attention to that great engineering feat. The acceleration of public works projects under the Roosevelt administration speeded construction and by 1935 such progress was made that the water was already backed up sixty-five miles behind the world's greatest dam, starting the man-made lake that will eventually extend 115 miles and have an average width of two miles. The hydro-electric plant will distribute 1,835,000 horse power and an area of 2,100,000 acres will be irrigated. The income will gradually cancel the entire cost of construction, towards which Congress had appropriated $165,000,000 in 1928 and in the course of fifty years accumulate a surplus calculated at an additional $165,000,000. The dam itself, 730ft. in height and 1,000ft. along the crest of its brim, is the largest in the world although several others boast a greater length.

Its services to the Rocky Mountain States will open a new field for colonization provided with an adequate supply of hydro-electric power and irrigation.

See U.S. Geological papers Nos. 395 and 556; Senate document No. 142 of the 67th Congress, 2nd session; *Annual Report of U.S. Federal Power Commission* (1922). (E. JA.)

COLORADOS, a tribe of South American Indians belonging to the Barbacoan (*q.v.*) linguistic stock, living in north-western Ecuador. At the present time the Colorados occupy the region west and south-west of Quito, on the upper waters of the Esmeraldas, Daule and Quevedo rivers. Their culture is simple. Clothing for the men consists of a cotton kilt and small poncho-like cape covering only the shoulders, for the women of a longer skirt. The teeth are stained black, and there is much use of body painting. Their dwellings consist merely of a thatched roof, without side walls. They are agricultural and make serviceable pottery and textiles. Weapons comprise the bow and the pellet blow-gun. The dead are buried under the floor of the house.

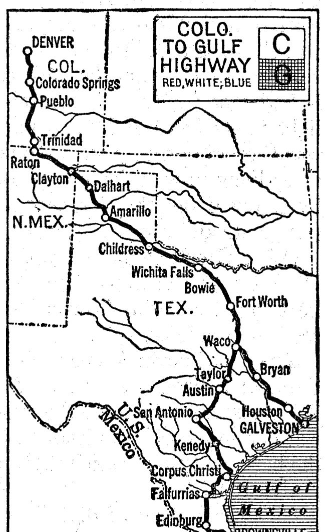
See P. Rivet, "Les Indiens Colorados," *Journ. Soc. Americanistes de Paris* (N.S.), vol. ii., pp. 177–208.

COLORADO SPRINGS, a city of Colorado, U.S.A., 75m. S. of Denver, on a mesa 6,036ft. above the sea, open to the great plains on the south-east and backed by mountains, including Pike's Peak (14,110 ft.); the county seat of El Paso county. It lies at the point where Monument creek joins Fountain creek; is on federal highways 24 and 85; and is served by the Santa Fe, the Rock Island, the Denver and Rio Grande Western, the Colorado and Southern, and the Missouri Pacific railways. The population was 33,237 in 1930 and 36,789 in 1940 by the federal census. Colorado Springs is the most popular tourist centre of the Rocky mountains, a noted health resort, an important railway point, the headquarters of the Cripple Creek mining companies, and a delightful residence city. It has ore-reduction plants, iron foundries and railroad shops. The assessed valuation of property in 1940 was $28,402,180.

Colorado college, the oldest college in the State, was established here in 1874. It has an enrolment of about 800, and an endowment of over $2,000,500. For a field laboratory in forestry it uses a tract of 6,000ac. (Manitou forest) 25 mi. N.W. of the city. Other institutions are the International union printers' home, the national home of the Modern Woodmen of America, the State institution for the deaf and blind and several sanatoria for the treatment of tuberculosis. In Manitou Springs, 5 mi. W. (pop. 1940, 1,462) a summer resort and the starting-point of the Cogwheel road to the top of Pike's Peak, are the 16 varied mineral springs which gave Colorado Springs its name. The Garden of the Gods, between the two cities (500ac. strewn with grotesque formations of bright-coloured sandstone) has been since

1909 a part of the park system of the city. Among other points of interest are the two Cheyenne canyons, the Cave of the Winds, the Grand Caverns and (at Florissant) a petrified forest. Many descriptions of this country may be found in the stories of Helen Hunt Jackson ("H.H."). Colorado Springs was laid out as a model city in 1871 by Gen. W. J. Palmer, president of the Denver and Rio Grande railway, which reached the valley that year. It was incorporated in 1872, chartered as a city in 1878, and in 1921 adopted a city manager form of government. The historic town of Colorado City, which sprang up during the gold rush of 1859 and was for four days in 1862 the seat of the territorial legislature, was consolidated with Colorado Springs in 1916.

COLORADO TO GULF HIGHWAY extends from Denver, Colo., to Galveston, Tex., about 1,200 m., and also to Brownsville, Tex., about 1,450 miles. For nearly 200 m. of the way, and at an elevation of 5,000 ft., its route is within view of the Rocky mountains. It skirts the eastern base of Pikes Peak, and traverses Raton pass between New Mexico and Colorado, affording from points in the latter views that extend southward for more than 100 miles. This highway crosses immense agricultural and live stock districts in Texas, and forms the main artery of travel from the Colorado Rocky mountains to the gulf of Mexico. Colorado Springs, Pueblo, Wichita Falls, Fort Worth, Houston, San Antonio and Corpus Christi are among the cities situated along its course.



COLORADO TO GULF HIGHWAY

COLORATURA (It.), a term in music applied to vocal passages of a florid and brilliant character, whereby the underlying melody is ornamented and, as it were, "coloured"; *aria di coloratura,* coloratura singing, and so on, being common uses of the term.

COLORIMETER, an instrument for determining the *intensity* of a colour (*q.v.*) relative to a standard colour intensity. The two are viewed simultaneously and the standard is modified by definite degrees until the intensities appear equal. This modification may be effected (*a*) for liquids, by altering the length of the column or the concentration of the standard liquid, (*b*) for solids or liquids, by interposing in front of or behind the standard a movable transparent, coloured wedge or some such device. *Colorimetric* methods may be used to determine hydrogen ion concentration. (*See* HYDROGEN ION CONCENTRATION; *Determination of Hydrogen,* etc.) (*See* CHEMISTRY: *Analytical.*) (*See* also CHROMATOMETER.)

COLOSSAE, once the great city of south-west Phrygia, was situated on rising ground (1,150 ft.) on the left bank of the Lycus (*Churuk Su*), a tributary of the Maeander, at the upper end of a narrow gorge 2½ m. long. It was a large, prosperous city (Herod. vii. 30; Xenophon, *Anab.* i. 2, § 6), until it was ruined by the foundation of Laodicea in a more advantageous position. Colossae was the seat of an early Christian church, the result of St. Paul's activity at Ephesus, though perhaps actually founded by Epaphras. The church, to which St. Paul wrote a letter, was mainly composed of mingled Greek and Phrygian elements deeply imbued with fantastic and fanatical mysticism. Colossae lasted until the 7th and 8th centuries, when it was gradually deserted under pressure of the Arab invasions.

COLOSSAL CAVERN, a limestone solution cave in Edmonson county, central Kentucky, U.S.A., 1½ m. from the famous Mammoth cave with which it is probably connected. Eden valley, which lies between these caves, is indisputably a "sink" formed by the collapse of a great chamber or series of chambers that formerly united them. Bed Quilt cave as well as many smaller caverns and grottoes in the vicinity are doubtless part of the same system of caverns, all hollowed out by solution in the St. Louis limestone beneath the overlying Chester sandstone. From the main entrance at the foot of a steep hill across Eden valley from Mammoth cave, the cavern extends southward by the "Chinese Wall," "Uncle Tom's Pool" and "Lizard Spring" to Vaughan's Dome, a great chamber 40 ft. wide, 300 ft. long and 79 ft. high, thence southward by Florence Avenue and the "Ruins of Carthage," a spacious hall 400 ft. long, 100 ft. wide and 30 ft. high of which the flat roof is one continuous limestone block to the so-called "Ruins of Martinique," where the general course changes south-eastward, and passing by a number of spectacular features, leads to Colossal Dome, the most impressive of all the chambers, fringed by innumerable tinted stalactites and stalagmites, richly resonant when struck. Continuing south-eastward past the "Pearly Pool" of limpid water, and by a passageway between stately columns and grotesque figures, the cavern ends in a copious chalybeate spring. The fauna of the cavern is characterized by paucity of species, though of these the number of individuals is relatively large. The temperature is uniformly 54° F., the atmosphere fresh and pure. (W. E. E.)

COLOSSEUM, the Flavian amphitheatre in Rome, begun by Vespasian, on the site of part of Nero's famous Golden House, and inaugurated by Titus in A.D. 80. It consisted originally of three arcaded storeys of stone and an upper gallery, originally of wood, which was rebuilt of stone in the present form sometime in the third century. The colosseum probably seated between 40,000 and 50,000 people. It is elliptical in plan with its long axis 620ft. and its short axis 513ft.; its arena, 281ft. long and 177ft. wide. Its total height to the top of the third century stone screen wall is about 160 feet. For a further description *see* AMPHITHEATRE.

COLOSSIANS, EPISTLE TO THE, the 12th book of the New Testament, one of the later letters of the Apostle Paul. Colossae, like the other Phrygian cities of Laodicea and Hierapolis, had not been visited by Paul, but owed its belief in Jesus Christ to Epaphras, a Colossian who had laboured not only in his native city, but also in the adjacent portions of the Lycus valley—a Christian in whom Paul reposed the greatest confidence (i. 7; iv. 12, 13). This Epaphras, like the majority of the Colossians, was a Gentile. It is probable, however, that Jews were there with their synagogues (*cf.* Josephus *Ant.* xii. 149) and that some of the Gentiles, who afterwards became Christians, were either Jewish proselytes or adherents, who paid reverence to the God of the Jews. At all events, the letter indicates a sensitiveness on the part of the Christians not only to oriental mysticism and theosophy (*cf.* Sir W. M. Ramsay, *Cities and Bishoprics of Phrygia* and the *Church in the Roman Empire*), but also to the Judaism of the Diaspora.

Our first definite knowledge of the Colossian Church dates from the presence of Epaphras in Rome, *c.* A.D. 60, when Paul was a prisoner. Paul has received news, perhaps by letter (J. R. Harris, *Expositor,* Dec. 1898, pp. 404 *et seq.*) touching the state of religion in Colossae. He learns, to his joy, of their faith, hope and love, but detects a lack of that strength and joy and perfection, that richness of the fullness of knowledge expected of those who had been made full in Christ (i. 6, 9–11, 28; ii. 2, 7, 10). The reason for this, Paul sees, is the influence of the claim made by certain teachers in Colossae that the Christians, in order to attain unto and be assured of *full* salvation, must supplement Paul's message with their own fuller and more perfect wisdom, and must observe certain rites and practices (ii. 16, 21, 23) connected with the worship of angels (ii. 18, 23) and elementary spirits (ii. 8, 20).

The origin and the exact nature of this religious movement are alike uncertain. (1) If it represents a type of syncretism as definite as that known to have existed in the developed gnostic systems of the 2nd century, it is inconceivable that Paul should have passed it by as easily as he did. (2) As there is no reference to celibacy, communism and the worship of the sun, it is improbable that the movement is identical with that of the Essenes. (3) The phenomena might be explained solely on the basis of Judaism (von Soden, Peake). Certainly the asceticism and ritualism might be so interpreted, for there was among the Jews of the Dispersion an increasing tendency to asceticism, by way of protest against the excesses of the Gentiles. The reference in ii. 23 to severity of the body may have to do with fasting preparatory to seeing visions (*cf. Apoc. Baruch,* xxi. 1, ix. 2, v. 7). Even the worship of angels, not only as mediators of revelation and visions, but also as cosmical beings, is a well-known fact in late Judaism (*Apoc. Bar.*, lv. 3; *Ethiopic Enoch,* lx. 11, lxi. 10; Col. ii. 8, 20; Gal. iv. 3). As for the word "philosophy" (ii. 8), it is not necessary to take it in the technical Greek sense when the usage of Philo and Josephus permits a looser meaning. Finally the references to circumcision, *paradosis* (ii. 8) and *dogmata* (ii. 20), directly suggest a Jewish origin. If we resort solely to Judaism for explanation, it must be a Judaism of the Diaspora type. (4) The difficulty with the last-mentioned position is that it under-estimates the speculative tendencies of the errorists and ignores the direct influence of oriental theosophy. It is quite true that Paul does not directly attack the speculative position, but rather indicates the practical dangers inherent therein (the denial of the supremacy of Christ and of full salvation through Him); he does not say that the errorists hold Christ to be a mere angel or an aeon, or that words like *pleroma* (borrowed perhaps from their own vocabulary) involve a rigorous dualism. Yet his characterization of the movement as an arbitrary religion (ii. 23), a philosophy which is empty deceit (ii. 8), according to elemental spirits and not according to Christ, and a higher knowledge due to a mind controlled by the flesh (ii. 18); his repeated emphasis on Christ, as supreme over all things, over men and angels, agent in creation as well as in redemption, in whom dwelt bodily the fullness of the Godhead; and his constant stress upon knowledge—all these combine to reveal a speculation real and dangerous, even if naïve and regardless of consequences, and to suggest (with Jülicher and McGiffert) that in addition to Jewish influence there is also the direct influence of Oriental mysticism.

To meet the pressing need in Colossae, Paul writes a letter and entrusts it to Tychicus, who is on his way to Colossae with Onesimus, Philemon's slave (iv. 7, 9). (On the relation of this letter to Ephesians and to the letter to be sent from Laodicea to Colossae, *see* EPHESIANS, EPISTLE TO THE.)

A letter like this, clear cut in its thought, teeming with ideas emanating from a unique religious experience, and admirably adjusted to known situations, bears on its face the marks of genuineness even without recourse to the excellent external attestation. It is not strange that there is a growing consensus of opinion that Paul is the author. With the critical renaissance of the early part of the 19th century doubts were raised as to its genuineness (*e.g.,* by E. T. Mayerhoff, 1838). Quite apart from the difficulties created by the Tübingen theory, legitimate difficulties were found in the style, in the speculation of the errorists and in the theology of the author. (1) As to style, it is replied that if there are peculiarities in *Colossians,* so also in the admittedly genuine letters, *Romans, Corinthians, Galatians.* Moreover, if *Philippians* is Pauline, so also the stylistically similar *Colossians* (*cf.* von Soden). (2) As to the speculation of the errorists it is explicable in the lifetime of Paul, recourse to the developed gnosticism of the 2nd century being unnecessary. (3) As to the Christology of the author, it does not go beyond what we have already in Paul except in emphasis, which itself is occasioned by the circumstances. What is implicit in *Corinthians* is explicit in *Colossians.* H. J. Holtzmann (1872) subjected both *Colossians* and *Ephesians* to a rigorous examination, and found in *Colossians* at least a nucleus of Pauline material. H. von Soden (1885), with well-considered principles of criticism, made a similar examination and found a much larger nucleus, and later still (1893), in his commentary, reduced the non-Pauline material to a negligible minimum. Harnack, Jülicher, McGiffert, Moffatt and Dibelius agree with Lightfoot, Weiss, Zahn (and early tradition) in holding that the letter is wholly Pauline—a position which is proving more and more acceptable to contemporary scholarship.

BIBLIOGRAPHY.—In addition to literature mentioned in the text, *see* Sanday, art. "Colossians" and Robertson, art. "Ephesians," in Smith's *Bible Dict.* (1893), and A. Jülicher, art. "Colossians" and "Ephesians," in *Encyc. Bib.* (1899); The Introductions of H. J. Holtzmann (1872), B. Weiss (1897), Th. Zahn (1900), Jülicher (1906), Moffatt (3rd ed., 1911); the Commentaries of J. B. Lightfoot (9th ed., 1890), H. von Soden (1893), T. K. Abbott (1897), E. Haupt (1902), Peake (1903), P. Ewald (2nd ed., 1910), M. Dibelius (2nd ed., 1927). (J. E. F.)

COLOSSUS, in antiquity, a term applied generally to statues of great size (hence the adjective "colossal"), and in particular to the bronze statue of the sun-god Helios in Rhodes, one of the wonders of the world, made from the spoils left by Demetrius Poliorcetes when he raised the siege of the city. The sculptor was Chares, a native of Lindus, and of the school of Lysippus. The work occupied him 12 years, it is said, and the finished statue stood 70 cubits high. It stood near the harbour, but at what point is not certain. As early as the 16th century the belief was current that it had stood across the entrance to the harbour, with a beacon light in its hand and ships passing between its legs. The statue was thrown down by an earthquake about the year 224 B.C.; then, after lying broken for nearly 1,000 years, the pieces were bought by a Jew from the Saracens, and probably reconverted into instruments of war.

Other Greek colossi were the Apollo of Calamis; the Zeus and Herakles of Lysippus; the Zeus at Olympia, the Athena in the Parthenon, and the Athena Promachos on the Acropolis—all the work of Pheidias.

The best-known Roman colossi are: a statue of Jupiter on the Capitol; a bronze statue of Apollo in the Palatine library; and the colossus of Nero in the vestibule of his Golden House, afterwards removed by Hadrian to the north of the Colosseum, where the basement upon which it stood is still visible (Pliny, *Nat. Hist.,* xxxiv. 18).

Gigantic statues of divinities and royalties are characteristic of Egyptian, Assyrian and Indian archaeology, size being an indication and measure of social and religious importance.

COLOUR. In this article colour is discussed mainly from the physical point of view. Under VISION it is discussed from the physiological point of view. It is not possible to make a clear-cut separation of the two aspects, and therefore the two articles supplement and overlap one another at certain points.

The Nature of Colour.—In looking round at the different objects surrounding him the person of normal vision recognises not only that they differ in form, but also that some are brighter than others and further that they differ in a respect which we name colour. As bodies are seen by the light proceeding from them this means that light as modified by various physical causes can produce different colour sensations. The nature of the sensation of colour is not a thing that can be explained to anybody who has never experienced it, although there have often been attempts to find analogies between sound and colours.

The sensation of colour can be produced by stimuli other than light, for instance by pressure on the eyeball in complete darkness. It can also be produced in darkness if the eye has previously been exposed to bright light of any colour: the so-called after-images are then formed. The particular colour sensation produced by a light of a particular kind and strength from a coloured object also depends upon the light to which the eye has been previously exposed, and upon the colour of the objects immediately surrounding it, phenomena which are referred to as successive and simultaneous contrast. These physiological effects are dealt with under VISION as are also the various types of deficiency of colour perception. We are here dealing with the colour effects produced in a normal eye in a normal state.

The physical side of the subject is approached most simply by considering pure spectral colours. When white light from a slit is passed through a prism and projected on a screen by a suitable arrangement of lenses, there is produced a band of light which is called a spectrum. The normal eye at once recognizes that the light at different parts of this band varies not only in brightness, but also in colour. The band is red at one end, violet at the other, and between lie a range of colours, in the order orange, yellow, green, blue and indigo, making in all the so-called seven primary colours. Physically the spectrum represents a continuous range of wave-lengths of light, which extends beyond the limits of vision at both ends, beyond the red into the infra-red, and beyond the violet into the ultra-violet. The wave-length of the extreme visible red is something less than twice the wave-length of the extreme visible violet. (*See* RADIATION.) The colour sensations excited by the light blend into one another, and it is impossible to say exactly where one of the primary colours stops, and the next begins. The distinction of these colours is entirely subjective, that is, a matter of the organs of sense-perception, for physically there are no steps in the spectrum corresponding to the different colours. While by using sufficiently refined instruments the number of wave-lengths distinguishable by physical means can be made practically as great as we like, yet the most trained eye never sees more than seven primary colours, within which are distinguishable shades of colour. The number of shades of colour, or hues, which the eye can pick out as distinguishable within the seven primary colours is also very limited. There is some dispute as to the number, which depends to a great extent upon the method employed to isolate patches which appear monochromatic to the eye; different experts vary in their estimate between 130 and 30. In any case the sensations of colour divide up the spectrum in a way manufactured by the observer, and not represented by any physical divisions. Roughly speaking, the wave-lengths corresponding to the boundaries between the primary colours found by a normal observer are given in the following table, but some people of good colour vision do not make any distinction between blue and indigo, and so naturally make a different division, while people of inferior colour vision distinguish still fewer primary colours (*see* VISION). The arbitrary element is still further emphasized by comparing the results of the two experienced investigators cited. The wave-lengths are given in thousandths of a millimetre, denoted by μ.

	Observations by Abney	By Listing
Red	End to ·62 μ	·723 to ·647μ
Orange	·62 ,, ·592μ	·647 ,, ·585μ
Yellow	·592 ,, ·578μ	·585 ,, ·575μ
Green	·578 ,, ·500μ	·575 ,, ·492μ
Blue	·500 ,, ·464μ	·492 ,, ·455μ
Ultramarine indigo	·464 ,, ·446μ	·455 ,, ·424μ
Violet	·446 ,, end	·424 ,, ·397μ

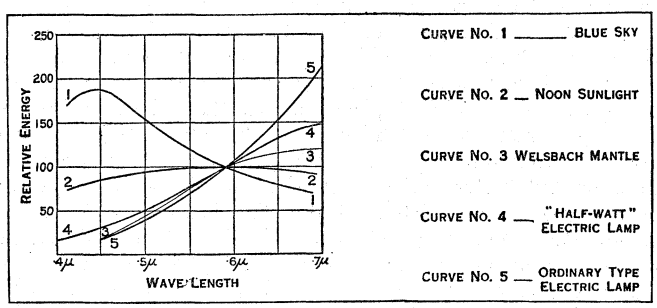
A coloured light that reaches the eye from, say, a lantern provided with coloured glasses, or from a coloured body, such as a piece of cloth, will not, in general, be a pure spectral colour, *i.e.,* light of a given single wave-length, or of a narrow range of wave-lengths. Rather, it will consist of one or more wide continuous ranges of wave-lengths. If we want to specify the light physically we must not only be able to measure what wave-lengths are present in the mixture, but also the intensity of each. When we have done this we shall have sufficient information to enable us to reproduce a coloured light which will have the same effect on any normal eye in a normal state. It must be emphasized, however, that the reverse does not hold, namely if we have a second coloured light which produces exactly the same effect as the first on a normal eye, it does not follow that it consists physically of the same wave-lengths in the same strength. For instance light of a pure spectral yellow, consisting of a narrow range of wave-lengths in the neighbourhood of ·590μ, can be matched exactly by a mixture of spectral green light and of spectral red light in suitable intensities. The eye is quite unable to decide if a colour is simple or compound. It is a fact of the greatest practical importance that any colour sensation, whatever the physical characteristics of the light that produce it, can be matched by light of three selected wave-lengths, by varying the relative intensities of these three components. This is an experimental fact which is quite independent of the validity of any three colour theory of vision. The question of the connection between the physical stimulus and the colour perceived is further considered in the last section of this article.

Coloured Bodies.—For the discussion of colour, white light, such as daylight, can be considered as consisting of a mixture of all wave-lengths of the visible spectrum. (The physical nature of white light is discussed in detail in LIGHT.) A body, such as a piece of cloth, illuminated by such light, appears coloured because it absorbs light of certain wave-lengths partially or completely, and throws back the remainder. Thus an ordinary blue object absorbs red, orange and yellow rays, and scatters blue together with some green, indigo and violet; the purer the colour the smaller is the spectral region of the unabsorbed light. A yellow object absorbs the blue, indigo and violet, and generally throws back with the yellow a certain amount of green, orange and red. The colour is thus produced by absorption. When white light, say, falls on a pigment a small part is reflected unchanged at the surface as white light, but the greater part penetrates a short distance into the body and then, as a result of internal reflections and refractions due to irregularities, emerges again, modified by the loss of the rays which are most strongly absorbed. This fact can be strikingly illustrated by taking a piece of brilliantly coloured glass, and crushing it to a fine powder; the powder will appear white. The crushing leads to the creation of a very large amount of new surface, at each of which a certain amount of surface reflection takes place, so that the light is no longer able to penetrate sufficient thickness of the substance for marked absorption to manifest itself. If the powder is now wetted with water or still better with an oil of about the same refractive index as the glass, which markedly diminishes the surface reflection, the colour is largely restored. Another illustration of the same phenomenon, given by R. W. Wood, is provided by a bead of fused borax, coloured with cobalt so deeply as to appear black. If such a bead is crushed the powder appears blue, for the diminished penetration leads to a less complete absorption. The white froth on a coloured liquid such as beer, is another aspect of the same phenomenon: the liquid of which the froth is composed appears brown when the light can penetrate a sufficient depth before being turned back, but the bubbles present so great a number of reflecting surfaces, that the light is unable to penetrate any depth, and the bubbles appear white.

Similarly, a transparent substance, such as a piece of coloured gelatine, held between a white light and the eye, owes its colour to the fact that it absorbs the remainder of the spectrum. Neglect of the fact that the colours of glasses and pigments are due to absorption often leads to great confusion as to the result of mixing colours. If we mix a blue and a yellow pigment the green sensation produced is not the result of mixing blue and yellow light. The blue pigment absorbs, roughly speaking, the red, orange and yellow: the yellow pigment absorbs the blue, indigo and violet. It follows that the only colour which escapes the double absorption is green, which accordingly is thrown back from the mixture. If we mix blue and yellow light, by letting a beam which has passed through a piece of ordinary yellow glass fall on a white screen which is also illuminated by the appropriate amount of light which has passed through an ordinary blue glass, the result is a white light, for yellow and blue are complementary colours. Of course if we let the light pass first through one glass and then through the other the result will be green light as with the pigments, for the light transmitted is the spectral region which escapes the double absorption. In the same way a red and blue glass, put together may stop all light and appear black, but red and blue light mixed produce a purple.

An interesting phenomenon due to absorption colour is the so-called dichromatism exhibited by certain bodies, which, viewed by transmitted light, appear one colour in thin layers, and another colour in thick layers. For instance, a thin plate of cobalt glass appears blue, a thick plate red. In such substances the fraction of the incident light absorbed in a layer of given thickness varies markedly with the wave-length. Thus if in the incident white light the green is visually more intense than the red, but the absorption coefficient for green in the substance is greater than that for red, a thin layer will appear green, a thicker layer, in which the green has been relatively reduced, yellow, and a thicker layer still, red. R. W. Wood has shown this well by dissolving the dyes "brilliant green" and "naphthalene yellow" in hot Canada balsam, and preparing a thin wedge of the substance between two glass plates; the thin edge of the wedge appears green, the thick edge red, the intermediate portion yellow. The fact that most bodies do not exhibit dichromatism means that their absorption coefficient is much the same for all wave-lengths.

The colour which a body exhibits must clearly depend upon the illuminating light. While there are certain exceptional substances which actually transform the light which falls on them to a different colour (*see* FLUORESCENCE AND PHOSPHORESCENCE) the ordinary pigment, whether natural, as in a flower, or artificial as in a dyed cloth, merely scatters back one colour of the mixed light falling upon it, and absorbs the rest; if the colour which we normally attribute to the body is not present, or is present only in reduced quantity, in the illuminating light, then the appearance of the body will be much modified. If a piece of white paper is placed in various coloured lights it will in each case take on the colour of the light, appearing blue in blue light, green in green light. If, on the other hand, a red poppy is placed in blue light it will appear black, for it completely absorbs blue light: in red light it will appear brilliant red, in yellow light a less brilliant yellow and in the green very dark indeed. The average blue pigment appears black in red, orange or yellow light, greenish in green light, for most blues do not completely absorb the green, and, of course, blue in blue light. The modifications in appearance which coloured bodies undergo with change of illumination is familiar to most people from the change in appearance of fabrics in natural and artificial light. This is particularly marked with blue, in consequence of the fact that artificial light differs from daylight chiefly by relative deficiency of blue. Thus a cloth that appears blue by day will appear nearly black by artificial light, for it absorbs all colours but blue, and there is little blue present in the illuminating light. Petruschewski showed that a white surface illuminated by light from a petroleum lamp presented exactly the same appearance as a dark orange surface illuminated by daylight, and a bright blue surface seen by the petroleum light matched a bright brown surface seen by daylight.



FROM L. C. MARTIN, "COLOUR AND METHODS OF COLOUR REPRODUCTION" (BLACKIE)

FIG. 1.—CURVES SHOWING THE RELATIVE ENERGY OF THE DIFFERENT SPECTRAL REGIONS FOR VARIOUS SOURCES OF LIGHT, ALL COMMONLY TERMED WHITE

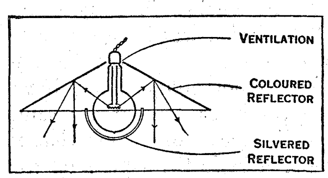
While most ordinary bodies, such as pigments, exhibit the absorption, or *body colour* which has just been discussed, with certain bodies the light that is reflected at the surface, without penetration, shows a marked colour. Such bodies are said to reflect selectively, and to show *surface colour;* they show a different colour when viewed by reflected light from that which they exhibit when viewed by transmitted light. Many of the aniline dyes show strong surface colour when prepared in thin films. The colours of the metals are of this nature; gold, for instance, which shows the well known yellow colour by reflected light, appears green by transmitted light, as can be easily shown by placing a goldleaf between two plates of glass, and looking at a white light through it. The leaf is thin enough to transmit an appreciable quantity of light.

Colours due to other physical causes also occur. Thin films, such as soap-bubbles, oil on water, and slivers of mica exhibit colours due to interference (*see* LIGHT). Films of uniform thickness exhibit a uniform colour, but wedge-shaped films, such as, using the term in a general sense, the air film between a slightly convex surface and a plane surface which gives rise to Newton's rings, show complicated sequences of colours due to the removal of different spectral regions by interference at the different thicknesses. The colours of certain iridescent crystals such as are found in potassium chlorate, and opals, are due to interference from a number of approximately equidistant thin laminae. The colour of the blue sky is due to the diffraction of light by small suspended particles and the air molecules themselves; the shorter wave-lengths, *i.e.,* those at the blue end of the spectrum, are more scattered by small particles than the larger wave lengths, so that, if light is passing through a medium containing such particles, an observer standing to one side sees the path of the light as blue (*see* LIGHT). As the blue light is not created, but merely scattered out of the white light, the beam itself will become redder. This accounts for the red appearance of the sun at sunset, when the rays pass through a great thickness of scattered particles, and on foggy days, when the number of particles in the atmosphere is large. The colours of the rainbow are due to interference, the refraction and general theory being more complicated than the refraction explanation given in elementary text books.

White, Black and Grey.—When we turn to the question of what precisely is meant by white light, which has been so frequently mentioned, we are confronted by the fact that there is no precise standard. It can be roughly defined as sunlight at noon on a clear day. It is necessary to mention the time of day and the atmosphere since the relative intensities of the different colours into which sunlight can be resolved are affected by the absorption of the atmosphere, so that sunlight in the early morning, at noon and at late afternoon is not of precisely the same colour. The colour of sunlight will similarly be slightly different at noon on a clear day in different latitudes. Artificial lights which are usually called white differ still more among themselves and are all much yellower than sunlight, that is, the blue end of the spectrum is relatively faint in the artificial light (*see* fig. 1).

White light serves to emphasize the fact that identical colour sensations can be produced by different physical stimuli. Not only can any white light containing all wave lengths be imitated by the mixture of light of three different narrow spectral regions, but there are various pairs of colours which, when taken together in correct proportions, produce the sensation of white. Any two colours constituting such a pair are called complementary colours. Such pairs are red light of wave length $\cdot 656\mu$ and bluish green light of wave length $\cdot 492\mu$; yellow light of wave length $\cdot 585\mu$ and blue light of wave length $\cdot 485\mu$. The most skilled eye is quite unable to analyse a white light or a coloured light into its spectral components.

The fact that "white" artificial light differs so markedly from white daylight, by reason of its deficiency of the blue end of the spectrum, leads to coloured fabrics appearing quite a different colour in daylight and in artificial light, as has already been mentioned. To obtain an artificial illumination which shall make coloured objects appear as they do in daylight, various types of so-called "daylight lamps" are made, which are extensively used by those who deal in fabrics. One such lamp is the Sheringham daylight lamp, illustrated diagrammatically in fig. 2, on which an ordinary electric hot wire lamp is used. The light from this lamp is thrown by a silvered reflector, which cuts off all direct light, on to a shade, the inside of which is covered with patches of colours in which green and blue predominate. These green and blue patches absorb most of the red end of the spectrum, while throwing back the green and blue practically unabsorbed, and so increase the relative proportion of the blue end in the way required to give a rough imitation of daylight. A body which absorbs a large fraction of the incident light, without absorbing any one colour markedly better than another, throws back a feeble white light, and appears grey. A body which absorbs completely inci-



FROM L. C. MARTIN, "COLOUR AND METHODS OF COLOUR REPRODUCTION" (BLACKIE)

FIG. 2.—THE SHERINGHAM LAMP FOR PRODUCING A LIGHT EQUIVALENT TO DAYLIGHT BY MEANS OF A COLOURED REFLECTOR

dent light of all wave-lengths throws back no light, and appears black. Black is an absence of all colour. Helmholtz says that black is a true sensation, even although it is produced by the absence of all light, and seeks to justify this somewhat paradoxical statement by pointing out that an object in our field of view which throws back no light appears black, but an object behind our back, which also throws no light into the eye, produces no sensation.

Classification and Measurement of Colour.—If we wish to classify the colour sensations produced by the light from coloured bodies the immediate problem is not to analyse the light physically into its different wave-lengths, each of a given intensity, but rather to find the simplest way in which the same colour sensation can be produced. It is a fact of experience that, apart from intensity, *i.e.,* the brightness of the colour, any colour can be matched by a spectral colour to which a proportion of white light has been added. Pure spectral colours, without admixture of white light, are said to be *saturated,* and, in proportion as white light is added, become less and less saturated. The spectral colour is usually referred to as a *hue,* the term colour being reserved for the general sensation. The statement that any colour can be matched by a spectral hue to which white has been added requires qualification, for the purple sensation cannot be so matched. A saturated purple is itself produced by mixing light from the violet and red ends of the spectrum, and such a purple must be added to the spectral hues to complete the description. The purple hue, which is compounded of the ends of the spectrum, can be regarded as affording a transition from one end to the other, so that the hues can be arranged in a circle, with purple between the red and violet, forming a bridge from one to the other. We may, then, taking the spectral colours and purple as saturated hues, say that colour sensations can differ in three respects only: hue, saturation and intensity. This classification was introduced by Helmholtz. Expressed somewhat differently, the sensation produced by any given coloured light, however mixed it may be physically, can be matched by a certain quantity of white light and a certain quantity of a saturated hue. To specify the sensation we must give the wave-length of the hue and the quantities of white light and of this coloured light. If we are dealing with a coloured surface we must clearly illuminate it with some kind of standard white light in order to make a measurement of the hue and saturation. The intensity of the light from the coloured surface will be proportional to the intensity of the illuminating light. It is therefore reasonable to take, as a measure of the intensity of the colour of the body, the ratio of the brightness of the light proceeding from the body to the brightness of the light from a perfectly white surface similarly illuminated. The term *brilliance* is often used, especially in America, to denote this ratio.

Newton arranged the saturated hues round the circumference of a circle as shown in fig. 3, and placed at the middle of the circle white. Any line joining the centre W to a point P of the circumference then represents the transition from the saturated hue represented by P to white light, the degree of saturation lessening to zero as we approach the centre. Newton also gave a rule by which the result of mixing colours could be obtained from his figure, certain weights being attributed to each spectral hue, and the centre of gravity found. This two-dimensional figure has been variously modified, a colour triangle being a more usual method of representation (*see* VISION). If, as Lambert did, we use three dimensions and let lines normal to the surface represent intensities, diminishing as we go upwards, we can represent any colour sensation. We have a pyramid of colour, the point of which will represent black. There have been many modifications of this three dimensional representation of colour sensation, designed to get over certain difficulties which arise in respect of the

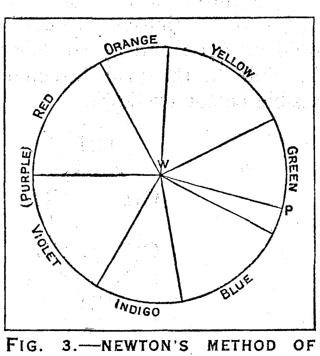


FIG. 3.—NEWTON'S METHOD OF COLOUR CLASSIFICATION

luminating values of the colour sensations. One of the most recent is that of Munsell, in which the three co-ordinates are:—the height of the point from the horizontal plane, representing the intensity, or brilliance; the distance from a vertical axis, representing the saturation; and the angle from a vertical plane, representing the hue.

A method of colour classification much adopted, on account of its simplicity of use, among those practically concerned with colour, such as manufacturers of paints and printing inks, is some form of colour atlas or colour chart, in which patches of various colours are arranged on some system. The Munsell colour tree to which reference has just been made is used to effect the classification in such a chart, known as the Munsell colour atlas, issued by the Munsell Colour Company, in America. Ostwald in 1917 brought out a very elaborate colour atlas, with about 3,000 colour specimens. He used a special classification—hue, white-content, black-content—in place of Helmholtz's hue, saturation and intensity. The Société des Chrysanthémistes issues a colour chart with colour names in four languages. A necessity of any such colour chart, is of course that all copies shall conform accurately and that the colours shall not fade.

A large number of instruments have been devised for colour measurement. For scientific investigations of colour perceptions much use has been made of the colour-patch type of apparatus, in which lights of two or more different wave lengths, isolated from a spectrum by slits, are brought into coincidence as superimposed patches on a white diffusing screen. The intensities of the separate colours can be varied so as to produce all possible shades. This apparatus exists in various forms. For technical work instruments are now being constructed in which, instead of a spectral hue, light which has passed through an arbitrary colour filter is being used. The three beams of light, one of which has passed through a red filter, the second through a green filter and the third through a blue filter, are brought into superposition on a screen. Each beam can be varied in intensity. One of the best forms of such apparatus is due to Guild. In Guild's trichromatic colorimeter the light enters by three sector-shaped windows, provided respectively with red, blue and green filters. By the mechanism of a revolving prism the field is illuminated by light from the three windows in rapid succession. When the speed of alternation is high enough the sensations blend and the mixed colour is perceived. Still another type of instrument, called the tintometer, depends upon passing the light *successively* through three filters of different colour, each of which subtracts something from the original white light. Although only three colours are chosen each must be represented by a series of various depths of colour, so that some 470 glasses are necessary in a complete matching set. The match is then given in terms of the depth of colour of each of the three filters which, placed one behind the other, transmit the given light.

A different type of apparatus is the spectrophotometer, by means of which the physical constitution of a coloured light may be actually measured. The light is resolved into a spectrum, and the intensity of each wave-length present is measured separately. This measurement is usually effected by the help of a standard source of white light, the intensity of the transmitted hue being controlled by polarizing prisms of one type or another. If two such prisms are used, one as polarizer and the other as analyser, the intensity of the light transmitted can be controlled by rotating the analyser, the angular position of which gives an exact measure of the percentage of light cut off (*see* LIGHT). The Nutting spectrophotometer and the König-Martins spectrophotometer are two well-known instruments which make use of this principle (*see* PHOTOMETRY). Such instruments are largely used for measuring the light transmitted by colour filters, coloured glasses, dyes and so on.

A third type of instrument is the colorimeter of the Nutting pattern, which matches any given coloured light by manufacturing a light of given hue, saturation and intensity. A spectral hue is separated out from a spectrum by means of an adjustable slit, and a given quantity of white light is added from a separate source. This gives adjustable hue and saturation. The intensity is varied by altering the width of the slits, or else by other means commonly used in physical instruments, such as rotating sectors with controllable gaps or polarizing prisms.

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INFLUENCE OF CHEMICAL CONSTITUTION

The sensation of white light is caused by electromagnetic vibrations of a certain wave length impinging on the retina of the eye. The sensation of colour is produced by the absorption of one or other of the coloured components of white light when the light strikes some suitable surface or passes through a suitable medium —the light reflected from the surface or transmitted through the medium consequently conveying to the retina a sensation of colour complementary to that absorbed. There is an analogy between variations of colour in light and pitch in sound.

Many substances do not absorb any definite portion of the visible spectrum—the name applied to the range of colours into which white light can be resolved—but give *general* absorption throughout the range.

Such substances appear, therefore, colourless both by transmitted and reflected light and it is only those materials which cause selective absorption, that is which absorb some definite portion of the visible spectrum, that appear coloured. It follows, therefore, that there must be some special property possessed by substances which produce the sensation of colour which distinguishes them from other substances that appear colourless.

As a matter of fact it is quite easy to detect the causes leading to the main underlying difference between the two types, for they may be divided into two classes which, for the sake of convenience, may be named the physical cause and the chemical cause; and, in the first instance at any rate, the reason for production of colour is quite clear and it is a comparatively simple matter to reproduce the effect mechanically. For example, white light is resolved into its component colours when it is allowed to impinge on a glass surface which has been ruled with a number of fine lines, and there are a number of other ways by which the sensation of colour can be imparted by purely mechanical means.

As a matter of fact many natural objects, especially in the animal kingdom, owe their colour to the physical cause. The vivid green of certain beetles, the colours of the peacock's feathers, the colours of butterflies' wings and the colour of blue eyes are all produced in this way, the colour effect being caused by the interference of white light through the agency of minute excrescences or fine filaments on the surface of the objects that appear coloured. The colour effects in such cases are, therefore, subjective and it would be just as reasonable to attempt to extract a coloured substance from the peacock's feather as it would be to do so from the rainbow.

On the other hand there are a great number of substances the colours of which must be ascribed to the second or chemical cause. These occur both naturally and artificially and are distinguished from those of the first or physical section by reason of the fact that the coloured substances in them can be extracted from the coloured materials and, when extracted, are found to be definite chemical compounds which owe their colour to their chemical constitution. In nature such coloured substances are to be found mainly in the vegetable kingdom, in the colouring matters, for example, of the flowers and of green grass or leaves. Moreover, it is easy to distinguish by a practical test between the two types because if a peacock's feather is viewed by transmitted light the brilliant colours will disappear, whereas, if a red rose leaf is treated in the same manner no change in colour will be noticed.

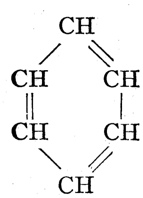
Nevertheless, it is only reasonable to suppose that the two types of phenomena are of the same order and that whilst the physical or subjective colour is due to the *intermolecular* interference of white light, the chemical colour is due to *intramolecular* interference, or, in other words, white light is "filtered" through the molecular structure of the chemical substance, leaving a "portion" behind in its passage. The colour is therefore dependent on the chemical composition of the particular compound. It remains then to compare those chemical compounds which produce colour with those that are colourless so as to reach some conclusion as to the influence of molecular structure on colour production. In the first place, however, it is necessary to attempt to arrive at some definition of what is meant by colour in a strictly scientific sense.

The Spectrum.—The range of the visible spectrum which is produced, for example, when a beam of white light passes through a quartz prism, represents a range of electromagnetic vibrations of wave lengths between 4,000 and 8,000 Ångström units. This is, however, only one octave in the range of 62 octaves of wave lengths from 0·01 to $3{\cdot}5\times10^{16}$ Ångström units which has been investigated. It is clearly, therefore, scientifically illogical to restrict the term "coloured" to those substances which cause absorption only in the short region capable of detection by the eye, because a substance which produces selective absorption in any other region of the electromagnetic range is also "coloured" although such colour requires the aid of some external influence in order that it may be detected.

It is necessary, therefore, to distinguish between *visible* colour and *invisible* colour and to describe those substances which give selective absorption in the visible region as visibly coloured and those which give selective absorption in other regions as invisibly coloured.

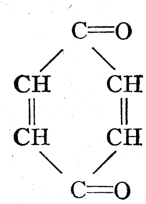
Infra-red and Ultra-violet Regions.—It is fortunate that the photographic plate is more sensitive to waves immediately outside the visible region of the spectrum than is the eye, for by its aid it is possible to detect selective absorption in those regions immediately outside the visible spectrum, which are known as the infra-red and the ultra-violet, and thus to show that many substances which appear colourless to the eye possess nevertheless intense invisible colour. Moreover, it is possible by simple chemical reactions to transform compounds having this invisible colour into those having visible colour or, in other words, by a change of structure, to throw the absorption from the invisible region into the visible region. In this way it is possible to correlate structure with visible colour.

For example, the hydrocarbon benzene (C_6H_6) appears colourless to the eye both by reflected and transmitted light, nevertheless when its spectrum is photographed marked selective absorption in the ultra-violet region is manifested. Benzene is, therefore, a substance having a strong invisible colour. By a simple series of reactions it is possible to transform benzene (I.) into quinone (II.) and by so doing to shift the absorption from the invisible to the visible region of the spectrum, thus obtaining visible colour (yellow).



I.

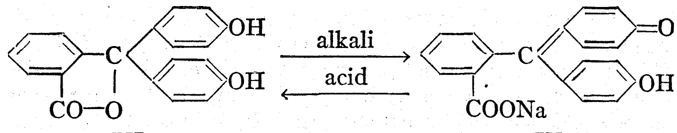
Benzene (invisibly coloured)



II.

Quinone (yellow)

Absorption.—This change, in the case of many derivatives of benzene, takes place with remarkable ease and with astonishing rapidity, thus the change from phenol-phthalein (III.), the benzenoid or invisibly coloured form, to the sodium salt (IV.), the quinonoid or visibly coloured form, by the action of alkali, and the reverse change which is effected by the action of acid, is so rapid and sensitive that the substance is used as an effective indicator in alkalimetry.

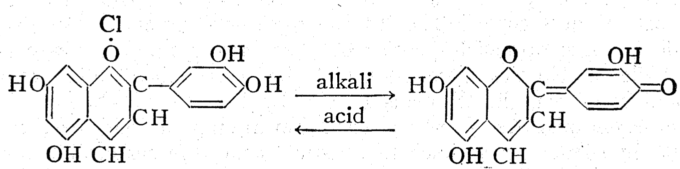


III. Benzenoid form (invisibly coloured)

IV. Quinonoid form (red)

The hydrocarbons naphthalene ($C_{10}H_8$) and anthracene ($C_{14}H_{10}$) provide further examples of the same kind and, in fact, the occurrence of colour among organic compounds which has led to the foundation of the coal-tar colour industry is based mainly on this change. It is also possible to start with a benzenoid derivative which by reason of its structure is visibly coloured and by a simple chemical change, such as that illustrated above, to throw absorption from one end of the visible spectrum to the other and thus to transform a red substance into a blue one. As a matter of fact Nature has utilized this method to produce her red and blue flowers. The red flowers are those in which the cell sap is acid, the blue those in which it is alkaline. If the cell sap is neutral the flowers are purple.

(*See* also ANTHOCYANINS AND ANTHOXANTHINS.)

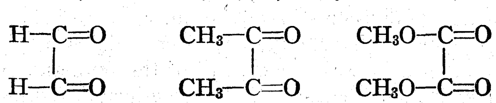


Red (rose)

Blue (cornflower)

It would appear, therefore, that the occurrence of visible colour is mainly adventitious and depends on molecular conditions which are subject to control. It happens to be a property of the quinone ring because the parent substance benzene possesses the power of causing absorption just outside the visible region. Even so, the formation of the quinone ring may not shift the absorption of benzene far enough to bring it within the visible region, and there are thus derivatives of quinone which have no visible colour. On the other hand the shift of the bands may be caused by other structures and there are, in consequence, derivatives of benzene such as azobenzene, $C_6H_5{-}N{=}N{-}C_6H_5$, to which no quinone structure can be assigned, yet which possess strong visible colour.

If the wider definition of colour be accepted it is probable that there is no such thing as a colourless material, because it is likely that every substance gives selective absorption somewhere within the range of electromagnetic vibrations. It appears to be in the power of many substances belonging to the aliphatic series of organic chemistry to give selective absorption in the infra-red region of the spectrum. Visibly coloured substances in this portion of organic chemistry are not of frequent occurrence, but when such colour occurs it is always associated with the presence of what is known as the conjugated system of double linkages; thus glyoxal (V.) and diacetyl (VI.) are yellow:—



(V.) (VI.) (VII.)

Methyl oxalate (VII.) is, however, visibly colourless and it must be assumed that in this case the infra-red absorption has not been thrown into the visible region. It is of interest to note that the same system of conjugated linkages is present in the conventional formula for benzene (I.).

Colour in Chemistry.—It is also significant that visible colour is shown only by unsaturated carbon compounds and that in no case has a visibly coloured saturated compound been prepared. It follows therefore:—That both visible and invisible colour are associated with unsaturation. That they are associated with the occurrence of selective absorption either outside or within the visible region of the spectrum, the former causing invisible, and the latter visible colour. That occurrence of this absorption is bound up with the presence of a system of conjugated double linkages within the molecule. (*See* also DYES, SYNTHETIC.)

The causes leading to the production of visible colour in inorganic compounds will not be clearly understood until more is known about the molecular structures of such substances. It is obviously due, initially, to the presence of a colour-producing element such as copper, chromium, cobalt, etc. The cause of colour in these elements is probably molecular, as instance the change in colour iodine undergoes when heated. Nevertheless the structure of the salt must also play a part as is shown, for example, in the disappearance of the blue colour of hydrated copper sulphate when it loses part of its water of hydration. In any case the causes of visible colour in this section of chemistry are not so clearly defined as they are in the organic section, and no useful purpose would be served by dealing with them in the present state of our knowledge. (*See* also RADIATION, RAYS; VISION OR SIGHT; LIGHT; OPTICS; SPECTROSCOPY.)

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(J. F. T.)

COLOUR AND RACE. The political and social questions involved in the differences of colour and race have gained in intensity and importance in the 19th and 20th centuries. Closer geographical contact, the spread of more uniform patterns of civilization and aspirations all over the earth, and especially the proclamation and propagation of the "racial" interpretation of history have emphasized a growing trend. In the political and social controversies much confusion is due to the indiscriminate interchange of three different meanings in which the word "race" is used today. The tension produced by colour and race theories is responsible for some of the most fateful misinterpretations and maladjustments which threaten to engulf many countries, and perhaps mankind itself, in bitter racial conflicts and to demoralize human relations by racial arrogance and colour prejudice.

The word race is primarily a biological term (*see* RACES OF MANKIND) and denotes groups of men differentiated by anatomical characteristics. None of them shows any fundamental or far reaching differences among the races: in all essential features mankind is one and clearly differentiated from all other species of the animal world. It is only in minor secondary attributes, like shape of skull, form of nose, texture of head hair, quantity of body hair and colour of skin that there is any measurable or appreciable difference among the various racial groups. The Biblical story of the common origins of the human race has not been contradicted by any modern scientific discovery.

Old and primitive superstitions have linked race and class with blood. In reality no such link exists. Medical science, in its early attempts at blood transfusion, has discovered four different types of blood; but these types, called O, A, B and AB, are found among all races. Certain of these blood types do not mix without agglutination of the red cells. Modern medical practice has eliminated this danger by the removal of the red and white blood cells; the remaining plasma in its dried form is entirely independent from all types of blood and equally usable for all men.

Of the non-essential differences among human groups those of the texture of the head hair and of the colour of the skin are most frequently used to establish a division of mankind into primary races. The various shapes of the skull (dolichocephalic or long-skulled, mesocephalic or medium-skulled, brachycephalic or short-skulled) are found among all the primary races. A clearer line of division is offered by the texture of the head hair, distinguishing the Caucasians with wavy hair (Cymotrichi), the Mongolians with smooth or lank hair (Leiotrichi) and the Negroes with frizzy or woolly hair (Ulotrichi). These differences of the texture of the head hair overlap, however, with the differences of colour, as there are black African tribes with wavy hair. Differences of the colour of the skin lead to the establishment of three similar primary races. Chemical research has established that the different shades of the skin are due to the quantity of two chemicals in the skin, melanin which darkens it, and carotene which gives it a yellowish colour. People with the whitest skin are found in northern Europe and are called Nordics, people with the blackest skin live in West Africa, while people in southeast Asia are distinguished by yellowish tan. The majority of men, however, are neither white, black nor yellow, but represent innumerable shades of swarthy and brown men.

Whatever the anatomical differences of various races, there is no scientific proof for any correspondence between colour or texture of hair and mental ability. The idea that differences of colour imply differences of mental ability is comparatively recent. All civilization originated with "coloured" races, the yellow men in the Chinese river valleys, the brown men of India, Mesopotamia and Egypt, and the swarthy men of the Mediterranean basin. Among them all the great religions of mankind were founded; their depth of religious feeling and of metaphysical thought was never surpassed in Nordic lands. Throughout the middle ages Europeans and orientals met as equals; Greek civilization was transmitted to the rising universities of the west by Arabic scholars.

Marco Polo travelling to the far east was awed by the splendour of the oriental realms. Islamic civilization, including Caucasians, Negroes in Africa, and brown men in the East Indies, has always been entirely free from any colour feeling. It began to show itself only after the centre of western civilization shifted from the Mediterranean to the North Atlantic.

With the 16th century began a rapid progress of western European civilization in the conquest of nature, in scientific research and in the application of rational and very soon also humanitarian principles to the art of government. In the 18th and 19th centuries far greater progress was achieved in the North Atlantic region in these fields than in all preceding ages and civilizations. Equipped with the new methods of science and government, the European communities, especially those bordering the north Atlantic and the North sea, soon faced the other lands and peoples with such a superiority that by the middle of the 19th century the whole globe was controlled by western men. Ancient and powerful empires like the Chinese, the Moghul, the Persian and the Ottoman empires, had to bow before the superiority of the rising influence of the white men, a superiority based not only on scientific rationalism and technical inventiveness but above all on a new spirit of civic responsibility, of individual initiative and of enlightened humanism.

In the middle of the 19th century Count Joseph Arthur Gobineau in his book *Essay on the Inequality of the Human Races* proclaimed the true Nordic Germans, whom he identified with the French aristocracy, the supremely creative race. According to him the human races were most unequal in creative ability; it was impossible for them to reach the same level of cultural life; he ascribed the decay of the Nordic race, which he as a violent opponent of all democratic trends believed to be taking place in the 19th century, to race mixture. This theory found only very few followers in France or England, but it was taken up and popularized by German scholars, propagandists, and artists like Richard Wagner, who developed a race theory based upon two premises: that there is a definite hierarchy of races and that the German race (sometimes identified with the Nordic and sometimes with an "Aryan" race) is the highest and most creative race; and that the ability of a race depended upon the "purity of its blood" and that therefore intermarriage was detrimental to civilization. This theory, widely held in Germany even before the rise to power of national socialism, became in 1933 the official fundamental doctrine of German science and of the German state. Its propaganda outside Germany served as an instrument of German aspirations. This accentuation of racial prejudice was one of the most aggravating factors in the era of violent political and intellectual clashes following the rise of national socialism. It was German influence which made the racial myth an integral part of all fascist movements to which it had originally been alien.

In reality it is impossible to define any modern nation by somatic characteristics. The whole "mythical" and unscientific character of the racial theory was recognized by the leading German authorities themselves. For how many people in Germany corresponded to the "Nordic" character of blond, tall, blue-eyed and straight-nosed humanity? Among all nations racial intermixture has gone on everywhere over a long period. Sexual attraction is common between men of different races, and even taboos and legislation have been unable to check it. Negroes and whites in the Caribbean and in the United States, Spaniards and Indians in Central and South America, Boers and Hottentots in South Africa have successfully intermingled. There exists no objective proof to show that offspring of even widely different races decrease in efficiency, intelligence or vitality.

This insufficiency of somatic characteristics led the "racialists" to use the word "race" increasingly in the ethnical sense meaning "nation" or "people." Thereby the confusion and the propagandistic value of racial theories has been many times increased. While the Nordics represent a biological race, tall, blond-haired and blue-eyed, the Germans or the English are not biological races but mixtures of several races; they are nations held together not by common somatic characteristics or uniform descent but by a common civilization and loyalty. Nor are there any Polish and Russian "races"; both are sometimes regarded as members of the same Slavonic "race," but in reality they represent nations with different civilizations and loyalties. Even Slavs are not a "race," but a linguistic group, peoples of Caucasian, Tartar, Finnish and many other racial strains, yet speaking closely related languages.

Race can be as little identified with modern nations, as with linguistic groups. The term "Aryan" does not denote any racial community, but a linguistic group, people speaking Aryan or Indo-European languages, a group including Nordics and coloured people, white men and brown men. Languages and civilizations have migrated and have been imposed or accepted irrespective of any boundaries of race or colour; in the 7th century Arabic became the language of all the various peoples in Syria and North Africa, while Latin was accepted by the Iberians in Spain, the Celts in Gaul, and the complex racial mixture living in Rumania.

With the failure of somatic or any other objective characteristics the racialists fall back upon the "racial spirit" or *Volksgeist*. Unfortunately the Nordic racial spirit is not "instinctively" shown by all men of Nordic "blood"; it has even to be forced upon Germans, and the truly Nordic Norwegians show very little of it and are predominantly dominated by the "un-Nordic," "unheroic" spirit of Western or "Jewish" liberalism. The German racialists regard what corresponds in their opinion to the presupposed mythical racial soul as *arteigen,* what is alien to the racial character as *artfremd.*

Yet the general division of mankind into several primary races, largely distinguished by colour, is a fact which gained political and social importance with the growth of the "superiority" of the white race in the 19th century. This "superiority" did not remain unchallenged. Western civilization, fundamentally rational and liberal, regarded itself from the beginning as universal in scope and its message of liberty destined for all. With the spread of European control throughout Asia, Africa, America and the Pacific, the European methods of political and economic organization and the underlying civilization of rational humanism and belief in progress began to influence the non-European populations and to arouse them from the tradition-bound ways of life. The European skill in administration, the integrity of the judicial system and the blessings of ordered liberty were understood and partly assimilated by tiny but growing numbers of non-European intellectuals. With the spread of European education the populations of India, China and other countries began to accept the western methods and standards as their own and to resent the superiority of the white man, especially its often tactless and arrogant assertion.

It was above all the contact with the liberal civilization of England, the mother country of modern liberty and of the spirit of tolerance, as it began to develop in the 17th century, which infused a new spirit into the coloured races, as it had influenced the growth of liberty in France and in the European countries. England offered the best example of a political organization which succeeded in adapting itself to a changing public sentiment with unparalleled flexibility and without doctrinaire theorizing; at the same time it derived its vigour from ideas which seemed to promote the evolution and the liberties of all mankind. English rule brought the most powerful ferment to the coloured races, especially to India, from where it began to radiate to the far east on the one hand and to Mohammedan Asia on the other. English policy and methods stirred the desire for extended liberty and self-government, unknown formerly in the orient. In bringing to the orientals English civilization and ideas, England roused in them the desire for their political freedom which is the inherent right of civilized man in the western concept.

As chairman of the Committee of Public Instruction in India, Thomas Macaulay presented in 1835 a memorandum pleading for the introduction of a system of education based upon the knowledge of natural science and of the growth of the tradition of liberty from ancient Greece to 19th century England. He wrote:

"It may be that the public mind of India may so expand under our system that it may outgrow that system, and our subjects having been brought up under good government may develop a capacity for better government, that having been instructed in European learning, they may crave for European institutions. I know not whether such a day will ever come, but if it does come it will be the proudest day in the annals of England."

This belief in the idea of liberty and in progress through education was later also applied in the United States to its coloured peoples, whether Negroes within the continental limits or dependent peoples in the Pacific and Caribbean areas. Under the influence of western ideas the educated classes among coloured peoples began, at the end of the 19th century, to demand complete equality; they became the leaders in the "revolt of the east," the rising tide of the coloured peoples which in the 20th century made itself felt in varying degrees yet without exception, among Indians and Negroes in the Americas, in Africa and above all in Asia.

With great justice the Montagu-Chelmsford Report on Constitutional Reforms in India (1918) characterized India's intelligentsia in a way applicable to the modern intelligentsia of all coloured peoples:

"Our obligations to them are plain, for they are intellectually our children. They have imbibed the ideas which we ourselves have set before them, and we ought to reckon it to their credit. The present intellectual and moral stirring in India is no reproach but rather a tribute to our work . . . we owe him (the educated Indian) sympathy because he has conceived and pursued the idea of managing his own affairs, an aim which no Englishman can fail to respect."

The multi-racial character of the empire was at the same time stressed:

It "can not be based on ties of race. It must depend on a common realization of the ends for which the empire exists, the maintenance of peace and order over wide spaces of territory, the maintenance of freedom and the development of the culture of each national unity of which the empire is composed."

The intellectual and moral stir among the coloured peoples and their desire for managing their own affairs and for complete equality was greatly accelerated by the victory of Ethiopia over Italy in 1896 and above all of Japan over Russia eight years later, the first two defeats of white powers by coloured peoples in modern times. Japan, which succeeded within a few decades, by unsurpassed national energy and discipline, in modernizing its governmental and economic structure and being recognized as an equal by the white powers, set an example for the coloured races everywhere. Unprecedented revolutionary movements shook the ancient theocratic empires of Persia (1906), Turkey (1908) and China (1912) and converted them into constitutional monarchies or republics after the 19th century western model. These revolutions aimed not only at internal reform but also at securing complete independence from foreign interference. Equality and self-government became the goals of all peoples under white control. In the Americas the Indians began to stir after four centuries of lethargy and oppression, and the revolution in Mexico in 1917 succeeded in their interests. The coloured and oppressed peoples of the Russian empire saw in the revolution of 1917 an opportunity for equality and self-government and their aspirations were, at least partly, fulfilled by the soviet government which granted complete equality to all the races of the multi-racial empire. This new status of the coloured peoples in the Russian empire acted as a powerful stimulant also outside its borders and contributed largely to the growing demand for equality among the coloured races. Nor did the Allied slogans of self-determination during World War I prove less effective. Constitutional reforms were everywhere introduced, the facilities for education and economic development increased, and a new feeling of confidence and rights began to animate the masses of the coloured peoples. The example of complete emancipation of dependent peoples was first set by Britain, which gave independence to Egypt (1922, completed 1936) and to the Arabs of Iraq (1932), and followed by the United States in 1934 when congress promised to grant independence to the Philippine Islands after a transitional period of 12 years.

A widespread popular error assumes that racial conflicts and colour prejudice are confined to the relations between white and coloured populations. But racial arrogance and conquest and exploitation of weaker races have been practised by all races, white and coloured alike. Coloured races, whether Asiatic Mongols or African Bantus or American Aztecs, have been great conquerors throughout the ages, many of them down to present times, and they have on the whole treated their subject races with greater cruelty than the white man has in modern times. In fact in many coloured areas like India and Africa the white man's administration has brought peace and has, by establishing the principle of equality before the law, considerably lessened existing racial conflicts and exploitations.

The most extreme system of colour bar and racial prejudice prevails in the caste system of Hindu India which has been sanctified by religious tradition. As the name for caste, *varna* or colour, reveals, the hereditary and strictly separated castes were originally determined by colour. The lowest of these castes, the so-called untouchables, *pariahs* or *panchamas*, represent in all probability the aboriginal deeply dark-skinned races who have retreated before the more light-skinned "Aryan" invaders from the northwest to the south. According to the Indian census of 1941 their number amounted to 48,813,180 among a total population of 254,931,000 Hindus. Their position among the Hindus has been infinitely worse than that of the Negroes in the Union of South Africa or in the southern United States. It amounts to a Jim Crowism of fantastic proportions. Only lately the position of the untouchables has improved; one of them, Bhimrao Ramji Ambedkar, became through the help of a native prince a doctor of science of Columbia university and was appointed a member of the Viceroy's Executive council in charge of the All-India department of labour.

Nor are the coloured races free of a highly elated racial superiority complex equalling, by the open assumption of divine sanction, even the most extreme cases of white racial superiority feeling. Japanese imperialism has been based on a racial theory similar to that of Germany. As the Germans regarded themselves as a race set apart from other white-skinned people (Poles or Czechs), and destined to govern them irrespective of colour, so the Japanese established an official religion of state, Shintoism, which proclaims Japanese racial superiority over all others, whatever their race or colour. The Japanese regard their country as "the Land of the Gods, whence we perceive the reason why our national structure is supreme among all the nations of the world." Japan was founded, according to the official Japanese doctrine, by the sun goddess, Amaterasu Omikami, from whom the imperial house is descended. Japan and the Japanese emperor are therefore singled out above all other nations for world domination, the divine Japanese imperial throne, "coeval with heaven and earth," is destined in the official word to "bring the whole world under one roof," the sacred policy of Hakko Ichi-u.

Racial conflicts and prejudices in the coloured world are in no way confined to the Japanese empire. Even light-skinned Negroes feel a "colour prejudice" against the black Negroes with pronounced Negro features. The Chinese empire has extended its dominion over numerous non-Chinese tribes in southwestern China, over Mongolia, Tibet and Sinkiang, and in the recent past over countries like Annam, Siam and Burma, which all wish to maintain or to regain their independence. Racial conflicts among colonial races are not only provoked by attempts at domination or by conflicting expansionist ambitions, or by the subordination of (often very large) minorities to majorities but also by immigration and economic competition. The immigration of British Indians to Burma has been as much resented as Chinese immigration to the Dutch East Indies, to Burma, Thailand and other oriental countries. The British colony of the Straits Settlements in Malaya had on June 30, 1940 a population of 17,322 Europeans, 149,074 Indians, 904,512 Chinese, and only 309,226 Malays. Even in the native Malay states the Chinese immigrants have outnumbered the Malays; there, as in many other oriental countries, the Chinese immigrants dominate most of the economic life of the land.

Nor are bitter "race conflicts" within the same colour group confined to Asiatics or Africans: they are as frequent among the whites, many of whom are speaking the same or kindred languages and are closely related in descent. The relations between English and Irish, Poles and Russians, Czechs and Germans, Hungarians and Rumanians, Castilians and Catalans, Croats and Serbs, Greeks and Turks, have evoked the same protests against "oppression," the same bitterness and affirmation of incompatibility of national temperaments as ever coloured races voiced against white control.

The position of coloured races is often much better in colonies dependent upon imperial governments than in independent countries where the white element predominates politically. The Negroes in British West Africa or in the French colonies of Guadeloupe and Martinique enjoy a much wider participation in political liberty, in economic and social advancement and educational facilities than the Negroes in the southern United States or in the Union of South Africa. In the latter, the Boer has been an especially hard master for the coloured population; his "colour feeling has something almost religious about it. He considers it his duty to hate black blood in all its manifestations" (Sarah Gertrude Millen). In the parts of South Africa under direct British imperial control, the position of the natives is much better. Cecil Rhodes regarded every educated man irrespective of colour or race as a citizen with a right to vote, but the complete independence granted the Union of South Africa led to a general deterioration of the position of the natives throughout its territory. The South African territories under imperial control, Basutoland, Bechuanaland and Swaziland, protect the status of the natives and their interests far better, and the natives have therefore violently protested all demands for the transfer of the territories from the British empire to the Union of South Africa. On the whole it may be said that the imperial government acts, often together with Christian missionaries, as the protector of native rights and well-being against the white settlers and their claims for self-government. This is the case in Rhodesia and in Kenya.

That colour feeling and resultant colour bars are nothing "natural" or "inherent" has been shown in a number of countries where harmonious relations among races in spite of differences in colour have been established. Such is the case in New Zealand where the small native Maori population enjoys complete equality, or in Brazil where the white population mingles with Negroes, Indians and mulattoes, without any feeling of colour bar. Brazil follows therein the example of Portugal where a strong African element, largely composed of imported Negro slaves, has been completely assimilated and absorbed. At present miscegenation is going on on a large scale in the soviet union. That even in countries with a severe colour bar no "instinctive" rejection of contact exists can be seen in the southern United States where Negroes occupy the position of trusted and intimate house servants.

From the end of the 19th century there has been much irresponsible and unrealistic talk of a great coming conflict of races, a final struggle between the white and the coloured man for the control of the globe. Japan's victorious war in 1894 and the Chinese Boxer revolt induced the German Emperor William II to predict "Asia's struggle against all Europe" and to warn of the "Yellow Peril." A generation later Oswald Spengler, one of Germany's representative thinkers, regarded the great coming decision as a war of the coloured peoples, among whom he counted the Russians, for the control of the globe against the white race. He summoned the white race, as Emperor William had done, to a crusade, under German leadership, against the spectre of a fusion of class war and racial war. At the same time some coloured people began to talk of a united coloured front, or of Asia for the Asiatics, without always explaining which Asiatics should dominate other Asiatics, and Africa for the Africans. None of these slogans, fears and hopes had any foundations in reality. Neither the white nor the coloured races did or could act as a united force with identical interests. In World War I as in World War II Japanese and Chinese interests and their political ideals were as opposed as German militarism and British liberalism. In Korea the Japanese are more hated, in the Malay peninsula the Chinese more feared than any white people. Though the Germans often envisaged a racial war for the conquest of the globe, nevertheless they ultimately fought their racial kin, the British and French, the Norwegians and Dutch, and allied themselves with racially much more distant peoples like the Italians, Magyars, Finns and the Japanese. The leading theoretician of National Socialism, Alfred Rosenberg, praised in *The Myth of the 20th Century* British imperialism in India as a dike against the flood of coloured barbarism and warned Britain in the interests of the white race not to yield to the Indian demands for dominion status. For the self-preservation of Europe, England was to stay in Suez, and Negroes in the United States should be deprived of their political rights and shipped to Africa. Rosenberg proclaimed as the aim of all German policy to "secure the political domination of the white race over the globe." To that end, the white man should not tolerate "any Negroes, any yellow men, any mulattoes, any Jew" in his lands. Though Germany has been leading in racial theories of this kind, there have been isolated individuals in other countries, who shared this vision or welcomed a coming war of colour. But the division of mankind and the lines of conflict have been drawn throughout the modern period, not according to colour, but according to national allegiance and political ideas. Nation fought nation, idea opposed idea, irrespective of colour or race. And many nations, especially the empires of Russia, Britain, the United States and France, included men of many races in a common loyalty.

Though colour and race are in no way a decisive factor in contemporary group conflicts, colour plays a special role, because it renders the conflicting groups easily recognizable, facilitates segregation, places each member irrevocably into his own group and renders the border line much less flexible than in any other order of division. These differences of colour make it easier to impose political, economic, social and cultural restrictions on weaker groups and to keep them underprivileged. These restrictions show a great variety, ranging from minor discriminations in employment and social intercourse to most serious handicaps, even to complete human degradation as with the untouchables under Hindu rule or to total annihilation as with the Jews in Germany.

The most acute colour problems are not found in the relations within empires or within the international world, but in some multiracial countries. There the policy pursued can be either one of segregation, rarely on the basis of equality, mostly on that of privilege or even of legal discrimination, or one of amalgamation. As environment and opportunity shape human character more than heredity, amalgamation is opposed rather from irrational motives than from any rational consideration. Racial segregation often serves as an artificial protection for the status of the poorer classes of the dominant race, as a weapon for the maintenance of privilege. Racial stereotypes are used to rationalize political and economic relations.

A further complication in colour and race relations is introduced by immigration policies, which wish to preserve the racial homogeneity of underpopulated countries and to that end bar the settlement or naturalization of members of certain races. Australia adopted such a "White Australia policy" at the beginning of the 20th century, Canada has barred the immigration of Asiatics, and the Union of South Africa has excluded Indians. The classical country of such an immigration policy is, however, the United States. According to the most reliable source, *A Century of Population Growth*, the white population of the United States in 1790 was, as regards their origins, 82.1% of English, 7.0% of Scotch, 5.6% of German, 2.5% of Dutch, 1.9% of Irish, and 0.6% of French descent. Negroes came to North America as early as 1619; in 1790 they numbered 19.3% of the entire population. The second half of the 19th century brought a large immigration to the United States which fundamentally altered the composition of the population, first in favour of the Irish, and later in favour of eastern and southeastern European elements. At the same time far eastern races began to settle on the Pacific coast. As the "melting pot" could not absorb these new immigrants fast enough, immigration quotas were introduced first in 1921 and then in the Immigration Act of 1924. The census of 1940 showed in a total population of 131,669,275 the following coloured races in the continental United States: 12,865,518 Negroes, 333,969 American Indians, 126,947 Japanese, 77,504 Chinese, 45,563 Filipino, 2,405 Hindus, 1,711 Koreans and 788 others.

Members of these races suffer under various, and often severe, legal or social disabilities. The Immigration Act of 1924 established the exclusion and the inability of naturalization for Asiatic immigrants. The Chinese Exclusion act, which was first passed in 1882, was repealed in 1943 by the congress of the United States as a recognition of China's fight as an ally in World War II, and in 1944 the government of India demanded a similar measure in favour of British Indians. Immigration of Japanese into the United States was for a time regulated by a "Gentlemen's Agreement," but the congress of the United States excluded all Japanese immigration by the Act of 1924.

The events leading to World War II, the extreme use made by the Germans of racial prejudice, the growing acuteness of the dangers of race conflict and of the involved human degradation, again put the demand for equal opportunity and equal rights of all races, irrespective of colour, into the forefront of public interest, for the questions of race and colour relations touch the roots of the social order. The majesty of justice and law, the substance of democracy and liberty, are threatened everywhere by the passions and fears evoked by race prejudice. Christian conscience as well as rational humanitarianism demand the recognition of human dignity and individual rights in every human being, irrespective of class, colour or race. The solution of the problems arising from colour and race forms one of the great tasks set before the generation liquidating World War II, in which both Germany and Japan have put the racial question into the centre of their propaganda.

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COLOUR-BLINDNESS, a term applied to a condition of vision in which the number of colours which can be differentiated is markedly less than normal. Many different types have been noted; Schjelderup recognizes at least 18 which need explanation by any theory of colour vision; and there are evidences of an indefinite variety of gradations from full trichromatic vision to total colour-blindness in which all things appear in shades of grey only. However, the data available at present indicates the following types as of principal importance: (1) anomalous trichromatism, involving a minimum of departure from the normal; (2) dichromatism, in which all colours can be matched by mixtures of two, instead of requiring three, elementary stimuli; (3) monochromatism, in which there is no discrimination of wave-length compositions, as such. Colour-blindness may rest either upon congenital and non-remediable conditions, or it may be a consequence of disease or injury to the optic nervous system. In the former case, the characteristics are biometrically more clear-cut than in the latter.

Colour-blindness of the first two types listed above is difficult to detect under ordinary conditions of life, because of the skill with which the affected individual utilizes brightness cues in judging the colours of objects. However, when presented with appropriately selected pigments, or with spectral stimuli, he may make egregious errors or show an easily measurable departure from normal. When an anomalous trichromat is required to match a spectral yellow with a mixture of spectral red and green, he may require either more red or more green than the normal, corresponding to the protanomalous and deuteranomalous conditions, respectively. For the protanomalous, reds are reduced in brightness as well as colour value, and the anomalous trichromats, in general, show weaknesses of the colour sense in the form of high thresholds, easy fatigability, increased contrast effects, and the like. It seems probable that anomalous trichromatism merely constitutes an extreme variant of normal trichromatic vision, which naturally differs in its exact characteristics from one individual to another.

Dichromatism represents the most common form of colour-blindness, being a characteristic of about 4% of males and about one-tenth this proportion of females. It shows the properties of a sex-linked character in the Mendelian scheme of heredity. These statements apply primarily to the two forms which are known as protanopia and deuteranopia, respectively. Tritanopia, a rarer dichromatic condition, is associated with pathological rather than with hereditary defects. Both of the first two forms are characterized by an inability to distinguish between reds and greens, when these colours are adjusted to the same brightness, for a given individual. In both types, a narrow region of the spectrum, having a wave-length lying somewhere between 490 and 500 $\mu\mu$, matches a white or grey, although for the normal observer this region is a slightly bluish green.

The brightness of the spectrum at the long-wave (red) end is very markedly reduced in the case of the protanope, yielding a distorted visibility curve, as compared with the normal. The deuteranope has a curve which is approximately the same as that of the normal trichromat. It is a general rule that colour matches or equations which are established by the latter are valid for the former, a fact which is taken to indicate that dichromatism is derived from trichromatism by the simple dropping out of a colour component. Tritanopia, or "blue-blindness," involves a confusion between blue and yellow, with a neutral band in the yellow region of the spectrum. It is associated with detachment of the retina. Data from cases of monocular colour-blindness indicate that the colour sensations of the protanopes and deuteranopes are confined to yellow, grey and blue. The tritanopes presumably see the spectrum in terms of red, grey, and green.

Monochromatism is a condition in which all objects or stimuli appear to be of the same colour—various shades of grey. In practically all cases, there is an accompanying condition of day-blindness or photophobia, confirming the view that monochromatism is referable to complete functional loss of the retinal cone system, which is responsible for chromatic discrimination in general. Vision is thus restricted to the rod system, which is achromatic even in the normal individual.

For a more detailed discussion of the facts and theories of colour-blindness, *see* J. H. Parsons *An Introduction to the Study of Colour Vision,* Part II. (1924). (L. T. T.)

COLOURED HEARING, a particular form of synaesthesia, which manifests itself by the appearance in consciousness of colours (or various shades of grey) whenever certain sounds are heard. These colours are most frequently associated with tones of the musical scale. For some individuals each tone of the scale has its specific colour; for others all of the tones within certain regions of the scale will have the same colour. It is seldom, however, that two people agree as to the colour they associate with the same tone or region of tone. It has been estimated that coloured hearing occurs in about 5% of the population.

COLOUR IN ARCHITECTURE refers to the use of special pigments to create colour effects in the appearance of a structure, whether applied purely as decoration, like paint, or built in as integral elements of the construction.

The range of available materials is wide. Bricks may be had in natural tones running from reds through the greys, whites, blacks and brown. Terra-cotta is burnt clay either unglazed or covered with coloured glazes fired on to the piece itself. Mosaic in glass, stone or marble, permits the widest range of tone and pattern, for it is frankly an application of small elements, each pure in colour, to a large composition on a flat or rounded surface. Marbles in every conceivable tone have always been favourite elements in the embellishment of buildings; the greenish limestones so popular in Italy, the warm, golden-coloured stones of France, the rich Kato or Kasota stones of western America may also be mentioned here. The granites present blacks, greys, rich reds and purples; and glass can be obtained in all shades. Metals, such as zinc, lead, copper and gold combined with alloys, such as bronze, are fertile with possibilities. Woods, either stained to emphasize their natural colour, or painted, allow further latitude. Paint, either mixed with water as a wash, or combined with oil as a more permanent covering, has been the usual resource in finishing a building. On roofs, the slates, brown, grey, green and purple, vie with tiles of baked earth.

USE OF COLOUR IN THE PAST

Historically, the monotone has been widespread since the days of the Italian Renaissance (*see* RENAISSANCE ARCHITECTURE). In Italy such fragments of Greek and Roman architecture as were then found apparently induced the artists of the period to assume that little colour had been employed by the ancients. Although the normal instinct of the Italians, as was later evidenced, tended towards the employment of interesting variations of colour, the classic palace of the 14th and 15th centuries developed into a stone structure, serious in composition and of a distinctly severe monotone in colour. In earlier centuries the cathedrals of Venice, Palermo, Siena and Florence used a play of marble and mosaic inlays that gave great distinction to their façades. In Venice, in particular, the strong Byzantine influence retained colour and decorations such as marked the Doges' palace and many of the stately houses along the canals. Throughout Italy, coincident with the severe perfection of such admirable buildings as the Farnese palace in Rome, came the delightful work of P. Lombardi in the Santa Maria dei Miracoli in Venice, the sgraffito decoration of Peruzzi in Rome, the terra-cottas of the della Robbias in Florence. In all these buildings the artists, fortunately emancipated from the distinction of architect and painter, gave expression to their talents in the production of structures agreeable in colour as well as form.

In spite of these agreeable variations the masters of the Renaissance, who were ultimately to inspire architects throughout Europe and America, swept on to a clear type of design. This tradition leads directly to the present and has consistently maintained so strong a check on the designer that the mere consideration of colour on an exterior is often met with shock and suspicion. So powerful has this influence been that in every capital of Europe and the Americas greyish-white stone structures decorated with carvings of the same materials are commonplace. Occasionally red, and more recently buff, brick buildings are seen, but it is fair to assume that the theory of the greyish mass is dominant. Before analysing the records antedating the Renaissance it may be interesting to note that in most of the countries in whose capitals traditional work was built the popular expressions were vastly different. In Spain, particularly in the south, the Moorish reactions produced houses brilliantly painted in primary colours, quite similar to the vigorous handling of the Dutch peasants' dwellings. Climatic conditions may, in part, be responsible for the striking appearance of the Dutch towns, but it is apparent that where no restraint existed, experiment has been permitted and a most delightful result obtained. Sweden and Norway made similar essays, which were also somewhat analogous to the brilliant tones of the Russian peasant buildings. Throughout Bohemia, Poland, Hungary and Austria, are similar evidences of painted wood and plaster, all, to be sure, in the smaller buildings in contrast to the chaste grey of the aristocratic town structures. It is quite clear that in European countries where the influence of Byzantium and the East was strong, colour has ever been dear to the populace and has been expressed quite as freely on the façades as in the interiors of their buildings.

Greece.—The theory that the buildings of Greece were of white marble has of course been shattered since the early part of the 19th century by the researches of Schliemann and countless other archaeologists, which have proved that the decorative features of the Greek temples, the mouldings, metopes, sculptures and especially the non-structural elements were brilliantly painted. Part of the restorations are necessarily conjectural, but sufficient evidence is available to show that the great Greek monuments must have been strikingly beautiful in brilliant colours contrasting with the purity of the marble mass. It is equally obvious that to the modern eye, trained to accept whiteness as perfection, the actual Greek masterpieces would appear garish and startling. A serious attempt at restoration has been made in the new art museum in Philadelphia where, under the direction of Leon Solon, a Greek design has been executed with terra-cotta in such colours as were probably employed on the Parthenon. In Rome, more particularly in the residential buildings, the Greek conception prevailed and in the excavations of Pompeii and Herculaneum the brilliant contrasts of painted plaster, coloured marbles and mosaics clearly indicate a tendency that must have been quite as marked in Greek domestic work of approximately the same epoch.

Asia.—In Asia two powerful influences were evident. Byzantium, the capital of Rome during the 4th century, exerted great power not only in Greece and the neighbouring countries of the Balkans, but indirectly in Russia and Italy proper. Reflecting the richness of Persia, Egypt and the East in general, Byzantium (*see* BYZANTINE AND ROMANESQUE ARCHITECTURE) poured on the West a stream of versatility and imagination more particularly reflected in the lavish use of strongly coloured mosaics. Ravenna still represents a glorious contribution to the history of the use of that particular medium. Further east, China had for centuries produced works of art in painting, sculpture and architecture (*see* CHINESE ARCHITECTURE) which were particularly notable in the epochs marking a lull in European cultural activity. The Mongol invasion of the 12th century had done more than conquer Persia and its great empire. Chinese forms, decorative motifs, were promptly absorbed in Persian decoration and some of the influence of China through Persia found its way to Spain. India likewise had developed a rich heritage of architecture (*see* INDIAN ARCHITECTURE; INDONESIAN AND FARTHER INDIAN ART) coloured no doubt by both China and Persia in proportion to the invading successes of their various rulers. All this truly eastern art expressed itself vigorously in sumptuous colour arrangements: in the buildings by the use of burnt clays, in lacquers by the lavish use of gold, crimson, etc., and quite noticeably in the magnificent costumes embroidered on the richest silk and satin. Marco Polo's amazement at the glories spread before his eyes in his travels through Persia, Turkestan and China was a sincere acknowledgment of the existence of something at least unusual to a Venetian in the days of the glory of his native city.

Gothic Architecture.—In Europe with the development of Gothic architecture (*q.v.*) it was evident that some of the richness of the East would remain. Curiously enough, the fact that the Gothic sculptured reliefs were quite as brilliantly painted as their prototypes in Greek Art is equally ignored. The interiors of the Sainte Chapelle in Paris and the restorations of some of the earlier châteaux in the Loire district indicate what the Gothic painted decoration must have been. Much of the Gothic sculpture of the 13th century was fully painted though, to be sure, the actual monuments retain little indication of colour apart from the brilliant stained glass (*q.v.*). It is evident that this desire for expression in colour would appear in varied forms in different peoples and throughout their histories. The Spanish iron work (*see* IRON IN ART) of the 16th century, possibly the finest in Europe, is likewise enriched with reds, blues and gold, all handled with the boldness of master craftsmen. Brussels is noteworthy for its great *Place* surrounded by stone structures now quite dark with the patina of age, but superbly ornamented with gold decorations.

Primitive peoples are lovers of colour in precise relationship to their independence of so-called civilized contacts. The artistic expression of the tribes of Central Africa, the natives of Polynesia, the Incas of South America, the Mayas of Central America, the American Indians and, finally, the Esquimaux, is shown in bold patterns of pure colour which cover the most sacred structures and also the boats, tents and domestic vessels. In Asia, the Assyrians produced magnificent tile decorations which are among the gems of the Louvre collection. Egypt in its constant unfolding of its treasures from the royal tombs proves the freedom and versatility of her artists (*see* EGYPTIAN ARCHITECTURE). The furniture, pottery, glass, jewellery, fabrics, indicate an understanding of the combination of colour and form that is almost incredible. In Persia the magnificent blue dome of Ispahan, the tile, lacquers, rugs of Persian history from the Sassanian period to our day are additional indications of an instinct for colour that has persisted through the historic races of the world.

CONTEMPORARY PRACTICE AND THEORY

In approaching contemporary architecture, one is faced with certain preconceived theories as to what is acceptable. If an architect ventures to experiment, even though he directly copies an example of accepted historic reputation, he risks making his building conspicuous. The tradition of the monotone has developed so uniformly that the very knowledge of how to experiment seems to be a lost art. The painter theoretically equipped to handle colour has withdrawn to his studio and in his own restricted dignity produces canvases that may or may not eventually decorate a building. Where the public might gain from the exercise of his ability he refrains, not necessarily from choice but for the obvious reason that where all buildings are monotonous there is no need of a colourist.

The New Architecture.—Granting that tradition has restrained development and that under existing conditions extensive use of colour is impossible, a new factor of enormous influence has appeared. The tall building on a comparatively narrow street in one of our big cities can no longer employ the decorative forms so lovingly and superbly handled by the masters of the past (*see* ARCHITECTURE). Two reasons are evident: copying any man's work intended for a particular place or period is not only false but a stamp of inability in design; the detail, charming in a structure 40 ft. in height is ludicrous in one 400 ft. higher. If the detail, as much of the earlier American sky-scraper architecture shows, is merely inflated to suit the increased distance from the eye the fallacy is no less obvious. The decoration of the tall building must produce the same agreeable effects of rhythm, symmetry, picturesqueness, sparkle or whatever basic theories the designer wishes, with quite new mediums. Flat surfaces take the place of the obsolete cornices, and colour in surfaces, in proportion to the distance from the observer, marks the accents that the artist desires. The practical question of material, whether the effect will be produced in burnt clay or terra-cotta, bricks covered with glazes baked under high temperatures, mosaic or glass, will depend, in large measure, on the ingenuity of the designers themselves. What seems to be particularly vital, however, is the conception of the use of colour as a part of the structure and not as merely applied ornament.

The dream of a coloured city, buildings in harmonious tones making great masses of beautiful pattern, may be less of a vision if the enterprising city developer realizes what it means. There is evident economy of effort in the application of colour in lieu of carved decoration which cannot be seen; and the novelty of a structure distinguishable from its neighbours has a practical value which must appeal without question to the designer and his public. The precise manner of handling colour, whether in masses, adapted as contrasts to the major tone of the building, as accents only, or in the entire structure by reason of its basic material, depends again on the programme of the creative designer; but a positive conception of the employment of colour cannot countenance mere spots of bright tiles, marbles or other substances used to relieve the sobriety of a façade. The individual must learn what media fit his taste and are adapted to the conditions of his work.

The classic conception of colour was that functional elements should be in base colours, particularly where stone and metal were employed, and that only decoration should be toned. In modern construction, where the entire façade is applied to a skeleton frame of concrete or steel, the design would be false if the artist persistently emphasized classicism where all construction is evidenced on the façade. As he creates his design, if he is willing, he can attempt accents and effects quite in keeping with contemporary building practice.

In recent years little of actual value has been produced that would indicate broad acceptance of the need of colour on buildings. The Radio City buildings in New York, striking as they are in mass and arrangement, carry on the classic principle of grey masses relieved by richly decorated sculptures and entrance features. They do not indicate a departure from the norm of the stone block.

In exposition architecture, however, the public has been privileged to see what might be accomplished with the architects encouraged to experiment. Here the painters have been asked to cooperate. In Chicago, in 1933–34, while the results were somewhat confused due to a lack of organization in scheme, the effect was nevertheless striking and had a considerable influence on the many visitors. In New York in 1939–40, a more carefully analyzed colour scheme, using mural paintings to a degree before unknown and accepting a policy of separating the Fair into broad zones of colour—gold, blue, red, white,—produced a superb effect of mass, that at night, with the added attraction of lights carefully set to produce accents on trees, flowers, and the building blocks, developed a substantial result in the use of colour on buildings.

It is important to note the fact that the painters helped materially to accomplish this effect. Paint was the main element, for the use of more substantial materials could not be general in view of the cost. To the public the Fair in New York demanded comparison with the white Exhibition of Chicago in 1893, which captivated the eye as an expression of neo-classicism, and where no colour of any consequence appeared. The World's Fair in San Francisco in 1939–40 also was designed with similar concentration on brilliant colour masses. The possibilities of colour in large masses have been established.

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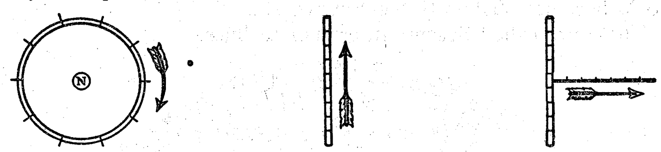
COLOUR INDEX, in astronomy, the difference between the visual magnitude and the photographic magnitude of a star. Since the ordinary photographic plate is proportionately more sensitive to blue light and less to red, this gives a measure of the colour of star. The colour index ranges from about −0·5 mag. for the bluest (hottest) stars to more than 2.0 mag. for the reddest stars.

COLOUR IN FLOWERS: *see* ANTHOCYANINS AND ANTHOXANTHINS.

COLOURING MATTERS: *see* DYES, NATURAL; and DYES, SYNTHETIC.

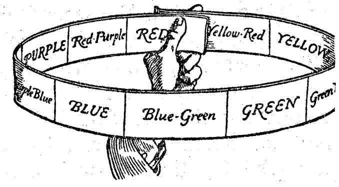
COLOUR MEASUREMENT (MUNSELL SYSTEM). The first essential to the application of the Munsell Colour System is a clear understanding of the three dimensions of colour, and once having grasped the simple logic of these, the practical advantages of the system will be manifest. Colour has three dimensions—*Hue, Value,* and *Chroma,* which fully and accurately describe any colour as readily as the three dimensions of a box describe its length, width, and height. The idea of the three dimensions of colour may be expressed thus:



HUE — Measurement around a circle
VALUE — Measurement up a vertical pole
CHROMA — Measurement on a horizontal away from a vertical pole

With these three simple directions of measurement well in mind, there need be little confusion in comprehending what is meant by colour measurement.

Hue.—This first dimension is defined by A. H. Munsell as, "The quality by which we distinguish one colour from another, as a red from a yellow, a green, a blue, or a purple." Suppose that a spectrum is cast by a prism, or a section of a rainbow. It is true that it contains all visible hues, merging one into the other by indistinguishable degrees—but always in a fixed order. Now imagine that such a spectrum is fixed or printed on a band of paper and that it begins at one end with red and going through all possible hues, it arrives back at red again at the other end. The hues are unevenly divided and they merge one into the other by indistinguishable degrees. But, preserving the order of these hues, divide them into equal steps, as a ruler is divided into inches, by selecting familiar colours—red, yellow, green, blue, purple. These may be called the Principal hues but between each of them another division is made, where each merges into the other. These may be called yellow-red, green-yellow, blue-green, purple-blue, and red-purple, and they will be known as Intermediate hues because they are intermediate or half-way between the Principal hues. The five Principal and five Intermediate hues may be called the major hues. Now, if this band is bent into a circular hoop, so that the red at one end meets and laps the red at the other end, there has been constructed a perfect scale of hue in the circular form, with the five Principal hues opposite the five Intermediate hues. The circle of hues with the five Principal hues and five Intermediate hues is shown in this form in the accompanying colour plate. The selection of five colours for the Principal hues is based on their complementary hues as determined by "after image." The five Principal hues and their complements, the five Intermediate hues, divide the hue



circle into ten parts—visually equidistant one part from another and readily expressed by the decimal system. So it is that when one states the first dimension of a colour, one is referring to its position on this circular scale of hues. In writing a colour notation, this first dimension is expressed by the initial letter of the hue—R for red, a Principal hue, and BG for blue-green, an Intermediate hue.

These ten steps being decimal numbers, may, of course, be infinitely subdivided and it may frequently happen that a given colour does not fall exactly on any of these ten divisions of hue, but somewhere between two of them. Allowance has been made for this by dividing each of the steps of the Principal and Intermediate hues into ten further divisions—called Special Intermediate hues. These ten subdivisions represent about as fine a variation of hue as even a trained eye can distinguish, and it would be obviously futile, for practical purposes, to carry it further. The numerals run from 1 to 10, 5 always marking a Principal hue or an Intermediate hue and 10 always falling half-way between a Principal and an Intermediate hue. Thus the system has a series of numerals denoting any practical step or gradation between one hue and another and in writing a colour notation, of which one of these special Intermediate hues is a part, the numeral is given, denoting the position of the hue on this scale, before the letter which stands for the nearest Principal or Intermediate hue, thus 7 R, 3 YR, 2 Y. The ten major hues then are expressed: 5 R, 5 YR, 5 Y, etc. The notation 10 R may also be expressed as Red Yellow-Red, it being half-way between these two hues, similarly 10 Y becomes Yellow Green-Yellow, etc.

These are called Second Intermediate hues.

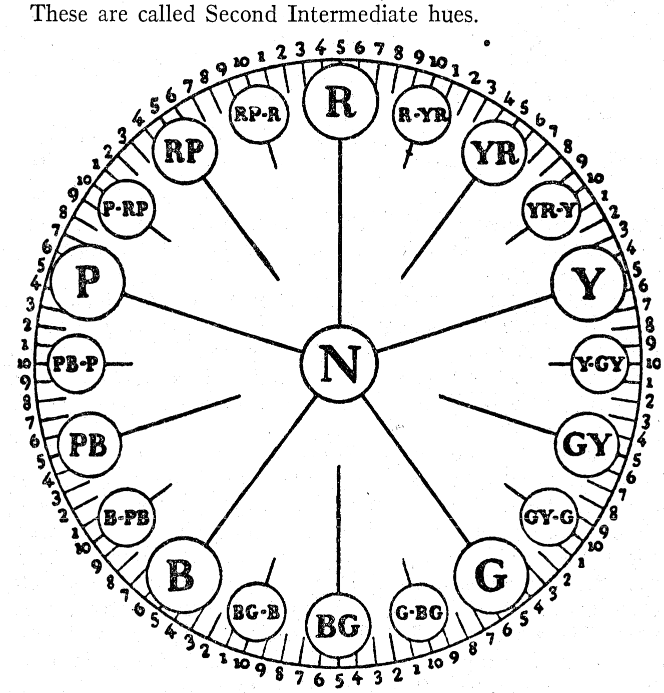
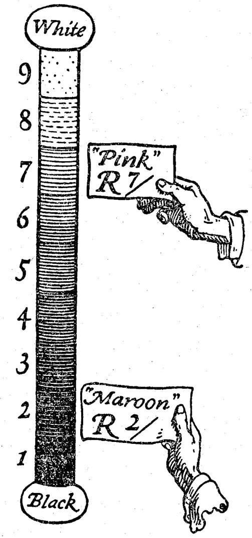


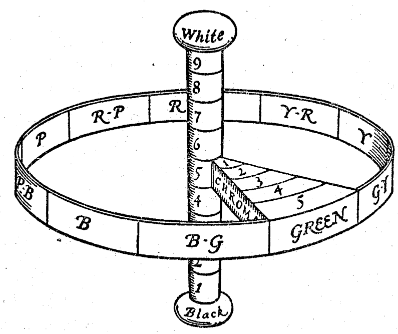
Diagram showing the 5 Principal Hues, the 5 Intermediate Hues, the 10 Second Intermediate Hues, and the 80 Special Intermediate Hues (indicated by the numerals, 1, 2, 3, 4, and 6, 7, 8, 9), in the 100 Hue circuit.

It should be remembered that the hue Red embraces all reds whether light or dark, weak or strong, its hue merely determines its point on the spectrum hue circle.

Value.—This is the second dimension and is probably the simplest to understand. It is, according to Mr. Munsell's definition, "The quality by which we distinguish a light colour from a dark one." Note that the first dimension did not tell whether a colour was light or dark. It told, for example, that it was red and not green, but there may be a light red and a dark red, and it is the function of this dimension of Value to tell how light or how dark a given colour may be. For this purpose a scale of Value is needed, which may be imagined as a vertical pole or axis to the circle of Hues, black at the lower end, representing total absence of light, and white at the top, representing pure light, and between these a number of divisions of grey regularly graded between white and black. This gradation could also be infinite. Since pure black is unattainable, it is called zero and the scale begins with the darkest grey as one, numbering the steps up to nine, which is the lightest grey. Pure white, which is also unattainable, may be called ten. In the practical use of the scale of Value, therefore, there are but nine steps and the middle one of these is five—which is referred to as Middle Value. The Value scale is shown in this form in the accompanying colour plate with proper divisions between black and white. In writing a colour notation this dimension of Value is expressed by a numeral, which denotes at which step on the scale of Value the colour falls. This numeral is written above a line, as B 6/ for example, by which is meant that this particular blue, regardless of its other qualities, is as light or as dark as the sixth step upon the scale of Value. A colour such as is called "maroon" is an example of a red which is low in value, because it is dark, and what is called a "pink" is a red which is high in value, because it is light.



Chroma.—When it is stated that the colour is blue or yellow or green, and that it is dark or light, two of its important qualities are indicated—its Hue and Value, but this by no means describes it completely. It may be said of a flower that it is red and that it is light, but it may also be said that a certain brick is red and also light, and yet there is a notable difference between their respective colours, if they are placed side by side. Both may be red and of the same Value, but the flower is strong in colour and the brick is weak in colour, or greyer. It is this difference which is measured on the dimensions of Chroma. This dimension is the measure of the strength or weakness of a colour. The scale of Value may be referred to in the convenient and easily understood form of a vertical pole, which represents the neutral axis of all the circle of Hues and is, of itself, of no colour, but is pure grey. Around this pole may be placed the band representing the scale of Hue and then any one of these hues on the circumference of the band may be imagined as growing inward toward the grey pole in the centre, growing greyer or weaker in colour strength until it reaches this centre pole and loses its colour entirely. This gives a visualization of the idea of the dimension known as Chroma. By dividing these bands into regular measured steps, one has a scale upon which the strength of colour may be measured. This dimension of Chroma is written in a colour notation by means of a numeral below a line, which denotes the step upon the Chroma scale at which it falls, thus /2, /4, /8, /10, etc.

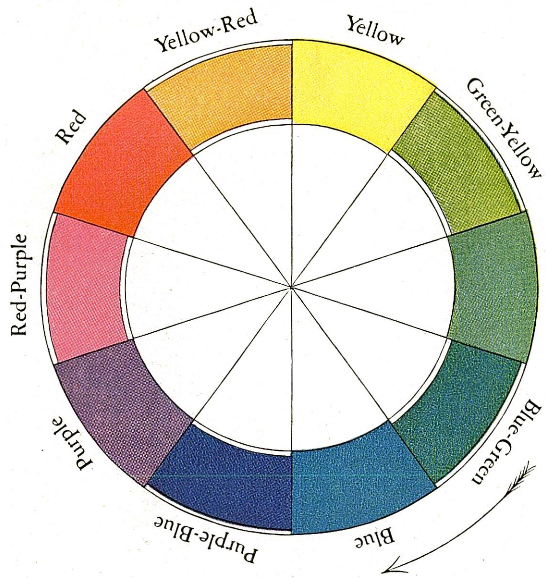


Needless to say, all of the Hues may be thus measured on this dimension at right angles to the vertical pole and grading from grey, step by step away from the pole to greater and greater strength of colour.

A complete Chroma chart of red is shown on the colour plate; on this chart the vertical scale of Value is repeated to emphasize its position in relation to Chroma.

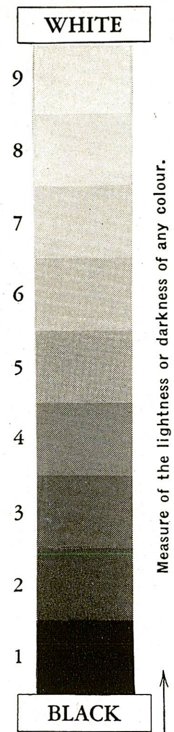
There are two important facts which should be considered. First, colours differ by nature in their Chroma strength, some being much more powerful than others. The strongest red pigment used, for example, is approximately twice as powerful as the

COLOUR MEASUREMENT

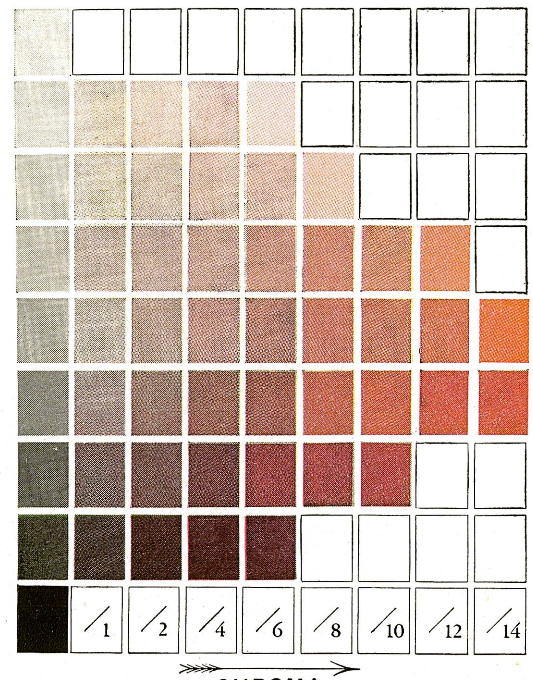


HUE

Quality that distinguishes one colour from another.



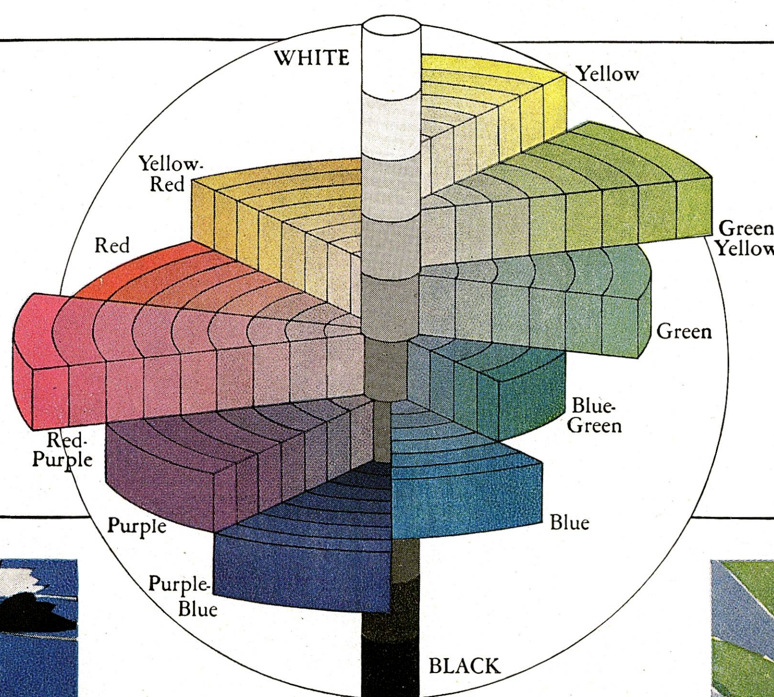
VALUE



CHROMA

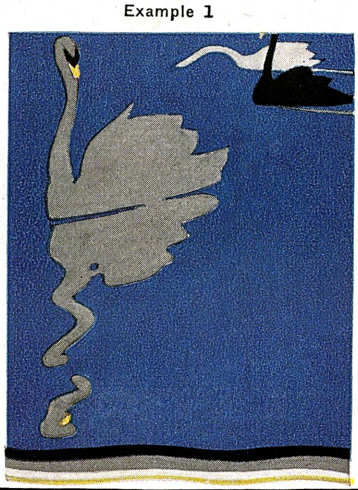
Measure of the strength or weakness of a colour.

At the right is a projection showing the Principal and Intermediate Hues arranged radially in ten equal divisions about the vertical scale of Value in the same order as the Hue circle above. For simplicity, Hues are shown only at the Value in which they reach their strongest Chroma. A complete Tree would show each Hue developed completely from black to white, as shown in the red Chroma chart above.



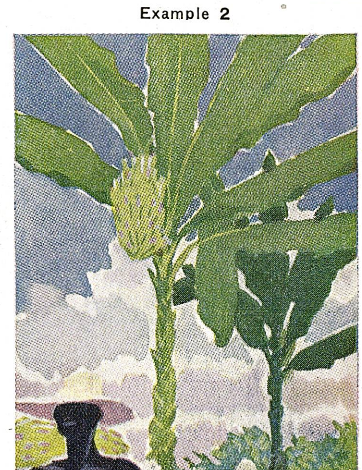
THE COLOUR TREE

Example 1



(1)
Purple-blue with grey and small areas of the complementary yellow. Note the yellowish hue of the grey, a result of simultaneous contrast.

Example 2



(2)
A free use of a number of complementary hues, purples and green-yellows predominating.

strongest blue-green pigment and the red pigment will, therefore, require a correspondingly greater number of steps on a longer path to reach grey. The second fact is that all colours do not reach their maximum Chroma strength at the same level of Value. It can be readily comprehended, for example, that the strongest yellow pigment is by nature much lighter, or higher in Value, than the strongest blue pigment and, therefore, the complete Chroma paths of these two colours will each touch the neutral pole at different values.

The form, which conveys most completely the character of colour qualities and dimensions governing the range of pigments in regular use, has been conceived by A. H. Munsell as a "Colour Tree." The "Colour Tree" has for its trunk the vertical scale of Value and the branches represent the different hues arranged radially about the trunk, these branches varying in length with the Chroma strength of each hue. A colour tree is shown in this form in the accompanying colour plate—the vertical scale of Value in the centre with the ten major hues are shown only at the Value level at which they reach their strongest Chroma. If each hue was shown at every level of Value the figure would become a solid with the strong colours outside gradually becoming greyer until they reach the grey Value scale.

Each of the three dimensions by which any colour may be measured has been described, and also how each is written in a colour notation. It remains only to put these separate notations together and to write a complete notation embodying all three dimensions. For example, given a certain colour to measure and define, it is found that upon the scale of Hue it is Purple-blue. Upon comparing it with the scale of Value, it is seen to be but three steps from the bottom, and two steps away from the neutral grey pole upon the scale of Chroma. A complete notation for this colour would, therefore, be written PB 3/2. It is scarcely necessary to point out the practical advantages of such a system of definite measurement and notation over the vague and variable terms in general use, borrowed from the animal, mineral, and vegetable kingdoms, such as plum, olive, fawn, mouse, etc., of which no two persons ever have quite the same idea.

The Use of Colour.—Contrast in Value is, perhaps, the most important factor in a composition or design. Value difference alone without regard to Hue or Chroma may make or mar the result. Value contrast will make lettering or type, for example, legible or illegible. A colour of middle Value will be least distinguishable on another colour of equal Value and the greater the contrast in Value the better the legibility.

Maximum contrast is obtained by the use of colours of extremely strong Chromas if they differ sufficiently in Value from black or white, or one another. Some examples of this form of contrast would be a yellow of extreme Chroma on a black; a low value purple-blue on white; a strong yellow on dark blue.

It is also useful to know the relative power of colours. Of course in considering the power of a colour it is impossible to think of it without a background colour and the contrast of Value and Chroma must be considered.

A strong yellow on a black field is an excellent example of maximum visibility. Although certain other factors have a bearing on the case, this visibility may be attributed to the extreme contrast plus the power of the yellow. The power of a colour may be considered as the product of the Value times the Chroma. The magnitude of the product is a good indication of the worth of a colour from the attention or attraction standpoint. Thus, a bright, strong yellow-red would be considered as a powerful colour because of the large product resulting from its high Value and strong Chroma.

For example, in terms of the Munsell notation a yellow-red at its present extreme Chroma would be YR 7/13 with a power product of 91 (7 x 13), whereas the strongest red R 4/14 has a power product of only 56. The strongest available yellow Y 8/12 will have a power of 96, a little higher than the yellow-red.

The simplest use of colour is the monochrome, by which one hue alone is used in its many combinations of Value and Chroma. Some of the pleasantest colour harmonies are in the group called "neighbouring" or analogous colour schemes which utilize a series of hues in their sequence on the chromatic circle.

Complementary colour schemes offer great varieties of colour relationships from the strongest to the weakest contrast, depending on the Value and Chroma adjustment. When complementary colours are used together they have the effect of making each other more brilliant. This should be borne in mind in selecting the proper Value and Chroma, because if the same Value and Chroma of each colour is used, an unpleasant condition of vibration between the two colours will occur.

If one colour of a pair of complementaries is weakened in Chroma, the other will appear still brighter by contrast. Complementary pairs may be used in all the steps from low to high Value and weak to strong Chroma, depending on the purpose of a design. More than one pair of complementaries may be used in a composition and possibilities in this group are limited only by the ingenuity and taste of the designer.

In summing up, remember that while genius may work in violent colour combinations, those of lesser talent must play safe. Satisfactory results may be achieved if colours of low Value and weak Chroma are used for larger areas and the small areas are contrasted with colours of high Value and strong Chroma.

Two examples of the use of colour are shown in the accompanying colour plate. The first of these shows the use of purple-blue with grey and small areas of its complementary yellow. The purple-blue is low in Value and moderate in Chroma as it occupies the larger area of the design. Its complementary yellow is high in Value and strong in Chroma. The grey shown in this example appears to be a yellow very weak in Chroma—this is the result of simultaneous contrast, the large area of purple-blue causing the grey to appear yellow (its complement) in comparison. The second example shows a free use of a number of complementary hues, purples and green-yellows predominating.

The context of this article is principally a revision and condensation of "A Practical Description of the Munsell System" written by T. M. Cleland for the Strathmore Paper Company. Material has also been used from "A Color Notation" by A. H. Munsell, and "Munsell Manual of Color" by F. G. Cooper. The section on "Use of Colour" and the two sketches, by Rudolph Ruzicka are from "Three Monographs of Color" published by the Research Laboratories of International Printing Ink Corporation, a division of Interchemical Corporation. Article and colour plate arranged and designed by Arthur S. Allen.

COLOUR MILL, a machine used in mixing and grinding paints. Its history may be traced back to the time when man first discovered that paint was made more tractable, and consequently furnished a more beautiful surface, by thoroughly grinding the contents. He secured two flat stones, placed the paint on the upper surface of the bottom stone, and milled it by rotating the top stone by hand. This method was slow and tiresome, and finally the principle was applied to a sort of gristmill type of which our present mills are a direct descendant.

Colour mills, or paint mills, fall into two general classifications: (1) those designed to grind or pulverize dry colours or dry paints, (2) those designed to grind paste paints and ready-mixed or liquid colours. The dry colour mills are divided into three groups: (1) The ball mill, which consists of a large cylinder made of cast iron, steel or bronze, and contains a quantity of balls, of similar metal, which pulverize the colours as the cylinder rotates; (2) The buhrstone mill, which is similar to the old-fashioned gristmill; (3) The disintegrator, which powders the dry colour by forcing it through closely set steel discs revolving at a tremendous speed. This is the most modern type of dry colour mill.

It is necessary to grind paint thoroughly in order to "wet" each pigment particle with the so-called paint vehicle, to break up the agglomerates of pigment particles, and to expel the occluded air. In the case of the fine oil colours, artists' colours and inks, the pigment particle itself is actually ground finer. Thus the *desiratum* of the grinding procedure is the creation of paints perfect in texture and supreme in beauty of colour.

The paste and ready-mixed paint mills are of five types: (1) the stone mill, (2) the roller mill, (3) the pebble mill, (4) the iron mill, (5) the colloid mill. The most widely used of these is the stone, or buhrstone, mill. It is made of two flat, round stones, which are usually cut from Virginia or North Carolina buhrstone, French buhrstone, or Esopus stone, which is softer than buhrstone. The top stone is stationary and has a hole or eye in its centre, the size of which depends on the size of the mill. The lower stone, which rotates, is solid and adjustable, which means that it can either be forced up hard against the top stone, or that any desired clearance between the two stones can be maintained. The paint to be ground is dropped through the eye of the top stone and a grinding action is accomplished by the rotation of the lower stone, which forces the paint between the grinding surfaces of the two stones.

Stone mills vary in size from 8 in. in diameter, for laboratory use, to 6 ft., although the sizes in general commercial use range from 15 to 36 inches. Some are water-cooled and others have no cooling device, and others are also made in "tandem form" which consists of two mills in one, for double grinding. Grooves about $\frac{1}{8}$ in. deep are cut into the grinding surfaces of the stones in such a manner as to give to the paint a scissor-cutting action between the stationary and revolving stones. For producing the most beautiful and delicate colours, the water-cooled 15 or 20 in. stone mills are used, the paint being reground until, when tested, it is found to be absolutely speckless.

Roller mills are constructed with one, three, or five chilled steel rollers, the three-roller type being the most widely used. These mills grind the paint by pulling it between the closely set rollers. Printing inks and the finest of enamels are ground on this type of mill and in many cases colours are ground and reground several times in order to produce the finest possible texture.

The pebble mill is constructed with a large cylinder holding 55% paint and 45% pebbles. By rotating the cylinder the pebbles fall through the paint and break up the agglomerates or lumps. This type of mill is generally used for grinding paints in the ready-mixed form, whereas stone or roller mills are generally used for grinding in paste form. The iron mill operates on the same principle as the stone mill, except that the grinding surface is smaller and of iron. This type is practically obsolete as paint "grinders," but is still being used to "feed" stone mills.

Colloid mills, which are the most recently developed, are high speed mills grinding by forcing the paint through the minute clearance formed by the swiftly revolving steel "rotor" and the stationary steel "stator." The faces of the "rotor" and "stator" are machined with such precision that they can be adjusted to form an exact clearance of $\frac{1}{2,000}$ in. throughout their entire circumference. This mill is more of an emulsifier than a grinder, and is not being used extensively in the paint trade.

(G. W. C.)

COLOUR-MUSIC is the term most frequently employed to designate an art which makes use of varying light or lights as its principal means of expression. The first mention of such an art was made in the eighteenth century. From very ancient times, however, certain analogies had been observed between colours and sounds and particularly between the principal colours of the rainbow and the seven notes of the diatonic scale. The analogy between colour harmony and sound harmony was remarked upon by Aristotle in his *De Sensu,* while in the sixteenth century Arcimboldo, a Milanese painter, invented a system of colour harmony based upon a colour scale analogous in its order to the musical scale.

That there was some mysterious fundamental relationship between colours and sounds was a natural assumption in an age which was given to philosophizing upon the "Music of the Spheres." No doubt Kepler's *The Harmonies of the Universe* considerably influenced Sir Isaac Newton, whose sponsorship of the analogy gave it an authority which it has continued to possess to this day. Newton was struck by an analogy between the relative spaces occupied by the principal colours of the spectrum and the ratios of the notes of the diatonic scale, but as this observation depended entirely on the deviation of the particular prism he employed his conclusions were inaccurate, and it is probable that he himself later realized the nature of his mistake. Without question, however, his arbitrary division of the spectrum into seven principal colours has misled numberless colourists and it was not until late in the nineteenth century that it was proposed to develop an art of light entirely independent of the art of music.

The undulatory theory of light first propounded by Dr. Thomas Young in the Bakerian lecture before the Royal Society in 1801, and later incorporated into the general theory of electro-magnetism in the hands of Clerk Maxwell and others, provided a new mathematical foundation upon which the indefatigable analogists might once more erect their specious systems. The measurement of the wave lengths of visible radiation, the curious fact that the frequency limits of visible radiation lie within the approximate compass of one octave, the fundamental similarity of the physical behaviour of electric waves and that of mechanical sound waves (namely, the similar laws of reflection, refraction, interference, etc.) all contributed towards an increasing confidence in the intimate correspondence between the two groups of phenomena. Only such great physicists as Helmholtz seemed to be able to perceive the deep divergences between the two and to refer at last to the weakest point in the argument of the analogists, namely, to the radically different construction and characteristic response to stimuli of the two organs of sense involved, the eye and the ear.

Louis Bertrand Castel (1688–1757) was probably the first to propose an art of colour-music. Born at Montpellier, November 11, 1688, he became a Jesuit and was recognised as one of the most eminent mathematicians of his day. He first describes his *La Musique en Couleurs* in 1720. *Esprits, Saillies et Singularités du Père Castel,* published after his death in 1763, contains a chapter, "Clavessin pour les Yeux," in which Castel states his general theory of colour-music, and describes a colour clavessin so constructed that the keys not only actuated the tongues for plucking the strings but also revealed certain transparent coloured tapes. Presumably it was his intention to place sources of light behind these.

Castel pursued his experiments with immense enthusiasm and wrote as intelligently about the subject as anyone ever has, but he was inevitably scorned by his contemporaries and almost forgotten by those who followed him. The fact remains that if anything ever comes of colour-music, Castel will hold the position of the great pioneer who first explored the ground. He is the Giotto or Guido d'Arezzo of colour-music.

D. D. Jameson wrote a singular little pamphlet on colour-music in 1844. He proposed a notation and gives examples. Apparently he constructed an instrument of some kind and gave demonstrations. He employed glass containers filled with coloured liquids and projected light through these filters into a room lined with tin plates. Mechanically controlled shutters were used.

A prophetic passage occurs in a book called *Music and Morals,* by the Rev. H. R. Haweis (1875)—"And here I will express my conviction that a colour-art exactly analogous to the Sound-art of music is possible. . . . Nor do I see why it should not equal any in the splendour of its results and variety of its applications."

Bainbridge Bishop of Essex County, New York State, having read Chevreul and Field, built (1877), a projection instrument which formed part of a house organ, by means of which he could blend colours on a small screen simultaneously with the playing of music, by attaching levers and shutters to the keys and directing first daylight and later the light from an electric arc through coloured glass.

William Schooling in an article in the *Nineteenth Century* (July, 1895), described an art of colour-music on the lines of the sound analogy, and proposed to use various vacuum-tubes, with intensity control in conjunction with a keyboard. This article was written in 1893.

In the same year Professor Alexander Wallace Rimington (1854–1918) had independently conceived the idea of a colour organ which he patented and constructed. It was completed in 1893 and he gave a private demonstration of its powers at the old St. James's Hall, London, on June 6th, 1895. A complete account of his theories and experiments, and of the colour-organ may be found in his book *Colour-Music: The Art of Mobile Colour* (1911).

The project was next considered by Louis Favre, in his *La Musique des Couleurs et les Musiques de l'Avenir* (1900). In the same year E. G. Lind, F.A.I.A., discussed a music-colour system and a projection instrument in *The Music of Color and the Number Seven.*

Mary Hallock Greenewalt, an American pianist, is one of the ablest experimenters of the present time. Though not insisting on a combined art of light and sound, she has spent most of her labours in the attempt to achieve such an aesthetic unity and her many patents and instruments are directed mainly to this end.

Thomas Wilfred, born in Denmark in 1889, began experimenting in 1905 and is perhaps the most active of contemporary colour-musicians. Proceeding on independent lines he has from the first refused to be misled by the sound analogy. In 1919 he completed his first important colour-projector in America, where he now resides, and this he named "The Clavilux." He has given colour concerts throughout the United States, and during 1925 he gave concerts in Paris, London and Copenhagen. Wilfred's procedure is to project upon a screen an even flood of light into which he introduces fantastic figures which rhythmically move and at the same time alter their form and colour.

In Australia, Alexander Burnett Hector has for some years experimented with various forms of colour-music. His first colour-organ made use of ordinary incandescent lamps combined with Geissler and X-ray tubes. M. Luckiesh, an American illuminating engineer, has also given the subject considerable attention and has experimented with various instruments for the production of mobile colour effects.

Other experimenters have been M. Carol-Bérard and M. Valère Berneird in France and Leonard C. Taylor, Claude Bragdon and Adrian Bernard Klein in England. The last named has constructed an instrument embodying optical means for the production of coloured light by prismatic dispersion, the addition of white light to monochromatic light, control over wave-length and luminous intensity. The projector possesses an electrically operated key-board and is well suited to experimental work in all forms of colour-music.

Before discussing the theoretical requirements for an art of colour-music brief reference should be made to the phenomenon of colour audition (synaesthesia), whereby many musicians associate different keys with different colours. One of the earliest scientific investigations of this phenomenon is that recorded by Francis Galton in his *Inquiries into Human Faculty* (1883).

The "coloured hearing" of Scriabin, the Russian composer, led him to compose his *Prometheus, the Poem of Fire,* for which he wrote an accompaniment of changing coloured light. It was performed in Moscow in 1911, with a colour-projection apparatus which apparently failed to function, and some years later (March 20, 1915), at Carnegie Hall, New York, with a "Clavier à Lumières," when, however, the results were not impressive.

Will colour-music as a means of expression ever be accorded the dignity of one of the great arts? At present it is impossible to say. Yet there seems no reason why the aesthetic enjoyment derived from the perception of the unity of a musical composition, its parts having unfolded in time, should not be aroused, equivalently, by observation of the construction of the various colour motifs, of combinations of sequences, and of the logical development of these, in a composition of light. The view is sometimes expressed that colour has little or no interest when it is divorced from form or familiar shape, but the literature of the subject is full of enthusiastic reports by those who have witnessed demonstrations of colour-music.

A great physicist, Prof. Albert A. Michelson, referring to the colour effects familiar to those who use optical instruments has written in his *Light Waves and their Uses* (1903), "Indeed, so strongly do these colour phenomena appeal to me that I venture to predict that in the not very distant future there may be a colour art analogous to the art of sound—a colour-music in which the performer seated before a literally chromatic scale, can play the colours of the spectrum in any succession or combination, flashing on a screen all possible gradations of colour, simultaneously or in any desired succession, producing at will the most delicate and subtle modulations of light and colour, or the most gorgeous and startling contrasts and colour chords! It seems to me that we have here at least as great a possibility of rendering all the fancies, moods and emotions of the human mind as in the older art."

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COLOUR PHOTOGRAPHY: *see* PHOTOGRAPHY.

COLOUR PRINTING. The introduction of colour printing is obscure, and the claims of the Chinese and Japanese cannot be discounted, for it is probable that these peoples were practising the methods of colour block printing, which they follow to-day and for which they are famed throughout the world, long before the inception of printing from movable types. The use of coloured inks was not common with the early printers, but, strangely enough, the very first books printed at Mainz in the 15th century were decorated with initials in colour. The "42-line Bible," believed to be the first book printed from movable type, contained initials in red, some printed and others drawn in the spaces left for the purpose; whilst the later works produced at Mainz had initials in both red and blue, the Psalter of 1457 being the most famous of these. Colour printing, therefore, may be said to have commenced with the birth of the typographic printer's art. The desire to rubricate the new method of producing books in the early days is not to be wondered at when it is recalled that printing took the place of the beautifully decorated written books produced in the scriptoriums—works of art which call for the admiration of the world as evidence of unstinted patience and skill given to what was often a life's work. In 1486, the famous schoolmaster printer of St. Albans produced a book which contained woodcuts of armorial designs printed in red, blue and brown, but strange to relate, when yellow was introduced it was put in by hand. This was the first specimen of English printing (and the last for over 200 years) in which coloured inks were introduced.

Early in the 16th century a new method of colour printing from wood blocks, called chiaroscuro, was introduced. This consisted of a black outline to which tints were added. There is uncertainty about the inventor of this process, both Germany and Italy claiming the credit for its invention. It found great favour on the Continent. About this period, what might be called stencilling was introduced. This was used principally in the production of playing-cards. About the year 1630 the method of obtaining prints from copper-plates, into which the design was incised (intaglio) was practised. There are a number of colour prints in the British Museum produced by this process, the method entailing the rubbing of coloured inks into hollows cut below the surface, and, when the plate was completely inked, passing it through a press, thereby obtaining an impression on a sheet of paper. The 18th century saw great developments in the art of colour printing. New methods were invented, and it was at this period that three-colour mezzotint prints were produced by a German of French extraction, named Le Blon, he being the first to apply the principles of the three primary colours (without, of course, the aid of photography). His method was to dissect the original painting into its primary colour and tints, and make a separate mezzotint plate for each colour; these he printed in the respective coloured inks one on top of the other and, when the three impressions were registered into each other, they produced a result approximating the original picture. Le Blon's process was largely practised by others after his death in Paris, in 1741. In 1718 an Englishman named Kirkall worked a process which had as its key a mezzotint plate, the colours being added by means of wood blocks. He also reverted to the original method of preparing an intaglio plate, dabbing the colours on to the plate by hand. This method of colour printing is still used for producing costly prints for art dealers. About the end of the 18th century a large number of mezzotints, stipples and line engravings in colour were produced, the best of which now command fabulous prices.

Early in the 19th century, chiaroscuro printing was revived by William Savage, and some of his prints contained as many as 30 colours. At this time, Senefelder's invention of lithography was applied to colour reproduction, when the picture was printed in flat tints. It was not until midway through the century that the superimposing of colour was attempted, and became known as chromo-lithography. In 1834, the first colour prints by George Baxter were published. The method employed in producing this class of colour work, now known as Baxter prints, was by the use of an intaglio key plate which was printed in black or brown, to which was added a number of colours printed from wood or metal blocks. Colour printing from woodcuts and line blocks was carried on until the introduction of what is now known as the three-colour process—a method in daily use by letterpress printers. In the latter half of the 19th century chromo-lithography began to make rapid strides, and collotype, a beautiful process, was developed to meet the demands of art dealers for a high standard of colour printing. (*See* COLLOTYPE.) Mainly due to the application of photography and the advance of mechanical science, great developments have taken place in colour printing within the last half century.

Printing Methods.—The basic methods by which prints are obtained may be summarized under three headings: *relief printing, intaglio printing* and *planographic printing.* Each of these methods has its own peculiar characteristics and each possesses certain qualifications for the production of work of a distinctive character, and it is not unusual to find a combination of two, or even three in modern reproductions.

Relief Printing.—This is generally known as letterpress printing and embraces impressions obtained from relief surfaces; such as type, woodcuts, line blocks and half-tone blocks.

Type.—When type is printed in colour, it is usual for the compositor to set up the matter complete, and then take out the lines or initials which have to be printed in colour. The space left blank by the removal of the lines or initials is filled up with "furniture," *i.e.,* material of the same width and length but lower in depth than type so that it will not print. The matter is then made portable by locking it into an iron frame, called a chase, by means of a series of wedges. The types which have been removed are placed in another chase, and are made to register, *i.e.,* fit the places left blank in the main forme; this is also done by making up with furniture. Proofs are then pulled of the two formes for the purpose of registering the one into the other. Great care has to be exercised in each printing when putting the sheets through the machine in order that the colours will print where they are required.

Woodcuts.—The production of woodcuts may be called a handicraft and is seldom used for present day commercial requirements, although attempts are being made to revive it in certain quarters, particularly in the form of cutting the design on linoleum. The method in this instance is to cut an outline of the design in relief and take impressions from the block which is "offsetted," *i.e.,* a wet impression is transferred to as many blocks as there are colours to be printed to complete the design. The cutter removes with a sharp knife those parts of the block that will not be required for a particular colour of ink in which it has to be printed. This manner of preparing colour printing blocks is mainly confined to amateurs and students of art schools.

Line Blocks.—The making of line blocks is a photo-mechanical process. The artist's drawing, which must be in line or stipple, is placed on the copy-board of a camera, specially made for the purpose, to which a prism is attached. This enables the image to be reversed on the photographic plate when the exposure is made. When developed and dried, the negative is placed in contact with a piece of metal (usually zinc) which has been coated with a sensitized solution of albumen and potassium bichromate. The negative and the plate are then placed in a screw frame to hold them in close contact during exposure to light. The light penetrating the white lines on the negative, hardens the sensitized coating and when sufficient exposure has been made the plate is washed; the parts which have been acted upon by light remaining hard whilst the parts not acted upon wash away. The parts which remain on the plate represent the design. This is then protected by an acid-resisting material and the plate placed in an acid bath which etches away the unprotected parts of the plate, leaving the lines and stipple as represented in the design standing in relief. Numerous operations take place before the plate is mounted on wood to make it type high to meet the printer's requirements. The outline is known as a key-plate, and colours are added as required, either by photographic means or by the offset method. Tints of the colour in which the block is to be printed are produced by means of stipple, or lines made on the plate before etching. Many of the delightful colour illustrations in Kate Greenaway's, Walter Crane's and Randolph Caldecott's books are printed from woodcuts or line blocks.

Three-colour.—This process is used for the reproduction of paintings of carpets and other colour subjects and is an adaptation of what is known as the half-tone process. A photographic negative of the subject is taken through a cross-lined screen which breaks up the picture into innumerable little dots, varying in number and size according to the grading of the screen, and the tones contained in the picture. It is by the three-colour process that a large amount of colour printing for commercial purposes is produced. When photographing a painting, however, the colours and their component tints are scientifically separated. This is done by placing in the camera a piece of coloured optical glass called a colour filter, representative of one of the fundamental colours of the spectrum, through which the light passes before reaching the specially prepared photographic plate. Different coloured filters are required for each colour sensitive negative. The object of the filter is to keep from being recorded on the negative the colours and their tints which are not complementary to the inks in which the printing blocks are to be printed. For the blue printing plate a red filter is used, for the red plate a green filter, and for the yellow plate, a blue filter; and when, as is usual at the present day, a fourth colour is used, another filter is employed which is of an amber tint. This fourth colour block may be printed in grey or black, which greatly assists in overcoming the difficulties met with in obtaining a correct rendering of the tones and colours in the original picture and, at the same time, materially helps the colour printer in producing clean and regular results throughout a long run.

In making colour plates the ruled screen, which breaks up and provides the necessary reticulation required for a printing surface, is turned round so that the dots are at a different angle for each colour. When the screen negatives are developed they are photographically printed on to a piece of metal, usually copper, and etched in a similar manner to that employed in making line blocks. Before a set of colour blocks is in a condition to be sent to the printer, however, a vast amount of artistic and painstaking work has to be done by etchers who endeavour, by means of repeated immersions in the etching bath, to obtain results in the finished print approximating to the original painting. To obtain the best results from half-tone blocks, a paper with a glossy surface, known as art paper, must be used. Objection, however, is frequently made to the glare of this coated paper but experiments are being made to make blocks which will print satisfactorily on a matt (*i.e.,* non-glossy) paper and recent results give reason to hope that this will materialize in the near future.

Relief Printing Machines.—The types of machine used for colour printing by relief methods are numerous, but they may be divided into two categories: (1) Platen machines, where the impression is obtained over the whole of the printing surface at the same moment; (2) Cylinder machines, where the pressure extends along the whole length of the sheet but with only about a ½in. contact with the printing surface.

Platen Machines.—Those generally known as "heavy" platens are most suitable for colour printing. The forme or plate is securely fixed in an iron frame called a chase, and placed on the "bed" in a perpendicular position, the inking rollers passing over the face of the forme, thus inking the surface. The ink, which is of a buttery consistency, is stored in a trough, and can be regulated according to the supply required. A sheet of paper is placed (usually by hand) on to the guides fixed on to the platen, which is flat and moves up with a rocking motion to get the impression from the inked plate. The platen then rolls back, and the printer removes the printed sheet with his left hand and places it on a board fixed to the machine, at the same time placing another sheet in position on the platen as it begins to make its upward movement. Sheets of about 22½in. by 17½in. can be printed on this type of machine, but great skill is required to place the sheet accurately into the guides, which if not done, will prevent the subsequent colours from registering, *i.e.*, fitting each other so that the finished print is sharp and clean, and the colour values of the original are faithfully reproduced.

Cylinder Machines.—These are used for large sheets and a heavy class of work. In this instance, the formes or plates are placed in a horizontal position and fixed securely on the bed of the machine which moves to and fro. During the travel the plates are inked by a series of rollers held in brackets. These receive their supply of ink from a slab to which the ink has been transferred from a duct, a trough which can be regulated to supply the amount of ink necessary. Working in conjunction with the bed on which the forme is placed is a large cylinder, secured in brackets, which rotates as the bed makes its to-and-fro movement, carrying with it a sheet of paper which has been placed in lays. This is taken by means of a "gripper," which automatically takes the sheet round the cylinder, and thus obtains the impression from the plates. The sheets are then mechanically deposited on to a board, where they are piled up one on top of the other until they are removed by the printer. On this class of machine, sheets ranging from 22½in. by 17½in. to 60in. by 40in., and sometimes larger, are printed. There are special machines for printing two, three or four colours before the sheet is delivered, but these are not used for the best class of work, although fair commercial results are obtained by this method, generally known as multi-colour printing.

By whichever type of machine the work is printed, a great deal of work requiring care and skill is necessary before the actual printing of the sheet commences. The blocks have to be made type high, and this is done by the skilful fixing of pieces of paper below the wood mount so that the printing plate will present an even surface to the inking rollers in order that the plate may be correctly inked. This is called underlaying. Another operation, called overlaying, is necessary. Briefly, this means the cutting out and pasting together of pieces of paper and fixing them on the machine in such a way that the requisite amount of pressure will be brought to bear upon the different tones contained in the plate. Thus, the solids would be represented by the thickest parts of the overlay, the middle tones correspondingly less, and the high lights just sufficient to make the impression firm and no more. The treatment of the ink also requires attention, in order that each colour should print clearly on the top of the previous one. Care is likewise required to protect the sheets from the effects of changing temperature; while the adjustments of the machine have to receive special attention in order to ensure that each of the colours will register, otherwise the work would be spoiled.

Intaglio Printing.—The intaglio method of producing prints is theoretically an ideal one since it produces the tones of an original in a similar way to that in which many artists obtain "weight" in a picture—by applying varying amounts of colour. In other words, solids in an intaglio print have a greater quantity of ink than the middle tones and high-lights, the latter being practically plain paper. The method applicable to this process may be divided into two sections: *hand work* and *mechanical.* The first includes engravings, etchings, aquatints, mezzotints and photogravure. Each process has a distinctive characteristic and special method of preparing the plate, which it is necessary to understand when dealing with colour prints commanding high prices.

Line Engraving.—The method of preparing plates for line engraving is as follows: a carefully prepared piece of copper is coated with a varnish on to which the design is drawn or transferred. The drawing is then gone over line by line with a liner or graver which cuts furrows into the metal plate. Various shapes and sizes of gravers are used according to the character of the line required, the incisions varying in depth and width according to the nature of the drawing. The greatest care, therefore, must be taken to preserve the surface of the plate from damage, since the slightest scratch will print.

Stipple Engraving.—In this method the plate is obtained by etching the copper or zinc sheet, which is covered with a wax acid resist, the work being produced on the plate by means of dots of various sizes and forms made by needles. These remove the wax coating and leave the metal bare. The plate is placed in a bath of diluted nitric acid and the bare metal is etched away. The parts which will appear as white in the print are protected by the wax. After necessary touching up has been done the plate is ready for printing.

Etchings.—As the term suggests, etchings are obtained from plates on which the work has been bitten below the surface. The method of making the plate is somewhat similar to that followed in stipple engraving. A selected plate is coated with an acid-resisting preparation—a composition of wax, the design being drawn upon this with a steel point which removes the wax and leaves the metal bare. A mordant (*i.e.*, acid) is then applied and etches away the metal where the steel point has removed the wax. Repeated application of the acid is required, the darker tones requiring more than the lighter. *Aquatints.* A plate for aquatint printing is covered evenly with powdered resin or bitumen. This is done by placing the plate in a box where resin or bitumen is agitated. The dust falls on to the plate which is then heated, melting the grains of powder which run together, and leaving the surface partially protected. This forms an acid-resisting ground. The subject to be reproduced is either drawn or transferred to the ground. The edges and back of the plate are stopped out with some acid-resisting liquid and after the first etch the parts of the picture which are to be white are stopped out, and the plate is again placed in the acid bath. This is repeated until all the tones are treated. The plate is then removed from the bath, washed and dried. Aquatint is often used along with etching, the subject being first etched, and the lines protected, before adding the aquatint grounds and proceeding with the additional etchings.

Mezzotints.—This is probably the ideal intaglio process for producing colour prints. It is not an etching process but one which is entirely dependent upon the skill of the artist. A flat and highly polished sheet of copper is roughened all over with what is called a rocking tool. This is from 2in. to 3in. broad and made with varying degrees of fine teeth. The tool is rocked backwards and forwards in every direction over the face of the plate until the plate is a mass of sharp teeth. An impression taken from the plate at this stage would yield a solid black velvety print. The subject is then drawn or traced on to the "rocked" plate. A tool called a scraper is employed to get a surface with different gradations of tones, from high lights to solids. This is done by expertly scraping away the grain or tooth from the plate in a greater or less degree, according to the strength of the tone required. When the grain is completely removed the high lights will appear white in the print, the deepest tones being represented by the natural grain obtained by the rocking tool.

Photogravure.—The making of a photogravure plate is somewhat similar to that adopted in aquatint, where the copper-plate receives a ground of resin or bitumen, but, instead of drawing the design on the ground, a special photographic print is employed. What is known as a carbon tissue is made, *i.e.*, a mixture of gelatin and carbon or pigment being made and a thin film of this spread on a piece of paper. When this is dry it is treated with potassium bichromate, which after drying is exposed to light under a reversed photographic positive of the subject. Gelatin thus treated with bichromate and dried becomes sensitive to light, and acquires the property of becoming insoluble in hot water wherever light has acted upon it; thus the layer of gelatin is penetrated by the light and rendered insoluble to varying depths according to the proportional strength of the light passing through the positive. This printed carbon tissue is soaked in cold water and pressed upon the prepared plate. Warm water is then applied, and as the gelatin not affected by light remains soluble, it dissolves, the paper support coming away at the same time, leaving a tone mould or relief of the subject affixed to the plate. This, along with the resin ground, constitutes the acid resist. The plate is then subjected to a series of etchings by a suitable mordant.

Intaglio Plates.—The printing of intaglio plates is indeed an art, calling for great skill, extreme patience, a high artistic sense and much experience. The general principle in inking a plate is to rub the colour all over it with what is called a "dabber," *i.e.,* a piece of blanket made into a pad. Care must be taken to get the ink into the deepest hollows as well as into the lightest tones. During this work the plate is kept warm by placing it on a stove. The surplus ink is then carefully wiped off the surface of the plate by cloths varying in degrees of fineness. Discretion must be used by the printer in wiping the plate, some parts requiring more than others. When producing colour prints the colours are painted on the plate by small dabbers or paper stumps, *i.e.,* a piece of suitable paper rolled in the shape of a pencil and dipped into the special colour required. This is then dabbed into the tones in the plate in accordance with the scheme of the original picture which the printer follows. When all the colours are filled in, the plate is wiped and polished, the finishing touch being given by the palm of the hand. It is then ready for the impression to be taken. This is done by placing the inked plate on the bed of what is known as a copper-plate press. A piece of special damped paper is placed upon the face of the plate, which is then backed with a soft packing and the impression obtained by running the plate and paper under a steel cylinder. Extreme care has to be taken in removing the print from the plate. It is by these intaglio processes that the high-priced prints sold by art dealers are produced. Usually, about 20 colours are used in a colour print, and frequently it takes at least a day to obtain a print.

Machine Photogravure.—Thanks to the progress of mechanical science, within recent years it has been made possible to apply the principles of photogravure (intaglio) to every day use, more particularly in the production of magazines and supplements to newspapers. This method of printing has made greater advances in America and on the Continent than in Great Britain, although excellent work is done in England where probably the best examples of colour work are produced. This method of reproduction masquerades under many titles, *i.e.,* gravure, machine photogravure, rotogravure, intaglio printing and sometimes photogravure. The method of preparing the printing surface is similar to that of photogravure; a photographic print is taken on a film of sensitized gelatin spread over a sheet of paper and mixed with a coloured pigment. To provide the necessary reticulation, in place of the resinous ground employed in hand photogravure, a photographic copy of a ruled screen is incorporated on the carbon tissue along with the design and then transferred to the copper-plate or cylinder, the latter being generally used. The plate is then mechanically etched and sent to the press room for printing.

Machines.—The machines used are of two types. One is the flat-bed machine, where the plate is flat and placed on a bed over which a cylinder carrying a sheet of paper travels, thus obtaining the impression. The inking and cleaning of the plate are done mechanically. The other variety is the rotary machine where the paper receives its impression when travelling between two cylinders, one of which bears the work and the other provides the necessary impression. This style is in most general use. The etched cylinder runs in a bath of volatile ink, and as it rotates a fine and delicately adjusted knife, called a "doctor," scrapes the surplus ink off the surface. This falls back into the trough, leaving the cylinder clean. The paper is either fed in by hand or supplied from a reel or web, this passing between the printing and pressure cylinders. Frequently both sides of the paper are printed before it is automatically cut up into sheets. Colour reproductions by this method require a distinct cylinder for each colour, the separation of colours being obtained in the same manner as that in the making of three-colour blocks. Great difficulty, however, is experienced due to register troubles in obtaining results equal to those by other printing processes. Experiments are continually being made, and no doubt in time colour reproductions will become part of the ordinary day's work of the gravure printer, instead of being confined to one or two firms who have made colour work a speciality.

Planographic Printing.—This, as the term denotes, means surface printing, such as lithography, and possibly collotype might be included.

Lithography.—The basic principle of this process is the antipathy of water to grease. A design is drawn or transferred on to a level stone or a sheet of metal which must be free from grease. This must also be water-absorbing. Upon a dry surface the lithographic artist either draws or paints the design in an ink of a greasy nature, with a pen or brush. The stone is then prepared for printing by gumming, rolling up with printing ink, and etching; the effect being that, when the printing surface is damped over with water and a roller charged with printing ink passed over the stone, the design which has rejected the water will accept the ink from the roller, while the clean parts of the stone which have absorbed the water repel the ink. A sheet of paper is then brought into contact with the stone and run through a press, thus an impression of the design is transferred to the sheet. The first attempts at colour printing by this process were obtained by printing flat tints. According to the number of colours in the picture, offsets were transferred on to as many stones as the number of colours required, and the parts of the design which had to be printed in a particular colour were painted in, following the practice of the engravers who cut woodcuts for colour printing. The next development was to print colours on the top of each other. This was done by stippling, and demanded great skill and patience. When the original picture was handed over to the lithographic artist he would first make an intricate tracing of the original, detailing every variation in form and colour; after drawing on the stone an elaborate key to scale, he proceeded to paint in the parts which had to be solid, and the graduated tints by making dots with a pen in circular formation, varying the sizes and spaces between them according to the tones and tints of colour he desired to reproduce. Thus, in each of the stones which represented a separate printing, he would incorporate a particular colour and its component tints. When the drawing of the various colours was finished, which would sometimes take weeks, proofs were taken on a hand press and alterations made where necessary. It was by this means that certain colours in their various hues would be obtained; *i.e.,* super-imposing blue on yellow produced a green; violet was obtained by printing blue on the top of red; and so on. The drawing was done with a black ink, but this did not affect the colour to be printed as it only provided the means by which the design is absorbed by the stone, each stone being printed separately in a different coloured ink. The colours were registered into each other by means of marks called "register marks." When artists use the lithographic process to reproduce their own work, they sometimes draw the design by freehand direct on the stone. Few lithographic artists are capable of doing this, the usual practice being to trace the original and reduce it to the size required by scaling. Another method is to use grained stones on which the artist works with crayons. It is by this means that chalk drawings are reproduced. Stippling is a tedious and laborious operation calling for great proficiency and many years of training. Many chromo-lithographic prints had as many as 25 printings, and good lithographic prints, produced in the early part of the 19th century, now command high prices.

Photo-Lithography.—As the demand for speed became greater mechanical means were adopted, and hand work has now largely been superseded by photographic methods, by which either a transfer taken from a specially prepared half-tone relief block is put on the printing surface, or what are known as photo-litho transfers are employed. The modern practice is to make screen colour negatives in the same way as those made for three-colour printing. The lithographic printing plate is coated with albumen and ammonium bichromate, the negative being placed in contact with it, and exposed to light. When sufficient exposure has been given, the plate is washed and the part of the sensitized coating which has been acted upon by light remains on the plate, and from this impressions are obtained. A different stone or plate is required for each colour and the sheet of paper passes through the press or machine for each printing. Reproducing pictures by this process has materially reduced the number of printings, seven or eight being the average number required.

Lithographic Machines.—The work is proved upon a press carrying the stone or plate on which, when damped and inked, a sheet of paper is placed opposite marks and backed with a few sheets of paper or other material. A hinged frame with a sheet of leather or metal called a tympan is then lowered on to the stone and run through under a scraper. Small editions can be printed on a press but when a large number of copies are required a machine, either flat-bed or rotary, is used.

Flat-bed.—By this method, the stone is placed on the carriage and levelled up to a certain height so that the proper inking may be given to the stone and the necessary pressure obtained to transmit an impression of the design from the stone to the paper. This is done by passing the sheet round a cylinder which is supported by brackets and runs in unison with the bed. At the crown of the cylinder there are boards to hold the paper, each sheet is laid into guides and by means of grippers, the sheet is carried by the cylinder over the stone. Behind the cylinder an apparatus is attached for automatically damping the stone as it passes to and fro, while in front of the cylinder there is a series of inking rollers which supply the necessary ink. The printed sheets are either taken off by hand or mechanically by "flyers" and deposited on to the delivery board.

Rotary.—This type of machine has a plate stretched round one cylinder, with apparatus for automatically damping and inking. The sheets are fed into the machine and taken round the impression cylinder by means of grippers, and thus the impression of the design is transferred to the paper. This type of machine allows for higher speed than the flat-bed and is mainly used for poster printing. Both these methods are rapidly giving way to what is called "offset." By the offset method the sheet of paper does not come in direct contact with the plate upon which the design is drawn, but transfers an inked impression to a sheet of rubber stretched round an auxiliary cylinder, when, as the machine rotates, the paper comes into contact with the rubber cylinder from which it receives its impression. The chief feature of the offset principle is that paper with a rough surface, or even fabric, can be printed, often adding additional quality to the print. This process has made rapid strides, and has, without doubt, great possibilities as a colour printing process.

Collotype.—Collotype is claimed to be the ideal colour reproductive process. Prints produced by this process command higher prices than those obtained by other processes, with the exception of hand intaglio methods. In this instance, no mechanical reticulation such as that obtained by the use of a screen, is required. The necessary grain is provided by the natural drying of the gelatin and cannot be distinguished by the naked eye. Continuous tone negatives are used, and these are retouched, to provide the proper colour rendering, by workers with a keen appreciation of colour and its analysis. It is then photographically printed on a sensitized film of gelatin floated on a glass plate about ½in. thick. It is then washed in running water, and the parts mostly affected by the light, which has passed through the negative, are hard and insoluble, whilst those which have only been partially affected are more or less soluble according to the intensity of light which has passed through the negative on to the sensitized gelatin film. The surface is, more or less, water-absorbent, and consequently resists the ink in varying degrees. There is no mechanical printing process more capable of giving finer reproductions of coloured subjects. It reproduces the atmosphere of the original picture with remarkable fidelity, whilst its capacity for giving depth of colour and quality is unsurpassed by any other printing method. The average number of printings is seven or eight.

Collotype Machines.—The machines used for collotype printing are similar to a flat-bed lithographic machine, but no damping is required. In fact, damp is the greatest enemy with which the collotype printer has to contend. It is seldom possible to obtain more than 1,000 copies from a plate. No printer of experience would care to prophecy by what particular method colour printing would be produced in the future. Experience has proved that each method adapts itself to its own particular field, and seldom does a new method entirely supplant processes which have proved successful. Since the 1880s great strides have been made in developing colour printing processes, and, with the aid of the engineer, machines are constantly being adapted to meet the demands for finer and more accurate results. Many colour prints are produced by a combination of the different methods of reproduction. (*See* PRINTING; PHOTO-ENGRAVING; COLLOTYPE; LITHOGRAPHY.)

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COLOURS, FAST. The dyestuffs producing the fastest shades upon textile materials are the "vat" dyes of the anthraquinone and indigoid classes, more especially the former. (*See* DYES, SYNTHETIC.)

COLOURS, MILITARY. The term "colours" is a colloquial expression embracing the standards and guidons carried by cavalry regiments and the colours proper carried by infantry regiments and certain other arms. Like all national and tribal flags, colours are symbols embodying the spirit of the people who fight under them. The origin of these symbols can be traced to the dim beginnings of history, a fact which is confirmed by recent excavations in India bringing to light evidence that there was a "cult of the standard" over 5,000 years ago. These primitive symbols were made of metal or wood. They are frequently mentioned in the Bible: "The children of Israel shall pitch every man by his own standard, with the ensigns of their fathers' house" (Num. ii., 2). It is not until just prior to the Christian era that we find standards made of cloth, silk or damask. The standards of Julius Caesar's army were made of metal, usually surmounted by an eagle, a practice copied later by the French.

Twofold Purpose of Colours.—These military flags have always had a twofold purpose: (*a*) to serve as visible rallying points on the field of battle; and (*b*) as distinguishing marks of persons of superior social status. Before the introduction of long-range weapons it was impossible to locate one's leader in the confusion and dust of battle unless his distinctive insignia was held aloft. Sometimes the insignia or ensign could not be seen, so the bugles, trumpets, drums, fifes, and, later, bands, usually played some music round the standard to assure the fighting men, through the sense of hearing, that the standard was still flying. This employment of flags and music is aptly stated in the Chinese *Book of War*, written 500 B.C.—"The drum and bell are used because the voice does not carry; the flag is used to assist the sight." To lose the standard, therefore, often meant that one's leader was lost, or at least there was no assurance that he was still leading, which caused the troops to become dispirited. The importance of "keeping the flag flying" was very great, but the conspicuity attendant upon the carrying of it increased the mortality of colour- or standard-bearers as long-range weapons became more efficient. The mortality of colour-bearers in the Crimean War was tremendous and this was the last European war in which British colours were carried. They were, however, carried in the Zulu War of 1877–79, when Lieuts. Melvill and Coghill of the 1st battalion, 24th Regiment (now the South Wales Borderers) endeavoured to save the Queen's colour at the notorious Isandlwana disaster on Jan. 22, 1879. Colours were last carried at the Battle of Laing's Nek on January 28, 1881, in the first Boer War. During the Russo-Japanese War, 1904–5, both sides carried colours. During the World War colours were not taken into action but identification was obtained by means of small flags during the day and by coloured flares at night. As regards the second purpose, that of being employed as distinguishing marks, early evidence of this may be seen in the sculptures unearthed at Nineveh which show two designs of standards attached to the yoke of the chariot of Darius. The continuity of this idea finds expression in all ages in the personal standard of royal personages and the nobility, and, in a lesser degree, in the flags used to denote the headquarters of higher commanders of the fighting services at the present time. Early military flags were of two main types: (*a*) the "personal," borne in feudal armies where service was rendered to the immediate overlord, and (*b*) the "national" or "standardized" as borne by national or standing armies. In the British service the transition period lasted from 1661, when Charles II. created the standing army, until 1743 when a clothing warrant stated "No Colonel to put his arms, crest, device, or livery, in any part of the appointments of his regiment." This abolished the "personal" aspect of the colour. The same warrant directed the "number of the rank of the regiment" to be painted in the centre of the regimental or second colour, thereby inaugurating the "regimental" aspect.

Modern Colours.—Present-day colours are the direct descendants of the mediaeval baron's banner. The baron's regiment consisted of companies under knights. Later the baron's flag became the "colonel's colour" and the knights' banners the "company colours." The baron's banner was usually square and bore his coat-of-arms. The banner of a person under the rank of knight-banneret was swallow-tailed like a guidon; this also bore the knight's coat-of-arms. Variety was the predominant note at this period and "standardized" colours were not introduced until about 1620 when Gustavus Adolphus regularized his cavalry, and ordered that each regiment should have eight troops, with a standard to each troop, each regiment having all its standards of one pattern and bearing similar devices. During the Commonwealth both Parliamentarian and Royalist forces adopted the standardized pattern of colours. In 1661, Charles II. issued a warrant to provide "twelve colours or ensigns for our Regiment of Foot Guards." In the same year he issued a further warrant for another regiment of Foot Guards then at Dunkirk, for "twelve colours of the same sort as those of Colonel Russell's Regiment," thereby pursuing the policy of standardization by ordering the same number of the "same sort" for both regiments. These warrants are also important from the fact that they authorized for these two regiments—which were amalgamated in 1665 to form the Grenadier Guards—the royal badges which they carry, in rotation, on their regimental colours at the present day. During the early part of William III.'s reign a reorganization of infantry took place by which they fought in three divisions, pikemen in the centre and musketeers on the flanks. The colours were therefore reduced to three per regiment and the cavalry standards were also reduced to the same number. In 1707 the pikemen were abolished as a tactical division and this caused the colours to be reduced again to two per regiment. Many regiments appear to have kept up their three colours until 1743 when George II. issued a warrant in drastic terms. This warrant was not very clear on many points and it was followed by another in 1751, under which each regiment was to have only two colours, viz., the first, or king's colour, to be the Great Union (except for Foot Guards), and the second, or regimental colour, to be of the colour of the facing of the regiment, with the Union in the upper canton, except those regiments faced with red or white, whose second colour was to be the red cross of St. George, in a white field and a union in the upper canton. In the case of the Foot Guards, the king's standard (crimson) is the first colour, and the second is the Great Union. Several line regiments were also authorized to bear "royal devices and ancient badges" on their colours. This warrant, the first of its kind, was revolutionary, and made a definite break with the past. It became the foundation of all subsequent warrants and, in fact, with slight modifications, is in force to-day. Although it permitted only two colours to be borne a few regiments acquired a third, particularly those which served in India between 1780 and 1806. These third colours were, however, definitely abolished in 1835. (T. J. E.)

British Colours in 1940.—Modern mechanization of the cavalry has necessitated a reduction in the number of regiments of that arm, some of the older regiments being combined in pairs. Where that occurred the combined unit bears the flags of both the old regiments. The Household Cavalry and the Dragoon Guards carry standards, the Dragoons have guidons. All are of crimson silk damask and are emblazoned with various badges. Royal arms and badges are borne on the standards of the Household Cavalry, regimental badges are placed on the standards and guidons of the other regiments. Lancer and hussar regiments have no standards. Each infantry regiment, with the exception of the rifle regiments, carries two colours; the first, or king's colour, and the second, or regimental colour. In the regiments of Foot Guards the king's colour is of crimson silk damask and bears some royal device which has been assigned to the regiment as a badge. The regimental colour is the national Union flag, with a regimental badge on the centre. The first colour of the other infantry regiments is the Union flag, with the title of the regiment on the centre. The second colour carries the regimental badges on a background of the colour of the facings of the uniform, except that when the facings are scarlet or white, the colour has the red cross of St. George on a white field. It should be noted that all regiments having the word "Royal" in the title have blue facings. The rifle regiments carry no colours. The royal crest, a crowned standing lion, forms the finial of the staff of all colours and standards. Colours of units of the Indian army and of Dominion troops follow the general rules for British regiments.

Battle Honours.—In addition to the distinctive badges pertaining to the different regiments, colours and standards in the British army bear the battle honours which have been earned. These honours are of two kinds, (1) a symbol or badge, (2) the name of a battle or campaign in which the regiment participated. The first battle honour granted was "Emsdorff," authorized in 1768 for the 15th Hussars for its distinguished services at that battle in 1760, where it defeated and captured five battalions of French infantry with their colours. In 1784 the word "Gibraltar" was authorized to be borne on the regimental colour of each regiment that had taken part in the defence of Gibraltar under Sir George Elliot (1779–83). In addition to the word "Gibraltar," a castle and key to symbolize that famous fortress is now embroidered on the colours. "Minden" was authorized in 1801. In 1802 the Sphinx, as a badge, was granted to the regiments which had taken part in the Egyptian campaign of the preceding year. In 1811 an order recognized and regulated the custom which had gradually come into being and in due course authorization was given for campaigns prior to Emsdorff, the earliest so recognized being "Tangier, 1662–80," borne on the colours of the Queen's Royal West Surrey regiment and the 1st Royal Dragoons. In addition to the castle and key for Gibraltar and the sphinx for Egypt a mural crown is used when the defence of a city is commemorated, a dragon for the campaign in China and either a tiger or an elephant for service in Indian wars. A rare badge is the naval crown granted for services afloat. One example is the Welch Regiment, which served as marines under Admiral Rodney in the West Indies in 1782. Another is the Queen's Royal West Surrey which served aboard the fleet under Admiral Howe in the victory of the "Glorious First of June," 1794. At first these battle honours were placed on both the king's and the regimental colours, but since 1844 they are on the second colour only with these exceptions; (a) the Foot Guards, who place their honours on both colours; (b) the Honourable Artillery Company, whose honours are on the king's colour only; and (c) the ten selected honours of the World War, which are placed on the king's colour in accordance with an order of 1922. Lancers and hussars, having no colours or standards, place their battle honours on the drum covers; rifle regiments paint them on their drums and place them on their cap badges.

COLOURS IN OTHER ARMIES

United States of America.—In March of 1779 the army regulations called for two colours for each regiment, one to be "the standard of the United States," the same throughout the army; the other a regimental colour varying according to the facings of the uniform. In other words the British system was adopted on paper, but it was not carried into effect. The Revolutionary War ended before any of these flags were issued. The colours actually carried were a heterogeneous collection issued by the different States or donated by individuals. It is doubtful whether the national flag, the Stars and Stripes, was carried by troops in that war, certainly not with any official authorization. In 1787 the one regiment then in existence was furnished one colour, showing the coat-of-arms of the United States and that plan was followed for subsequent regiments until 1834 when the artillery was furnished with two colours, one, the regimental, having a red background, the other, the national flag. In 1841 the same system was extended to the infantry, but it was not until 1895 that the cavalry was given a standard of the Stars and Stripes. The regimental colour in those days had the arms of the United States. After the World War (1914–18) the regimental colour was changed by replacing the shield, crest and motto of the United States by the regimental devices on a background in the colour of the facings, red for artillery and engineers, yellow for cavalry, blue for infantry, etc. The battle honours are carried on silk streamers made in the same colours as the ribbons of the different campaign medals, each streamer being inscribed with the principal battles of that war in which the regiment participated. The streamer is attached to the staff of the regimental colour only, just below the spearhead finial. The regiments which were decorated with the fourragère by the French for particularly brilliant services in the World War, attach a fourragère to the staff. Each company has a guidon inscribed with the company letter and regimental number. The background is in the colour of the facings, except cavalry guidons, which are red and white in two horizontal stripes.

France.—The military colours of France had their origin in the 15th century, when Charles VII and Louis XI organized royal foot troops among the burghers of cities in their effort to curb the power of the nobles, and unify the country. These troops usually carried banners bearing the arms or device of the parish, surmounted by a white cross. From that time until the Revolution the colours of the infantry in the French army bore a white cross. In 1791 the Assembly prescribed that the "first flag of each regiment will hereafter carry the three national colours," blue, white and red, charged with the number of the regiment and the motto "Discipline et Obéissance à la loi." It was not until 1803, however, that the colours were arranged in the familiar three vertical stripes, there was no systematic arrangement before that year. Prior to the Revolution the staff of each colour was surmounted by a fleur-de-lis. Under the First Republic a spearhead was used. When Napoleon became Emperor he used the Roman eagle standing on a thunderbolt, and that became the most important part of the standard, so that the entire device, eagle and flag, was known as an "Eagle." Under Louis Philippe the Gallic cock was used as a finial. Napoleon III returned to the eagle of his uncle, while the Third Republic uses a spearhead, bearing the monogram "RF." There is but one colour for each regiment, the tricoloured flag of France, bearing the number of the regiment within laurel wreaths and the inscription "La République Française" on one side. On the other side is "Honneur Patrie" and the names of the most important battles in which the regiment has participated. Prior to the World War only four such names were permitted, now the number has been doubled. Attached to the staff, just below the spearhead, is a "cravate," on which are placed the decorations which the regiment has earned for specially meritorious services in action, the Legion d'Honneur, Medaille Militaire, Croix de Guerre, or perhaps a fourragère. The fourragère is a cord, similar to an aiguillette, in the colours of the ribbon of one of the above mentioned decorations.

Germany.—German troops do not carry the national flag. In the days of Frederick the Great, Prussian regiments bore a white flag on which was a black eagle from the coat-of-arms of Prussia. That was typical of all German troops, as each principality and kingdom used the local coat-of-arms on the colours of their own regiments. This practice lasted until the National Socialist government abolished all territorial subdivisions. Now the regimental flag shows an iron cross with a swastika in each corner of the flag. On the centre of the cross is the badge of Nazi Germany, a black eagle standing on a swastika, within a wreath of oak leaves. The field of the flag varies according to the arm of service, white for infantry, yellow for cavalry, red for artillery, pink for mechanized infantry, etc. The eagle on a swastika forms the finial of the staff. Colours of foot troops are square, motorized and mounted regiments carry guidons.

Spain.—Each regiment in the Spanish army carries one colour, the national flag having the coat-of-arms on the centre. Since the victory of the Nacionalistas in the Civil War, the old flag of the monarchy has been restored, with the coat-of-arms of Ferdinand and Isabella, in a revised form to show all five of the ancient kingdoms comprising modern Spain. There are, however, many exceptions to this rule, as all older regiments are authorized to carry the colours they formerly bore, in some cases as far back as the 17th century. These ancient colours are of two kinds, (1) the red raguled saltire cross of Burgundy, the flag used by the armies of the Emperor Charles V in the 16th century, and (2) a purple flag, the most notable of which is the colour of the regiment Inmemorial del Rey, which dates back historically to 1634, and by tradition much earlier. The regiments thus honoured comprise most of the artillery and engineers and the First Royal Infantry regiment. The Fifth Engineers of Valencia and the air service bear the red cross of Burgundy superimposed on the national flag. The staff is always topped by a spearhead, more or less decorated.

Belgium, Portugal, Italy, Japan.—Other nations follow the French and Spanish custom by using the national flag for the only colour carried by a regiment. The Belgians embroider in gold the battles for which the regiment was decorated for distinguished services, and place the decoration itself on the cravate. The Portuguese use a knot of silk ribbon in the colours of the decoration which has been awarded. This is attached to the staff above the flag. Italian colours also have a cravate, called "nastro" in Italian. The colour carried by the Japanese is the rising sun with 16 rays.

Nothing is placed on it except the regimental title.

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COLOUR-SERGEANT, a rank peculiar to the British army, created in 1813 at Wellington's request, and till 1915 the senior N.C.O. of a company. One particular duty of the colour-sergeant is that of "Attending the Colours." The original distinctive badge was a "Colour supported by two cross swords and ensigned with a Crown" worn above the chevrons on the tunic. In 1915 a new rank, that of warrant officer class 2, was created and generally the senior of the colour-sergeants of a double company was promoted thereto.

COLOURS OF ANIMALS. This is a subject at once of considerable aesthetic appeal and of high scientific interest. Many of the most beautifully coloured objects in nature are animals or are derived from animals. On the scientific side, there are questions of the physical and chemical basis of animal coloration, and of its value, if any, in the economy of the organism. Colour, indeed, has figured importantly in nearly every branch of biology: in biochemistry, physiology, pathology, histology, taxonomy and genetics, both of animals and plants; as well as in psychology, both human and comparative. In general, the colours of animals are the result of two chief causes: (a) the minute structure of materials, chiefly ones on the body surface (the so-called physical or structural colours); (b) the presence of substances which possess colour independently of the arrangement of their particles (chemical or pigmental colours).

STRUCTURAL COLOURS

The physical principles of total reflection, interference, scattering and to some extent, diffraction, all familiar in the inanimate world, are encountered also among tissues and tissue products of animals.

Total reflection of light, imparting whiteness to animal structures, often arises from the separation of finely divided structural materials by air spaces in the way that whiteness is conferred upon snow. Examples of this are seen in the whiteness of feathers, fur and hair, and in the wings of certain butterflies. Secretions or deposits in animal tissues may also contribute to the whiteness of total scattered reflection, examples being colloidally dispersed fatty or lipoid materials, calcium carbonate in the skeletons of numerous molluscs, crustaceans, corals, echinoderms and protozoans, silica in sponges, proteinaceous materials in various serous membranes, deposits of white pterins in the wings of pierid and other butterflies and silvery aggregates of crystalline guanine or other purine materials (*q.v.* infra) in numerous invertebrates and in fishes' scales.

Disintegration of white light into its spectral components occurs in animal structures chiefly through interference, wherein the incident light penetrates and is reflected back through successive thin-layered films or laminae to give striking iridescence, even in diffuse light. Iridescent interference colours are very common in certain animal structures, including the wing scales of *Morpho* and other butterflies, the brilliant rainbow hues observed in the feathers of humming-birds, peacocks, pheasants, etc., in the wing covers of many beetles, the outer skin of reptiles, nacreous surfaces of Pearls and in molluscan shells and the setae or bristles of numerous marine worms (*e.g., Aphrodite*). The brilliant lustre of human or other mammalian hair and its iridescent appearance in direct sunlight is due to the same phenomenon, the light being reflected in its disintegrated components by minute transparent scales which surround each individual hair. Pure prismatic refraction of light in animals is probably very rare, and limited to cases wherein direct beams of light encounter certain microcrystalline deposits. Diffraction by natural gratings or regular fine parallel striations is not uncommon among certain insects, but is perceptible only when a direct beam of light strikes such structures at an angle. Studies with the electron microscope have confirmed the presence of such natural diffraction gratings in some insects, notably the elytra or wing coverings of certain iridescent beetles.

Very common in animals is the display of blue colours, arising not from blue pigments but from scattering of reflected light by finely dispersed colloidal systems, lying over layers of dark melanin deposits. Examples of these structural blues are numerous. Blue eyes, wherein the turbid stroma of the iris overlies the dark membrane or uvea, may be simulated by placing disks of agar gel or dried collodion film upon a black surface. The blue skin about the head and neck of the cassowary or on the face and buttocks of certain primates results from the scattering of light by colloidally dispersed materials in the skin, overlying an absorbing layer of melanin pigment beneath. The gorgeous blues of the integument of various reptiles and fishes could be added to the many other examples of structural blue.

Two types of structural coloration may be combined, *e.g.,* diffraction and interference. In many other cases, the two underlying causes, structural and pigmental, are superimposed. Most of the greens found in fishes, amphibia and reptiles do not really depend upon the presence of a green pigment, but result from the association, within the tissues, of black and yellow. The otherwise sombre colours of black or brown pigment, when suitably reinforced structurally, may give rise to a resplendent glitter.

THE CHEMISTRY AND PHYSIOLOGY OF ANIMAL PIGMENTS

The visible range of light is selectively affected by reflection from or transmission through materials, only if the latter contain structural units whose size or vibrational frequencies lie between 3000Å and 7000Å. Those physical structures in the biological world which may disintegrate white light into spectra have already been considered; namely, very thin, finely spaced laminations, or closely placed ridges or striations, or very fine, colloidally dispersed micelles which scatter incident light, reflecting only the blue rays, these being the most refrangible.

This brings the discussion to a consideration of the chemical pigmentary compounds which, irrespective of physical orientation, selectively absorb a part of the light and reflect or transmit the unaffected fraction. Since the word pigment is based upon a Latin verb meaning "to paint," its original significance obviously had to do with the use of colouring matters for human ends. Those coloured substances were called pigments which were used as such. In transferring the term to the living world, this functional connotation has for some reason been abandoned. Any coloured substance which can be extracted from an animal or plant, regardless of its function, forthwith becomes a pigment. Owing to long-established precedent, this somewhat illogical use of the term will be employed in the present article, though a more recent word, biochrome, will be used as an alternative.

The colour of a compound depends upon the selective absorption of incident light within definite wave lengths, the unabsorbed residue being reflected or transmitted to the eye. This capacity to absorb visible light is due, in turn, to varying kinds and degrees of chemical unsaturation, or unfulfilled valencies, located in so-called chromophores (colour-carrying groups) within the molecule (*see* DYES). These areas of special molecular activity arise from reduction in the relative speed or frequency of motion on the part of one or more pairs of the compound's many rapidly vibrating electrons. Indeed, sufficient modification in the speed of electronic vibration imparts to the entire molecule a degree of special vibratory motion or chemical resonance. And this phenomenon, in the modern view, is the basis of colour manifestation.

Consider, as a crude analogy, a long horizontal cord or chain (representing a chemical compound), suspended just above or below the view of an observer looking through a long, narrow slit placed parallel to it (representing the visible spectrum of light). If, at certain points or links of the chain, threads be attached, and if these threads be given rhythmic jerks by an operator, the whole length of the chain will be thrown into a series of waves. As a result, portions of the chain will come into view through the slit, at heights and intervals depending upon the intensity and frequency of the pulses imparted to the chain at the various points of focus. Obviously, rapid, gentle pulls at a number of points of the chain would give the observer a resonance pattern of many rapid undulations of minor calibre, while more vigorous jerks at one or two points would reveal through the slit slower, higher wave pulses, and so on.

A molecular chainlike compound in a resonating condition absorbs, by internal interference or frictional forces, that critical fraction of incident light whose wave length corresponds with the resonance-frequency peculiar to the compound. The absorbed light is converted into heat, and the residual portion which emerges is of a complementary colour. Thus, if the resonance involves short, rapid waves (corresponding with rapid undulations in the analogous chain seen through a slit) the shortest visible light waves will be absorbed, *i.e.,* those of the violet and blue spectral region, and the compound will appear yellow. Red substances, having slightly longer resonance values, similarly extinguish light in the blue and green, while blue or green compounds result from cancellation of light in the red or orange realm. Black substances absorb all light equally and completely.

The colours of most chemical compounds are not of spectral purity, but include all of the visible light excepting the absorbed fraction; the colour of a molecule depends upon the dominant wave length, or that of maximum transmission.

There is good ground for the view that colour and chemical reactivity, and hence the potential metabolic value of a pigment to an organism, are parallel expressions of the same underlying molecular property of unsaturation. This is a reason for the careful consideration of the physicochemical attributes of biochromes and for continued researches regarding their metabolic position in the animal organism.

The more important biochromes of animals may be grouped into classes whose molecules are without combined nitrogen and others which contain this element.

Of the non-nitrogenous pigments, by far the most important, the most conspicuous and the most widely distributed are the carotenoids or polyenes. Indeed these are among the most widely distributed of all biochromes. Chromolipoids, naphthoquinones, anthraquinones and flavones represent other nitrogen-free pigments which occur in animals, but these are limited in distribution, and but little is known of their physiological attributes.

In the nitrogenous group are several pigments of very diverse chemical nature and metabolic position. The tetrapyrrolic pigments include both the porphyrin class, present in the blood of many animals, and the bile pigments, occurring in many secretions and excretory products; the dark melanins occur in skin, hair and other parts, and represent metabolic end-products. Several purines, while usually white or silvery in appearance, are included as biochromes or pigments because they contribute to the total colour of numerous lower animals; similarly the pterins, which are derivatives of pyrimidine, are frequently white, but may often be yellow in colour; the lyochromes or flavines, detectable in the tissues of all or nearly all living organisms, are identified with certain important biocatalysts; finally the indole derivatives, which are somewhat limited in any conspicuous manifestation are, like the melanins, purines and pterins, end-products of metabolism.

In the following treatment are outlined the chemical configuration, colour, source and metabolic features, insofar as the latter are known, of some representative animal biochromes comprised in these groups. Lastly, a few of many miscellaneous coloured compounds will be considered, whose chemical structure is yet imperfectly known.

Carotenoids (Fig. 1).—These red, orange, or yellow pigments, whose numbers of known compounds is constantly increasing, are of such wide distribution throughout the living world as to be nearly universal. The carotenoids are insoluble in water, but may be readily dissolved in alcohol, ether, chloroform and the various other organic fat-solvents. They show pronounced and consistent crystalline habits, and in solution, exhibit usually two, often three, but in some cases only a single absorption band, characteristically in the violet to blue, sometimes extending into the green region of the visible spectrum. They are readily bleached by light and by exposure to atmospheric oxygen, are unstable also in the presence of mineral acids, their chloroform solutions giving dark blue coloration upon treatment with concentrated sulphuric acid.

The chromophore grouping, or chemical configuration responsible for the colour, is the long chain of alternating points of unsaturation, or so-called conjugated double-bond structure, represented in the formula given for β-carotene. A number of carotenoid hydrocarbons share this constitutional formula $C_{40}H_{56}$. Carotenes and xanthophylls ($C_{40}H_{56}O_n$ . . .) occur together in many organisms, and may be separated on the basis of their preferential solubilities in certain solvents, and by differential adsorption from solution upon packed columns of relatively inert powders, such as chalk, sugar, alumina, magnesium oxide, etc., wherein the pigments appear as distinct coloured bands or zones. They may then be resolved into individual components by chemical extraction of each mechanically isolated zone.

These pigments occur in plant organisms ranging from the simplest types, *i.e.*, bacteria, fungi and algae, to the most highly evolved flowering plants. Animals from simple Protozoa to the highest mammals, including man, contain carotenoids, although the tissues, and notably the blood sera of a number of mammals, are almost or entirely devoid of these pigments. The livers of some of such species often yield carotenoids, and it is known that the lives of these animals depend upon a supply of carotene or its metabolic derivative, vitamin A. Carotenoids are relatively more concentrated in ovaries or eggs, some testes, liver (or liver-like analogue in invertebrates), skin, eyes and milk. Outstanding common examples of visible carotenoid pigmentation are in the legs, body-fat and eggs of domestic poultry, the bright red, orange and yellow feathers of many birds, similarly coloured wing covers of numerous insects, and the milk-fat of cattle. In some animals, a high degree of specificity exists for the absorption of either the hydrocarbon (carotene) class or the oxygenated (alcoholic or xanthophyllic) type of carotenoid. The horse, for example, absorbs through the intestine only carotenes, from green food containing an ample supply of both kinds of carotenoid. The hen, on the other hand, stores only members of the xanthophyll class; many fishes and marine invertebrates likewise store only xanthophyllic carotenoids, rejecting in the faeces or otherwise totally disposing of the carotenes. Other animals, including the frog and man, assimilate and store both classes in depot-fat.

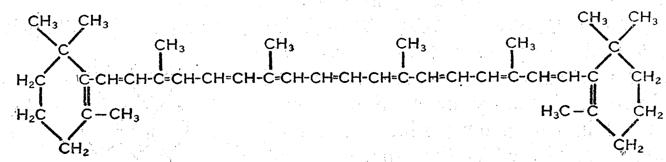

FIG. 1.—β-CAROTENE

Strikingly beautiful displays of carotenoids are encountered in the skins of numerous amphibians, notably among salamanders, many species of fish, and countless marine invertebrates, especially among the echinoderms (sea stars and brittle stars), molluscs, ascidians (sea squirts), crustaceans, the tissues of coelenterates including many anemones and corals and many species of marine worms. The gorgeous blue and green, some gray or chocolate tones, violet and near-black pigments of certain crustaceans, naked molluscs and sea stars are in many instances due to carotenoids in chemical conjugation with protein. Denaturation of the protein by immersion of the specimen in boiling water or in alcohol unmasks the bright red colour of the carotenoid involved. Hence the familiar red colour of boiled lobsters. Marine animals commonly derive their rich supplies of carotenoids directly or indirectly from the countless microscopic plants. Even carnivorous fishes and flesh- or mud-eating invertebrates from the great unlighted depths frequently exhibit rich pigmentation, derived ultimately from supplies of carotenoids long since generated in lighted waters and buried in the ocean floor.

A yellow condition of the skin, known as xanthosis, carotenaemia or artificial jaundice may follow excessive eating of carotenoid-rich foods such as carrots or oranges; the condition, less common in adults than in children, is unaccompanied by pathological symptoms and disappears when excessive supplies of carotenoids are withheld from the diet.

Hens and fish mobilize body carotenoids in their eggs during laying (or spawning) season, with an obvious diminution of the yellow biochrome from its former conspicuous position in the skin. Males of these species may continue to exhibit the pigmentation, however, those of many species showing an actual enrichment of the colour during the reproductive period.

Naphthoquinones (Fig. 2).—These compounds, occurring in many plants, are yellow, orange, red or purple in colour, soluble in various organic solvents, and have found considerable use as dyes for fabrics. Their occurrence in any conspicuous degree among animals seems to be limited to the echinoids (sea urchins and sand dollars) whose spines, shell and thin skin are consequently rendered distinctly red, purple and in some instances green by echinochromes. Red aggregates of this class of biochrome are found in the body fluid, inner lining of the shell, and in the lining of the alimentary tract of numerous species of echinoid, and some members bear the dye also in distinct masses within the jelly surrounding the eggs.

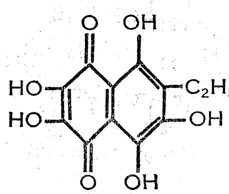

FIG. 2.—ECHINOCHROME

Like other quinones, echinochromes are mildly oxidizing, and lose their colour when treated with chemical reducing agents. They assume different colours also according to the acidity or alkalinity of their surroundings. The purple or red colour of sea urchins is consistent with the faintly alkaline condition of the tissues and calcareous shell. The antihaemorrhagic factor, vitamin K, is a naphthoquinone of yellow colour. Other naphthoquinones are reported to possess vitamin K potency as well. Echinochrome has been assigned a role as respiratory stimulant for sea urchin eggs. It is believed by some investigators to cause stimulation of the spermatozoa of certain species of sea urchins and to attract the latter to the eggs.

The diverse coloration of spines, tests and other structures of certain species of sea urchin are attributable to the presence of mixtures of echinochrome and a chemical homologue, spinochrome, in various proportions. Studies of crystalline melting point, absorption spectrum and other properties indicate that a number of different echinochromes exist.

Anthraquinones (Fig. 3).—A large number of brilliantly coloured compounds which have found wide application as dyes and chemical indicators of acidity or alkalinity are included in this group. Like the naphthoquinones, with which they share a common chromophoric structure, they may be chemically reduced by certain reagents. Carminic acid is the red biochrome constituting about 10% of the product cochineal, obtained from the female scale insect *Coccus cacti,* found in Mexico and Central America. The pigment imparts permanent red colours to mordanted wool and silk. Kermesic acid from another scale insect, *Coccus ilicis,* is yellow-red in water, and violet-red in acid solutions; it is employed as a dye as is carminic acid, from which its chemical structure differs in only a minor way. Laccaic acid is isolated from lac dye or lac-lac, the solid exudation of East Indian lac insects, *Coccus laccae.* This scarlet or carmine-red dye possesses a constitution similar to that of the above-named compounds. While these conspicuous anthraquinones are beyond doubt derived by scale insects from the plants upon which they feed, no information is yet available relative to their metabolic path or possible physiological role.

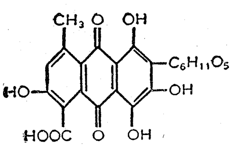

FIG. 3.—CARMINIC ACID

Flavones (Fig. 4).—Considerable chemical study has been devoted to this large group of coloured compounds which occur in a wide variety of plants and in a few insects which feed upon such plants and assimilate some of the pigment. These compounds impart yellow colours to flowers and other plant parts. The chemical properties of a yellow biochrome isolated from the wings of a butterfly, *Melangaria galatea,* correspond closely with those of the plant pigment quercitin. The chemically related anthocyanins, which are the red, violet and blue compounds often seen in blossoms, fruit and leaves of plants, are occasionally encountered in certain dipterous and hemipterous insects and their larvae, commonly in the albuminoid inclusions of fat cells. None of these classes of biochromes has been shown to fulfill particular physiological functions in animals, although they are believed to be involved in certain biochemical oxidations in the plants which synthesize them.

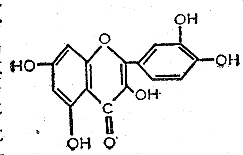

FIG. 4.—QUERCITIN

Tetrapyrroles.—*A. Porphyrin Compounds (Fig. 5).*—Porphin is the parent compound of the whole class of nitrogenous water-soluble biochromes under discussion in this subsection. Bearing side chains of various lengths composed of carbon, hydrogen, and frequently oxygen, linked to different carbon atoms of the four pyrrole nuclei, porphyrins are represented in the green photosynthetic chlorophylls of plants and in animal haemoglobins. Haemoglobins are conjugation products between a protein body, globin, whose composition varies with the species, and a porphyrin, haem, $C_{34}H_{32}O_4N_4Fe$, whose pyrrolic nitrogen atoms are attached to an atom of iron. Haemoglobins are present in the red blood cells of mammals, birds, reptiles, amphibians and fishes, and in the circulatory fluids of numerous invertebrates, notably among the worms, and in scattered members of the arthropod, echinoderm and molluscan phyla. Having the unique capacity to combine with atmospheric oxygen in lungs, gills or other respiratory surfaces of the body, and to again release it among tissues of lower oxygen content, haemoglobins thus serve as respiratory catalysts. These compounds are responsible for the pink to red colours observed in combs and wattles of birds and the skin of man and other primates, notably that covering portions of the face, buttocks and genital regions of baboons.

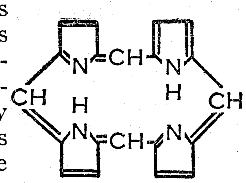

FIG. 5.—PORPHIN

Other biochromes chemically allied to the haem compounds are cytochrome, the red oxidation enzyme which occurs in minute concentrations in nearly all cells; catalase, an enzyme of similar distribution which accelerates the breakdown of hydrogen peroxide; pinnaglobin, a brown compound which serves as a respiratory aid in the mollusc *Pinna squamosa;* chlorocruorin is a green pigment which plays a similar role in the blood of tube-building annelid worms; a red compound, helicorubin, is encountered in the liver and gut of some snails, and actineohaematin is responsible for some of the beautiful red colours of sea anemones. The physiological functions, if any, of the latter two pigments have not been clarified.

Numerous porphyrins are present in secretory and excretory products of animals, and others may be extracted from ancient deposits such as coal, petroleum and mud from long-buried strata of the ocean floor. Many porphyrins are readily isolated, crystallized and identifiable by their manifestation of spectral absorption bands at given positions in the visible spectrum.

Oöporphyrin is responsible for the red flecks upon the eggshells of the plover. The shell of the emu egg is coloured by a biliverdin, found also in the skeleton of the blue coral *Heliopora caerulea.* The remarkable turaco bird excretes a copper salt of uroporphyrin in its quill-feathers. This red pigment, known as turacin, is readily leached out of the feathers by water containing traces of alkali. A similarly occurring green porphyrin in feathers of the turaco is turacoverdin. Certain molluscs excrete coloured porphyrins in the material of their shells. Bonelline, obtained from alcoholic extracts of the worm *Bonellia viridis,* is an alkaline biochrome giving blue solutions in acids; its properties have led to its inclusion among the pyrrole pigments. The chemical structure of so-called enterochlorophyll found in the liver of numerous molluscs, crustaceans and even in the digestive gland of carnivorous sea stars, has not been determined.

B. Bile Pigments (Fig. 6).—Among the metabolic breakdown products of haem or allied biochromes is a series of yellow, green, red or brown nonmetallic tetrapyrroles arranged in open-chained molecules typified by the simplest synthetic member bilane. Small quantities of the red compound, bilirubin ($C_{33}H_{36}O_4N_6$), its green oxidation-product biliverdin, and various other chemically homologous products occur in normal tissues, and may be conspicuous in excretory and secretory products under certain pathological circumstances.

Various compounds of the bile-pigment series are encountered in birds and in lower animals. Oöcyan, closely related to bilirubin, imparts a blue or blue-green colour to the eggshells of numerous birds. Pterobilin is a blue pigment observed in many pierid butterflies' wings, and other insects and their larvae exhibit or excrete allied compounds. The liverlike organs of numerous invertebrates seem to lack bile pigments, containing instead porphyrin compounds, exemplified by helicorubin in some molluscs and crustaceans. Certain leeches, nourished by the blood of vertebrates, contain blue-green, red or brown bile pigments in their blood, probably as a result of the breakdown of ingested haemoglobin.

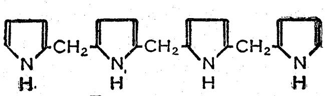

FIG. 6.—BILANE

The sea anemone *Actinia equina* carries beneath the outer skin and at the base of the foot a green pigment believed to be biliverdin which occurs also in other anemones. The dark red or violet biochrome encountered in the strikingly coloured anemone *Calliactis parasitica* has been termed calliactine. It is a natural indicator, being yellow-brown in acid, becoming golden to orange in less acidic solutions, and changing to blue, violet and finally red in alkalis. It can be crystallized in a pure state as blue-violet rosettes of needles which, when dissolved in dilute aqueous solutions, exhibit characteristic absorption bands, according to the acidity or alkalinity of the solvent. Calliactine is easily and reversibly oxidized and reduced, which fact suggests its possible function in oxidative metabolism. Certain molluscs display colours in their tissues or shells which are attributable to the presence of biochromes of the bile-pigment class. Examples are the red compound, rufine, in the snail *Arion rufus,* another red colouring matter in the shells of abalones and some turban shells, called rufescine, and a blue-green one in another species of abalone. The purple colour of the offensive, mucous-laden ink of the sea slug *Aplysia* (*Tethys*) is due to a pigment, aplysiopurpurin, closely similar to mesobiliviolin, conjugated with protein material as are other pigments, including mesobilirhodin and urobilin which accompany it. Numerous fishes among the Belonidae and Cottidae bear strikingly blue-green coloured skeletons. The green pigment in the bones and scales of the garfish *Belone belone* is a bile pigment, related to biliverdin.

Melanins (Fig. 7).—Dark colours, indicating the presence of melanin pigment, are observed in mammalian hair and eyes and in the skin and scales of numerous fishes and reptiles, the ink of cephalopods, various tissues of numerous other invertebrates and in skin-moles of man and black tumorous growths of various mammals. Melanin, an end-product of metabolism, is formed as a result of serial oxidation and polymerization of tyrosine or similar phenolic compounds. This oxidation by dissolved atmospheric oxygen is catalyzed by an enzyme tyrosinase. Chemically reversible yellow, orange or red stages in the successive oxidation are followed, if uninterrupted, by a final intensely black product. Some white or albino animals may lack the enzyme tyrosinase in its active form, or they may have means of excluding the enzyme and the substrate, tyrosine, from each other. Completely white or red variants of the anemone *Metridium senile,* for example, fail to develop melanin in their tissues as do brown variants of their species. But upon death, or upon grinding of the tissues of such an albino animal, the macerated material blackens rapidly with the formation of melanin.

Pale yellow, tawny, buff, red and brown colours of hair are due to melanin in intermediary phases of formation or in relatively finely divided condition. The importance of dark, light-absorbing sublayers of melanin in intensifying structural blues or iridescent colours has been mentioned. Genetic or photically induced melanization of human skin serves an important function in protecting underlying tissues from injurious sunrays.

Certain fishes exhibit a striking ability to synthesize and store in their skins more melanin when kept on dark backgrounds than do members of the same species maintained in pale surroundings, all of the specimens receiving the same amount of incident light from above. (See *Adaptive Colour Change,* below.)

Black or brown melanins or melanoproteins are to be observed in numerous invertebrate animals in addition to those mentioned. Certain of the worms, numerous crustaceans and many classes of molluscs exhibit melanism in the integument. The red intermediate compound, formed during the transformation of tyrosine to melanin (*see* formula) is hallachrome, which is encountered also in the marine worm *Halla parthenopaea.* It is green in alkali beyond pH 8.3. This biochrome may be reversibly oxidized and reduced; it is said to stimulate increased respiration in certain invertebrate eggs. Its original precursor may be either tyrosine or tryptophane. Red or yellow uranidines, found in sponges, corals, medusae, holothurians (sea-cucumbers) annelid worms and tunicates, are believed to be chemically related to the melanins.

Urochrome, the principal yellow pigment of urine, is considered to be a modified melanin. In certain diseases, melanin precursors cause urine to darken as oxidation occurs on standing (melanuria, alkaptonuria).

Indole Derivatives (Fig. 8).—Certain similarities between katabolic features applying to the two amino acids, tyrosine and tryptophane, lead next to a consideration of the biochromes derived from the latter compound. Like melanins, the indole derivatives are excretory products of certain animals, but in contrast to melanins, their distribution as pigmentary compounds is relatively limited. Unlike the dark, sombre melanins, too, numerous indole compounds are of striking red, green, blue or purple colours. Indigo occurs as a glucoside in many plants of Asia, the East Indies, Africa and South America. It has long been used as a blue dye. While the pigment itself does not occur in healthy animals, certain chemical derivatives of it are found in secretory and excretory products.

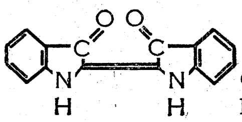

FIG. 8.—INDIGO

Hallachrome, the red pigment in the epidermis of a marine worm, has been discussed. This compound, as well as the chromogen of human melanuria, which is probably a derivative of 5,6-dehydroxy indole, may be generated from the breakdown of either of the common amino acids, tyrosine or tryptophane.

Tyrian purple, a purple of the ancients, is 6–6′–dibromindigo obtained by the irradiation of a glandular secretion of several species of gastropod molluscs of the genera *Murex* and *Purpura.* While this red-violet dye has long been employed commercially in certain countries, its physiological use to the animals producing it is obscure. In all probability it is an excretory product.

Purines (Fig. 9).—The members of the purine class of compounds are hardly to be considered as true pigments, since they are usually white crystals. But they often contribute to the colour scheme of lower vertebrates and invertebrates, hence their inclusion in the section. The position of purines as excretory products is amply illustrated by the large amounts of guanine in the excrement of birds, and of uric acid in that of reptiles. Uric acid has also been found in the yellow sheets of mucous excreted by sea anemones. The brilliant whiteness of some anemones, notably the white variant of *Metridium senile,* results partly from microcrystalline deposits of uric acid in the tissues. These crystalline aggregates are especially noticeable in the mesenteries. Other purines, such as xanthine, have been reported as occurring in the wings of pierid butterflies. Mention has already been made of the notable deposition of guanine crystals in the leucophores or iridocytes of fishes, contributing a whiteness, or often a brilliant silvery appearance to extensive areas of the skin. Note has also been made of the ability of some fishes to vary the quantities of deposited guanine in proportion to the lightness of the background upon which they are living. Purine compounds constitute part of the complex nucleic acids which abound in the nuclear material of all cells; it is therefore presumed that they play an indispensable part in cell metabolism. The purine compound hypoxanthine exercises a specific stimulating and accelerating effect upon the growth of embryonic tissues of the chick.

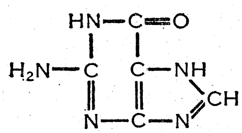

FIG. 9.—GUANINE

Pterins (Fig. 10).—Closely related to the purines, and formerly classed among them, are the so-called pterins, which derive their name from their notable appearance and primary chemical isolation from the wings of certain species of butterflies, wherein they are sometimes accompanied by purines. Pterins are encountered as white, yellow, orange or red granules in association with the wing material, and contribute the yellow colour to the body-integument of numerous wasps.

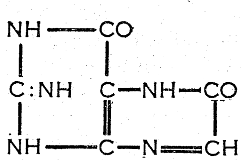

FIG. 10.—XANTHOPTERIN

The pterins are soluble in aqueous solutions, often more so in the presence of ammonia, and insoluble in the usual organic solvents. Leucopterin is a white compound obtained from *Pieris brassicae* and *P. napi,* and has been found accompanied by other pterins in other species. Xanthopterin is a

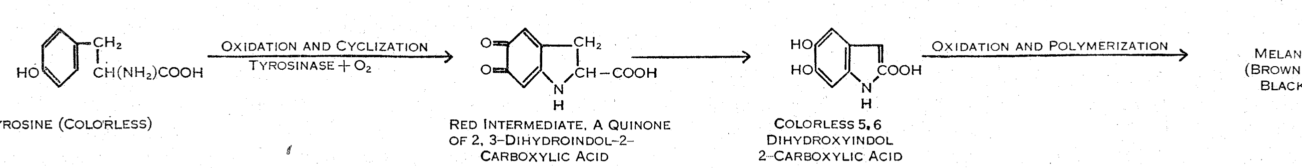

FIG. 7.—TYROSINE (COLOURLESS) CONVERTED TO MELANIN PIGMENT

yellow biochrome responsible for the yellow colour in the wings of *Gonepterix rhamni* and other butterflies, and in the abdominal skin of wasps (*Vespa* spp.). It occurs also in human urine, and therefore is often called uropterin. This compound has been found to be effective in preventing nutritional anaemia in rats and in young salmon. No physiological roles other than their excretory character have been recognized in the other pterins which occur in Lepidoptera; the colourless compounds guanopterin and mesopterin may be accompanied by chrysopterin, an orange compound, or by a red homologue erythropterin; the latter imparts conspicuous red colours to the wings of several species. The red biochrome in the eyes of the fruit fly, *Drosophila melanogaster*, of great interest and usefulness to geneticists, is believed to be related to the pterin class.

Lyochromes or **Flavines (Fig. 11)**.—This class of yellow, greenly fluorescent, water-soluble biochromes is very widely distributed in plant and animal tissues, although their presence in very small amounts renders their colour unappreciable in animals save following appropriate chemical extraction. Although synthesized by bacteria, yeasts and the green plants, the lyochromes, notably lactoflavine (riboflavine), which is identical with vitamin B_2, is not manufactured by animals, which thus depend upon plant material for their ultimate supply of this important factor. Lactoflavine, conjugated with a protein, has been shown to be identical with the yellow oxidizing enzyme described by O. Warburg and W. Christian in 1932. The enzyme is capable of combining with molecular oxygen, whereupon the yellow colour develops. It may then release this element for intracellular oxidation processes, with simultaneous loss of colour. The colour is again restored by fresh supplies of oxygen. Blood, milk, eggs, liver, kidney and muscle contain appreciable quantities of the biochromic catalyst. Physiologically, a nutritional lack in the supply of lactoflavine leads to impairment of cellular respiration, retardation in growth of young mammals, and to cataract in the eyes of mice, chickens and monkeys. The compound is not stored in quantity and is a normal excretory product. This flavine has been encountered in somewhat concentrated amounts in the Malpighian tubules of insects, which obtain it from fresh vegetable material. The larvae of mosquitoes responsible for carrying yellow fever fail to develop normally, or to complete their metamorphosis if deprived of flavine and purine.

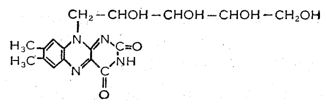

FIG. 11.—LACTOFLAVIN

MISCELLANEOUS BIOCHROMES

There are many animal colouring matters whose constitutions remain unknown. Of these, only a few of the more conspicuous examples will be mentioned.

Chromolipoids are a class of yellowish, reddish or brown fat-soluble biochromes often encountered in the fat-droplets of eggs and other cells and in other lipoid-rich tissues. These compounds have often been mistaken for both melanins and carotenoids. They are believed to be derived from partially oxidized fatty acids, phospholipids or other lipoid compounds, perhaps in ways similar to those in which commercial fats may gradually become discoloured on being heated or after long standing in air.

Haemocyanin is the respiratory catalyst encountered in the plasma of molluscan and crustacean blood. It is colourless in the reduced condition, but assumes a blue colour upon exposure to oxygen, with which it combines. During the circulation of the blood, the oxygen carried in combination with haemocyanin is released to the tissues requiring it. Chemically, haemocyanin is composed of a large protein complex bound to copper, whose presence is responsible for the blue colour of the oxidized molecule.

Haemerythrin is an iron-containing proteinaceous biochrome present in the blood of gephyrean worms, serving there as a reversible oxygen carrier just as do haemoglobin, chlorocruorin and haemocyanin. The blood containing haemerythrin is pale when in the reduced condition, but red or reddish-brown when oxygenated.

Vanadium chromogen occurs in blue, green or orange aggregates within the corpuscles of the blood of tunicates. Chemically this unique biochrome series represents protein combined with vanadium in various stages of oxidation. Owing to the presence of rather remarkable amounts of dilute sulphuric acid in the corpuscles of these animals, the biochrome readily yields its combined oxygen to surrounding tissues.

Numerous coelenterates exhibit brilliant pigmentation, the chemical nature of which is as yet very imperfectly known. For example, the lasting red pigment in skeletons of the corals *Corallium rubrum* and *Tubipora musica,* and the red, orange and yellow colouring matters of many other alcyonarian skeletons are chemically obscure.

USES OF COLOURS TO ANIMALS

Under this head are two distinct classes of problems: (a) the value of the colours as such to the organisms possessing them; (b) the value to the organisms of the substances giving rise to these colours. The one case has to do with the value of appearance to the animal, regardless of how this is brought about; the other case with the utilization for one or another function of substances which happen to be coloured. Any discussion of these matters must include black and white pigments among the substances influencing colour. The second of these classes of problems has already received some attention, in connection with the chemistry and physiology of animal pigments. As there stated, some of these coloured substances have a high physiological importance to the organism, in relation to their respiratory function, or as products of fundamental metabolic processes.

One service which the pigments or biochromes render to the organism is the protection of certain tissues, notably the retina and central nervous system, from the rays of the sun. Here should be mentioned, too, the dense layer of pigment cells (chromatophores) which lines the peritoneum of many fishes and some other vertebrates. The function of such a layer is not certain, though it may well relate to the protection of the viscera from sunlight. The cephalopod molluscs, when disturbed, discharge a dense cloud of black ink (melanin) into the water. This is commonly interpreted as a smoke screen, serving to baffle pursuers.

As already stated, white in the animal kingdom is sometimes due to special white substances (guanine, etc.) deposited in the tissues; in other cases to the mere lack of coloured substances, the place of these being taken by air. This is notably true of the hair of white mammals and the plumage of white birds. The colours of arctic animals belong in a later section of this discussion, since the importance of these animals' appearance is probably a real factor in the evolution of their colour. However, the suggestion has often been made, and with some plausibility, that a white plumage or pelage is of value in retarding the radiation of heat. Consistent with this view is the fact that some of these animals lay aside their white garb and assume a darker one during the summer. It is possible that in these cases both factors, the concealing and the heat-conserving one, are operative.

Concealing Coloration (Procryptic and Anticryptic Coloration).—The optical principles which became familiar to the world after World War I, under the name of camouflage, have probably been utilized in the animal kingdom from the time that predators began to rely upon their sight in hunting their prey. Naturalists were doubtless early impressed by the widespread existence of protective coloration, since any collector of living specimens, vertebrate or invertebrate, is constantly balked in his search for objects which, as he may know, lie before his very eyes. The prevailing sandy hue of desert animals, and the frequency of green in animals inhabiting trees are familiar to the field naturalist. Less familiar are special cases where extensive areas of black, volcanic rock in the desert have called forth appropriate darkening effects in animals which, in surrounding areas, display the prevailing pale hue. Such facts serve to refute any general explanation of the pallor of desert animals as due either to the direct effects of solar radiation or to the animal's need of reflecting this from its surface. The importance of the principle of protective coloration as a factor in evolution was fully recognized by Darwin and some of his contemporaries, and it soon became one of the standard examples of the working of natural selection. It required considerable sophistication for zoologists of a later generation to reject the plain testimony of their senses and to dismiss the protective coloration theory as unfounded. However, more extensive knowledge, including experimental evidence that protective coloration does in reality protect, led to a return, more nearly, to the views of Darwin and his followers. If one had to do, in these cases, merely with a general resemblance in colour between the organism and its more familiar environment, one might seek for some direct physical or chemical influence of the latter upon the former, as has been done by more than one critic of natural selection. But one frequently has to do with a striking resemblance in pattern, *i.e.,* in the distribution of pigment upon the animal's surface such as frequently to match in detail features of the more habitual background which the animal occupies. Some of the most striking cases of this sort are to be found in the special fauna of the *Sargassum* or floating seaweed of certain areas of the tropical Atlantic. Here are animals, belonging to several different subdivisions of the animal kingdom, not only displaying the colours of the seaweed itself, carefully reproduced, but even copying the white patches of the encrusting bryozoan by which this is conspicuously mottled. In certain of these organisms, too, the skin is extended into long fleshy appendages which closely imitate similar structures upon the fronds of the weed. It is hardly likely that these resemblances would be attributed to chance by anyone who had actually seen these organisms together under natural conditions. Furthermore, any naturalist with much field experience knows that correspondences of this sort are far from being rare or exceptional. Specific resemblances to particular natural objects, *e.g.,* to leaves, sticks or stones, or to other animals, occur with convincing frequency, while even the spider which seems to mimic the excrement of birds is difficult to interpret in any other terms. We must add to these resemblances in colour and structure the frequent occurrence of appropriate instincts controlling the attitude assumed by the animal, or imposing quiescence or movements of a sort calculated to deceive the enemy. The walking stick, for example, would not be duly protected by its form, unless it also behaved like a stick and reduced its movements to a minimum.

Another class of camouflage principles was later in being recognized than those which have to do with general conformity to background, or resemblance to specific objects in this. Here colours or patterns which make the organisms inconspicuous or unrecognizable must be considered, regardless of background. For the recognition of these principles, chief credit must be given to the American artist, Abbott H. Thayer (*q.v.*), whose discoveries in this field were first announced in 1896, but were not given wide publicity until 1909 (G. H. Thayer, *Concealing Coloration in the Animal Kingdom.*) The first of these principles is that of counter-shading or obliterative shading, which had, however, been clearly stated by E. B. Poulton a few years earlier. This is a generalization of the fact that in the great majority of animals, both terrestrial and aquatic, the dorsal surface of the body is more heavily pigmented than the ventral, while there is a gradient of decreasing pigmentation from one to the other. Thayer called attention to the fact, which he illustrated by solid models, that such a distribution of pigment makes for minimum visibility, when the animal is lighted, as it most commonly is, from overhead. Another principle, stressed by Thayer, which has been widely adopted in the camouflage both of animals and of ships, is that of ruptive and secant patterns. In such cases the natural continuity of the body's outline has been broken up by intrusions of black or white or other pigment at the margins, or a less conspicuous general colour scheme of the body has been nullified to the observer by conspicuous markings which are quite irrelevant to this. The effect is to render an object so treated unrecognizable, even though it remains in full view. Under the name coincident disruptive colouring, H. B. Cott discussed a class of cases in which disruptive patterns were carried continuously through regions of the body which are not morphologically continuous, *e.g.,* pigmented bars which run crosswise upon the hind legs of a frog, but are evident only when the animal's legs are doubly folded in the resting position. Similar pigmented stripes, disposed longitudinally, frequently include the eye. They divide the body into two or more longitudinal sections and tend to render it unrecognizable as a single organism of familiar form.

Adaptive Colour Change.—Many animals, belonging to several of the major subdivisions of the animal kingdom, are able to conform their shades (as lighter or darker) or in some cases their actual colours, to those of the backgrounds on which they happen to lie. These changes are mediated through the eyes and the central nervous system, in some cases involving the endocrine glands. The effector organs are special cells in the skin or elsewhere, known as chromatophores. The most familiar of these are black, white, yellow and red. Colour changes of this type have been most fully investigated in fishes, amphibia and reptiles among the vertebrates, and in crustacea and the cephalopod molluscs among the invertebrates. The literature in this field has become very extensive.

Colour changes resulting from chromatophore action are of two chief sorts: (1) rapidly ensuing changes, often induced within a few minutes, or even seconds. These are brought about by the aggregation or dispersion of pigment granules within the chromatophores. The aggregated condition results in a withdrawal of much of the pigment from view, and thus to a paling of the animal. On the other hand, the dispersion of pigment leads to a darkening of the chromatophores, and thus of the surface of the body as a whole. These processes are frequently, but incorrectly, referred to as contraction and expansion of the chromatophores, whereas the outlines of the chromatophores are commonly little affected.

The second type of color change (2) usually involves an increase or decrease in the number of chromatophores present, as well as in the actual amount of pigment contained in the individual chromatophores. Such changes result from more prolonged subjection of the animal to the same stimuli which call forth the more familiar, immediate responses. In either case, it is important to note that the shade assumed, or the amount of pigment produced, is dependent not upon the absolute degree of illumination to which the animal is subjected, but upon the albedo of the background, *i.e.,* to the ratio of reflected to incident light. For one species of fish (*Girella nigricans*) it was determined that the amount of melanin present at the end of four months was about twice as great in specimens kept on black as in those which had been kept on white, while the amount of the white pigment, guanine, was four times as great in the latter as in the former. The differences in appearance, moreover, were much greater than these figures would seem to indicate. The black-adapted specimens were nearly dead black, the white-adapted ones were very pale gray.

Evidence that this capacity for pigmentary adjustment to background may be of lifesaving value to fishes has been obtained experimentally. Large numbers of fishes which differed widely in the extent to which this adjustment had been carried were subjected to the attacks of fish-eating birds and of larger fishes. It was found that the ratio of less-adapted to more-adapted fishes among the casualties was consistently high, averaging about two to one. Aside from such tests, however, the mere existence of the mechanism for adjustable coloration would seem to constitute strong evidence for the effectiveness of protective coloration. For this complicated mechanism has been evolved independently in several unrelated branches of the animal kingdom. Furthermore, so far as aquatic animals are concerned, no plausible function except concealment has ever been suggested. To clinch this argument more completely, it may be pointed out that the adjustment of some fishes to their backgrounds includes pronounced and appropriate changes in the disposition of light and dark areas on the skin (*i.e.,* in the pattern), which can have no significance except as affecting appearance. The old familiar objection to the protective coloration theory that many of the presumed predators are not known to possess colour vision loses its force completely in the face of these facts. It is possible, however, that in some terrestrial animals, *e.g.,* lizards, the colour changes are secondarily concerned with the absorption or reflection of heat rays from the sun. This may be an important matter in desert species.

Warning (Aposematic) Coloration.—Many animals, especially among insects, which are themselves edible and inoffensive, have developed a superficial resemblance to other species, often widely unrelated to themselves, which are avoided by predators, owing to the possession of repellent or dangerous characteristics (*see* MIMICRY). This earliest discovered (Batesian) type of mimicry is believed to be supplemented by another (Müllerian) type, in which a number of species of animals that are equally obnoxious appear to have adopted a common, conspicuous livery, supposed to be recognized by predators as belonging to animals which had better be left alone. Thus, we have the warning colours of wasps and many other insects which are protected by stings, offensive scent glands, etc., of certain frogs which are known to be poisonous, and indeed of a wide variety of animals belonging to various groups. Experiments by a number of naturalists provide reasons for believing that birds, monkeys and perhaps some other animals do exercise choice in the selection of insects and tend to reject those having certain brightly coloured patterns. The results of such experiments are not wholly consistent, however, and the efficacy of warning coloration is perhaps more limited than has been claimed.

Recognition Colours.—This term has been applied to certain cases in which conspicuous markings are displayed, that may serve to identify an animal in the eyes of another of the same species, either at the time of mating or when they are flocking together for mutual protection. The white flag of the retreating cottontail rabbit, and the showy rumps of some of the deer are examples which are frequently cited in this last connection. According to A. R. Wallace, however, a large proportion of the differences of colour pattern which distinguish one species of birds or of insects from another are to be interpreted as recognition marks.

COLOUR AND SEX

In many species of animals the sexes differ more or less widely in colour. The most familiar examples of this are to be found among the birds, fishes and insects, although instances may be cited from some other of the major groups of animals. In cases where one sex is more highly coloured or more ornate than the other, it is usually the male which is so characterized. Much study has been devoted to the relation between sex hormones and the colours and other secondary sexual characters of animals, particularly of birds. In this group, as a rule, the castrated male retains the plumage colours of the normal animal, sometimes even to an exaggerated degree. The spayed female, on the other hand, takes on the colours of the male, and this may happen, without operation, as a result of disease of the ovary. These facts make it evident that the colours of the male in such species may develop in the absence of any hormone from the testis, while the colours of the normal female require the presence of a hormone from the ovary. The part played by the latter is further illustrated by the production of feminized males by grafting ovarian tissues into castrated cocks (capons).

In some birds and fishes these sexual differences of colour become greatly emphasized during the breeding season, diminishing or disappearing during the periods of sexual inactivity.

In the Spring a fuller crimson comes upon the robin's breast;
In the Spring the wanton lapwing gets himself another crest.

Among birds, these changes in plumage are usually due to the replacement of feathers, following the spring moult, less frequently to the shedding of the deciduous tips of feathers. In some cases, both among birds and mammals, it has been shown that the onset of moulting may be hastened or delayed through artificial control of the diurnal period of illumination. Shortening of this in the summer may lead to an earlier assumption of the winter plumage (or pelage), while the spring moult may be hastened by lengthening the period of daylight in the winter. In general, these alternations of plumage are not dependent upon the presence of sex hormones, and may follow their normal course in castrated birds. The same cannot be said, however, of the seasonal colour changes of some other parts, such as the bill and certain areas of skin, which are more likely to be under hormonal control. So far as known, the brilliant colours which are displayed in the spring by the males of many species of fresh-water fishes are hormonally controlled. They fail to appear in castrated males, while these same colours may be induced in females through the injection of the male hormone. In the latter case, actual quantitative increases of pigment may result, which persist for some time after the hormone treatment has been discontinued. In general, the nature and extent of the hormonal control of secondary sexual characters varies greatly from one organism to another. In insects such control seems to be lacking, sexual differences being more directly controlled by the hereditary complex, without the intermediation of hormones.

A question quite different from that of the physiological basis of sexual colour differences is that of the utility of these colours, if any, to the organism. Are the gorgeous colours of male birds, for example, of advantage to the wearers of these colours? Darwin, as is well known, answered this question in the affirmative with his hypothesis of sexual selection. The showy characters of the male plumage, he contended, arose through the continued selection by the females of more ornate mates. Darwin was able to point to cases among birds in which competitive display by the males and selection by the females seemed to be incontrovertible facts. And the extraordinary perfection to which certain colour schemes have been carried (*e.g.*, in the secondary wing feathers of the male argus pheasant) speaks for a level of aesthetic appreciation which certainly would not have been expected in a bird. However, the range of phenomena which can reasonably be explained by this sexual selection theory is certainly much less extensive than Darwin supposed, and in those cases for which it is regarded as relevant, the theory has undergone considerable changes in its formulation (*see* SELECTION and COURTSHIP OF ANIMALS). One alternative explanation which was offered by A. R. Wallace to account for certain sexual differences of coloration in birds would seem to have considerable inherent probability. Wallace contended that part of this difference might be due to the modification of the brooding female in the direction of concealment, the male being in less need of such protection. Indeed, the suggestion has been made by others that it might be advantageous to the species for the male to be more conspicuous during the nesting season in order to divert the attention of predators from the (at that time) biologically more important female.

All in all, it must be admitted for a considerable proportion of sexual differences in coloration that no explanation can be found and, indeed, that perhaps no explanation of a bionomic nature is called for. Knowledge of the animal's metabolism, when this is attained, will perhaps be sufficient. And it might be added, that the same conclusion is probably justified in regard to much of the coloration of animals in general. One does not inquire how minerals such as cinnibar or malachite benefit from their respective hues and the question may be equally irrelevant in the case of many animals.

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(D. L. F.; F. B. SR.)

COLOUR VISION: *see* VISION or SIGHT.

COLSTON, EDWARD (1636–1721), English philanthropist, the founder of Colston's Charity and a generous donor to other foundations in his native city of Bristol and elsewhere, was born at Bristol on Nov. 2, 1636, and died at Mortlake, near London, on Oct. 11, 1721. His father was a keen Bristol merchant and an ardent Royalist. Edward Colston was educated at Christ's Hospital, London, of which school he was later on governor and a generous benefactor. He made his fortune in trade with the West Indies and in a sugar refinery which he established in Bristol, and though he was domiciled in London he spent much time in his native city. There he endowed (1708) "Colston's Charity" for the education of 100 boys in the principles of the Church of England. This school, built on Augustine's Back, was subsequently removed to Stapleton, Gloucestershire. Almshouses, homes for sailors and other schools in Bristol were endowed by him, and he made many benefactions to London hospitals and schools.

Colston, who was in the habit of bestowing large sums yearly for the release of poor debtors and the relief of indigent age and sickness, and who gave (1711) £6,000 to increase Queen Anne's Bounty Fund for the augmentation of small livings, was always keenly interested in the organization and management of his foundations; the rules and regulations were all drawn up by his hand, and the minutest details of their constitution and economy were dictated by him. He was a high churchman and Tory.

See T. Garrard, *Edward Colston, the Philanthropist* (4to, Bristol, 1852); G. Pryce, *A Popular History of Bristol* (1861).

COLT, SAMUEL (1814–1862). American inventor, born July 19, 1814, at Hartford, Conn. Colt ran away to sea at 16, sailing from Boston, Aug. 2, 1830, for India. During this voyage he whittled a wooden model of the Colt revolver. (*See* PISTOL.) He had several metal models made between 1831 and 1835.

Colt's invention was a single-barrelled pistol or rifle having a many-chambered rotating breech which was turned, locked and unlocked by cocking.

He took out English and European patents in 1835, and United States Patent No. 138, Feb. 25, 1836. On March 5, 1836, the Patent Arms Manufacturing Co., of Paterson, N. J., was formed to manufacture and sell Colt's arms. The first military use of Colt arms was in the Seminole War in 1837. They were also used by the Texas Rangers in the war between Texas and Mexico. Lack of general acceptance of the new weapons, however, caused the Patent Arms company to fail in 1842.

Colt then turned to the invention of electrically-discharged submarine mines. He also conducted a telegraph business which utilized the first cable ever laid under water.

As a result of the Mexican War, 1846–48, Captain Walker was sent to Colt with a government order, dated Jan. 4, 1847, for 1,000 revolving pistols. These were made at the factory of Eli Whitney at Whitneyville, Conn. Colt established his own plant at Hartford in the latter part of 1847. He moved twice, until in 1855 he set up the largest private armory in the world on the site of the present Colt plant.

Colt developed beyond any maker before him the manufacture of interchangeable parts, and the production line as we know it. He also had advanced ideas concerning working conditions and employee welfare. His invention netted him one of the outstanding fortunes of the period. He died at Hartford, Jan. 10, 1862. (C. T. H.)

COLTON, a city of San Bernardino county, California, U.S.A., 55 mi. E. of Los Angeles; served by Southern Pacific, Santa Fe, Union Pacific and Pacific Electric railways. The population was 8,014 in 1930 and 9,686 in 1940. Citrus, grapes and other fruits and garden produce are packed and shipped from there. The largest Portland cement plant in the west is there; also concrete pipe and conduit manufacturing, citrus by-products plant, flour and feed mills, car shops, candy plant, large fruit refrigeration plant and various other industries. It was settled about 1860 and incorporated in 1887.

COLT'S-FOOT, the popular name of a small herb, *Tussilago Farfara,* a member of the family Compositae, which is common in Great Britain in damp, heavy soils. It has a stout, branching, underground stem, which sends up in March and April scapes about 6 in. high, each bearing a head of bright yellow flowers. The fruits bear a soft, snow-white, woolly pappus, somewhat like that of the dandelion. The leaves, which appear later, are broadly cordate with an angular or lobed outline, and are covered on the under-face with a dense white felt. They are smoked in cases of asthma.

In eastern North America the colt's-foot has become extensively naturalized, having the appearance of a native plant, along banks, roadsides and the shores of streams from Nova Scotia to Minnesota and southward to Pennsylvania.

COLUGO: *see* FLYING LEMUR; GALEOPITHECUS.

COLUMBA, SAINT (Irish, *Colum*) (521–597), Irish saint (also Columkille "of the church"), was born on Dec. 7, 521, at Gartan in Co. Donegal. His father, Feidlimid, was a member of the reigning family in Ireland and was closely allied to that of Dalriada (Argyll). His mother Eithne was descended from the king of Leinster. To these connections as much as to his piety and ability he owed his immense influence. Columba studied under the distinguished Finian of Moville (at the head of Strangford lough) and Finian of Clonard, and *c.* 551 was ordained priest. During his residence in Ireland he founded a number of churches and the famous monasteries Daire Calgaich (Derry), on the banks of Lough Foyle, and Dair-magh (Durrow) in King's county.

In 563 Columba with 12 disciples established himself on the island of Hy or Iona, where he erected a church and a monastery, and in 565 applied himself to the task of converting the Picts. By his preaching, his holy life and miracles he converted the whole of northern Scotland and established many monasteries there, the monastery of Iona being regarded as the mother house and its abbots as the chief ecclesiastical rulers even of the bishops. Columba, in his character of chief ecclesiastical ruler, gave formal benediction and inauguration to Aidan, the successor of Conall, as king of the Scots. He accompanied that prince to Ireland in 575, and took a leading part in a council held at Drumceat in Ulster, which determined the position of the ruler of Dalriada with regard to the king of Ireland. The last years of Columba's life appear to have been spent mainly at Iona, where he was already revered as a saint. He died on June 8, 597.

Several Irish poems are ascribed to Columba, but they are manifestly of a later age. Three Latin hymns may be attributed to the saint with some degree of certainty.

The life of St. Columba by Cuminius, who became abbot of Iona in 657, was enlarged by Adamnan, who became abbot in 679. These narratives were supplemented by the notices given by Bede. *See* W. Reeves, *Life of St. Columba, written by Adamnan* (1857); W. F. Skene, *Celtic Scotland,* vol. ii. "Church and Culture" (1877).

COLUMBAN (543–615), Irish saint and writer, was born in Leinster, and educated in the monastery of Bangor, Co. Down. About 585 he left Ireland with 12 other monks, and established himself in the Vosges, in an ancient fortification called Anagrates, the present Anegray in the department of Haute-Saône. He then built the abbey of Luxeuil, for the congregation of which he drew up his rule. His enemies accused him before a synod of French bishops (602) for keeping Easter according to the Celtic usage, and a powerful conspiracy was organized against him at the court of Burgundy for boldly rebuking King Theuderich II. and the queen-mother Brunhild. Being forcibly removed from his monastery, with St. Gall and other monks he withdrew to Switzerland, where he preached to the Suebi and Alamanni. Finally he was forced to retire to Italy, where he founded the monastery of Bobbio in the Apennines, where he died on Nov. 21, 615. His writings, which include some Latin poems, prove him a man of learning, acquainted with the Latin and Greek classics.

St. Columban's writings were published by Patrick Fleming in his *Collectanea sacra Hiberni* (Louvain, 1667), and reproduced by Migne, vol. lxxxvi. *See* further, Wright's *Biographia Literaria;* and U. Chevalier, *Repertoire des sources hist.*

COLUMBANI, PLACIDO, Italian architectural designer, who worked chiefly in England in the latter part of the 18th century. He belonged to the school of the Adams and Pergolesi, and like them frequently designed the enrichments of furniture. He was a prolific producer of chimney-pieces, which are often mistaken for Adam work, of moulded friezes, and painted plaques for cabinets and the like. There can be no question that the English furniture designers of the end of the 18th century, and especially the Adams, Hepplewhite and Sheraton, owed much to his graceful, flowing and classical conceptions, although they are often inferior to those of Pergolesi. His books are still a valuable storehouse of sketches for internal architectural decoration. His principal works are:—*Vases and Tripods* (1770); *A New Book of Ornaments* (1775); *A variety of Capitals, Friezes and Corniches, and how to increase and decrease them, still retaining their proportions* (1776).

COLUMBARIUM, originally a pigeon house, and so still used, particularly of the large, round, tower-like structures common in many districts in France; a dove cote. The term is also, and more commonly, applied to a sepulchral building containing many small niches for funerary urns. Columbaria were the most common places for the disposal of the ashes of the dead in imperial pre-Christian Rome, except for the very wealthy. Many have been excavated and are one of the most fruitful sources of Latin inscriptions. Columbaria were erected by societies, gilds, the slaves and freedmen of great families and similar associations. They usually took the form of an open court, the walls of which contained the arched niches for the urns. Occasionally they were treated with considerable architectural splendour as in the columbarium of the freedmen of Livia in the Via Appia, Rome (early first century A.D.). In modern times, with the revival of cremation, there has come a new development of columbaria in connection with the great crematories, the most famous example being that surrounding the crematory of Hanover, Germany.

For Roman columbaria *see* R. Lanciani, *Ancient Rome in the Light of Recent Excavations,* chap. iii. (1889); G. Rivoira, *Roman Architecture,* Fig. 29 (1925).

COLUMBIA, a city near the centre of Missouri, U.S.A., about 10m. N. of the Missouri river, at an altitude of 720ft.; the county seat of Boone county. It is on Federal highways 40 and 63, and is served by the Missouri-Kansas-Texas and the Wabash railways. The population was 10,392 in 1920 (18·5% Negroes) and in 1940 was 18,399 by the federal census. It is in a region of diversified agricultural interests; has large flour mills and several other manufacturing industries; is the seat of the University of Missouri, the Christian college for women (Disciples), Stephens college and the Bible college of Missouri (Disciples); and is the headquarters of the State teachers' association. In the quadrangle on the campus is the monument of gray granite from the grave of Thomas Jefferson, designed by him and bearing the famous inscription he wrote for it. It was given to the university by his descendants when Congress erected the monument now standing on his grave. Columbia was settled about 1821, and was incorporated as a city in 1826.

COLUMBIA, a borough of Lancaster county, Pennsylvania, U.S.A., amid beautiful scenery on the Susquehanna river (a mile wide at this point), 80 mi. W. by N. of Philadelphia. It is on the Lincoln highway, and is served by the Pennsylvania and the Reading railways. The population in 1940 was 11,547 by the federal census. Columbia is a busy trading and shipping centre, and has numerous and varied manufacturing industries, with an output in 1939 valued at $7,186,400. Columbia was settled by Quakers in 1726 and was incorporated in 1814. It was one of the places considered by the congress in 1790 for the permanent site of the national capital.

COLUMBIA, the capital of South Carolina, U.S.A., and the county seat of Richland county, on the Congaree river, in the geographical centre of the state. It is on federal highways 1, 21 and 76; is served by the Atlantic Coast line, the Columbia, Newberry and Laurens, the Seaboard Air line and the Southern railways; a municipal airport is located 3½ miles southeast of the post office.

The population in 1930 was 51,581 (37·8% Negroes) and was 62,396 in 1940. Suburbs just outside the city limits add 28,000 to the metropolitan population.

The city is beautifully situated on a bluff above the river. Wide streets, many trees and fine public buildings make it very attractive. The state house is built of granite from near-by quarries and has specimens of over 50 species of trees on its grounds. Columbia is the centre of a rich agricultural and forest district. It has important manufactures, especially of cotton goods, cottonseed oil, fertilizer and machinery. The output of its 175 industries in 1939 was valued at $30,000,000. The assessed valuation of property is over $20,000,000. The University of South Carolina, chartered in 1801 as South Carolina college, and opened there in 1804, has an enrolment of over 2,000. Among the other educational institutions are Columbia college (1854); Columbia Bible college; Benedict college (1870), for Negroes of both sexes; Allen university (1870), for Negroes of both sexes; and Lutheran Theological Southern seminary (1829). The state penitentiary and the state insane asylum are there. In 1786, when the site was still largely forest, it was chosen for the capital, and a town was laid out, which was governed directly by the legislature until 1805, when it was incorporated as a village. A city charter was secured in 1854. On Feb. 17, 1865, Gen. Sherman entered Columbia, and that night a fire broke out which destroyed most of the city. From June 1862, until the close of the war, the buildings of the university (then the college) were used by the Confederate government for a hospital.

COLUMBIA, a city of Tennessee, U.S.A., 46 mi. S. by W. of Nashville, on the Duck river; the county seat of Maury county. It is on federal highway 31, and is served by the Louisville and Nashville and the Nashville, Chattanooga and St. Louis railways. The population in 1920 was 5,526 (35% Negroes); it was 7,882 in 1930 and 10,579 in 1940. It is in a fine farming region, where tobacco, corn, wheat, alfalfa and potatoes are grown, and many mules are raised. Phosphate rock is mined within 12 miles. The city has a large mule market. Its factories include flour mills, a cannery, a cotton mill and plants making furniture, work clothes and lighting fixtures. Columbia was settled about 1807 and incorporated in 1822. In 1862–63 it was Gen. N. B. Forrest's base of operations, and during Gen. Hood's Nashville campaign (Nov.–Dec. 1864) it was occupied alternately by federal and Confederate troops. James K. Polk began there (1820) to practise law.

COLUMBIA RIVER, the largest river flowing into the Pacific ocean from the western continent, is one of the world's great hydroelectric power streams. More than 30% of the potential hydro power of the United States is located within its watershed.

The Columbia river rises in the ice fields of the Rocky mountains in British Columbia (50° N., 116° W.), about 80 mi. N. of the international boundary, and flows northwest for about 170 mi. to lat. 52°, where it turns sharply south, nearly encircling the Selkirk mountains. It enters the United States near the northeast corner of Washington. Through Washington the Columbia flows circuitously, in what is called the Big Bend, to its junction with the Snake, its largest tributary. Not far below it turns west and forms the boundary between Washington and Oregon for about 325 mi. Ice of the glacial period, which extended as far south as the Big Bend, greatly modified its course, once the line of the series of lakes now in the Grand Coulee.

The total area drained by this system is 259,000 sq.mi., of which 220,300 are in the United States. The total length of the river is about 1,210 mi. The mean flow at its mouth is about 280,000 sec.ft. (maximum about 1,250,000)—approximately eight times the mean flow of the Colorado at Yuma, and nearly double that of the Nile at Assuan. The fall through 400 mi. in Washington is over 1,000 ft.

Numerous rapids in the upper river afford many hydroelectric power sites. The Columbia's mouth is the only deepwater harbour between San Francisco and Cape Flattery, a distance of 770 mi. Tides are perceptible 140 mi. up the river. The mean tide at Astoria is about six feet, and the average tidal flow at the mouth is about 1,000,000 sec.ft.

Early development in the river basin was confined to navigation and irrigation. Navigation improvement has been developed by the U.S. war department, while irrigation has been handled for the most part by the department of the interior. A project for a 30-ft. channel 300 ft. wide, from Portland to the sea, was authorized in 1911, and a 35-ft. channel 500 ft. wide in 1928. A lock was completed at Cascade rapids in 1898, and an 8-mi. canal was built in 1918 around Celilo falls. Principal irrigation developments have been the Yakima project, irrigating slightly more than 500,000 ac. in 1941, with water from one of the Columbia's principal tributaries, and the Vale-Owyhee project in the Snake river basin.

First surveys for complete utilization of the river system were begun by the war department in 1927. In 1933 construction of the first two of a series of multiple-purpose dams was begun at Bonneville, Ore., 140 mi. from the ocean, and at the juncture of Grand Coulee with the present course of the river 450 mi. above Bonneville.

Because the river's power potentialities are peculiarly suited to the needs of electrolytic and electric furnace operations, government economists planned development of the northwest as a light metals manufacturing centre.

Bonneville dam, completed in 1937 for the dual purpose of navigation improvement and ultimate generation of 518,400 kw. of electricity, comprises a spillway 1,090 ft. long between the Washington shore and Bradford island, and a powerhouse and navigation lock between the island and the Oregon shore. With completion of a 27-ft. channel from Portland to Bonneville in 1942, the lock will permit ocean vessels to ascend the river 192 mi. As a result of navigation improvement, tonnage on the river above Bonneville increased from 417,000 to 700,000 between 1939 and 1940.

Grand Coulee dam, first operated in 1941, was designed to supply water for the Columbia basin irrigation project and for generation of 1,944,000 kw. of electric power. The dam is 3,000 ft. long at its crest, and the height from bedrock is 550 ft. The spillway has a capacity of 1,000,000 cu.ft. per sec.

On Aug. 20, 1937, congress passed an act establishing the Bonneville power administration as agency for the transmission and sale of power generated at Bonneville. A presidential executive order signed Aug. 26, 1940, made the agency the transmission and marketing unit for Grand Coulee power.

By June 30, 1941, the combined generating capacity of both dams had reached a total of 214,400 kw., and a total of 322,000 kw. had been contracted to retail power distribution agencies and electrometallurgical and electrochemical industries. Nearly 1,400 mi. of high-voltage transmission system had been constructed. Complete generator installation at Bonneville was scheduled for 1943.

COLUMBIA RIVER HIGHWAY begins at Astoria, Oregon, and ends at Pendleton, 336 mi. distant in the same State. Of this mileage 202 mi. are paved and 134 mi. are of oiled rock or gravel. It runs within sight of the Columbia river practically all the way, sometimes along its lower banks and sometimes along rocky walls at great heights above the stream, often passing by tunnel through projecting mountain spurs. Portland, Hood River, The Dalles and Umatilla and also the great snow-crowned peaks, Multnomah Falls and Mt. Hood are points of interest along its course. It is part of the old "Oregon Trail" made famous by the Astor family and is one of the most notable scenic highways in America.

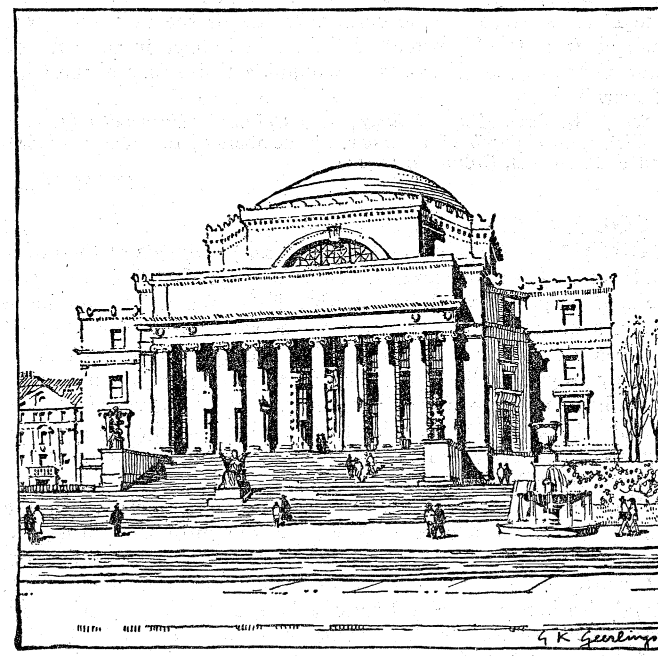
COLUMBIA UNIVERSITY, one of the oldest and most important of the higher institutions of learning in the United States, situated for the most part on Morningside Heights, New York city. It embraces Columbia college, founded as King's college in 1754; a school of medicine (the College of Physicians and Surgeons) founded 1767, removed in 1928 to a site on the Hudson above 165th Street where, in conjunction with the Presbyterian hospital and allied institutions, it forms the nucleus of a great medical centre; school of law (1858); school of engineering, organized as school of mines in 1863; school of architecture (1881); graduate facilities of political science (1880), philosophy (1890) and pure science (1892); school of journalism (1912); school of business (1916); school of dental and oral surgery (1916); school of library service (1926). Closely affiliated to it and incorporated in its educational system are the College of Pharmacy (1829), in West 68th Street; Teachers college, founded in 1886, as the New York College for the Training of Teachers, and essentially a part of the university since 1895; Barnard college (for women) founded in 1889, and essentially a part of the university since 1900; Bard (formerly St. Stephen's college), Annandale-on-Hudson (for men) founded in 1860, and essentially a part of the university since 1928, New York Post-Graduate Medical School, founded in 1882 and essentially a part of the university since 1931. Reciprocal relations also exist between the university and Union Theological Seminary, thus practically adding to the university a theological faculty.

In co-operation with the Ministry of Education in Porto Rico the university in 1924 assumed responsibility for educational and scientific work of the school of tropical medicine on the island of Porto Rico. Three research institutes are connected with the university, the Institute of Educational Research, the Institute of Cancer Research and the De Lamar Institute of Public Health. Courses in university extension are open to men and women who can give only a portion of their time to study, but who desire to pursue subjects included in a liberal education. These courses, as such, do not lead to degrees. Under university extension there is also an Institute of Arts and Sciences which conducts a series of lectures and recitals of a popular nature. Women are admitted by all faculties of the university with the exception of that of engineering. Since 1900 a summer session has been held for six weeks. Teachers and others, under the direction of the Teachers college, are afforded an opportunity to pursue courses *in absentia* and so meet some of the requirements for an academic degree or a teacher's diploma.

In 1936 there were in Columbia university in all departments 3,190 instructors and administrative officers, and in the 12 months ending June 30, 1935, 33,495 students were enrolled. Of these, roughly one-third were registered in the 1935 summer session; more than one-third in the degree-granting schools and faculties during the academic year 1935–1936. In addition to the resident students there were 676 non-resident students in home study and 1,986 non-resident students in extra-mural and special courses. The numerous university publications include works embodying the results of original research published by Columbia University Press; "Studies" published in the form of a series by each of several departments; various periodicals edited by some members of the faculty, such as *The Romanic Review, The Germanic Review, The Political Science Quarterly,* etc. and several papers or periodicals, published by the students, among which are the *Columbia Spectator,* a daily paper, the *Columbia Law Review* and the *Columbia Jester.*

With one exception the 69 buildings of the university on Morningside Heights have been erected since 1896. They include besides the several department buildings and laboratories, two library buildings, a university hall (with gymnasium), Earl Hall (for social purposes), St. Paul's chapel (dedicated in 1907), President's house, Faculty house, faculty residential halls, residence halls for men and for women, and four centres of foreign interests, the Maison Française, the Casa Italiana, the Deutsches Haus, and the Casa de las Españas. The library contains about 1,520,000 volumes exclusive of duplicates and unbound pamphlets.

The highest authority in the government of the institution is vested in a board of 24 trustees, vacancies in which are filled by co-optation; but the immediate educational interests are directed largely by the members of the university council, which is composed of the president of the university, the dean and elected representatives from the faculty of each school. The alumni of the university have been given a definite part in the government of the institution by an agreement under which six of the 24 trustees are elected on alumni nomination. The productive endowment of the university, including the endowments of Teachers college, Barnard college, College of Pharmacy, Bard College, and New York Post-Graduate Medical School had a book value in 1936 of $85,749,434, which, added to the property occupied for educational purposes, made a total capital holding of $144,336,580. The tuition fees to the students in the several schools range from $400 to $545. The total budget appropriations for the maintenance of the work of the whole educational system of the university for the year 1936–1937 were $14,840,633.25.



LOW MEMORIAL LIBRARY

The library, one of the first five buildings to be erected on the present site of the college when it removed to Morningside Heights in 1896, was the gift of Seth Low, at that time president of the institution. The statue half way up the steps represents Alma Mater

The charter granted by the Crown in 1754, for the establishment of King's college, was so free from narrow sectarianism as to name ministers of five different denominations for ex-officio governors, and provide that the governors should not "exclude any person of any religious denomination whatever from equal liberty and advantage of education or from any of the degrees, liberties, privileges, benefits or immunities of the said college on account of his particular tenents in matters of religion." The purpose of the institution as set forth by its first president, Dr. Samuel Johnson (1696–1772) was about as broad as that now realized.

In 1756 the erection of the first building was begun at the lower end of Manhattan island, near the Hudson, and the institution prospered from the beginning. From 1776 to 1784, during the Revolutionary War, the exercises of the college were suspended and the library and apparatus were stored in the New York city hall. In 1784 the name was changed to Columbia college, and an act of the legislature was passed for creating a State university, of which Columbia was to be the basis. But the plan was not a success, and three years later, in 1787, the act was repealed and the administration of Columbia was entrusted to a board of trustees of which the present board is a successor. In 1857 there was an extensive reorganization by which the scope of the institution was much enlarged, and at the same time it was removed to a new site on Madison Avenue between 49th and 50th Streets.

From 1890 to 1895 much reorganization and centralization in its administration was effected. In 1896 the name of Columbia university was adopted, and in the autumn of 1897 the old site and buildings were again abandoned for new, this time on Morningside Heights. In 1912 the corporate title of the university was changed from the "Trustees of Columbia College in the City of New York" to the "Trustees of Columbia University in the City of New York."

See J. B. Pine, *King's College, now Columbia University* (1896); *A History of Columbia University*, by members of the faculty (1904) and F. P. Keppel, *Columbia* (1914).

(N. M. B.)

COLUMBIDAE: *see* DOVE; PIGEON.

COLUMBINE, any plant of the genus *Aquilegia* of the crowfoot family (Ranunculaceae). They bear slender, delicate, long-stalked, deeply divided leaves with blunt segments, and loose panicles of handsome, drooping, blue, white or yellow flowers, which are characterized by having all the five petals spurred.

They grow in woods and thickets, and often in alpine meadows. Some horticultural varieties are well known in cultivation. There are about 75 species of columbine, natives of north temperate regions, together with numerous varietal forms and crosses developed by cultivation.

The 20 odd species found in North America, chiefly in the Rocky Mountain region, rank among the most beautiful wild flowers of the continent, several of which, including the following, are widely cultivated. The eastern columbine (*A. canadensis*), called also honeysuckle and rock bells, found in dry woods from Nova Scotia to North-West Territories and southward to Florida and Texas, with nodding, scarlet and yellow flowers, an inch or more across, is a favorite spring wild flower. The Rocky Mountain columbine (*A. coerulea*), with handsome, erect, blue and white flowers, 2 in. or more across and spurs 2 in. long, is the state flower of Colorado.

The golden columbine (*A. chrysantha*), found from western Texas to Arizona, grows 3 ft. to 4 ft. high, with clear yellow flowers, sometimes 3 in. across and very slender spurs about 3 in. long. The Sitka columbine (*A. formosa*), which ranges from Utah and northern California to Montana and Alaska, has nodding red and yellow flowers, about 2 in. across, with short, thick spurs.

The common columbine of California is a form of this, with pendulous, scarlet flowers and short spurs.

Columbine, in pantomime (*q.v.*), is the fairy-like dancer who is courted by Harlequin. In the mediaeval Italian popular comedy she was Harlequin's daughter. (*See* COMMEDIA DELL' ARTE.)

COLUMBITE, a rare mineral consisting of iron niobate, $FeNb_2O_6$, in which the iron and niobium are replaced by varying amounts of manganese and tantalum respectively, the general formula being $(Fe, Mn)(Nb, Ta)_2O_6$. It was in this mineral that Charles Hatchett discovered, in 1801, the element niobium, which he himself called columbium after the country (Columbia or America) whence came the specimen in the British Museum collection which he examined. It crystallizes in the orthorhombic system, and the black, opaque crystals are often very brilliant with a sub-metallic lustre. Hardness 6; sp. gr. 5·3. With increasing amount of tantalum the specific gravity increases up to 7·3, and members at this end of the series have been given the name of *tantalite* ($FeTa_2O_6$). These minerals occur as crystals and compact masses in granite and pegmatite.

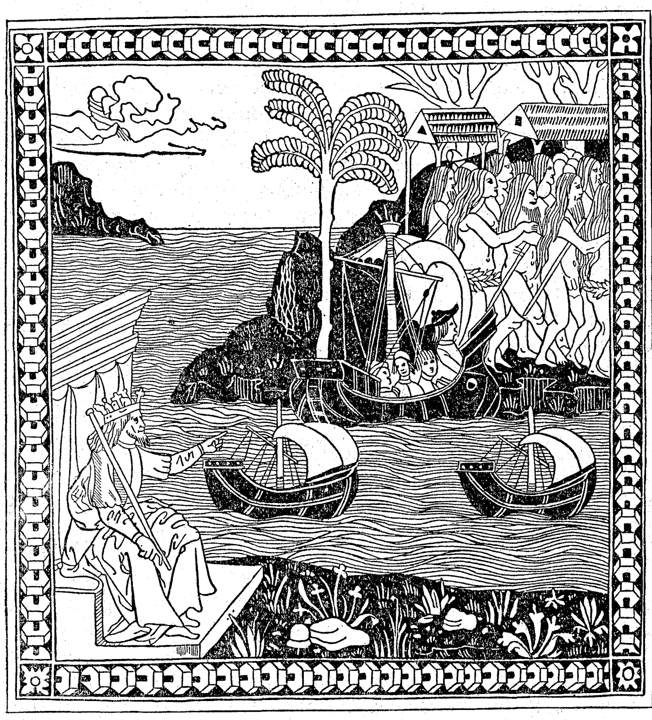
COLUMBIUM or **NIOBIUM,** a metallic chemical element, which has, as yet, found little application in the arts. First observed in 1801 by C. Hatchett in a New England mineral, since named columbite, it was identified by Rose in 1844. The metal was first prepared by Blomstrand (1866) by reducing its chloride with hydrogen. Later its oxide was reduced, by Moissan in the electric furnace in contact with carbon and by Goldschmidt by the use of aluminium powder.

Columbium, whose symbol is Cb or Nb, is a steel-grey metal, atomic number 41, atomic weight 93·1, of specific gravity 7·06 and melting point 1,950° C. It has nearly the same hardness as wrought iron in massive pieces, is malleable and may be welded. It burns on heating in air, is scarcely attacked by hydrochloric or nitric acid, but is soluble in warm concentrated sulphuric acid. It is related to vanadium and tantalum chemically and occurs associated with the latter most frequently in nature; the chief minerals being tantalite, columbite, fergusonite and yttrotantalite. With other elements it is found in pyrochlor, euxenite and samarskite. Three oxides of columbium are known, namely the *dioxide*, Cb_2O_2, the *tetroxide*, Cb_2O_4, and the *pentoxide*, Cb_2O_5, whilst a fourth oxide, *columbium trioxide*, Cb_2O_3, has been described by E. F. Smith and P. Maas (1894).

Columbium tetroxide, Cb_2O_4, is obtained as a black powder when the pentoxide is heated to a high temperature in a current of hydrogen. It is unattacked by acids. Columbium pentoxide, Cb_2O_5, is obtained from columbite after the removal of potassium tantalifluoride. (*See* TANTALUM.) The mother liquors are concentrated, and the double salt K_2CbOF_5, H_2O, which separates, is decomposed by sulphuric acid, or by continued boiling with water. The pentoxide is a white amorphous infusible powder, which when strongly heated in sulphuretted hydrogen, yields an oxysulphide. Several hydrated forms are known, yielding salts known as columbates. A percolumbic acid, $HCbO_4 \cdot nH_2O$, has been prepared by P. Melikoff and L. Pissarjevski (1899), as a yellow amorphous powder by the action of dilute sulphuric acid on the potassium salt, which is formed when columbic acid is fused in a silver crucible with eight times its weight of caustic potash.

Columbium trichloride, $CbCl_3$, is obtained in needles or crystalline crusts when the vapour of the pentachloride is slowly passed through a red-hot tube. When heated in a current of carbon dioxide it forms the oxychloride $CbOCl_3$, and carbon monoxide. Columbium pentachloride, $CbCl_5$, is obtained in yellow needles when a mixture of the pentoxide and sugar charcoal is heated in a current of air-free chlorine. It melts at 194° C (H. Deville) and boils at 240·5° C. It is decomposed by water, and dissolves in hydrochloric acid. Columbium oxychloride, $CbOCl_3$, formed when carbon tetrachloride and columbic acid are heated together at 440° C, forms a white silky mass which volatilizes at about 400° C. It deliquesces in moist air, and is decomposed violently by water. Columbium pentafluoride, CbF_5, is obtained when the pentoxide is dissolved in hydrofluoric acid. It is only known in solution; evaporation of the solution yields the pentoxide. The oxyfluoride, $CbOF_3$, results when a mixture of the pentoxide and fluorspar is heated in a current of hydrochloric acid. It forms many double salts with other metallic fluorides. These double salts belong to an isomorphous series in which fluorine is replaced atom by atom by oxygen, *e.g.*, K_2TiF_6, H_2O, K_2CbOF_5, H_2O and $K_2WO_2F_4$, H_2O.

COLUMBUS, CHRISTOPHER (*c.* 1446 or 1451–1506) (in Spanish, CRISTOBAL COLÓN), was the eldest son of Domenico Colombo and Suzanna Fontanarossa, and was probably born at Genoa, the exact date of his birth being uncertain. According to the *Life of Columbus* by his son Ferdinand (a statement supported by Las Casas), young Christopher was sent to the University of Pavia, where he studied astronomy, geometry and cosmography. Yet, according to the admiral's own statement, he became a sailor at fourteen. Evidently this statement, however, cannot mean the abandonment of all other employment, for in 1470, 1472 and 1473 we find him engaged in trade at Genoa, following the family business of weaving, and (in 1473) residing at the neighbouring Savona. In 1474–75 he appears to have visited Chios, where he may have resided some time, returning to Genoa perhaps early in 1476. Thence he seems to have again set out on a voyage in the summer of 1476, perhaps bound for England; on Aug. 13, 1476, the four Genoese vessels he accompanied were attacked off Cape St. Vincent by a privateer, one Guillaume de Casenove, surnamed Coullon or Colombo ("Columbus"); two of the four ships escaped, with Christopher, to Lisbon. In Dec. 1476, the latter resumed their voyage to England, probably carrying with them Columbus, who, after a short stay in England, claims to have made a voyage in the northern seas, and even to have visited Iceland about Feb. 1477. This last pretension is disputed, but it is perhaps not to be rejected, and we may also trace the Genoese about this time at Bristol, at Galway, and probably among the islands west and north of Scotland. Soon after this he returned to Portugal, where (probably in 1478) he married Felipa Moñiz de Perestrello, daughter of Bartholomew Perestrello, a captain in the service of Prince Henry the Navigator, and one of the early colonists and first governor of Porto Santo.



THE FIRST PICTORIAL VERSION OF COLUMBUS' DISCOVERY OF AMERICA
This woodcut, executed in the year Columbus returned to Spain after his discovery of America, shows the three boats that made up the expedition. After a woodcut in "La lettera dellisole che ha trouato nuouamente il Re dispagan," Florence. 1493

About 1479 Columbus visited Porto Santo, here as in Portugal probably employing his time in making maps and charts for a livelihood, while he pored over the logs and papers of his deceased father-in-law, and talked with old seamen of their voyages, and of the mystery of the western seas. He seems step by step to have conceived that design of reaching Asia by sailing west which was to result in the discovery of America. In 1474 he is said to have corresponded with Paolo Toscanelli, the Florentine physician and cosmographer, and to have received from him valuable suggestions, both by map and letter, for such a Western enterprise. (The whole of this incident has been disputed by some recent critics.) He had perhaps already begun his studies in a number of works, especially the *Book* of Marco Polo and the *Imago Mundi* of Pierre d'Ailly, by which his cosmographical and geographical conceptions were largely moulded. His views, as finally developed and presented to the courts of Portugal and Spain, were supported by three principal lines of argument, derived from natural reasons, from the theories of geographers, and from the reports and traditions of mariners. He believed the world to be a sphere; he underestimated its size; he overestimated the size of the Asiatic continent. And the farther that continent extended towards the east, the nearer it came towards Spain. Nor were these theories the only supports of his idea. Martin Vicente, a Portuguese pilot, was said to have found, 400 leagues to the westward of Cape St. Vincent, and after a westerly gale of many days' duration, a piece of strange wood, wrought, but not with iron; Pedro Correa, Columbus's own brother-in-law, was said to have seen another such waif at Porto Santo, with great canes capable of holding four quarts of wine between joint and joint, and to have heard of two men being washed up at Flores "very broad-faced, and differing in aspect from Christians." West of Europe, now and then, men fancied there hove in sight the mysterious islands of St. Brendan, of Brazil, of Antillia or of the Seven Cities. In his northern journey, too, some vague and formless traditions may have reached the explorer's ear of the voyages of Leif Ericson and Thorfinn Karlsefne, and of the coasts of Markland and Vinland. All were hints and rumours to bid the bold mariner sail towards the setting sun, and this he at length determined to do.

QUEST FOR A PATRON

For the promotion of the plan the concurrence of some state or sovereign was necessary. Columbus, on the accession of John II. of Portugal, seems to have entered the service of this country, to have accompanied Diego d'Azambuja to the Gold Coast, and to have taken part in the construction of the fort of St. George at El Mina (1481–82). On his return, he submitted to King John his scheme for reaching Asia by a western route across the ocean. The king was interested in the rival scheme (of an eastern or south-eastern route round Africa to India) initiated by the Genoese in 1291, and revived, for Portugal, by Prince Henry the Navigator; but he listened to the Genoese, and referred him to a committee of council for geographical affairs. The council's report was adverse; but the king, who was inclined to favour the theory of Columbus, assented to the suggestion of the bishop of Ceuta that the plan should be carried out in secret and without its author's knowledge. A caravel was despatched; but it returned after a brief absence, the sailors having lost heart, and refused to venture further. Upon discovering this treachery, Columbus left Lisbon for Spain (1484), taking with him his son Diego, the only issue of his marriage with Felipa Moñiz, who was by this time dead. He departed secretly;—according to some writers, to give the slip to King John; according to others, to escape his creditors.

Columbus next betook himself to the south of Spain, and while meditating an appeal to the king of France, opened his plans to the count (from 1491, duke) of Medina Celi. The latter gave him great encouragement, entertained him for two years, and even determined to furnish him with three or four caravels, to carry out his great design. Finally, however, being deterred by the consideration that the enterprise was too vast for a subject, he turned his guest from the determination he had come to of making application at the court of France, by writing on his behalf to Queen Isabella; and Columbus repaired to the court at Cordova at her bidding (1486). It was an ill moment for the navigator's fortune. Castile and Leon were in the thick of that struggle which resulted in the final conquest of the Granada Moors; and neither Ferdinand nor Isabella had time as yet to give due consideration to Columbus's proposals. The adventurer was indeed kindly received; he was handed over to the care of Alonso de Quintanilla, whom he speedily converted into an enthusiastic supporter of his theory. He made many other friends, and among them Beatriz Enriquez, the mother of his second son Fernando. But the committee, presided over by the queen's confessor, Fray Hernando de Talavera, which had been appointed to consider the new project, reported that it was vain and impracticable.

From Cordova Columbus followed the court to Salamanca, having already been introduced by Quintanilla to the notice of the grand cardinal, Pedro Gonzalez de Mendoza, "the third king of Spain"; the latter had befriended and supported the Genoese, and apparently arranged the first interview between him and Queen Isabella. At Salamanca prolonged discussions took place upon the questions now raised; the Dominicans of San Esteban entertained Columbus during the conferences (1486–87). In 1487 Columbus, who had been following the court from place to place (billeted in towns as an officer of the sovereigns, and gratified from time to time with sums of money towards his expenses), was present at the siege of Malaga. In 1488 he was invited by the king of Portugal, his "especial friend," to return to that country, and was assured of protection against arrest or proceedings of any kind (March 20): he had probably made fresh overtures to

King John shortly before; and in the autumn of 1488 we find him in Lisbon, conferring with his brother Bartholomew and laying plans for the future. We have no record of the final negotiations of Columbus with the Portuguese Government, but they clearly did not issue in anything definite, for Christopher now returned to Spain (though not till he had witnessed the return of Bartholomew Diaz from the discovery of the Cape of Good Hope and his reception by King John), while Bartholomew proceeded to England with a mission to interest King Henry VII. in the Columbian schemes. If the London enterprise was unsuccessful (as indeed it proved), it was settled that Bartholomew should carry the same invitation to the French court. He did so; and here he remained till summoned to Spain in 1493. Meantime Christopher, unable throughout 1490 to get a hearing at the Spanish court, was in 1491 again referred to a *junta,* presided over by Cardinal Mendoza; but this *junta,* to Columbus' dismay, once more rejected his proposals; the Spanish sovereigns merely promised him that when the Granada war was over, they would reconsider what he had laid before them.

Columbus was now in despair. He at once betook himself to Huelva, a little maritime town in Andalusia, north-west of Cadiz, with the intention of taking ship for France. He halted, however, at the monastery of La Rabida, near Huelva, and still nearer Palos, where he seems to have made lasting friendships on his first arrival in Spain in Jan. 1485, where he especially enlisted the support of Juan Perez, the guardian who invited him to take up his quarters in the monastery, and introduced him to Garcia Fernandez, a physician and student of geography. Juan Perez had been the queen's confessor; he now wrote to her in urgent terms, and was summoned to her presence; and money was sent to Columbus to bring him once more to court. He reached Granada in time to witness the surrender of the city (Jan. 2, 1492), and negotiations were resumed. Columbus believed in his mission, and stood out for high terms; he asked for the rank of admiral at once ("Admiral of the Ocean" in all those islands, seas, and continents that he might discover), the vice-royalty of all he should discover, and a tenth of the precious metals discovered within his admiralty. These conditions were rejected, and the negotiations were again interrupted. An interview with Mendoza appears to have followed; but nothing came of it, and before the close of Jan. 1492, Columbus actually set out for France. At length, however, on the entreaty of the queen's confidante, the Marquesa de Moya, of Luis de Santangel, receiver of the ecclesiastical revenues of the crown of Aragon, and of other courtiers, Isabella was induced to determine on the expedition. A messenger was sent after Columbus, and overtook him near a bridge called "Pinos," 6 m. from Granada. He returned to the camp at Santa Fé, and on April 17, 1492, the agreement between him and their Catholic majesties was signed and sealed.

As his aims included not only the discovery of Cipangu or Japan, but also the opening up of intercourse with the grand khan of Cathay, he received a royal letter of introduction to the latter. The town of Palos was ordered to find him two ships, and these were soon placed at his disposal. But no crews could be got together, in spite of the indemnity offered to criminals and "broken men" who would serve on the expedition; and had not Juan Perez succeeded in interesting in the cause the Palos "magnates" Martin Alonso Pinzon and Vicente Yañez Pinzon, Columbus' departure had been long delayed. At last, however, men, ships and stores were ready. The expedition consisted of the "Santa Maria," a decked ship of 100 tons with a crew of 52 men, commanded by the admiral in person; and of two caravels; the "Pinta" of 50 tons, with 18 men, under Martin Pinzon; and the "Niña," of 40 tons, with 18 men, under his brother Vicente Yañez, afterwards (1499) the first to cross the line in the American Atlantic.

THE NEW WORLD DISCOVERED

The First Voyage.—The adventurers numbered 88 souls; and on Friday, Aug. 3, 1492, at eight in the morning, the little fleet weighed anchor, and stood for the Canary islands. An abstract of the admiral's diary made by Las Casas is yet extant; and from it many particulars may be gleaned concerning this first voyage. Three days after the ships had set sail the "Pinta" lost her rudder; the admiral was in some alarm, but comforted himself with the reflection that Martin Pinzon was energetic and ready-witted; they had, however, to put in at Teneriffe, to refit the caravel. On Sept. 6, they weighed anchor once more with all haste, Columbus having been informed that three Portuguese caravels were on the look-out to intercept him. On Sept. 13, the westerly variations of the magnetic needle were for the first time observed; on the 15th a meteor fell into the sea at four or five leagues distance; soon after they arrived at those vast plains of seaweed called the Sargasso Sea; while all the time, writes the admiral, they had most temperate breezes, the sweetness of the mornings being especially delightful. On the 17th the men began to murmur; they were frightened by the strange phenomena of the variation of the compass, but the explanation Columbus gave restored their tranquillity. On the 18th they saw many birds, and a great ridge of low-lying clouds; and they expected to see land. On the 20th they saw boobies and other birds, and were sure the land must be near. In this, however, they were disappointed; and thenceforth Columbus, who was keeping all the while a double reckoning, one for the crew and one for himself, had great difficulty in restraining the evil-disposed from the excesses they meditated. On the 25th Martin Alonso Pinzon raised the cry of land, but it proved false, as did the rumour to the same effect on Oct. 7, from the "Niña." But on the 11th the "Pinta" fished up a cane, a pole, a stick which appeared to have been wrought with iron, and a board, while the "Niña" sighted a branch covered with berries; "and with these signs all of them breathed and were glad." At ten o'clock on that night Columbus himself perceived and pointed out a light ahead, and at two in the morning of Friday, Oct. 12, 1492, Rodrigo de Triana, a sailor aboard the "Niña," announced the appearance of what proved to be the New World. The land sighted was an island, called by the Indians Guanahani, and named by Columbus San Salvador. It is generally identified with Watling island. The same morning Columbus landed, richly clad, and bearing the royal banner of Spain. He was accompanied by the brothers Pinzon, bearing banners of the Green Cross (a device of the admiral's), and by a great part of the crew. When they all had "given thanks to God, kneeling upon the shore, and kissed the ground with tears of joy, for the great mercy received," the admiral named the island, and took solemn possession of it for their Catholic majesties of Castile and Leon. At the same time such of the crews as had shown themselves doubtful and mutinous sought his pardon weeping, and prostrated themselves at his feet.

This voyage resulted in the discovery of the islands of Santa Maria de la Concepcion (Rum Cay), Fernandina (Lond island), Isabella (Crooked island), Cuba or *Juana* (named by Columbus in honour of the young prince of Spain), and Hispaniola, Haiti, or San Domingo. Off the last of these the "Santa Maria" went aground, owing to the carelessness of the steersman. No lives were lost, but the ship had to be unloaded and abandoned; and Columbus, who was anxious to return to Europe with the news of his achievement, resolved to plan a colony on the island, to build a fort out of the material of the stranded hulk, and to leave the crew. The fort was called La Navidad; 44 Europeans were placed in charge. On Jan. 4, 1493 Columbus, who had lost sight of Martin Pinzon, set sail alone in the "Niña" for the east; and two days afterwards the "Pinta" joined her sister-ship. A storm separated the vessels, and Columbus did not reach the island of Santa Maria in the Azores until Feb. 18. Here he was threatened with capture by the Portuguese governor, who could not for some time be brought to recognize his commission. On Feb. 24, however, he was allowed to proceed, and on March 4 the "Niña" dropped anchor off Lisbon. The king of Portugal received the admiral with the highest honours. On March 13 the "Niña" put out from the Tagus, and two days afterwards, Friday, the 15th, she reached Palos.

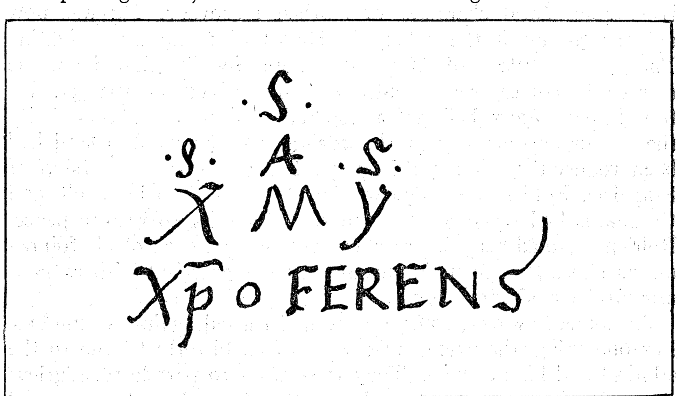
The court was at Barcelona; and thither Columbus proceeded. He entered the city in a sort of triumphal procession, was received by their majesties in full court, and, seated in their presence, related the story of his wanderings, exhibiting the "rich and strange" spoils of the new-found lands,—the gold, the cotton, the parrots, the curious arms, the mysterious plants, the unknown birds and beasts, and the Indians he had brought with him for baptism. All his honours and privileges were confirmed to him; the title of Don was conferred on himself and his brothers; he rode at the king's bridle; he was served and saluted as a grandee of Spain. A new and magnificent scutcheon was also blazoned for him (May 4, 1493), whereon the royal castle and lion of Castile and Leon were combined with the five anchors of his own coat of arms. On May 3–4, Alexander VI. granted bulls confirming to the crowns of Castile and Leon all the lands discovered, or to be discovered, west of a line of demarcation drawn 100 leagues west of the Azores, on the same terms as those on which the Portuguese held their colonies along the African coast. A new expedition was got ready to secure and extend the discoveries already made.

Second Voyage.—After several delays the fleet weighed anchor on Sept. 24, 1493. It consisted of three great carracks (galleons) and 14 caravels (light frigates), having on board over 1,500 men, besides the animals and materials necessary for colonization. Twelve missionaries accompanied the expedition, under the orders of Bernardo Buil or Boil, a Benedictine; Columbus had already been directed (May 29, 1493), to endeavour to Christianize the inhabitants of the islands, to make them presents, and to "honour them much," while all under him were commanded to treat them "well and lovingly," under pain of severe punishment. On Oct. 13, the ships, which had put in at the Canaries, left Ferro; and on Sunday, Nov. 3, after a single storm, an island was sighted to the west, which was named Dominica. Northwards from this the isles of Marigalante and Guadalupe were next discovered and named; while on the north-western course to La Navidad those of Montserrat, Antigua, San Martin, Santa Cruz and the Virgin Islands were sighted, and the island now called Porto Rico was touched at, hurriedly explored, and named San Juan Bautista. On Nov. 22, Columbus came in sight of Hispaniola, and sailing westward to La Navidad, found the fort burned and the colony dispersed. He decided on building a second fort, and coasting on 30 m. east of Monte Cristi, he pitched on a spot where he founded the city of Isabella.

COLONIZATION

The climate proved unhealthy; the colonists were greedy of gold, ignorant and mutinous; and Columbus, whose inclination drew him westward, was doubtless glad to escape the worry and anxiety of his post, and to avail himself of the instructions of his sovereigns as to further discoveries. On Feb. 2, 1494 he sent home, by Antonio de Torres, that despatch to their Catholic highnesses by which he may be said to have founded the West Indian slave trade. He established the mining camp of San Tomaso in the gold country of central Hispaniola; and on April 24, 1494, having nominated a council of regency under his brother Diego, and appointed Pedro Margarit his captain-general, he again put to sea. After following the southern shore of Cuba for some days, he steered southwards, and discovered (May 14) the island of Jamaica, which he named Santiago. He then resumed his exploration of the Cuban coast, threaded his way through a labyrinth of islets which he named the Garden of the Queen (Jardin de la Reyna), and, after coasting westwards for many days, became convinced that he had discovered continental land. He therefore caused Perez de Luna, the notary, to draw up a document to this effect (June 12, 1494), which was afterwards taken round and signed (the admiral's steward witnessing) by the officers, men and boys of his three caravels, the "Niña," the "Cordera," and the "San Juan." He then stood to the south-east, and sighted the island of Evangelista (now Isla de los Pinos), revisited Jamaica, coasted the south of Hispaniola, and on Sept. 24, touched at and named the island of La Mona, in the channel between Hispaniola and Porto Rico. Thence he had intended to sail eastwards and complete the survey of the Caribbean Archipelago; but he was exhausted by the terrible tear and wear of mind and body he had undergone (he says himself that on this expedition he was 33 days almost without sleep), and on the day following his departure from La Mona he fell into a lethargy that deprived him of sense and memory, and had well-nigh proved fatal to life. At last, on Sept. 29, the little fleet dropped anchor off Isabella, and in his new city the admiral lay sick for five months.

The colony was in a sad plight. Every one was discontented, and many were sick, for the climate was unhealthy and there was nothing to eat. Margarit and Boil had deserted the settlement and fled to Spain, but ere his departure the former, in his capacity of captain-general, had done much to outrage and alienate the



COLUMBUS CIPHER. THE INTERPRETATION OF THE SEVEN-LETTERED CIPHER, ACCEPTING THE SMALLER LETTERS OF THE SECOND LINE AS THE FINAL ONES OF THE WORDS, SEEMS TO BE SALVE CHRISTUS, MARIA, YOSEPHUS. THE NAME CHRISTOPHER (CHRISTOFERENS) APPEARS IN THE LAST LINE

Indians. The strongest measures were necessary to undo this mischief, and, backed by his brother Bartholomew, Columbus proceeded to reduce the natives under Spanish sway. Alonso de Ojeda succeeded by a brilliant *coup de main* in capturing the cacique Caonabo, and the rest submitted. Five ship-loads of Indians were sent off to Seville (June 24, 1495) to be sold as slaves; and a tribute was imposed upon their fellows, which must be looked upon as the origin of that system of *repartimientos* or *encomiendas* which was afterwards to work such mischief among the conquered. In Oct. 1495 Juan Aguado arrived at Isabella, with a royal commission to report on the state of the colony; here he took up the position of a judge of Columbus's government; and much recrimination followed. Columbus decided to return home; he appointed his brother Bartholomew *adelantado* of the island; and on March 10, 1496 he quitted Hispaniola in the "Niña." The vessel, after a protracted and perilous voyage, reached Cadiz on June 11, 1496, where the admiral landed, wearing the habit of a Franciscan. He was cordially received by his sovereigns, and a new fleet of eight vessels was put at his disposal. By royal patent, moreover, a tract of land in Hispaniola, of 50 leagues by 20, was offered to him, with the title of duke or marquis (which he declined); for three years he was to receive an eighth of the gross and a tenth of the net profits on each voyage; the right of creating a *mayorazgo* or perpetual entail of titles and estates was granted him; and his two sons were received into Isabella's service as pages.

DISCOVERY OF SOUTH AMERICA

Third Voyage.—Meanwhile, however, the preparing of the fleet proceeded slowly, and it was not till May 30, 1498 that he set sail with his main fleet of six ships—two caravels had already been sent on ahead. From San Lucar he steered for Porto Santo, Madeira, and Gomera, despatching three vessels direct from the Canaries to Hispaniola. He next proceeded to the Cape Verde islands, which he quitted on July 5. On the 31st of the same month, being greatly in need of water, and fearing that no land lay westwards as he had hoped, Columbus had turned his ship's head north, when Alonzo Perez of Huelva saw land about 15 leagues to the south-west. It was crowned with three hill-tops, from which circumstance, and in fulfilment of a vow made at starting (to name the first land discovered on this voyage in honour of the Trinity), the admiral named it Trinidad, which name it yet bears. On Wednesday, Aug. 1, he beheld for the first time the mainland of South America, the continent he had sought so long. It seemed to him but an insignificant island, and he called it Isla Santa. Sailing westwards, next day he saw the Gulf of Paria (named by him the Golfo de la Ballena), into which he was borne at immense risk on the ridge of waters formed by the meeting of the sea and the Orinoco estuaries. For several days he coasted the continent, esteeming as islands the various projections he saw, and naming them accordingly, nor was it until he had realized the volume poured out by the Orinoco that he began to perceive the truly continental character of his last discovery. He was now anxious to revisit the colony in Hispaniola; and after sighting Tobago, Grenada, and Margarita, made for San Domingo, the new capital of the settlement, where he arrived on Aug. 31. He found that affairs had not prospered well in his absence. By the vigour and activity of the *adelantado,* the whole island had been reduced under Spanish sway; but under the leadership of Francisco Roldan the malcontent settlers had risen in revolt, and Columbus had to compromise matters in order to restore peace. Roldan retained his office of chief justice; and such of his followers as chose to remain in the island were gratified with *repartimientos* of land and labour.

At home, however, court favour had turned against Columbus. For one thing, the ex-colonists were often bitterly hostile to the admiral and his brothers. They were wont to parade their grievances in the very court-yards of the Alhambra, to surround the king when he came forth with complaints and reclamations, to insult the discoverer's young sons with shouts and jeers. Again, the queen began to criticize severely the shipment of Indians from the new-found lands to Spain. And once more, there was no doubt that the colony itself, whatever the cause, had not prospered so well as might have been desired. Ferdinand's support of Columbus had never been very hearty, and his inclination to supersede the Genoese now prevailed over the queen's friendliness. Accordingly, on May 21, 1499, Francisco Bobadilla was appointed governor and judge of Hispaniola during royal pleasure, with authority to examine into all complaints. Columbus was ordered to deliver up his charge to Bobadilla, and to accept whatever the latter should deliver him from the sovereigns. Bobadilla left Spain in June 1500, and landed in Hispaniola on Aug. 23.

Columbus, meanwhile, had restored such tranquillity as was possible in his Government. With Roldan's help he had beaten off an attempt on the island of the adventurer Ojeda, his old lieutenant; the Indians were being collected into villages and Christianized. Gold-mining was profitably pursued; in three years, he calculated, the royal revenues might be raised to an average of 60,000,000 reals. The arrival of Bobadilla, however, speedily changed this state of affairs. On landing, he took possession of the admiral's house and summoned him and his brothers before him. Accusations of severity, of injustice, of venality even, were poured down on their heads, and Columbus anticipated nothing less than a shameful death. Bobadilla put all three in irons, and shipped them off to Spain. Alonso Vallejo, captain of the caravel in which the illustrious prisoners sailed, still retained a proper sense of the honour and respect due to Columbus, and would have removed the fetters; but to this Columbus would not consent. He would wear them, he said, until their highnesses, by whose order they had been affixed, should order their removal; and he would keep them afterwards "as relics and as memorials of the reward of his service." He did so. His son Fernando "saw them always hanging in his cabinet, and he requested that when he died they might be buried with him." Whether this last wish was complied with is not known.

A heart-broken and indignant letter from Columbus to Doña Juana de Torres, formerly nurse of the infante Don Juan, arrived at court before the despatch of Bobadilla. It was read to the queen, and its tidings were confirmed by communications from Alonso Vallejo and the alcaide of Cadiz. There was a great movement of indignation; the tide of popular and royal feeling turned once more in the admiral's favour. He received a large sum to defray his expenses; and when he appeared at court, on Dec. 17, 1500, he was no longer in irons and disgrace, but richly apparelled and surrounded with friends. He was received with all honour and distinction. The queen is said to have been moved to tears by the narration of his story. Their majesties not only repudiated Bobadilla's proceedings, but declined to inquire into the charges that he at the same time brought against his prisoners, and promised Columbus compensation for his losses and satisfaction for his wrongs. A new governor, Nicolas de Ovando, was appointed, and left San Lucar on Feb. 13, 1502, with a fleet of 30 ships, to supersede Bobadilla. The latter was to be impeached and sent home; the admiral's property was to be restored; and a fresh start was to be made in the conduct of colonial affairs. Thus ended Columbus's history as viceroy and governor of the new Indies which he had presented to the country of his adoption.

HIS LAST ADVENTURE

The Fourth Voyage.—His hour of rest, however, was not yet come. Ever anxious to serve their Catholic highnesses, "and particularly the queen," he had determined to find a strait through which he might penetrate westwards into Portuguese Asia. After the usual inevitable delays his prayers were granted, and on May 9, 1502, with four caravels and 150 men, he weighed anchor from Cadiz, and sailed on his fourth and last great voyage. He first betook himself to the relief of the Portuguese fort of Arzilla, which had been besieged by the Moors, but the siege had been raised before he arrived. He put to sea westwards once more, and on June 15 discovered the island of Martinino (probably St. Lucia). He had received positive instructions from his sovereigns on no account to touch at Hispaniola; but his largest caravel was greatly in need of repairs, and he had no choice but to abandon her or disobey orders. He preferred the latter alternative, and sent a boat ashore to Ovando, asking for a new ship and for permission to enter the harbour to weather a hurricane which he saw was coming on. But his requests were refused, and he coasted the island, casting anchor under lee of the land. Here he weathered the storm, which drove the other caravels out to sea, and annihilated the homeward-bound fleet, the richest that had till then been sent from Hispaniola. Roldan Bobadilla perished with others of the admiral's enemies; and Fernando Columbus, who accompanied his father on this voyage, wrote long afterwards, "I am satisfied it was the hand of God, for had they arrived in Spain they would have never been punished as their crimes deserved, but rather been favoured and preferred."

After recruiting his flotilla at Azua, Columbus put in at Jaquimo and refitted his four vessels; and on July 14, 1502 he steered for Jamaica. For several days the ships wandered painfully among the keys and shoals he had named the Garden of the Queen, and only an opportune easterly wind prevented the crews from open mutiny. The first land sighted (July 30) was the islet of Guanaja, about 40 m. east of the coast of Honduras. Here he got news from an old Indian of a rich and vast country lying to the eastward, which he at once concluded must be the long-sought-for empire of the grand khan. Steering along the coast of Honduras, great hardships were endured, but nothing approaching his ideal was discovered. On Sept. 12 Cape Gracias-a-Dios was rounded. The men had become clamorous and insubordinate; not until Dec. 5, however, would he tack about and retrace his course. It now became his intention to plant a colony on the river Veragua, which was afterwards to give his descendants a title of nobility; but he had hardly put about when he was caught in a storm, which lasted eight days, wrenched and strained his crazy, worm-eaten ships, severely, and finally, on Epiphany Sunday 1503, blew him into an embouchure which he named Belem or Bethlehem. Gold was very plentiful in this place, and here he determined to found his settlement. By the end of March 1503 a number of huts had been run up, and in these the *adelantado* (Bartholomew Columbus), with 80 men, was to remain, while Christopher returned to Spain for men and supplies. Quarrels, however, arose with the natives; the cacique was made prisoner, but escaped again; and before Columbus could leave the coast he had to abandon a caravel, to take the settlers on board, and to relinquish the enterprise of colonization. Steering eastwards, he left a second caravel at Puerto Bello; he thence bore northwards for Cuba, where he obtained supplies from the natives. From Cuba he bore up for Jamaica, and there, in the harbour of San Gloria, now St. Ann's bay, he ran his ships aground in a small inlet still called Don Christopher's cove (June 23, 1503).

The expedition was received with great kindness by the natives, and here Columbus remained upwards of a year, awaiting the return of his lieutenant Diego Mendez, whom he had despatched to Ovando for assistance. During his critical sojourn here, the admiral suffered much from disease and from the lawlessness of his followers, whose misconduct had alienated the natives, and provoked them to withhold their accustomed supplies, until he dexterously worked upon their superstitions by prognosticating an eclipse. Two vessels having at last arrived for his relief, Columbus left Jamaica on June 28, 1504, and, after calling at Hispaniola, set sail for Spain on Sept. 12. After a tempestuous voyage he landed once more at San Lucar on Nov. 7, 1504. As he was too ill to go to court, his son Diego was sent thither in his place, to look after his interests and transact his business. Letter after letter followed the young man from Seville—one by the hands of Amerigo Vespucci. A licence to ride on mule-back was granted him on Feb. 23, 1505; and in the following May he was removed to the court at Segovia, and thence again to Valladolid. On the landing of Philip and Juana at Coruña (April 25, 1506), although "much oppressed with the gout and troubled to see himself put by his rights," he is known to have sent off the *adelantado* to pay them his duty and to assure them that he was yet able to do them extraordinary service. The last documentary note of him is contained in a final codicil to the will of 1498, made at Valladolid on May 19, 1506. By this the old will is confirmed; the *mayorazgo* is bequeathed to his son Diego and his heirs male, failing these to Fernando, his second son, and failing these to the heirs male of Bartholomew; only in case of the extinction of the male line, direct or collateral, is it to descend to the females of the family; and those into whose hands it may fall are never to diminish it, but always to increase and ennoble it by all means possible. The head of the house is to sign himself "The Admiral." A tenth of the annual income is to be set aside yearly for distribution among the poor relations of the house. A chapel is founded and endowed for the saying of masses. Beatriz Enriquez is left to the care of the young admiral. Among other legacies is one of "half a mark of silver to a Jew who used to live at the gate of the Jewry, in Lisbon." The codicil was written and signed with the admiral's own hand. Next day (May 20, 1506) he died.

After the funeral ceremonies at Valladolid, Columbus's remains were transferred to the Carthusian monastery of Santa Maria de las Cuevas, Seville, where the bones of his son Diego, the second admiral, were also laid. Exhumed in 1542, the bodies of both father and son were taken over sea to Hispaniola and interred in the cathedral of San Domingo. In 1795–96, on the cession of that island to the French, the relics were re-exhumed and transferred to the cathedral of Havana, whence, after the Spanish-American War of 1898 and the loss of Cuba, they were finally removed to Seville cathedral, where they remain. The present heir and representative of Columbus belongs to the Larreategui family, descendants of the discoverer through the female line, and retains the titles of admiral and duke of Veragua.

In person Columbus was tall and shapely. The only authentic portrait of him is that which once belonged to Paulus Jovius, and is still in the possession of the de Orchi family (related to Jovius by female descent) at Como. It shows us a venerable man with clean-shaven face, thin grey hair, high forehead, sad thoughtful eyes. It bears the inscription *Columbus Lygur. novi orbis repertor.*

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COLUMBUS, a city of Georgia, U.S.A., 100m. S.S.W. of Atlanta, at the head of navigation on the Chattahoochee river; the county seat of Muscogee county. It is on Federal highway 80, and is served by the Central of Georgia, the Seaboard Air Line, and the Southern railways, and by river steamers to Apalachicola, on the Gulf of Mexico. The population was 31,125 in 1920 (29·2% negroes), and was 53,280 federal census in 1940. Including suburbs, there were over 65,000 persons living within 3m. of the county court house. Phoenix City and Girard (Ala.) lie just across the river, which is spanned by two concrete highway bridges. Columbus is one of the leading industrial centres of the South, with 100 plants making 200 different articles. Most of them are operated by electricity, generated from the falls of the river, which drops 362ft. in 34m. just above the city. The cotton mills have over 555,000 spindles. Other leading manufactures are brick, tile, concrete pipe, fertilizer, ice-making and refrigerating machinery, cotton gins, textile machinery, agricultural implements, cane mills, engines, boilers, shafting and pulleys, log skidders, doors, bank and office furniture and other lumber products. The output of the factories within the city in 1939 was valued at $60,000,000, and there are many plants just outside the corporate limits. The assessed valuation of property for 1940 was $39,569,005. Columbus has a large export trade in cotton, and is the shipping point also for the pecans, peanuts, dairy products, live stock and diversified crops grown in the vicinity.

Columbus was founded in 1828 by the State of Georgia, as an outpost on the border of the Indian lands and as a vantage point from which to utilize the water-power and the transportation facilities of the river. It was laid out by the State engineers, with avenues and streets 99–164ft. wide and ample reservations for public squares and buildings. The cotton-gin industry was established in 1832; the textile industry in 1837. This was the point of embarkation for troops from the south-east during the Mexican War. During the Civil War the city ranked next to Richmond in the manufacture of supplies for the Confederate Army. On April 16, 1865, after Lee had surrendered, it was captured by a Union force under Gen. James Harrison Wilson. Hydro-electric development was begun about 1900. The first cotton-mill worked by electricity was in Columbus, and it was here artificial ice was made on a commercial scale. Columbus was also the first city in the South to establish municipal graded schools, and the first in the country to provide industrial training as part of its public-school system. In 1922 it adopted a commission-manager form of government. Muscogee county also is governed by commission.

At Ft. Benning, 8m. S. of Columbus, is the infantry school of the U.S. Army. The reservation, selected partly for its variety of terrain, consists of 97,000 ac. along the river, and the personnel numbers about 35,000.

COLUMBUS, a city of Indiana, U.S.A., on the east fork of the White river, 41m. S.E. of Indianapolis; the county seat of Bartholomew county. It is on Federal highway 31, and is served by the Big Four and the Pennsylvania railways. The population in 1930 was 9,935; in 1940 it was 11,738. The city is surrounded by a fine farming region. Its manufactures include leather, textiles, lumber, handles, iron castings, transmission, metal furniture, radios, auto parts, meat packing and diesel engines.

COLUMBUS, a city of northeastern Mississippi, U.S.A., on the Tombigbee river, near the Alabama state line; the county seat of Lowndes county. It is on federal highways 45 and 82, and is served by the Columbus and Greenville, the Mobile and Ohio, the Southern and the Frisco railways. The population in 1930 was 10,743, and was 13,645 (51·2% Negroes) in 1940 by the federal census. The city ships cotton, hay, cattle and hardwood lumber; has a large floral industry; and the output of its cotton and lumber mills, veneer and brick plants, marble works and other manufacturing industries was valued in 1939 at $3,330,000. The dairy industry is developing rapidly; three large cheese factories began operations in the county early in 1928. The Mississippi State college for women (enrolment, 1,140 in 1941) was established there in 1884.

At Starkville, 25 mi. W., is the Mississippi state college.

De Soto in 1540 crossed the Tombigbee river near the site of Columbus. The land was ceded to the United States by the Choctaw Indians in 1816, and the first log cabin was built in 1817. In 1821 the city was incorporated, and Franklin academy, the first free public school in the state, was established. During the Civil War the Confederate government maintained a large arsenal there, and in 1864 the city was for a short time the capital of the state. After the battle of Shiloh it was a hospital centre. About 1,500 soldiers were buried in Friendship cemetery, where on the first "decoration day" (April 25, 1866) the women of Columbus inaugurated the custom of placing flowers on northern and southern graves alike.

COLUMBUS, a city of eastern Nebraska, U.S.A., on the Loup river, just above its junction with the Platte, 87 mi. W. of Omaha; the county seat of Platte county. It is at the intersection of the Lincoln and the Meridian transcontinental highways, and is served by the Union Pacific and the Burlington railways. The population in 1930 was 6,898; in 1940 it was 7,632 by the federal census. It is the centre of a fertile farming region that raises corn, wheat, alfalfa, hogs, cattle and poultry, and has several factories. The city was founded about 1857.

COLUMBUS, the capital of Ohio, U.S.A., near the centre of the state, at the confluence of the Scioto and the Olentangy rivers; a port of entry and the county seat of Franklin county. It is on federal highways 23, 33, 40 and 62; has three airports; and is served by the Baltimore and Ohio, the Chesapeake and Ohio, the New York Central, the Norfolk and Western and the Pennsylvania railways and by two transcontinental air lines, American Airlines and Transcontinental & Western Air. The area is 39·5 sq.mi. The population in 1940 was 306,087. The city lies on a level plain. The state house, constructed between 1839 and 1859 at a cost of $1,400,000, is a dignified building in Doric style (304 by 184 ft., with a rotunda 158 ft. high) of gray limestone from a local quarry, set in a square of ten acres. On the Scioto river, near the capitol, a civic centre development includes these structures: city hall, American Insurance Union Citadel (the city's tallest skyscraper, 555·5 ft.), City Safety building, U.S. post office and court house, Ohio departments of state building, Central high school and Columbus auditorium. The centre flanks a graceful bend of the Scioto for a distance of three city blocks. A planning commission was created in 1920, and zoning ordinances are in force. The water supply is obtained from the Scioto river by means of the Griggs dam (1904–05) and the O'Shaughnessy dam (1922–24), impounding respectively 1,500,000,000 and 5,000,000,000 gallons. Both dams are in parklands of great beauty owned by the city. Filtering and softening plants and a municipal electric-light plant were completed in 1908. Natural gas is available from the fields of eastern Ohio. The city has 81 public and 24 parochial schools; libraries aggregating 1,500,000 volumes to which the public has access; 540 mi. of paved streets; 806 mi. of sewers; 11 hospitals; three municipal markets; and 1,200 ac. in public parks. The state fairgrounds of 150 ac. are just 2½ mi. from the centre of the city. Columbus is the seat of the Ohio State university, of Capital university (1850) including the Evangelical Lutheran theological seminary, of the state penitentiary and of state institutions for the insane, the feeble-minded, the blind and the deaf. There are three daily papers, including the *Ohio State Journal* (estab. 1811), which is widely known throughout the country. The private philanthropic agencies of the city are financed jointly through a "community fund," with an annual budget of over $600,000. Columbus is the home of Battelle Memorial institute, one of the world's largest research agencies, and several other organizations conducting research in metallurgy, fuels, ceramics, business and agriculture. The city's assessed valuation of property in 1940 was $369,637,850.

Ohio State university occupies a beautiful campus 3 mi. N. of the state house. Its campus and farm cover 1,400 ac., and the total value of its plant is more than $25,000,000. Its magnificent stadium (opened in 1922), in a 92 ac. tract on the bank of the Olentangy, covers 10 ac. and has 72,000 seats. Within the city limits is Ft. Hayes (formerly Columbus barracks), which in 1922 became headquarters of the 5th corps area of the U.S. army. In East Columbus, on a reservation of 281 ac., is one of the three general reserve depots of the army.

Columbus has a large trade in coal from the Ohio fields in the neighbourhood, and in wool, livestock, grain and other agricultural products. Its jobbing market serves a territory in which there are 30,000 dealers and 1,622,000 consumers. The manufacturing industries are important and diversified, with an aggregate output in 1937 valued at $169,717,720. Among the leading manufactures are iron and steel products (notably mining machinery and steel railway cars), shoes, glass, teeth, flour, cereal products, caskets, aeroplanes, fire fighting equipment, coated fabrics and agricultural implements. There are several meat-packing plants.

Postal receipts in 1940 amounted to $3,998,284; bank debits to individual accounts in 1940 were $2,164,073,254.

This region was opened to settlement in 1787. In 1797 the first log cabin within the present limits of Columbus was built at Franklinton, on the west bank of the Scioto, which became the county seat when Franklin county was organized in 1803. Through the enterprise of four citizens who offered the general assembly land for a state house and a penitentiary on the higher ground east of the Scioto, that site was chosen for the seat of government, and in 1812 a town was there laid out on the "refugee lands" appropriated by congress for Canadians and Nova Scotians who had sympathized with the colonies in the recent struggle. It was named after Christopher Columbus, because "to him we are primarily indebted in being able to offer the refugees a resting place." The first state house, a plain two-story brick building, was completed in 1814. The borough of Columbus was incorporated in 1816; it became the county seat in 1824; and in 1834, when the population was 3,500, it was incorporated as a city. In 1860 the population was 18,554; in 1880, 51,647; in 1900, 125,560. Franklinton was annexed in 1871, and the area was increased by successive additions of territory in every decade thereafter. The present charter (Jan. 1, 1916) provides for a mayor as executive, a legislative council of seven elected at large, a nonpartisan ballot, the recall of elected officials and the referendum. In the flood of 1913 about 100 lives were lost in Columbus, three bridges were destroyed, more than 4,000 dwellings were flooded and some 20,000 persons were temporarily homeless. As a protection against future floods the channel of the Scioto has been widened and revetments have been built.

COLUMELLA, LUCIUS IUNIUS MODERATUS, of Gades, writer on agriculture, contemporary of Seneca the philosopher, flourished about the middle of the 1st century A.D. His extant works treat of the cultivation of all kinds of corn and garden vegetables, trees, flowers, the vine, the olive and other fruits, and of the rearing of cattle, birds, fishes and bees. They consist of the twelve books of the *De re rustica* (the tenth, which treats of gardening, being in dactylic hexameters in imitation of Virgil), and of a book *De arboribus,* the second book of an earlier and less elaborate work on the same subject.

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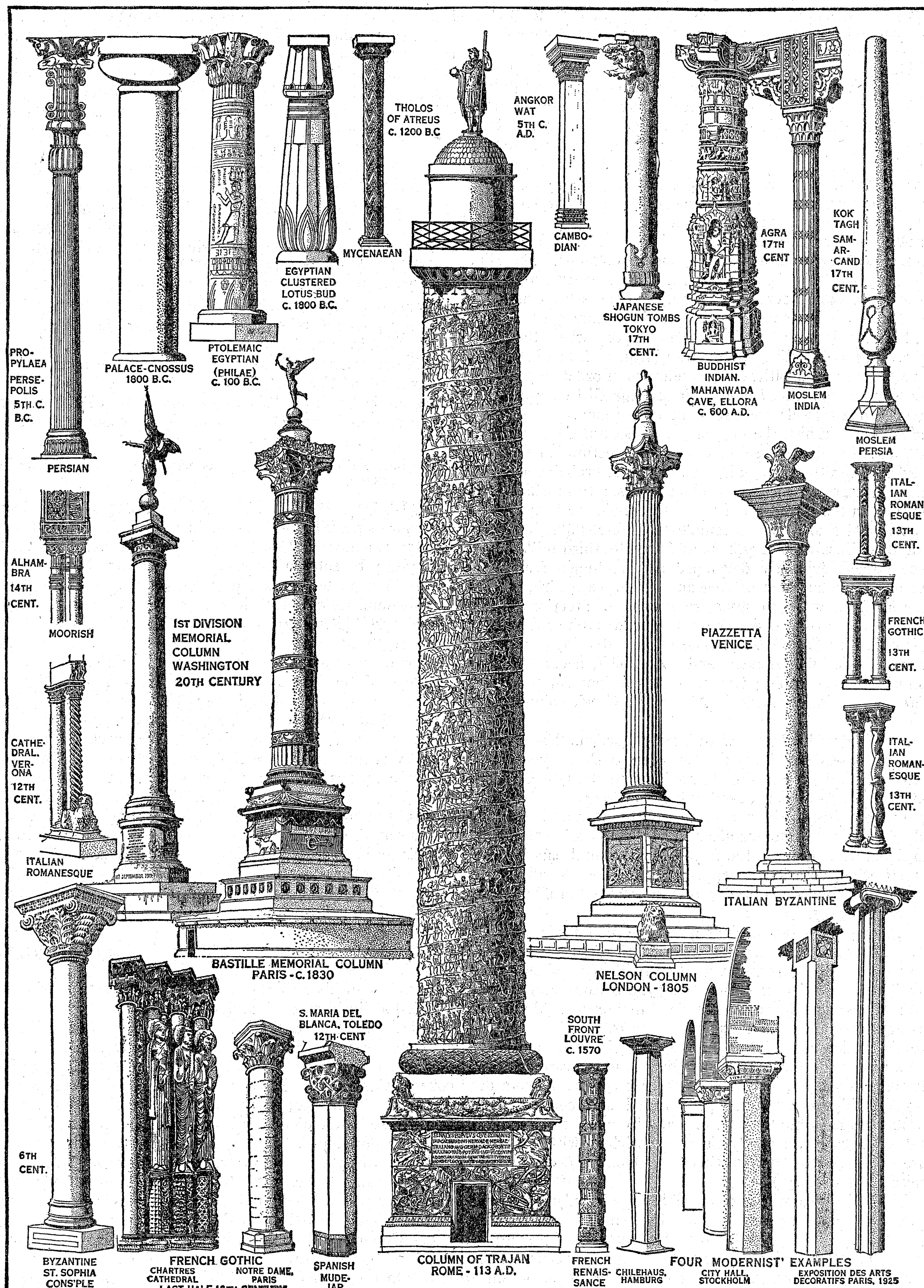

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HISTORICAL DEVELOPMENT OF THE COLUMN FROM ITS ORIGIN IN ANCIENT EGYPT TO MODERN TIMES

Columellae vita et scriptis, by V. Barberet (1887), and G. R. Becher (1897), a compact dissertation with notes and references to authorities. *See* also W. E. Heitland, *Agricola* (Cambridge, 1921).

COLUMN, in architecture, a vertical support, round or polygonal in plan, in contradistinction to a pier (*q.v.*), usually rectangular in plan. Occasionally the word is used for any vertical support. The earliest columns were undoubtedly simple tree trunks; large wooden columns, tapered, with the small end down, were a characteristic feature of the Aegean architecture (*see* WESTERN ASIATIC ARCHITECTURE: § *Knossos,* vol. 23, p. 526), as in the palace at Knossos (*c.* 1500 B.C.); contemporary frescoes show that such columns were common and were used, not only structurally but as cult objects (the Lion Gate at Mycenae, *c.* 1200 B.C., shows two lions flanking such a column). The Hittites, the Assyrians and the Egyptians in their smaller works also used wooden columns for which many stone bases exist. In modern times wooden columns play an important part in the monumental architecture of China and Japan, when they are usually covered with brilliantly coloured lacquer. Stone bases are almost universally used with wooden columns in order to preserve the wood from damp. Those of Assyria and the Hittites are richly decorated. Stone capitals are also sometimes found.

Stone columns furnish the greatest architectural opportunities, however, and they have been favourite architectural motives in many styles. Primitive types of stone columns, probably derived by cutting the corners off square, rock-cut piers, a form which may have resulted in the invention of the flute (*q.v.*), are to be found in the polygonal shafts of the temple at Deir-el-Bahri, and the tombs of Beni Hassan, in Egypt, both from the third millennium B.C. The Greeks evidently developed their columns from two sources; one a modification of Aegean prototypes, which, changing material from wood to stone, reversed the direction of the taper so that the smaller end was up in a growth which gave rise to the Doric order (*see* ORDER). The other a development from Asiatic sources, is more slender, and has a high, decorated base and a much enriched capital (*q.v.*). This development produced the Ionic and Corinthian orders. Almost all Greek columns are fluted.

Etruscan structural columns were largely wooden. The decorative representations remaining in stone tombs show types both Greek and Oriental. Under the Roman empire the Greek orders were much used and further developed, but owing to the fact that the shafts were frequently marble monoliths, fluting was often omitted. Renaissance columns generally follow classic precedent, but additional decoration, in the form of ornamental banding and heavy rustication, occasionally appears. The taper of all classic and Renaissance columns is produced with a curved profile known as the entasis (*q.v.*).

Although most columns thus far noted are monolithic, or built with drums (horizontal stones the entire width of the column, set one above the other), columns were often built of small stones or brick, and in the mediaeval period this type became almost universal. Small columns, however, remained monolithic. Mediaeval columns are generally without taper or entasis.

In Mohammedan countries columns follow either Byzantine or classic tradition, with, however, many changes in the capitals. But in India there is a separate and characteristic type of column design. Indian columns are extremely varied and complex, and much broken up horizontally and vertically by many small mouldings and sinkages, occasionally further enriched with fantastic sculpture. (*See* BASE, CAPITAL, ENTASIS, ORDER and the articles on Architectural History.) (T. F. H.)

COLUMNIST, one who is responsible for a stipulated amount of writing, humorous or semi-serious in character, on a daily newspaper. Originally this material was confined to the editorial page as a relief from its serious nature, but it now occurs in the sports section, if the writer's trend is in that direction, or on a page devoted to various types of feature writing. The columnist may do all his own writing or he may depend to a greater or less extent upon contributors, in which case he acts as editor of the column. In either case he maintains a running commentary on contemporary life. He attacks its shams and hypocrisies and especially the individuals who best epitomize them, and in so doing has a variety of tools at his disposal, including jokes, jingles, light verse, short editorials, paragraphs, anecdotes, humorous mottoes, reminiscences and short essays. He may be obviously humorous, subtly so, cynical or satirical or any combination of these, but the result must be entertaining; his own personality must always shine through and his personal bias be apparent. Since the success of the column depends upon the utter freedom of expression of the writer he escapes the ordinary editorial restrictions.

COLURE, in astronomy, either of the two principal meridians of the celestial sphere, one of which passes through the poles and the two solstices, the other through the poles and the two equinoxes; hence designated as *solstitial colure* and *equinoctial colure,* respectively. (From Gr. *κόλος,* shortened, and *οὐρά,* tail).

COLUTHUS or **COLLUTHUS,** of Lycopolis in the Egyptian Thebaid, Greek epic poet, flourished during the reign of Anastasius I. (491-518). According to Suidas, he was the author of *Calydoniaca* (probably an account of the Calydonian boar hunt), *Persica* (an account of the Persian wars), and *Encomia* (laudatory poems). These are all lost, but his poem in some 400 hexameters on *The Rape of Helen* was discovered by Cardinal Bessarion in Calabria. It is a poor imitation of Homer. It related the history of Paris and Helen from the wedding of Peleus and Thetis down to the elopement and arrival at Troy.

The best editions are by Van Lennep (1747), G. F. Schäfer (1825), E. Abel (1880).

COLVIN, JOHN RUSSELL (1807–1857), lieutenant-governor of the North-West Provinces of India during the mutiny of 1857, was born in Calcutta on May 29, 1807. Passing through Haileybury he entered the service of the East India Company in 1826. In 1836 he became private secretary to Lord Auckland, and his influence over the viceroy has been held partly responsible for the first Afghan war of 1837; but it has since been shown that Lord Auckland's policy was dictated by the secret committee of the company at home. In 1853 Colvin was appointed lieutenant-governor of the North-West Provinces by Lord Dalhousie. On the outbreak of the mutiny in 1857 he had with him at Agra only a weak British regiment and a native battery, too small a force to make head against the mutineers. A proclamation which he issued was censured at the time for its clemency, but it followed the same lines as those adopted by Sir Henry Lawrence and subsequently followed by Lord Canning. Exhausted by anxiety and misrepresentation he died on Sept. 9, just before the fall of Delhi.

His son, SIR AUCKLAND COLVIN (1838–1908), followed him in a distinguished career in the same service, from 1858 to 1879. He was comptroller-general in Egypt (1880–82), and financial adviser to the khedive (1883–87), and from 1883 till 1892 was back again in India, first as financial member of council, and then, from 1887, as lieutenant-governor of the North-West Provinces and Oudh. He was created K.C.M.G. in 1881 and K.C.S.I. in 1892, when he retired. He published *The Making of Modern Egypt* in 1906, and a biography of his father, in the "Rulers of India" series, in 1895. He died at Surbiton on March 24, 1908.

COLVIN, SIR SIDNEY (1845–1927), English literary and art critic, was born at Norwood, London, on June 18, 1845, and died on May 11, 1927. He was scholar and then fellow of Trinity college, Cambridge. In 1873 he was elected Slade professor of fine art at Cambridge; he was four times re-elected, and from 1876 to 1884 was director of the Fitzwilliam museum. From the date of his fellowship in 1868 onwards he had contributed many articles to the reviews and to the *Encyclopædia Britannica* on the fine arts. In 1873 he met Robert Louis Stevenson, and formed a friendship which endured until Stevenson's death. The story of this friendship is told in the *Vailima Letters,* which appeared under Colvin's editorship in 1890. Colvin also edited the Edinburgh edition of Stevenson's works and two further volumes of letters in 1895 and 1911. In 1884 he was appointed keeper of the prints and drawings in the British museum. In addition to the reorganization of the system, which made the rich collections of the museum more readily available to students and to the general public, he arranged for the acquisition of numerous precious collections before their value was generally realized. He was knighted on his retirement in 1921.

Among his works are: *Landor* (1881); *Keats* (1887); *Early History of Engraving in England* (1905); *Memories and Notes* (1921).

See E. V. Lucas, *The Colvins and Their Friends* (1928).

COLWYN BAY, municipal borough, Denbighshire, Wales, on the Irish sea, 40½ mi. W.N.W. of Chester by the L.M.S.R. Pop. (est. 1938) 21,240. Area, 9.6 sq.mi. The town grew rapidly after 1918, until it became virtually continuous with Old Colwyn and Rhos-on-Sea, with which it is linked by a promenade 3 mi. long. It is a seaside resort and a centre for excursions in north Wales. It was incorporated in 1934. Many local beauty spots are corporation property. To the southeast (2½ mi.) is Llanelian-yn-Rhos, famous for its "cursing well" (*Ffynnon Elian*). The name Colwyn is that of the lords of Ardudwy, the narrow tract of country between the mountains and the sea in west Merionethshire.

COLY, a small group of African birds about 12 in. long, with crested heads, finchlike bills, short, rounded wings and long tails. The six species are all included in the genus *Colius,* which constitutes the peculiar order Coliiformes and family Coliidae. They are somewhat related to trogons and swifts (*qq.v.*). They are often called mousebirds, probably from their habit of creeping along the boughs of trees with the whole tarsus applied to the branch. They generally have a dun or slate-coloured plumage that sometimes brightens into blue or is diversified with white or chestnut. All toes are ordinarily directed forward, and it is reported that they sleep hanging upside down. They feed almost wholly on the fruits, but occasionally take insects. All the species belong to the Ethiopian region. There are six species. The commonest is *C. striatus,* with some 16 races, ranging from Ethiopia to Capetown and west to northern Nigeria and the lower Congo; *C. macrourus* occurs in thornbrush and semiarid country from Senegal to Ethiopia, south to Tanganyika; *C. indicus* is found throughout South Africa; *C. colius,* in western South Africa; the other two species occur in Angola and Kenya. (G. F. Ss.)

COLZA OIL, a nondrying oil obtained from the seeds of *Brassica campestris,* var. *oleifera,* a variety of the plant which produces Swedish turnips. Colza is extensively cultivated in France, Belgium, the Netherlands and Germany; and, especially in the first-named country, the expression of the oil is an important industry. In commerce colza is classed with rape oil, to which both in source and properties it is very closely allied. It is a comparatively inodorous oil of a yellow colour, having a specific gravity varying from 0.912 to 0.920. The cake left after expression of the oil is a valuable feeding substance for cattle. Colza oil is extensively used as a lubricant for machinery and for burning in lamps.

COMA, in medicine, a complete and prolonged loss of consciousness from which a patient cannot be roused. There are various degrees: in the slighter forms the patient can be partially roused only to relapse again into a state of insensibility; in the deeper states, the patient cannot be roused at all. Coma may arise abruptly from: (1) concussion, compression or laceration of the brain from head injuries, especially fracture of the skull; (2) alcoholic and narcotic poisoning; (3) cerebral haemorrhage, embolism and thrombosis. It may also supervene in diabetes, uraemia, general paralysis, meningitis, sleeping and sleepy sickness, cerebral tumour and acute yellow atrophy of the liver. The depth of insensibility to stimulus is a measure of the gravity of the symptom; thus the conjunctival reflex and even the spinal reflexes may be abolished, the only sign of life being the respiration and heartbeat. A characteristic change in respiration known as Cheyne-Stokes breathing occurs prior to death in some cases. *Coma Vigil* is a state of unconsciousness met with in the algide stage of cholera and some other exhausting diseases. The patient's eyes remain open, and he may be in a state of low muttering delirium.

The word "coma" which is used in astronomy for the envelope of a comet and in botany for a tuft, though spelled the same in English, is derived from a different Greek word.

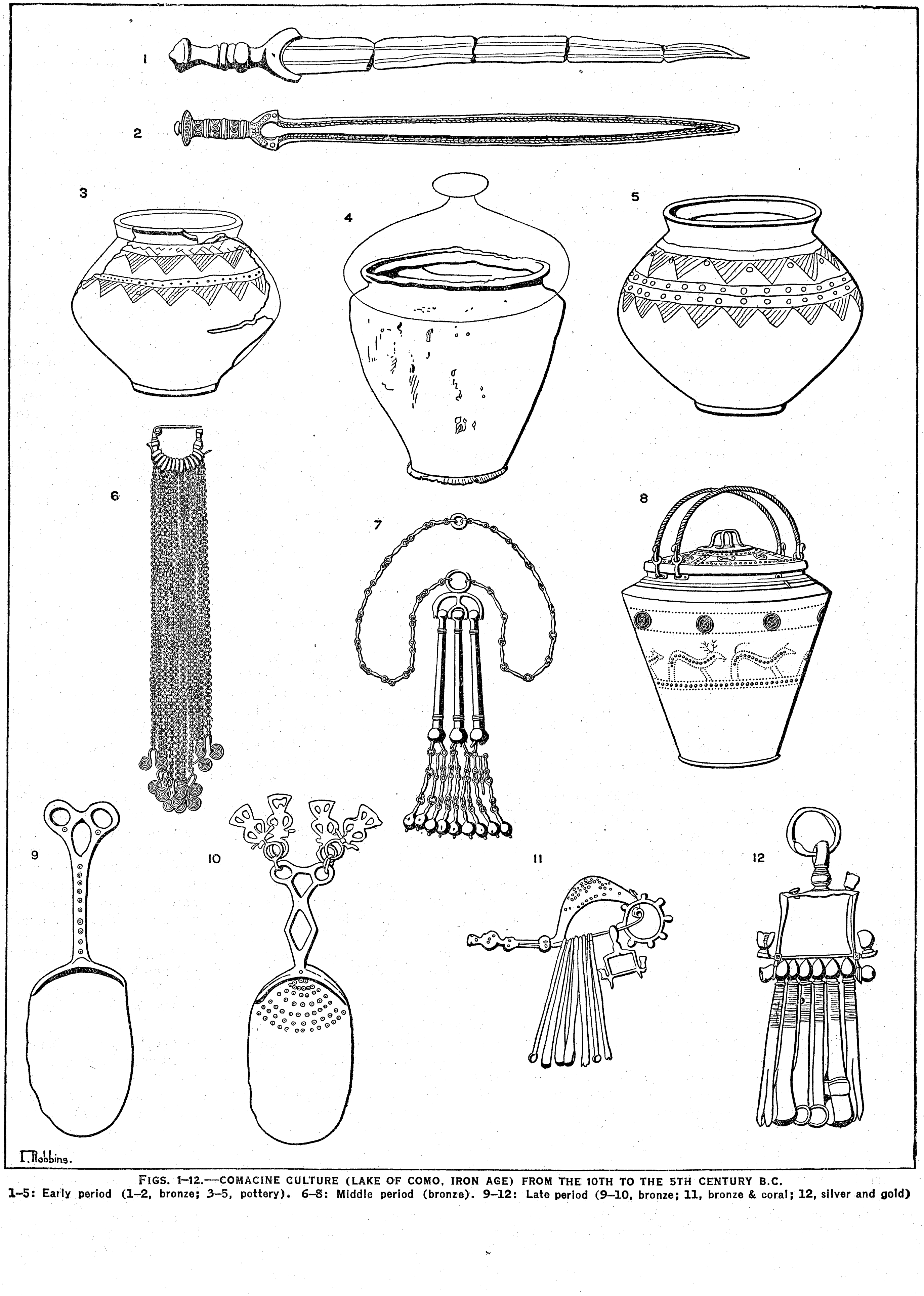
COMA BERENICES ("Berenice's hair"), in astronomy, a constellation of the northern hemisphere; it was first mentioned by Callimachus, and Eratosthenes (3rd century B.C.), but is not included in the 48 asterisms of Ptolemy.

COMACCHIO, a town of Emilia, Italy, province of Ferrara, 30 mi. E.S.E. by road from the town of Ferrara, on the level of the sea, in the centre of the lagoon of Valli di Comacchio, just north of the present mouth of the Reno. Population (1936) 9,141 (town); 13,894 (commune). It is built on 13 different islets, joined by bridges, and its industries are fisheries and saltworks. Comacchio appears as a city in the 6th century, a fortress owing to its central position in the centre of the lagoons. It was included in the "donation of Pippin"; it was taken by the Venetians in 854, but afterward came under the archbishops of Ravenna; in 1299 it came under the house of Este. In 1597 it was claimed by Clement VIII as a vacant fief. *See* also SPINA.

COMACINES, THE, may be defined as the people who lived in the Iron Age all round the Lake of Como, and on the adjoining lakes of Lugano and Varese. They are close relatives of the Golasecca tribes near Lago Maggiore but show some points of difference from them (*see* GOLASECCA). The records for the Como region begin much earlier than for the Somma plateau on the Ticino. At Malgesso near Varese, and at Albate, Moncucco, San Fermo and Villa Nessi, four sites clustered at the south end of the Lake of Como, have been found objects which, though few, yet demonstrate that there were settlements here at the very opening of the Iron Age, made by a branch of those cremating peoples who came over the Venetian Alps in successive waves between 1200 and 1000 B.C., and who must be judged on this evidence to have found their way into Lombardy as early as into any other region. Their march westward was probably by way of the Val di Sole and the Valtellina. They buried, like the Villanovans and all the other cremating invaders, in pottery jars, which contained the ashes of the deceased and a few small objects or personal ornaments. Weapons and larger objects might be placed adjoining the jar, which was often enclosed in a shelter of rough slabs as shown in fig. 13. The archaeology of the Iron Age in the region of Como and Varese falls into three well-defined periods. From the 12th century to about 750 B.C. is the Early period, contemporary with the two Benacci stages of Bologna. The Middle period is the correlative of the Arnoaldi period of Bologna, equivalent to the Golasecca civilization of 750 to 500 B.C.; and the Late period runs from 500 B.C. down to the Gaulish invasions of the 4th century. A fair amount of material representative of all this time has been discovered and chronicled by local archaeologists, whose records have been published for the last 50 years in the *Rivista archeologica della provincia di Como*. So far as the objects have been collected in any one place they may be seen in the municipal museum of the town of Como.

In the Early period, represented by the cemeteries of Moncucco, Villa Nessi and San Fermo, very archaic *fibulae* have been found which can hardly be later than the 12th century B.C., of types familiar in other parts of Italy at Pianello, Timmari and Bismantova. A certain number of the Comacines had thus arrived at their new homes simultaneously with the establishment of the earliest Villanovans in Etruria and Latium. The ossuary employed for burial was, however, not the Villanovan urn but a pottery *situla* or spherical *olla,* as seen in Nos. 3–5 of the plate. All the pottery of this stage is of the rough hand-made style seen in these examples, often incised with bands and chevrons formed by rows of dots. Apart from pottery, the most important objects of the Early period are the weapons, particularly the bronze swords. All belong to types which must have been imported from north of the Alps. There was one instance of the antennae-handled sword, well known as a transalpine product, which occurs on a number of different sites in north Italy as well as in Etruria. More remarkable than this, however, are the examples figured as Nos. 1 and 2 in the plate, which are not familiar elsewhere in Italy. No. 2, a famous sword from Bernate near Como, is a definitely Hungarian model, which may be matched by one lately found at Sondrio in the Valtellina and another from Serravalle near the Ticino. Another foreign type is No. 1, from Moncucco, closely resembling a sword found at Colico on the northern edge of the Lake of Como.

To the Middle Comacine period of 750 to 500 B.C. belong a few graves at Rebbio and Albate, as well as sporadic finds from sites nearer to the Po; but the principal material is derived from 40 graves at Valtravaglia, situated on Lago Maggiore though belonging by its affinities rather to the Varese district than to Golasecca. The pottery of Valtravaglia, exhibited in the museum of Como, has a misleading appearance, for it looks exceedingly primitive, being hand-made and incised with simple geometrical patterns. The ossuaries were of the *olla* shape with resemblance to Golasecca forms, as well as to those of Moncucco; *fibulae* were of unmistakable forms of the 7th and 6th centuries; weapons were completely absent. Ornamental art of the Middle period is well exemplified by the ribbed *fibula* with hanging chains, the



FIGS. 1–12.—COMACINE CULTURE (LAKE OF COMO, IRON AGE) FROM THE 10TH TO THE 5TH CENTURY B.C.
1–5: Early period (1–2, bronze; 3–5, pottery). **6–8:** Middle period (bronze). **9–12:** Late period (9–10, bronze; **11**, bronze & coral; **12**, silver and gold)

necklace of bronze chains with poppyhead pendants, and the engraved *situla,* all shown in the plate. This *situla* was found on the Adda at Trezzo a little east of Monza. Its *pointillé* technique and the style of the animal-drawing are closely comparable to the rude art of the Sesto Calende *situla* (*see* GOLASECCA).

The Late Comacine period is considerably influenced by the Etruscans, whose products began to penetrate into the Lake region about 500 B.C., before which time they were quite unknown there. Bronze palettes such as those shown in Nos. 9 and 10 of the Plate are an Etruscan invention; they were used for shifting the ashes and placing the incense on the sacrificial fire. A gaudy set of manicuring implements on a chatelaine of massive silver picked out with gold (No. 12) is of late Etruscan origin, and a complete series of Etruscan objects was found at Rondineto. Many of the *fibulae,* however, are different from the Etruscan and the Bolognese, belonging to types peculiarly characteristic of the Lake region, many of which are found also in the Italian-speaking Swiss canton of Ticino. No. 11 is a good example of a very popular form.

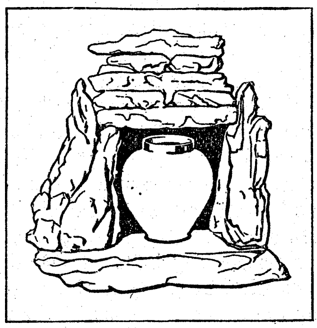


FIG. 13.—PLAN OF A TOMB AT MONCUCCO

Closely connected with the Comacine civilization is that of the

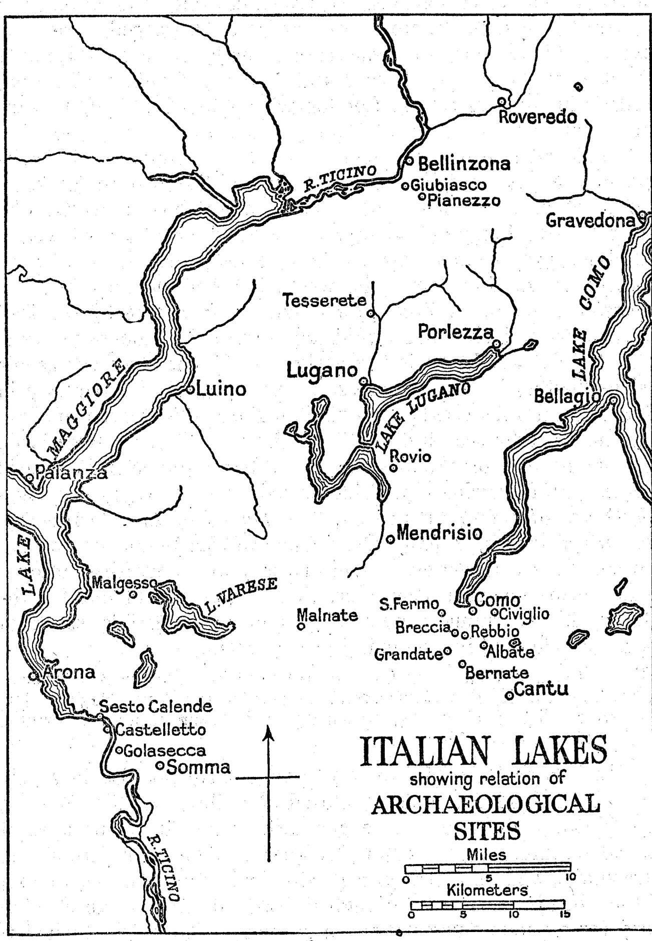


FIG. 14

Canton Ticino as seen in a group of cemeteries clustering about Bellinzona. The burial-rite is inhumation, which has led some authors to regard these people as Ligurian colonists from the western plain of the Po. They exploited their geographical position at the opening of the principal pass then in use, which was not the St. Gotthard but the Val di Mesocco, to become the porters and carriers of a transport service between northern Italy and the head-waters of the Rhine. Through their mediation Etruscan, Greek, Bolognese and Venetian products found their way to Switzerland, western Germany, France, Belgium and even England. Being of a peaceful disposition, these Ligurians possessed no weapons, but they were well provided with ornaments and other objects showing a high standard of luxury. Many of these were obtained from their clients on either side of the Alps, but a certain number were produced locally. In particular the Ticinese developed a primitive but independent style of metal-work, shown at its best in their bronze girdles. These barbaric objects contrast curiously with the sophisticated bronze vessels of Campanian workmanship found in the same graves. The Bellinzona cemeteries begin about 600 B.C. and continue down to the Roman empire. It is to be observed that the Early La Tène (*q.v.*) period 500 to 300 B.C. is free of all Gaulish influence, but the middle La Tène which succeeds this is entirely Gaulish in character.

D. Randall-MacIver, *The Iron Age in Italy,* gives the few original authorities. (D. R.-M.)

COMANA, a city of Cappadocia (frequently called CHRYSE or AUREA, *i.e.,* the golden, to distinguish it from Comana in Pontus; mod. *Shahr*), celebrated in ancient times as the place where the rites of Mā-Enyo, a variety of the great west Asian Nature-goddess, were celebrated with much solemnity. The service was carried on in a sumptuous temple with great magnificence by many thousands of *hierodouloi* (temple-servants). To defray expenses, large estates had been set apart, which yielded a more than royal revenue. The city, a mere apanage of the temple, was governed immediately by the chief priest, who was always a member of the reigning Cappadocian family, and took rank next to the king. The number of persons engaged in the service of the temple, even in Strabo's time, was upwards of 6,000, and among these, to judge by the names common on local tombstones, were many of Persian race. Under Caracalla, Comana became a Roman colony, and it received honours from later emperors down to the official recognition of Christianity. The site lies at Shahr, a village in the Anti-Taurus on the upper course of the Sarus (Sihun), mainly Armenian, but surrounded by new settlements of Avshar Turkomans and Circassians. The place has derived importance both in antiquity and now from its position at the eastern end of the main pass of the western Anti-Taurus range, the Kuru Chai, through which passed the road from Caesarea-Mazaca (mod. *Kaisarieh*) to Melitene (Malatia), converted by Septimius Severus into the chief military road to the eastern frontier of the empire. The extant remains at Shahr include a theatre on the left bank of the river, a fine Roman doorway and many inscriptions; but the exact site of the great temple has not been satisfactorily identified. There are many traces of Severus' road, including a bridge at Kemer, and an immense number of milestones, some in their original positions, others in cemeteries.

BY COURTESY OF THE SMITHSONIAN INSTITUTION

COMANCHE INDIAN OF THE SHOSHONEAN STOCK

See P. H. H. Massy in *Geog. Journ.* (Sept. 1905); E. Chantre, *Mission en Cappadocie* (1898). (D. G. H.)

COMANA, an ancient city of Pontus, said to have been colonized from Comana in Cappadocia, standing on the river Iris (Tozanli Su or Yeshil Irmak). The moon-goddess was worshipped in the city with a pomp and ceremony in all respects analogous to those employed in the Cappadocian city. The slaves attached to the temple alone numbered not less than 6,000. Some slight remains of Comana are still to be seen near a village called Gumenek on the Tozanli Su, 7 m. from Tokat.

COMANCHE, a Plains Indian tribe, close relatives of the Wind River Shoshone of Wyoming. They ranged from this State south-westward into Texas, were active raiders, penetrating into Mexico, and fought the Mexicans, Texans and various tribes consistently. They were among the most nomadic of bison-hunting

Indians. In the historic period their affiliation has been closest with the Kiowa. There remain 1,600 on a reservation in Oklahoma.

COMAYAGUA, a city and former capital of Honduras, Central America, now the capital of the department of Comayagua. Population (1940) 4,758; at one time (1827) it had a population of about 18,000 people. The city lies on the right bank of the Humuya river in a fertile valley 32 mi. long by 16 mi. wide, and is distant from the capital, Tegucigalpa (*q.v.*), about 70 mi. by road. It lies on the line of the proposed transcontinental railway, but, what is more important at the present time, on the highway from Tegucigalpa to the north coast, a route which includes a boat trip across Lake Yojoa to Portrerillos (about 100 mi. from Comayagua), the inland terminus of the National railway. Comayagua boasts a handsome cathedral, dating from 1715, and other public buildings of the colonial era which have fallen into disrepair. The town was founded originally in 1540, with the name of Valladolid la Nueva, by Alonso de Cáceres, under instructions from the Spanish government to found a town midway between the two oceans. The new town soon afterwards became the capital of the province of Honduras, was given the rank of a city in 1557 and became the site of an episcopal see in 1561. In 1827 it was burned by the revolutionaries, suffered from various subsequent battles and in 1880 Tegucigalpa was made the capital.

COMAYAGÜELA, the twin city of Tegucigalpa (*q.v.*), capital of Honduras, from which it is separated only by a narrow river. Comayagüela is to be distinguished from Comayagua (*q.v.*).

COMB. A toothed toilet implement used for cleaning and arranging the hair, and also for holding it in place after it has been arranged; the word is also applied, from resemblance in form or in use, to various appliances employed for dressing wool and other fibrous substances, to the indented fleshy crest of a cock, and to the ridged series of cells of wax filled with honey in a beehive. Hair combs are of great antiquity, and specimens made of wood, bone and horn have been found in Swiss lake-dwellings. Among the Greeks and Romans they were made of boxwood, and in Egypt also of ivory. For modern combs the same materials are used, together with others such as tortoise-shell, metal, india-rubber and celluloid.

There are two chief methods of modern manufacture. A plate of the selected material is taken of the size and thickness required for the comb, and on one side of it, occasionally on both sides, a series of fine slits are cut with a circular saw. This method involves the loss of the material cut out between the teeth. The second method, known as "twinning" or "parting," avoids this loss and is also more rapid. The plate of material is rather wider than before, and is formed into two combs simultaneously, by the aid of a twinning machine. Two pairs of chisels, the cutting edges of which are as long as the teeth are required to be and are set at an angle converging towards the sides of the plate, are brought down alternately in such a way that the wedges removed from one comb form the teeth of the other, and that when the cutting is complete the plate presents the appearance of two combs with their teeth exactly dovetailing into each other. In india-rubber combs the teeth are moulded to shape and the whole hardened by vulcanization.

COMBACONUM or **KUMBAKONAM,** a city of British India, in the Tanjore district of Madras, in the delta of the Cauvery, on the South Indian railway, 194 m. from Madras. Pop. (1941) 67,008. The city is historically interesting as the capital of the Chola race, an old Hindu dynasty, from whom the whole coast of Coromandel, or Cholamandal, derives its name. It has a notable *gopuram,* or gate pyramid, rising to a height of 100 ft. and ornamented with stucco figures. One of its water tanks is traditionally connected with the Ganges by a subterranean passage and as such forms a centre for pilgrims. Brass and other metal wares, silk and cotton cloth and sugar are manufactured here.

COMBE, GEORGE (1788–1858), Scottish phrenologist, was born in Edinburgh on Oct. 21, 1788. After attending Edinburgh high school and university he entered a lawyer's office in 1804, and in 1812 began to practise on his own account. In 1817 his first essay on phrenology was published in the *Scots Magazine;* these and other papers were published in 1819 in book form as *Essays on Phrenology,* which in later editions became *A System of Phrenology.* In 1820 he helped to found the Phrenological Society, which in 1823 began to publish a *Phrenological Journal.* By his lectures and writings he attracted public attention to the subject on the continent of Europe and in America, as well as at home; and a long discussion with Sir William Hamilton in 1827–28 excited general interest.

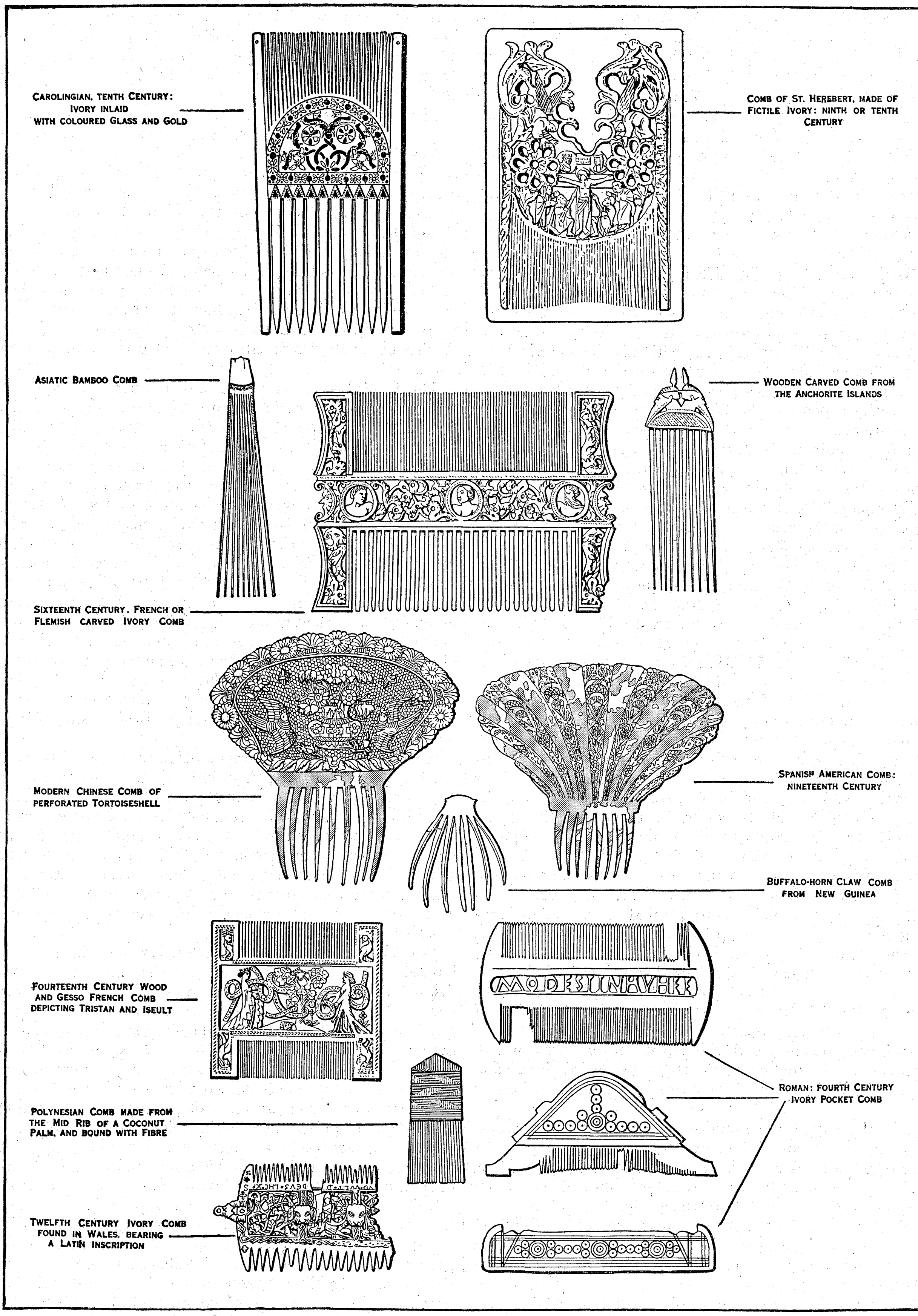
His most popular work, *The Constitution of Man,* was published in 1828. In 1838 he visited America and spent about two years lecturing on phrenology, education and the treatment of the criminal classes. On his return in 1840 he published his *Moral Philosophy,* and in the following year his *Notes on the United States of North America.* In 1842 he delivered, in German, a course of 22 lectures on phrenology in the university of Heidelberg, and he travelled much in Europe, enquiring into the management of schools, prisons and asylums. He married in 1833 Cecilia Siddons, a daughter of the great actress. He was engaged in revising the ninth edition of *The Constitution of Man* when he died at Moor Park, Farnham, on Aug. 14, 1858.

COMBE, WILLIAM (1741–1823), English writer, the creator of "Dr. Syntax," was born in Bristol in 1741. He was educated at Eton, where he was contemporary with Charles James Fox, the 2nd Baron Lyttelton, and William Beckford. William Alexander, a London alderman and his reputed father, bequeathed him some £2,000 (a little fortune that soon disappeared in a course of splendid extravagance which gained him the nickname of Count Combe) and after a chequered career as private soldier, cook and waiter, he finally settled in London (about 1771), as a law student and bookseller's hack. In 1776 he made his first success in London with *The Diaboliad,* a satire full of bitter personalities. Four years afterwards (1780) his debts brought him into the King's Bench; and much of his subsequent life was spent in prison. Periodical literature of all sorts (pamphlets, satires, burlesques, "two thousand columns for the papers," "two hundred biographies,") filled up the next years, and about 1789 Combe was receiving £200 yearly from Pitt, as a pamphleteer. In 1809–11 he wrote for Ackermann's *Political Magazine* the famous *Tour of Dr. Syntax in search of the Picturesque* (descriptive and moralizing verse of a somewhat doggerel type), which, owing greatly to Thomas Rowlandson's designs, had an immense success. It was published separately in 1812 and was followed by two similar *Tours,* "in search of Consolation," and "in search of a Wife," the first Mrs. Syntax having died at the end of the first *Tour.* Then came *Six Poems* in illustration of drawings by Princess Elizabeth (1813), *The English Dance of Death* (1815–16), *The Dance of Life* (1816–17), *The Adventures of Johnny Quae Genus* (1822)—all written for Rowlandson's caricatures. In his later years, notwithstanding a by no means unsullied character, Combe was sought out for the sake of his charming conversation and inexhaustible stock of anecdote. He died in London, June 19, 1823.

Brief obituary memoirs of Combe appeared in Ackermann's *Literary Repository* and in *The Gentleman's Magazine* for Aug. 1823; and in May 1859 a list of his works, drawn up by his own hand, was printed in *The Gentleman's Magazine.*

COMBE or **COOMB,** a term particularly popular in south-western England for a short closed-in valley, either inland on the side of a down or, more generally, when it forms a small coastal feature. It appears in place-names as a termination, *e.g.,* Ilfracombe, and as a prefix, *e.g.,* Combemartin. The etymology of the word is uncertain; in English *combe* or *cumb* is an obsolete word for a "hollow vessel," and a similar meaning is attached to the Teutonic forms *kumm* and *kumme.* The Welsh *cwm,* in place-names, means hollow or valley, and may be compared with *cum* in several Cumbrian and Scots place-names. The Greek κύμβη also means a hollow vessel, and there is a French dialect word *combe* meaning a little valley.

COMBERMERE, STAPLETON COTTON, 1ST VISCOUNT (1773–1865), British field-marshal and colonel of the 1ST Life Guards, was the second son of Sir Robert Salusbury Cotton



BY COURTESY OF THE DIRECTOR OF THE VICTORIA AND ALBERT MUSEUM, LONDON AND THE TRUSTEES OF THE BRITISH MUSEUM

COMBS OF VARIOUS COUNTRIES RANGING IN DATE FROM THE 4TH CENTURY ONWARDS of Combermere Abbey, Cheshire, and was born on Nov. 14, 1773, at Llewenny Hall in Denbighshire. He was educated at Westminster school, and when only 16 obtained a second lieutenancy in the 23rd regiment (Royal Welsh Fusiliers). He served in Cape Colony (1796), India (1797–1800), Ireland (1800), and in the Peninsula (1808–1812). He commanded Wellington's cavalry in Portugal, and fought at Salamanca (1812). His career of active service was concluded in India (1826), where he besieged and took Bhurtpore. For this service he was created Viscount Combermere. In 1855 he was made a field-marshal and G.C.B. He died at Clifton on Feb. 21, 1865.

See Viscountess Combermere and Capt. W. W. Knollys, *The Combermere Correspondence* (1866).

COMBES (JUSTIN LOUIS), ÉMILE (1835–1921), French statesman, was born at Roquecourbe, Tarn, on Sept. 6, 1835. He was a doctor by profession, practising at Pons, Charente-Inférieure. In 1885 he was elected to the senate by the department of Charente-Inférieure. He sat with the democratic Left. On Nov. 3, 1895, he entered the Bourgeois cabinet as minister of public instruction, resigning with his colleagues on April 21 following. He actively supported the Waldeck-Rousseau ministry, and upon its retirement in 1903 he was himself charged with the formation of a cabinet. In this he took the portfolio of the interior, and devoted himself to the struggle with clericalism. The parties of the left in the chamber, united upon this question in the *Bloc republicain,* supported Combes in his application of the law of 1901 on the religious associations, and voted the new bill on the congregations (1904), and under his guidance France took the first definite steps toward the separation of Church and State. The defection of the Radical and Socialist groups induced him to resign on Jan. 17, 1905, although he had not met an adverse vote in the Chamber. He sat in the Briand cabinet of 1915–16 without portfolio. He died on May 25, 1921, at Pons.

COMBINATION IN INDUSTRY. The term combination, in its industrial sense, is used to designate the entire process whereby the competition of rival manufacturers or traders has given place, in the evolution of industry, and is still giving place, to concerted or unified business control and action. The word is not a particularly happy one in this usage, recalling as it does, the Combination laws directed against trade unionism, but no better word has suggested itself as capable of covering every phase of the movement whereby the old type of trade competition disappears and something that is certainly not the old competition appears in its place. The simplest, though not necessarily the least sophisticated, kind of combination is that which occurs where a number of manufacturers or traders, who are rivals in business, meet from time to time and arrive at an "honourable understanding" or "gentlemen's agreement" as to the prices they shall charge or the districts they shall serve. (*See* GENTLEMEN'S AGREEMENT.) These are for the most part casual and always informal.

A more organic form of the same kind of combination is the association of manufacturers or traders for the regulation of prices, output, selling areas, etc. (*See* ASSOCIATIONS, INDUSTRIAL.) These associations are composed of independent business concerns temporarily associated for the particular purpose of limiting competition and are to be distinguished from permanent fusions or mergers.

An intermediate type of combination between the association and the permanent fusion is the profit-pooling agreement under which two or more firms may agree for a term of years to share, in a fixed ratio based upon the pre-agreement profits of the several firms, the combined future profits of the group. From these casual or systematic combinations of independent interests one passes almost insensibly to the various types of consolidation, though in the passage from terminable to permanent combination a great gulf is crossed for only in the most extreme circumstances and in the rarest event will a permanent combination ever again break up into its original components.

"Vertical" and "Horizontal" Combinations.—Permanent combinations are termed consolidations, and of these a distinction may usefully be made between "vertical" consolidations formed of a number of firms engaged in the production of a commodity at various stages of manufacture (*e.g.* coal and iron mining, pig iron, iron and steel, ships); and "horizontal" combinations formed of firms engaged in the same line of manufacture at the same stage of production. From this point the terminology becomes arbitrary and overlapping.

The word "trust," which is used as a popular label for any large business or association of businesses which is suspected of using monopolistic powers, was originally an American form of organization in which "trustees" figured as the controllers and directors of a group of financially centralized enterprises. (*See* TRUSTS for a fuller account and discussion of all kinds of consolidations having monopolistic powers.) In England the term combine is fairly consistently appropriated in popular speech—it seldom if ever appears in the registered title of a company—to horizontal consolidations of firms that were originally of somewhat the same order of importance and which, after their finances are merged and their direction centralized, remain to outward appearances as distinct firms trading under their original names and using their former trademarks.

The Cartel.—Another type of permanent or semi-permanent combination is the cartel, characteristic of but not exclusive to German industrial development (*see* CARTEL), in which the generic idea around which the organization is shaped is frequently the joint selling agency; and yet another manner in which ostensibly competing concerns may be brought under collusive direction is by arrangements under which one or more of the directors of one concern serve on the board of a rival concern and *vice versa.*

"Holding Company."—The particular manner in which a consolidation is effected and afterwards operated gives rise to another range of terminology. "Trust" has already been referred to. "Holding company" is another term in the same class and denotes an arrangement whereby a new limited company is formed to purchase the whole of, or a controlling interest in, the share capitals of each of the companies which are to be merged into one interest. "Absorption" is preferably confined to cases in which a large firm purchases outright a smaller concern, which thereupon disappears as a separate entity, its custom and goodwill passing as far as may be to the purchasing firm.

A very different type of organization from any of the above, yet one that partakes of combination in a reflex sense is the co-operative society (*see* CO-OPERATION) in which consumers associate to establish stores and to a lesser extent factories and workshops from which they can purchase the goods they require, the surplus profits being returned to the members in the shape of dividends on purchases. From the present point of view of concentration and centralized control the co-operative movement must take its place as a part of the general movement from competition towards combinations.

Combinations and the Community.—In the growth of combination as a ruling factor in the conduct of industry and trade, two distinct though related elements may be seen. One is concerted control determining the levels of production and price which were previously the fortuitous resultant of the pursuit of gain by competing individuals; the other is the substitution of a few big businesses for many small businesses and the emergence in the economic field of that concentrated power—over sources of supply, over instruments and processes of production, over the channels of trade, over public policy—that bigness gives. The emergence of conscious control and concentrated financial power in industry has created a new order of problem for the industrial communities of the world, for "the law of demand and supply" can no longer be relied upon to insure that prices and supplies will be about what they ought to be; nor can "the law of struggle and survival" be relied upon to ensure that the industrially more fit will succeed against the industrially less fit. Intelligent control has tremendous advantages over blind struggle if used in the best interests of the producers themselves and the community generally; the problem for the future is whether and how far concerted control and concentrated power will be used aright, and how far it will prove desirable and practicable to control the controllers. For a fuller examination of the social and political problems of combination *see* TRUSTS, also MONOPOLY. (J. H.)

For bibliography, *see* that under TRUSTS.

COMBINATION LAWS, the name given to the British acts of 1799 and 1800, which made trade unionism illegal. Previously combinations of journeymen had only been illegal when, as was frequently the case, parliament had passed special legislation dealing with the organization of the trade, and journeymen's combinations could reasonably be regarded as attempts to interfere with operation of a particular statute. Combinations of workmen to secure the enforcement of such laws (which generally included provisions for the fixing of wage rates) were indeed permissible, and petitions from such combinations were frequently accepted by parliament throughout the first three-quarters of the 18th century. Parliament in addition passed from time to time laws forbidding combinations in particular trades: in 1800, according to Samuel Whitbread, there were 40 such acts. But toward the end of the 18th century, judges began to declare that trade unions were also illegal at common law: and this opinion, together with skilful pressure by employers, led in 1799 to the passing of the first Combination act, which was hurried through all its stages in no more than 24 days. The vigorous protests that it aroused secured the passing of a second act in 1800, but the modifications secured were trifling.

The law, as finally amended, sentenced to three months in jail or to two months' hard labour any working man who combined with another to gain an increase in wages or a decrease in hours, or who solicited anyone else to leave work, or objected to working with any other workman. The sentence was to be given by two magistrates and appeal was forbidden unless "two sufficient sureties in the penalty of £20" were given, which was the more improbable as anyone contributing to the expenses of a person convicted under the act would be fined £10, and the recipient another £5. The removal of a conviction by *certiorari* was forbidden, and defendants could be forced to bear witness against each other. Other clauses forbade employers' combinations, but these were never in any recorded case put into operation. Despite, however, the attractive nature of this act, the employers and the government often preferred to proceed by means of the law against conspiracy, trade unionism being now officially an offense. Thus in 1818 at Bolton two secretaries and the president of a union were sentenced to two and one years of imprisonment respectively for "conspiracy" in calling and attending a meeting of operatives on the request of the employers. In Ireland, according to the evidence given in 1824, the punishments inflicted included public whippings.

The laws were repealed in 1824 as a result of the patient intrigue of the radical tailor, Francis Place (*q.v.*), acting through Joseph Hume, M.P. The repealing bill attracted little attention, and the prime minister, though he supported it, later declared he was ignorant of its contents. The repeal was followed by a rush of strikes and in 1825 an attempt was made to re-impose the acts. This was frustrated by Place's persistent wirepulling and agitation, and the final act of 1825 differed very little from the plain repeal of 1824. The whole story is told by Place, probably with a bias in his favour, in his mss. in the British museum (Add. mss. 27798–9).

See also S. and B. Webb, *History of Trade Unionism* (1898, latest ed. 1920); R. W. Postgate, *The Builders' History* (1923); G. Wallas, *Life of Francis Place* (1925). (R. W. P.)

COMBINATORIAL ANALYSIS. Combinatory analysis is a branch of mathematics dealing with various elementary topics in number theory, algebra, and tactical geometry and extensive developments therefrom. Historically this title includes the beginnings of topics now rightly assigned to number theory, Diophantine analysis, the theory of probability, determinants, group theory, topology, and the theory of aggregates. Even the formulas of the theory of partitions may be included in number theory, and symmetric functions in the theory of forms.

Many of the traditional problems which involve at most the investigation at any stage of a discrete number of possibilities, usually fall under the general designation of combinatorial problems. Among the best developed might be said to be the subjects of triple systems (established on a firm basis by the work of J. Steiner, 1852, and E. H. Moore, 1893); magic squares, Latin squares, the map colouring or four-colour problem, the eight queens problem, the Game of Nim (C. L. Bouton, *Annals of Mathematics,* 2nd ser., vol. i, 1902), unicursal or maze problems, theory of knots, tesselation or parquetry, decimation problems and the Problem of the Virgins. Such subjects as cryptograms, bridge problems, and chess problems, while deeply studied, continue largely unmathematical.

A hint as to the historical sequence (mentioning only conspicuous early investigators) in the development of the elementary fundamental subjects in this field may be afforded by the following bare list: (1) figurate numbers (triangular, square, and polygonal numbers generally, pyramidal, cubic, prismoidal numbers, etc.)—earliest Pythagoreans, Nicomachus (*c.* A.D. 100), Diophantus (*c.* A.D. 250), Pierre de Fermat (1621), J. L. Lagrange and Leonard Euler (1770), K. F. Gauss (1801); (2) the binomial coefficients—reputed Chinese writings of 14th century, Michael Stifel (1544), Henry Briggs (1620), Blaise Pascal (1665), G. W. v. Leibniz (1666), Isaac Newton (1676), John Wallis (1685), Jacques Bernoulli (1713); (3) permutations, combinations, probability—Jacques Bernoulli (1713); (4) symmetric functions—Albert Girard (1629), Abraham de Moivre (1698), Isaac Newton (1707), Edward Waring (1762), Lagrange (1770); (5) determinants—Leibniz (1690), Gabriel Cramer (1750), Lagrange (1773), Gauss (1801), A. L. Cauchy (1815); (6) the application of generating functions to problems in partitions—Euler (1770), N. M. Ferrers (1853), J. J. Sylvester (1882).

Illustrative Examples.—Consider the following simple problem in *permutations* (one of the two traditional uses of the term, here meaning "arrangement"): What numbers of two figures each (in the usual decadic notation) can be formed with the digits, 1, 3, 5, 7? To make the problem precise it must be stated whether repeated use of a digit in the representation of a single number will be permitted. We may obviously form a table as follows:

Tens' digit	1	3	5	7
Units' digit				
1	11	31	51	71
3	13	33	53	73
5	15	35	55	75
7	17	37	57	77

The numbers are all distinct and are clearly $4^2 = 16$ altogether, of which four, those in the "principal diagonal" have repeated digits, leaving $4.3 = 12$ numbers with digits distinct.

Analogous problems in *combinations* are distinguished from problems in permutations in that the arrangement of the elements is now regarded as without significance, attention being devoted merely to which elements are selected. For example: In how many way can two numbers whose sum is even be selected from among the numbers, 1, 2, 3, 4, 5, 6, 8? We note first that both summands must be even or both odd to have an even number as their sum, and that the order of their choice is immaterial.

Again the problem must be made precise by stipulating whether or not two equal summands are to be accepted. Suppose distinct summands only are desired. For odd summands, there are two pairs using the number 1, namely (1, 3), (1, 5) and one more using the number 3, namely (3, 5). There are similarly three pairs using the number 2, namely (2, 4), (2, 6), (2, 8), two new pairs using 4 but not 2, namely (4, 6) and (4, 8), and one remaining pair (6, 8). The total number of pairs is therefore $(2+1)+(3+2+1)=9$.

Two Numerical Functions.—Before making a systematic study of such problems, it is desirable to introduce two numerical functions. The first of these logically, although not historically, is the *factorial function* $n!$ or $\underline{n}$, defined, for $n>1$, as the continued product of the natural numbers up to and including n.

Thus $n!=1.2\ldots(n-1).n$. For each positive integer $n>1$, we have the recursion relation $(n+1)!=(n+1)(n!)$. In conformity with this relation we naturally define $1!$ as 1 and $0!$ as 1, and regard $n!$ for negative integers as not finite. The first few values of $n!$ are given by $0!=1$, $1!=1$, $2!=2$, $3!=6$, $4!=24$, $5!=120$, $6!=720$, $7!=5{,}040$, $8!=40{,}320$, $9!=362{,}880$. The value of $n!$ increases, with increasing n, with extraordinary rapidity. The remarkable size of the answers to certain combinatorial problems due to this fact has interested and astonished generations of schoolboys. For large values of n an approximation of $n!$ is afforded by Stirling's asymptotic formula (1730), which, to give only the leading term, approximates $n!$ by $\left(\frac{n}{e}\right)^n\sqrt{(2\pi n)}$ where e is the "Naperian base," 2.71828. . . . The factorial function $(n-1)!$may be regarded as exhibiting the integral values only of the celebrated *gamma function* (of Euler), $\Gamma(n)$, while $\Gamma(x)$ is defined for complex numbers generally. It is of interest that $\Gamma(\frac{1}{2})=\sqrt{\pi}$, and more generally $\Gamma(x)\ \Gamma(1-x)=\pi/\sin\ (\pi-x)$. Further study of this function leads through the very heart of modern analysis to difference equations, complex functions, definite integrals, contour integration, asymptotic series, etc. In number theory $n!+1$ may be used in Euclid's proof that the number of primes is infinite, and occurs also in Wilson's theorem.

The next function needed is the *binomial coefficient* $\binom{n}{k}$, a numerical function of two independent integers, n, k, and definable in terms of factorials by $\binom{n}{k}=n!\,/\,[(n-k)!\,k!]$, (Newton, 1676), although much older than either factorials or the binomial theorem. The values of $\binom{n}{k}$ may be conveniently exhibited by the so-called Pascal's arithmetical triangle (Apianus, 1527; Michael Stifel, 1544; Blaise Pascal, 1665; and apparently by Chu Shï-kie, 1303), where the $(k+1)$st element counting whether from left to right or from right to left in the $(n+1)$st horizontal row (counting from the top) is $\binom{n}{k}$. The triangle extends downward indefinitely. It starts as follows:

$$\begin{array}{ccccccccccc}
 & & & & & 1 & & & & & \\
 & & & & 1 & & 1 & & & & \\
 & & & 1 & & 2 & & 1 & & & \\
 & & 1 & & 3 & & 3 & & 1 & & \\
 & 1 & & 4 & & 6 & & 4 & & 1 & \\
1 & & 5 & & 10 & & 10 & & 5 & & 1 \\
 & \cdot & & \cdot & & \cdot & & \cdot & & \cdot &
\end{array}$$

A table of its values up to n, $k=50$, is given by J. W. L. Glaisher (*Messenger of Mathematics*, 47, 1917, 97–107). The law of formation of a horizontal row from the elements of the row above may be expressed concisely by the conditions $\binom{n}{0}=\binom{n}{n}=1, \binom{n+1}{k}=\binom{n}{k}+\binom{n}{k-1}$. These properties of $\binom{n}{k}$ alone, are used in establishing by complete induction the binomial theorem:

$$(a+x)^n=\binom{n}{0}a^nx^0+\cdots+\binom{n}{r}a^{n-r}x^r+\cdots+\binom{n}{n}a^0x^n$$

for positive integral exponents n. In the theory of combinations $\binom{n}{k}$ is sometimes denoted by ${}_nC_k$, and may then be called "the k-combination of n" or "the number of combinations of n distinct things taken k at a time without repetitions."

Many important and surprising relations hold among these binomial coefficients for which reference may be made to Hagen, *Synopsis der höheren Mathematik* (vol. i, 1891, p. 64 *sqq.*, or Netto, chap. xiii.).

Two Fundamental Problems.—Perhaps the simplest and most fundamental general problem in the subject of permutations may be stated in traditional form as follows: *To determine a systematic method of securing once and only once each possible arrangement* (or "permutation") *of k things selected from among n given distinct things;* (a) *when repetitions are allowed,* (b) *when the things in each arrangement of k things are distinct. Also to determine the number of such arrangements.* In an "arrangement" as here used, the only feature considered is the ordinal count of the distinct objects, *i.e.*, as to which is first, which is second, which is third, and so forth. When repetitions are permitted, one may select the first object for our arrangement in any one of n ways, since one may select any one of the given objects of the set to be the first of the arrangement. This having been done one can again select any one of the n as the second, and so forth, obtaining n^k possible arrangements of exactly k things from among n permutations permitted. For repetitions not permitted, the first is selected in any one of n ways, the second arbitrarily from among the $(n-1)$ left available. This makes $n(n-1)$ ways of selecting this first ordered pair. The third may be chosen as any one of the $n-2$ remaining things, giving $n(n-1)(n-2)$ distinct possible ordered triads, and so forth. The number of distinct arrangements of k distinct elements selected from among n given distinct elements is therefore $n(n-1)\cdots(n-k+1)=n!/(n-k)!$, denoted sometimes by ${}_nP_k$, "the k-permutation of n," or "the number of arrangements (or permutations) of n distinct things taken k at a time without repetitions."

The corresponding problem in combinations is in some ways more fundamental. It may be stated as follows: *To determine a systematic method of securing once and only once each possible combination of k things selected from among n given distinct things:* (a) *when repetitions are allowed,* (b) *when the things in each combination of k things are distinct. Also to determine the number of such combinations.* By a combination is meant a collection without regard to the sequence or order among the elements. Instead of starting afresh as may be done, let us assume that the permutation problem has been solved and a table is before us giving all distinct arrangements of k things selected from among the given n. We may treat to some extent simultaneously cases (a) and (b). The following procedure is analogous to the use of the *Sieve of Eratosthenes* (*c.* 230 B.C.) in the theory of prime numbers. Establish in any arbitrary manner a sequence among the "arrangements" appearing in the table. Take the first arrangement. Note what k things are there contained. Go through the entire table crossing out all other arrangements comprising these same k things and constituting merely rearrangements of this first accepted arrangement. Proceed to the next arrangement that has not yet been crossed out and repeat the process. This is clearly a procedure that never requires one to turn back and re-examine or cross out any arrangement once accepted. All the arrangements that finally remain will constitute also distinct combinations. In case (b) when no arrangement contains repeated elements, the number of distinct arrangements which constitute the same combination is clearly ${}_kP_k=k!$, since it is possible to arrange a given set of k things in exactly $k!$ ways and each of these possible ways must appear once and only once in the table. The entire collection of ${}_nP_k=n!/(n-k)!$ distinct arrangements contains therefore each combination exactly $k!$ times, so that the number of distinct combinations is $(n!/(n-k)!)/k!$, or $\binom{n}{k}$.

Before taking up the count in case (a), the case of combinations with repeated elements, it is convenient to note certain combinatorial relations in a set of integers arranged in increasing order. Consider a set, s, of k distinct numbers selected from among the first $n+k-1$ natural numbers, and let this set be arranged in increasing order. It is to be noted that the hth number in this set, s, $(h=1, 2, \cdots, k)$ cannot be less than h nor more than $n+h-1$. For its smallest value would occur when the first h numbers of the set are consecutive, giving the value h, and its largest value would occur when the last $k-h+1$ numbers are consecutive, giving the value $n+h-1$. If from the hth number of the set we subtract $h-1$, $(h=1, 2, \cdots, k)$, the consequent *derived* set, s', will be arranged in non-decreasing order, and no one of its elements is greater than n. This derived set may contain repeated elements. Two distinct given sets, s, result in two distinct derived sets, s', and conversely distinct derived sets, s', correspond to distinct given ordered sets, s. We may state the following important theorem in partitions. *For each set, s, of k distinct natural numbers arranged in order of increasing magnitude selected from the first $n+k-1$ natural numbers, there is a uniquely determined set s' of k natural numbers arranged in order of magnitude selected with repetitions allowed, from the first n natural numbers, and conversely.* Returning now to case (a) for combinations, we may imagine our original set of n distinct things numbered ordinally from 1st to nth. In each combination of k things selected from this set, the k things retain their ordinal designation, so that each combination may have its k elements arranged ordinally in a unique manner except for repeated elements, among which order is regarded as immaterial. By applying the theorem stated above, we see that the theory of combinations allowing repetitions as considered in case (a) may be replaced by the theory of combinations of k elements selected from an initial set of $n+k-1$ elements, no repetition being allowed. Thus the number of combinations permitting repetition in case (a) is

$$\binom{n+k-1}{k}.$$

Partitions.—A subject at first sight independent of permutations but in fact almost identical with it is that of *partitions*, one theorem in which subject has been mentioned above. This topic is but a phase of the general subject of distributions, being the theory of combinations of summands having a given sum. For compactness in display, it is convenient to formulate the typical problem as follows: In how many ways can the number $m+n$ be represented as the sum of exactly n positive integers? Thus for $n=4$, $m=2$, we have

$$6=3+1+1+1=2+2+1+1,$$

two ways, and for $n=2$, $m=4$, we have $6=5+1=4+2=3+3$, three ways. The following table was given by Euler who studied the recursion relations among the values of this function.

n =	1	2	3	4	5	6	7	8	9	10	11	...
$m=0$	1	1	1	1	1	1	1	1	1	1	1	...
1	1	1	1	1	1	1	1	1	1	1	1	...
2	1	2	2	2	2	2	2	2	2	2	2	...
3	1	2	3	3	3	3	3	3	3	3	3	...
4	1	3	4	5	5	5	5	5	5	5	5	...
5	1	3	5	6	7	7	7	7	7	7	7	...
6	1	4	7	9	10	11	11	11	11	11	11	...
7	1	4	8	11	13	14	15	15	15	15	15	...
8	1	5	10	15	18	20	21	22	22	22	22	...
9	1	5	12	18	23	26	28	29	30	30	30	...
10	1	6	14	23	30	35	38	40	41	42	42	...
.	.	.	.	.	.	.	.	.	.	.	.	

If this partition function be denoted by $P(n, m)$, we have the relations of Euler: $P(1, m)=P(n, 0)=P(n, 1)=1$, $P(n, m)=0$, $(m<0)$, $P(n, m)=P(n-1, m)+P(n, m-n)$, $P(n, m)=\sum_{s=1}^{n} P(s, m-s)$, and of Stern (1840),

$$P(n, m)=P(n-1, m)+P(n-1, m-n)$$
$$+P(n-1, m-2n)+P(n-1, m-3n)+\cdots.$$

From the simplest tactical considerations (Ferrers, 1853) of the horizontal rows and vertical columns of a *point diagram* ("lattice diagram" or "graph") such as the following, one may infer an important general theorem. Here we have twenty points arranged in horizontal rows containing respectively; 5, 4, 4, 3, 2, 2, points and also in vertical columns containing respectively 6, 6, 4, 3, 1, points:

```
. . . . .
. . . .
. . . .
. . .
. .
. .
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From such observations we have the Theorem of Reciprocity (Sylvester, 1882): *Every partition of n into k positive summands of which the greatest is equal to h, determines a reciprocal partition of n into h positive summands of which the greatest is equal to k.* As immediate corollaries one has: *The number of partitions of n into k parts is equal to the number of partitions of n into parts of which the largest is k;* and, *The number of partitions of n into not more than k parts is equal to the number of partitions of n with no part greater than k.*

Another Problem in Permutations.—Another typical general problem in the domain of permutations and combinations is the following: Given a partition of n, say $n=m_1+m_2+\cdots+m_h$, to determine the number of distinct possible arrangements using all of n given things, each once only, of which m_1 are alike (say of type 1), m_2 are alike, but of another type (say type 2), and so forth, there being in all, h distinct types. Since rearrangements within each type are freely possible, among the total $n!$ possible arrangements of elements, one has $m_1!$ arrangements differing only with respect to interchanges among elements of type 1. These are independent of rearrangements within type 2, and so forth, giving $n!/[m_1!\,m_2!\cdots m_h!]$ arrangements distinct with respect to type. This number is called a *multinomial coefficient* on account of its being the coefficient of $x_1^{m_1}x_2^{m_2}\cdots x_h^{m_h}$ in the expansion of $(x_1+x_2+\cdots+x_h)^n$ in powers of the separate arguments. This is the germ of two lines of investigation, the study of the powerful method of *generating functions* in which the coefficients of the several terms of a power series are interpreted as numerical functions (used throughout MacMahon's treatise), and the study of divisibility of factorials by products of factorials, since the multinomial coefficient is necessarily an integer. (*See* Dickson, *History of Theory of Numbers*, vol. i., ch. ix.) As to generating functions, lack of space and the complexity of the subject require us to dismiss briefly this fundamental tool for research in combinatorial analysis. It is known that

$$(1+x)(1+x^2)(1+x^3)(1+x^4)\cdots=\frac{1}{(1-x)(1-x^3)(1-x^5)(1-x^7)\cdots}$$

is a valid identity for all complex values of x less in absolute value than unity. By imagining the expansion in power series and comparing coefficients, we infer at once that *the number of representations of n as a sum of odd integers allowing repetitions is equal to the number of representations of n as a sum of distinct integers* (allowing both odd and even numbers). De Morgan's theorem illustrating the simplest case of Sylvester's *denumerants*, proved by use of generating functions, states that *the number of representations of n as a sum of the numbers 1, 2, 3, allowing repetitions is equal to the integer lying nearest to* $\frac{1}{12}(n+3)^2$.

Sets and Subsets.—The theory of combinations with distinct elements is identical with the theory of *finite aggregates* or *finite sets*. Many of the concepts apply equally to all well-defined sets whether finite or infinite. There are many grave philosophical difficulties associated with the general definition of set (*see* Whitehead and Russell, *Principia Mathematica*, vol., i., ch. ii., particularly p. 63 *sqq.*), but this concept lies at the basis of modern analysis. (Hobson, *Functions of a Real Variable*, 2nd ed. 1, p. 1-2.) One may at least say that a set is a collection comprising distinct objects of any sort, called *elements* of the set, such that it may be definitely ascertained whether any arbitrarily assigned object is or is not an element of the set. If A and B are sets, A is called a *subset* of B (and B a *superset* of A) if and only if each element of A is an element of B. Thus A is a subset and superset of itself. It is convenient to introduce a unique *null-set* with no elements, which is a subset of every set. Any subset of A which is neither A itself, nor the null-set is a *proper* subset of A. The elements common to two sets A and B constitute the *section* or *logical product* of A and B. The set each element of which is in at least one of the sets A, B, is the *spread* or *logical sum* of A and B. Given three sets A, B, C, the sets A and B are said to be *supplementary in C*, if and only if

A and B have no common element, and C is their spread. In this case only is subtraction possible. We write then $B=C-A$, and $A=C-B$. This notion may be used to demonstrate the theorem, *If $n>k>h$, the number of combinations of n distinct things taken k at a time (without repetitions), which include h specified elements, is equal to the number of combinations of these same n things taken $n-k$ at a time (without repetitions) which exclude each of these h specified things.* In particular for $h=0$, $\binom{n}{k}=\binom{n}{n-k}$. If a set has a finite number, n, of elements, the total number of subsets is 2^n, since each element in turn may independently be included or excluded. Hence $\binom{n}{0}+\binom{n}{1}+\binom{n}{2}+\cdots+\binom{n}{n}=2^n$, as follows also by putting $a=x=1$ in the binomial expansion.

Uniform Correspondences.—If a correspondence is established from a set A to a set B such that for each element of A there is one and only one corresponding element of B, the correspondence determines a *single-valued* (or uniform) *function* "on A to B." This is the sense in which "function" is now used throughout mathematics, after successive extensions through centuries. Here A is the *domain* of the function and B, or the part of B used, is the *range*.

If a correspondence is, furthermore, one-to-one from A to B so as to establish an actual pairing off of elements of A against elements of B, it is *biuniform*. The correspondence then has a unique biuniform *inverse* correspondence K^{-1} from B to A, which determines the same tallying or pairing off. Two sets between which there can exist a biuniform correspondence are said to be *equivalent* or to have the same *cardinal number*. (*See* NUMBER, or Cantor, *Theory of Transfinite Numbers* [trans.], 1915).

When two finite sets A and B have the same cardinal number n, there exist $n!$ distinct biuniform correspondences from A to B. It is sometimes convenient to select one of these correspondences as a *principal* correspondence and by means of it establish a corresponding notation for the two sets. When A and B coincide, this principal correspondence is chosen as merely the *identical* correspondence whereby each element corresponds to itself. A biuniform correspondence within a single set may be called a *substitution* (or "permutation" in the more fundamental sense). The simplest type of substitution is a *circular* or *cyclic* substitution, permuted elements all following in a single cycle. Each element of the cycle may be carried into any other element of the cycle by repeating the given correspondence or its inverse sufficiently often. (Where the cycle contains but a finite number of elements, the inverse is itself obtained by repeating the direct correspondence a certain number of times.) The simplest cyclic substitution after the identity is a *transposition*, by which a single pair of elements is interchanged, and every other element left unaltered. *Each substitution in a finite set may be expressed (in an infinite number of ways) as the result of a finite number of transpositions, but more interestingly, as the result of a finite number of component cyclic substitutions each of which leaves unaltered every element permuted (not left invariant) by any other of the component cyclic substitutions.* Thus each substitution breaks up the given finite set of elements into uniquely determined cycles. A substitution within a finite set is said to be *even* or *odd* according as the number of cycles each with an even number of elements is even or odd. In this connection we have the important theorem: *A substitution in a finite set which is expressible as the result of an even number of transpositions is even, and one expressible as the result of an odd number of transpositions is odd. Each substitution is either even or odd, but never both even and odd.*

Any study of substitutions leads to the consideration of *groups* of substitutions. From this fundamental point of view the theory of permutations (in the sense of arrangements) so far as the case of distinct elements is concerned is a phase of the study of substitutions among elements of subsets of a given set.

Matrices and Determinants.—Given two sets (not necessarily finite), A and B. Let a denote a variable element of A, and b a variable element of B. A set C is called a direct product of A and B (to be distinguished from "logical product") if there is a biuniform correspondence between the elements of C and the ordered pairs (a, b). If the elements of C are independent algebraic variables, then C is called a general *matrix* on (A, B), with elements, x_{ab}, where a determines the (horizontal) *row* and b the (vertical) *column* of the matrix. When A and B have the same cardinal number, the matrix is *square*. If a principal correspondence is chosen between A and B, the notation x_{aa} acquires a meaning. The set of all these variables with repeated subscripts are said to constitute the *principal diagonal* of the square matrix. There need be no preassigned arrangement among the elements of A. Thus, if A consists of the three symbols $+$, $\times$, 0, then there is a general square matrix of nine independent variables, say w_{++}, $w_{+\times}$, w_{+0}, $w_{\times+}$, $w_{\times\times}$, $w_{\times0}$, w_{0+}, $w_{0\times}$, w_{00}, which can be written in any order but of which w_{++}, $w_{\times\times}$ and w_{00} form the elements of the principal diagonal, and for example, $w_{\times0}$, $w_{\times+}$, $w_{\times\times}$ are in the same row (in some order). By a *determinantal product* of the elements of a general square matrix of *order n, i.e.*, with n rows and n columns, is meant a product Πx_{ab} of elements "one from each row and each column," that is, a product of n elements where the first subscripts, a, take on each value in A once and only once, and the second subscripts, b, take on each value once and only once. For example, the following are determinantal products of the matrix given above, $w_{+0}\ w_{\times+}\ w_{0\times}$, $w_{00}\ w_{\times+}\ w_{+\times}$, $w_{\times\times}\ w_{00}\ w_{++}$, but such a product as $w_{+0}\ w_{\times+}\ w_{+\times}$ is not a determinantal product since among first subscripts $+$ appears twice and 0 not at all. The product of the elements of the principal diagonal is always a determinantal product (the *principal* determinantal product). For a finite square matrix of order n, there are $n!$ such determinantal products. (Only n^2-2n+2 are independent [G. Polya, *Arch. d. Math. u. Phys.* [3] 24 [1916], pp. 369–375].) Now each product determines a biuniform correspondence from A to B and hence among the set of symbols used in common by the two sets. This correspondence is that by which the value of a appearing as first subscript in any factor corresponds to the value of b which is the second subscript of this same factor. Thus for a square matrix of finite order, each of the $n!$ determinantal products determines definitely either an even or an odd substitution. The principal determinantal product determines the identical substitution which is even. For $n>1$, there are the same number, $n!/2$, of even as of odd substitutions. To each of the $n!$ determinantal products a sign is attached, $+$, if the substitution it defines is even, $-$, if the substitution is odd. The algebraic sum of all these signed products is defined as the *determinant* of the general matrix. (*See* DETERMINANT.) For a matrix of order nine, the product $x_{27}x_{18}x_{49}x_{66}x_{73}x_{81}x_{35}x_{94}x_{52}$ determines the cycles (2735) (18) (49) (6), with three of an even number of elements. This product is given the minus sign. For the traditional method of determining the sign of a term by counting "permanences" and "inversions," *see* Scott and Matthews, *Theory of Determinants* (2nd ed., 1904, p. 1–14).

Symmetric Functions.—The application of substitution groups to algebra finds a rich development in the Galois Theory of Equations. The simplest topic in this connection, essentially preliminary and incidental to the latter subject, is the theory of *symmetric functions*, fundamentally equivalent to much of the theory of distributions. A symmetric rational integral function of n independent variables $\alpha, \beta, \cdots, \nu$, may be expressed as a sum of terms, each of the form $k\Sigma\alpha^{i_1}\beta^{i_2}\cdots\nu^{i_n}$ where $i_1, i_2, \cdots i_n$ are non-negative integers, where the summation sign, Σ, covers all terms obtainable by transpositions among the variables. The sum $\Sigma\,\alpha^{i_1}\,\beta^{i_2}\cdots\nu^{i_n}$ has a unique term for which $i_1\geqq i_2\geqq i_3\geqq\cdots\geqq i_n\geqq 0$. This is called the *leader*, and the whole sum is called a *monomial sum*. A monomial sum is completely identified by the *specification*, $(i_1, i_2, \cdots i_n)$ of its leader, where the final set of zeros, if any, may be omitted, and where successive equal indices such as $i_a=i_{a+1}=\cdots=i_{a+h-1}$ may be condensed by writing i_a^h. The most important monomial sums are the n *elementary symmetric functions* (1^m), $(m=1, 2, \cdots, n)$ and the infinite sequences of *power-sums*, $s_m=(m)$, $(m=1, 2, \cdots)$, $s_0=n$. It is often convenient to define the symbol (1^m) for $m>n$ as identically zero, thereby enabling many recursion relations to hold universally. Another important fundamental system of symmetric functions is the infinite sequence of *homogeneous product-sums* denoted by h_m where for example, $h_4=(4)+(31)+(2^2)+(21^2)+(1^4)$, and h_m generally is the sum of all monomial sums whose specifications are partitions of m. A system of great interest, relatively little studied in this connection (T. N. Thiele, 1889) is the system comprising in addition to $t_0=1$, and $t_1=(1)/n$, the algebraic semi-invariants, t_m (Arthur Cayley, 1886) definable by the implicit recursion relation

$$s_{m+1}=\Sigma\binom{m}{k}t_{k+1}\,s_{m-k}.$$

Here $t_m(c\alpha, c\beta, \cdots, c\nu)=c^m t_m(\alpha, \beta, \cdots, \nu)$,

$t_m(\alpha+c, \beta+c, \cdots, \nu+c)=t_m(\alpha, \beta, \cdots, \nu)$, $m>1$, but $=t_1(\alpha, \beta, \ldots, \nu)+c$, for $m=1$.

For the relations among these involved in Newton's Identities, Waring's Formulae and the proofs, and generalizations, the reader is referred to treatises on algebra.

The entire subject of symmetric functions acquires new significance when studied from the point of view of *algebraic invariants*. The differential operators of invariant theory are illustrated for example by the Hammond operator, D, used to determine explicit coefficients in certain expansions. (*See* MacMahon.)

The process *transvection* by which concomitants of a system of forms are obtained suggests the use of *multi-linear symmetric functions* of m systems, a subject not yet developed. The set of independent variables $(\alpha, \beta, \cdots, \nu)$ may become infinite in number or even continuously infinite as in the theory of integral equations. Or again all explicit mention of them may be suppressed as in certain algebraic studies, and a general theory including that of symmetric functions be developed, but applicable to much wider domains. Determinants in non-commutative domains have been investigated (*see* LINEAR ALGEBRAS), and this suggests further problems in this line also. Recent studies in symbolic logic and in combinatorial topology present fresh applications of combinatorial principles.

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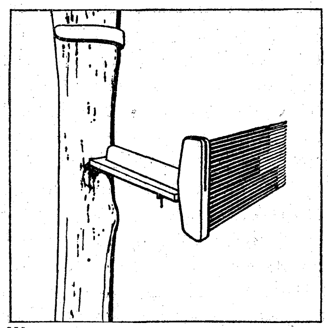
COMBINES. The term "combine" is in popular use throughout Great Britain and the Dominions as a synonym for what is more commonly spoken of in the United States as a "merger." It is employed to denote the large and probably monopolistic concern which results from the permanent "combination" of a number of smaller concerns in the same line of business. The combine is one form of industrial consolidation and is dealt with more fully, along with other forms, under TRUSTS.

COMBING. Prior to the development of mechanical means of fibre-spinning, each fibre was treated in accordance with its nature—more particularly its length. Thus the silk fibre 400 to 600yd. long was readily reeled. The cotton fibre—often not more than an inch in length—was spun on what is known as the spindle-draft system, a comparatively thick sliver of the material, usually drawn from a bundle of the raw material, being actually attenuated into a finer sliver while twist is being inserted, the twist simply controlling the fibres and keeping the thread intact while the fibres are gliding upon one another. On the attenuation's being completed much more twist is inserted, usually to give the maximum strength to the thread. Two fibres—flax and long wool—did not lend themselves to either of these processes, being either too short for reeling or too long for spindle-draft spinning. For flax a process termed "scutching" or "dressing" has been evolved; for wool a process termed "combing." It is interesting to note, however, that the dressing process for flax has been successfully applied to what is termed waste or spun silk, and the combing process (originally worked out for wool) even to comparatively short cotton fibres—for reasons which are obvious when the process of combing is understood.

As Bishop Blaize, a saint of the 4th or 5th century, is the patron saint of the wool-combers, it seems probable that the craft goes back at least into mediaeval times. In its latest form as a handicraft, wool-combing was performed with two combs, one of which, after being heated, was fixed to the "pad-post." The wool to be combed was then lashed by hand into the teeth of this fixed comb, and the fringe hanging from it was then combed by drawing the other comb, also heated, at right angles across the face of the pad-post comb, gradually straightening out all the fibrous mass. After feeding back into the pad-post comb and again combing, the ultimate result was that both combs held equally a straightened fringe of wool fibres. The wool was then drawn off each comb in succession, by hand, as a continuous sliver some three to five feet long, leaving in the comb "milkings" and "backings" which were combed with the subsequent lot, and "noil"—the short fibres actually left in the comb teeth, which were too short to comb again. The combed slivers were then broken up and again combed, this operation being termed "straightening"; little noil was taken out, but the long fibres were arranged longitudinally in a neat sliver from which a parallel-fibre thread—termed a worsted thread—could be spun. Hand-combing was practised as an established craft until about 1860 when the development of the machine comb, interacting with the supply of merino wool from Australia (Botany bay—hence the term Botany wool), resulted in the evolution of an industry turning over many times the weight of material that had been turned over by the hand-combers.



WOOL COMBING AS A HANDICRAFT
A heated comb is seen fixed to a "pad-post," and the wool is lashed into the teeth of the comb. The fringe is then combed by drawing another heated comb through it and the fibres are gradually straightened out on both combs

Cartwright's Invention.—Dr. Edmund Cartwright, a clergyman with an unusually ingenious mind, thought out, about 1785 to 1800, the ideas which underlie the two types of comb at present in use. In the first comb he employed a vertical cylinder or barrel into which the comb teeth were fixed more or less radially, this being the prototype of the various forms of Heilman combs which are now employed both in the short wool and long cotton industries. In the second comb he placed the large carrying cylinder horizontally, charging it with tufts of combed wool overlaid so that on being drawn off a continuous sliver was formed. Thus the idea of hand-combing was imitated, but with circular combs lending themselves to continuity of action.

Other inventors followed Cartwright, but it was not until Heilman, Lister and Holden were at work that the comb showed signs of being a practical success. Heilman and Lister were both practically successful with their "tuft" combs, Heilman employing the vertical and Lister the horizontal circular positions. In a great lawsuit Heilman proved himself to be the first inventor of the "tuft" idea; Lister promptly bought him out and suppressed his vertical cylindrical comb in Britain from about 1854 to 1900, when, French combers having established a large trade with this comb on the Continent and having become the envy of their British competitors, attempts were made to wrest some of the finest wool trade from them, and this necessitated the reintroduction of the Heilman comb for wool. In the meantime, however, a Mr. Donisthorpe, working in Leeds with a man named Noble, evolved another type—now termed the "Noble" comb (*see* WORSTED MANUFACTURE)—and this has proved the best for crossbred and medium Botany wools. It consists of Cartwright's horizontal large circle, with two smaller horizontal circles which work inside the larger circle, touching tangentially, and thus forming two combing positions. The wool is dabbed into the pins of the touching circles, and as in revolving these separate, the combed wool lies between them as a continuous fringe on the inside of the large circle and the outside of the small circle. These two fringes are drawn off by vertical rollers, united together and also to the two corresponding slivers from the other combing position, thus forming what is termed the "top." The short fibres, termed "noil," rest in the teeth of the two small circles inside the large circle. This noil is thrown out with "noil-knives" so that the small combs are freed from fibre in order to proceed continuously with the combing operation in conjunction with the larger circle which has been freed by the drawing-off rollers. The wool which has to follow on for combing is now lifted out of the pins of the large comb, a little more is drawn off and dabbed into the pins of both large and small circles where they impinge, and the combing operation is continued. The Noble comb is not a "tuft" comb, and, with the exception of the dabbing mechanism, is circular and continuous in all its motions. Thus of the practical combs employed for both wool and cotton to-day, three—viz., Lister's, Holden's and Heilman's—are "tuft" combs and one—the Noble—a non-tuft comb. All, however, deliver continuous combed slivers. The Heilman cotton comb, specially designed for the purpose by Nasmith and other cotton engineers, is the only type which has ever been successfully employed for cotton. Only the best cottons—Sea Island, Egyptian and the very best American—are combed. (A. F. B.)

COMBUSTION. This term implies the process of burning and in the popular mind is generally associated with the production of flame (*q.v.*). So far as terrestrial conditions are concerned, it is due to the combination of a combustible substance with oxygen and the consequent evolution of heat. The condition of flame is due to the oxidation of gases or vapours at a very rapid rate so that high temperatures are attained, the molecules concerned thereby becoming highly radiant. Scientifically, the term has a broader meaning and is extended to other oxidations. At atmospheric temperature oxidation of a combustible material generally occurs, if at all, only very slowly, and usually with little outward manifestation. When, however, the temperature is raised, as for example by the application of some external source of heat, the process becomes greatly accelerated, and if the "ignition point" be reached, heat will be developed at a rate greater than that at which it can be dissipated and flame will ensue. Thus, when a lighted match is applied to coal-gas issuing from a jet, the temperature is so raised that self-propellant combination is established between the gas and the oxygen of the air with which it intermingles, flame then appears and is maintained at the jet. Similarly, when coal is heaped on a fire, its volatile constituents liberated by heat mix with the surrounding air and after ignition give rise to flame; the residual coke, consisting largely of carbon, becomes incandescent, its primary oxidation proceeding without flame.

The explanation of the nature of fire or flame was sought in very early times. At first fire was thought to be an element, but as far back as the fourth century B.C. it was demonstrated that air plays an important part in the phenomenon. During the middle ages, however, the notion of an "element of fire" universally prevailed until Francis Bacon classed it among his "phantoms of the market place" as one of those "fictions which spring from vain and false theories" (*Novum Organum*). The first important experimental study of combustion commenced with the Oxford School of Chemistry about 1660 under the leadership of Robert Boyle. With the assistance of his pupil Robert Hooke, he had contrived his "Machina Boyleana," a forerunner of the modern air-pump, and by its aid proved that neither charcoal nor sulphur burns when strongly heated in vessels exhausted of air, although each inflames as soon as air is readmitted. Having found that a mixture of either substance with nitre catches fire even when heated in a vacuum, Boyle concluded that combustion depends upon the action of something common to both air and nitre. He concluded further that, in the calcination of metals a ponderable "fire-stuff" is taken up, thus accounting for the gain in weight already observed by the French physician, Jean Rey, in 1630. Robert Hooke said (*Micrographia,* 1665) ". . . that shining transient body which we call Flame, is nothing else but a mixture of Air, and volatil sulphureous parts of dissoluble or combustible bodies, which are acting upon each other whilst they ascend. . . ."

It was, however, John Mayow, another of Boyle's pupils, who in his *Tractatus Quinque Medico-Physici* (1674) expounded views nearest to those held to-day. In common with Hooke, Mayow regarded heat and light as originating in the motions of particles. By making the now familiar experiment of burning a candle or other substance in a bell jar of air enclosed over water, he observed that the air is diminished in bulk by combustion and that when the flame expires the residual air is inactive and will not support combustion. Also he observed that the respiration of animals in an enclosed space had the same effect, and concluded that respiration and combustion were analogous processes. He therefore postulated the existence of two kinds of particles: (*a*) inflammable particles which exist in all combustible substances, and (*b*) nitro-aerial particles which, originating in the sun, become linked to normal aerial particles (which *per se* are inert) in the upper atmosphere. These particles (*a* and *b*) are mutually so hostile that when suitably brought together they enter into sharp conflict, whereby they are thrown into violent motion the outcome of which is the appearance of fire. Such a view differs from that propounded by A. L. Lavoisier a century later and now held, in that (i.) it did not recognize that common air is a mixture of two physically similar but chemically distinct gases, and (ii.) it regarded combustion only as the interplay and not as the actual combining of two opposite kinds of particles. But for his early death in 1679 Mayow might have discovered the gas now called oxygen.

At the beginning of the 18th century, another view of combustion known as the "phlogiston" theory, originally propounded by J. J. Becher (1635–1681), was developed and promulgated by G. E. Stahl, and soon became universally accepted. According to this theory, all combustible bodies contain at least two "principles"—one of "combustibility" called phlogiston (from the Greek φλογιστός, burnt) which escapes during combustion, and the other of "incombustibility" which remains behind as the ash. More easily combustible substances, *e.g.,* charcoal, were supposed to consist so largely of phlogiston that after its escape during combustion little or no visible residue remains. The inherent defect of the theory was that it did not account for the fact that the products of combustion are invariably heavier than the original substance. This was overcome by ascribing to phlogiston a negative weight. The phlogiston theory dominated chemistry during the greater part of the 18th century but it did not long survive the discovery of oxygen by K. W. Scheele and by J. Priestley; for Lavoisier was able to prove that this gas is really the active constituent of air, and in 1783, after Henry Cavendish's discovery of the composition of water, he correctly interpreted its compound nature as an oxide of hydrogen. In his *Réflections sur le Phlogistique* he denied the existence of phlogiston and propounded his new oxygen theory of combustion. His main contentions were, (1) inflammable substances will burn only in oxygen or where oxygen is present; (2) oxygen is consumed in combustion and, uniting with the substance burnt, causes an increase in weight and a corresponding decrease in the weight of the air used.

Spontaneous Combustion.—In certain circumstances ignition may occur without the application of any external source of heat. Thus, when heaps of finely divided coal or of cotton waste soaked in oil are kept in badly ventilated places, oxidation, proceeding slowly at first, may cause heat to accumulate until ultimately the temperature is raised to the "ignition point," when inflammation occurs. The spontaneous firing of hay-ricks is the result of similar causes.

Slow and Catalytic Combustion.—It has already been mentioned that oxidation of a combustible material can occur at temperatures below those at which flame is developed. Thus, Davy in 1817 discovered that when mixtures of hydrogen and oxygen are passed through a tube heated at temperatures between 360° and 500° C they combine to form water "without any violence and without light." W. A. Bone and his collaborators have found that mixtures of certain gaseous hydrocarbons with oxygen are very reactive at 300° C and in some cases even at

250° C. The rate of such combination is always accelerated by contact of the reacting gases with some foreign material or surface, a phenomenon of the greatest importance in chemistry and known as "catalytic" or "surface" combustion. As a result of these and other researches, it is necessary to distinguish between two possible conditions under which gaseous combustion may occur, viz., (i.) *homogeneously, i.e.,* uniformly throughout the system as a whole, (*a*) at temperatures below the ignition point, slowly and without flame, and (*b*) at temperatures above the ignition point, rapidly and with flame; and (ii.) *heterogeneously, i.e.,* in layers in direct contact with a hot surface.

Incandescent Surface Combustion.—Davy also set out to enquire whether, seeing that the temperatures of flame far exceed those at which solids become incandescent, a body can be maintained in an incandescent state by combination of the gases at its surface without actual flame. He discovered that if a heated platinum wire be plunged into a mixture of coal-gas with air rendered non-explosive by excess of the combustible, the wire immediately becomes red hot and continues so until nearly the whole of the oxygen has disappeared. In 1906 W. A. Bone was able to effect a *flameless incandescent surface combustion* by burning explosive gas–air mixtures in contact with surfaces of ordinary refractory material, which were thereby maintained in a continuous incandescence without flame; and in conjunction with C. D. McCourt he applied this discovery to various domestic and industrial heating operations, including steam raising, etc. The advantages of such a system are, (i.) the combustion is greatly accelerated by the incandescent surface, (ii.) the combustion is perfect with a minimum excess of air, (iii.) the attainment of very high temperature is possible and (iv.) owing to the large amount of radiant energy developed, transmission of heat from the seat of combustion to the object to be heated is very rapid.

Lastly, it should be mentioned that combustion is not necessarily controlled by simple thermal factors but may be profoundly influenced by the electrically charged condition (degree of ionization) of the reactants. Such is probably the case in the ignition of explosive mixtures by electric discharges and also in catalytic combustion.

Gaseous Explosions.—When a combustible gas issuing from an orifice is ignited, a stationary flame is maintained by the active chemical combination of the combustible with the oxygen of the atmosphere with which it intermingles. Should, however, the combustible previously be mixed with air (or oxygen) in suitable proportion, the mixture becomes explosive, and given favourable conditions flame will be propagated through it. When such a mixture is ignited in a confined space, the heat developed raises the gases to a high temperature with consequent rapid increase in pressure. This explosion pressure is the source of power in gas- and petrol-engines.

In order that a gaseous mixture may be explosive it is necessary that the percentage of the particular combustible present should lie between certain limits. Also, in order to initiate flame the mixture must be raised locally at least to its ignition temperature. In neither case are these conditions constant, but they are dependent on the temperature and pressure of the mixture and also on its environment. Usually, however, they can be reasonably well defined; thus at atmospheric temperature and pressure the following figures have been found:

	Hydrogen and air		Carbon monoxide and air		Methane and air	
	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit
Limits of inflammability (volume percentage of combustible gas in air) . . .	4·1	75·0	12·8	72·0	5·4	14·8
Ignition temperatures (approximate) . .	570° C		680° C		660° C	

It should also be borne in mind that in certain cases the electrically charged state of the gases may play an important rôle in the initiation of flame.

Propagation of Flame.—In the case of mixtures of "limit" composition, the heat liberated by oxidation of the combustible is just sufficient to raise adjacent layers of gas to the "ignition temperature," flame being propagated only very slowly. When richer mixtures are exploded the nature of flame movement is dependent on circumstances. Thus if a mixture be ignited at the *open* end of a tube which is closed at the other end, an initial slow "uniform movement" usually occurs, its velocity being dependent on (1) the composition of the mixture, (2) its temperature and pressure, (3) the nature and diameter of the tube employed, (4) the direction of flame propagation, and (5) the source and character of the ignition. Flame movement so initiated usually proceeds at uniform velocity for a certain distance and its termination is marked by a period of accelerated vibrational flame movement which may in certain cases give rise to detonation. When a mixture is ignited near the *closed* end of a tube the forward movement of the flame is continuously accelerated until ultimately detonation may be set up. It should also be mentioned that, when an explosive mixture is ignited in a state of turbulence, as in a gas engine, the rate of normal flame propagation (and hence pressure development) is much more rapid than if the mixture were stagnant.

Detonation.—When detonation (Fr. *l'onde Explosive*) occurs, flame is propagated at an enormously high velocity (*c.* 2,000 to 3,000 metres per second), each successive layer of the explosive mixture concerned being ignited by adiabatic compression in an explosion wave. In such circumstances chemical reaction is more intense and of much shorter duration than in normal combustion; in addition, the pressure in the wave is much greater than that developed in ordinary explosions, thus accounting for its shattering effect. It is set up when a sufficiently explosive mixture is ignited by means of a detonator (*e.g.,* a fulminate charge) or in circumstances such that an advancing flame is exposed to the effects of compression waves. When once established, the velocity of the wave is constant and within wide limits unaffected by the material and diameter of the tube employed, being solely dependent on the nature of the explosive mixture, its temperature and pressure.

(For heats of combustion, *see* THERMOCHEMISTRY.)

See W. A. Bone and D. T. A. Townend, *Flame and Combustion in Gases* (1927); R. T. Haslam and R. P. Russell, *Fuels and their Combustion* (1926). (D. T. A. T.)

COMEDY, the general term applied to a type of drama the chief object of which, according to modern notions, is to amuse. It is contrasted on the one hand with tragedy and on the other with farce, burlesque, etc. As compared with tragedy it is distinguished by having a happy ending (this being considered for a long time the essential difference), by quaint situations, and by lightness of dialogue and character-drawing. As compared with farce it abstains from crude and boisterous jesting, and is marked by some subtlety of dialogue and plot. It is, however, difficult to draw a hard and fast line of demarcation, there being a distinct tendency to combine the characteristics of farce with those of free comedy. This is perhaps more especially the case in the "musical comedy," which has been popular in Great Britain and America since the later 19th century, where true comedy is frequently subservient to broad farce and spectacular effects.

The adjective "comic," which strictly means that which relates to comedy, is a modern usage generally confined to the sense of "laughter-provoking." The phenomena connected with laughter and that which provokes it, the comic, have been carefully investigated by psychologists, in contrast with other phenomena connected with the emotions. It is generally agreed that the predominating characteristics are incongruity or contrasts in the object, and shock or emotional seizure on the part of the subject. It has also been held that the feeling of superiority is an essential, if not the essential, factor; thus Hobbes speaks of laughter as a "sudden glory." Physiological explanations have been given by Kant, Spencer and Darwin. Modern investigators have paid much attention to the origin both of laughter and of smiling, babies being watched from infancy and the date of their first smile being carefully recorded. For an admirable analysis and account of the theories *see* James Sully *On Laughter* (1902). (*See* DRAMA, HUMOUR, CARICATURE, etc.)

COMENIUS or **KOMENSKY, JOHANN AMOS** (1592–1670), a famous writer on education, and the last bishop of the old church of the Moravian and Bohemian Brethren, was born either at Comna, or at Niwnitz, in Moravia. Having studied at Herborn and Heidelberg, and travelled in Holland and England, he became rector of a school at Prerau, and later of a school at Fulnek. In 1621 the Spanish invasion drove him into Poland. Soon after he was made bishop of the Moravians. While teaching Latin at Lissa, he published *Pansophiae prodromus* (1630), a work on education, and *Janua linguarum reserata* (1631), the latter being produced in 12 European languages, and in Arabic, Persian and Turkish. He subsequently published similar works, as the *Eruditionis scholasticae janua* and the *Janua linguarum trilinguis.* His original method of teaching Latin and Greek consisted in giving, in parallel columns, useful sentences in the vernacular and the languages to be taught. In some of his books, as the *Orbis sensualium pictus* (1658), pictures are added; this work is, indeed, the first children's picture-book. In 1638 Comenius was requested by the Government of Sweden to draw up a scheme for the management of its schools; and a few years after he was invited to join the commission that the English parliament intended to appoint for the reform of education. He visited England in 1641, but the disturbed state of politics prevented the appointment of the commission, and Comenius left for Sweden where the minister, Oxenstjerna, employed him in the organization of Swedish schools. He died Nov. 15, 1670, at Amsterdam.

Comenius was disgusted at the pedantic teaching of his own day, and insisted that the teaching of words and things must go together. Languages should be taught, like the mother tongue, by topical conversation—pictures and objects should be used. In his course he included singing, economy, politics, world-history, geography, science and the arts and handicrafts.

As a theologian, Comenius was influenced by Boehme. His religious zeal is manifested in his semi-educational work, *The Labyrinth of the World and the Paradise of the Heart,* ed. Lutzom (Temple classics, 1905). The *Great Didactic* was edited by M. W. Keatinge (1910). Comenius also published three historical works—*Ratio disciplinae ordinisque in unitate fratrum Bohemorum, Historia persecutionum ecclesiae Bohemicae* (1648), and *Martyrologium Bohemicum. See* C. von Raumer, *Geschichte der Pädogogik* (1857); D. J. G. Carpzov, *Religionsuntersuchung der Böhmischen und mährischen Bruder* (1742); S. S. Laurie, *John Comenius* (1881).

COMETS. In addition to the planets and their satellites, the sun's retinue contains a very large number of comets. These are distinguished from the planets in three ways: (1) their orbits, instead of being appreciably circular, like those of the planets, are elongated ellipses, which, in the majority of cases, are almost parabolic; (2) their masses are exceedingly small compared with those of the major planets, and are probably much less even than those of the minor planets; (3) they are generally surrounded by hazy or nebulous envelopes; these are styled the "coma" when their outline is nearly circular, or the "tail" when it is greatly extended. The name "comet" is derived from the Greek and Latin words for "hair," from a fancied resemblance between the tails of comets and long hair streaming in the wind. The terms for them used in China and Japan, translated "besom star," may come either from a comparison between a comet's tail and the bundle of twigs in a broom, or from a fancied resemblance between the motion of a comet's tail across the constellations and that of a broom over a floor.

Distances and Periods of Comets.—The distances of comets from the sun vary within enormously wide limits; the comets 1880 I. and 1887 I. approached within 90,000 miles of the sun's surface, and several other comets approached almost as closely. The greatest distance to which comets recede from the sun can only be given vaguely; but it seems to be a large fraction of the distance (25 millions of millions of miles) that separates us from the nearest fixed star. Indeed, in a few cases comets are found to be moving in hyperbolic orbits, which implies that they may pass beyond the sun's control into that of some other star; but such cases are exceptional. The periods of comets, that is, the times required to accomplish a single revolution in their orbits, likewise vary enormously; the shortest known period is that of Encke's comet, three and one-third years, whilst the longest is in the neighbourhood of a million years. The average periods of comets are very long, certainly many thousands of years, and the number of comets of long period that approach the sun in a century is about 300 (making some allowance for undetected ones). The majority of these show no appreciable deviation from a parabolic orbit, and we are probably not overestimating their average period if we put it at 40,000 years. We thus obtain 120,000 as the total number of comets in the solar system, which makes them by far the most numerous class of objects in the system; the minor planets are probably to be reckoned by thousands, but the highest estimate of their number is about 50,000.

Comets in Ancient Times.—Comets appear at irregular intervals, and their rapid, capricious movements, combined with the occasional size and brilliance of their tails, have caused them to be regarded with mingled interest and apprehension. Since the belief was long prevalent that the movements of the heavenly bodies influenced the affairs of men, it is not unnatural that comets were regarded as particularly potent in such influences; later they were associated with plague, famine and war. These erroneous ideas had, however, the useful result of causing the movements of comets to be noted with great care. Many such notices have come down to us, especially in the Chinese annals; they have been useful in enabling the history of Halley's comet to be carried back 2,000 years, and in giving probable identifications of a few other comets.

There were two schools of opinion concerning the nature of comets in early times; one regarded them as true celestial bodies, the other as vaporous exhalations within the earth's atmosphere. The former view was held by the Roman philosopher, Seneca, who made the sagacious forecast: "Some day there will arise a man who will demonstrate in what regions of the heavens the comets take their way; why they journey so far apart from the other planets; what their size, their nature." Unfortunately European astronomers for many centuries exhibited less sagacity than Seneca, and adopted the view that comets were atmospheric exhalations, though this was capable of easy refutation by the fact that comets shared in the daily revolution of the heavens, rising and setting like the stars. The erroneous view had the effect of causing very little attention to be paid to the positions of comets among the stars, so that up to the 16th century the European cometary records are far inferior in accuracy to the Chinese ones. It was one of the useful achievements of Tycho Brahe to establish, by comparison of observations made at two distant observatories, that comets are more remote than the moon, so that they must be regarded as heavenly bodies.

ORBITS OF COMETS

Law of Gravitation Applied to Comets.—It was impossible to ascertain the true orbits of comets till the law of gravitation had been established. Newton proved that under a force that diminished in proportion to the inverse square of the distance, a body could describe any of the curves known as "conic sections," that is, the circle, ellipse, parabola or hyperbola. It was soon recognized that the observed movements of comets could be explained on the hypothesis that they were travelling round the sun in elongated ellipses or in parabolas, being visible for only a small portion of their orbits in the neighbourhood of the sun. Newton himself applied the new principle to the brilliant comet of 1680; subsequently he obtained the assistance of Halley, who in 1704 collected the observations of 24 comets, commencing with that of the year 1337, and calculated their orbits; he made the preliminary assumption that they were moving in parabolas, since this simplified the work. All parabolas are of the same shape, so that tables can be constructed that are available for all cases; the same assumption is still made in calculating the orbits of new comets, since it is known to be true in the majority of cases.

On collecting the orbits thus found, Halley noticed that there were three, those of 1531, 1607 and 1682, that were moving in paths that were practically identical. The intervals between their appearances were not exactly equal, the first being longer by 15 months; but Halley saw that this could be readily explained by the disturbing action of the large planets, Jupiter and Saturn; in the case of elongated orbits a small change of velocity has an exaggerated effect on the period. Examination then revealed records of another appearance of the same comet in 1456. It was confidently and correctly assumed that all four apparitions belonged to a single body, whose return might be expected about 1758. The fact of a comet's return was now established for the first time. There had been some conjectured cases earlier; but they were erroneous, the orbits not having been deduced on correct principles. Halley's prediction was justified by the result, the comet having returned in 1759 and again in 1835 and 1910.

Comets of Short Period.—Halley called his comet a "Mercury among comets," supposing that it had the shortest period of any; this has been known to be incorrect since the discovery of Encke's comet early in the 19th century. This is the true "Mercury of comets," its period being three and one-third years. More than 60 other comets are known whose periods are less than 80 years. These divide themselves naturally into four groups, to which are given the names of the four giant planets. There is not much doubt that there is some connection between each group and the planet whose name it bears. Jupiter's family is much the largest, containing some 50 members, whose periods lie between 3·3 and 8·9 years; the mean is 6·38 years, which is 0·538 of Jupiter's period; the orbits of most of the members pass close to that of Jupiter. Saturn's family has four members; their periods lie between 13·1 and 17·7 years; the mean is 14·9 years or 0·57 of Saturn's period. Uranus has only two comets; the mean period is 36·6 years, or 0·44 of Uranus's. Neptune has the considerable family of nine comets, including that of Halley; their mean period is 70·9 years, or 0·43 of Neptune's. The connection of the first family with Jupiter is not disputed; his influence on many of its members has been considerable. But the connection of the other planets with their families is not universally recognized. There seems to be a good case for assuming connection; the divisions between the families are well marked, and the mean period of each family is about half that of its planet; this implies that their *aphelia* (the points of their orbits furthest from the sun) are near the orbits of their respective planets; no other comets are known with periods of less than 120 years, except those in the four families. The nature of the connection between the planets and their families will be discussed in the section "Origin of Comets."

Our knowledge of the short-period comets may be said to date from 1819. There were a few cases before that when a parabolic orbit was found not to satisfy the observations, and an elliptical one was deduced. The following is a list of them: Lahire's comet 1678, period 5·38 years; Grischow's comet 1743 I., 6·73 years; Helfenzrieder's comet 1766 II., 4·5 years; Messier's comet 1770 I. (now known as Lexell's comet), 5·6 years; Montaigne's comet 1774 (now known as Biela's comet), 6·77 years; Pigott's comet 1783, 5·89 years. In many of these cases the observations were rough, and the period considered doubtful; it had not been verified by the return of the comet. We now know that Biela's comet was seen again in 1806, 1826, etc., but this had not then been recognized.

Encke's Comet.—On Nov. 26, 1818, Pons, an assiduous comet hunter at Marseilles, found a telescopic comet that was observed for 40 days; J. F. Encke, a celebrated German astronomer, undertook the study of its orbit, and found that it was an ellipse with a period of 3·3 years, which was then, and still remains, the shortest known cometary period. Encke was able to prove, by laborious calculation of the disturbances produced by Jupiter, that comets seen in 1786, 1795 and 1805 were identical with it; he predicted the circumstances of its return in 1822, which were exactly verified. From that day to the present time, the comet (which bears Encke's name, owing to his brilliant work upon it) has been observed at every return. There is only one other comet that has a similar unbroken record, namely Halley's comet. The reason in the case of Encke's comet is that it passes within 31 million miles of the sun, which is much closer than the other comets of short period; it is then so brightly lit up that it is usually an easy object to observe. It has also been fortunate in having a succession of able mathematicians, Encke, von Asten and Backlund, to calculate the disturbances in its orbit. One peculiarity noticed by Encke was that, after making allowance for planetary disturbances, the period was getting shorter by two and one-half hours each revolution. It was conjectured that this might arise from a "resisting medium" in space, which slightly retarded the comet's motion; it can be shown that such a retardation brings the comet nearer the sun and shortens its period. Against this suggestion is the fact that other short-period comets do not show the effect; but it can be replied that Encke's comet passes nearer to the sun than they do, and the medium would probably be denser there. A more serious objection is that the effect has gradually diminished in amount; it lost 20% in 1858, another 20 in 1868, 28% in 1895, and there was a further loss about 1905, bringing the amount down to one-ninth of what it was before 1858.

It is worth while to exhibit the changes in the period by giving a table of the dates of *perihelion passage* (that is, the time when the comet is nearest to the sun). These are given in Greenwich civil time; after each perihelion up to 1871 is given the interval in days to the 18th following perihelion, about $59\frac{1}{2}$ years later (equal to five revolutions of Jupiter and two of Saturn, so that their disturbing action nearly repeats itself after the interval). It will be seen that the interval suffers a rapid diminution at one part of the table, but remains almost stationary towards the end of it; it is easy, with the aid of this table to predict future returns within less than a day.

Perihelion	Interval (days)	Perihelion	Interval (days)
1786 Jan. 31·37	21,739·73	1862 Feb. 6·75	21,705·81
1789 May 19	21,740	1865 May 28·42	21,705·52
1792 Sept. 4	21,740	1868 Sept. 15·11	21,705·60
1795 Dec. 21·94	21,740·58	1871 Dec. 29·31	21,705·6
1799 Apr. 10	21,740	1875 Apr. 13·48	..
1802 Aug. 1	21,739	1878 July 26·67	..
1805 Nov. 22·00	21,737·42	1881 Nov. 15·80	..
1809 Mar. 12	21,736	1885 Mar. 8·13	..
1812 June 26	21,734	1888 June 28·49	..
1815 Oct. 12	21,732	1891 Oct. 18·48	..
1819 Jan. 27·75	21,729·92	1895 Feb. 5·25	..
1822 May 24·46	21,725·34	1898 May 27·36	..
1825 Sept. 16·78	21,722·35	1901 Sept. 15·96	..
1829 Jan. 10·24	21,719·25	1905 Jan. 12·38	..
1832 May 4·49	21,715·99	1908 May 1·41	..
1835 Aug. 26·86	21,712·39	1911 Aug. 19·53	..
1838 Dec. 19·51	21,708·85	1914 Dec. 5·43	..
1842 Apr. 12.52	21,705·44	1918 Mar. 24·81	..
1845 Aug. 10·10	21,704·28	1921 July 13·56	..
1848 Nov. 26·58	21,703·83	1924 Oct. 31·94	..
1852 Mar. 15·21	21,705·32	1928 Feb. 19·71	..
1855 July 1·53	21,705·90	1931 June 3·9	..
1858 Oct. 18·87	21,705·94		

Encke's comet is generally easier to see before perihelion than after it; the approach to the sun causes its envelopes to expand till they become very diffused and faint. This comet makes occasional close approaches to Mercury, whose perturbations of its motion afford the best determination of Mercury's mass; Backlund deduced the value of one nine-millionth of the sun or one twenty-seventh of the earth, a smaller value than that previously adopted.

Other Comets of Jupiter.—The aphelion point of the orbit of Encke's comet lies 84 million miles inside Jupiter's orbit. The other members of Jupiter's comet family make much closer approaches to it, occasionally penetrating within its satellite system. The smallness of cometary masses is demonstrated by the absence of any disturbance to the motion of the satellites, whereas the comet's orbit suffers great changes. The orbit of Lexell's comet of 1770 underwent such changes both in 1767 and 1779 that its previous and subsequent paths were outside our sphere of vision. Other comets that have undergone large disturbances from Jupiter are d'Arrest's in 1860, Brooks's in 1886, Wolf's in 1875 and 1922; curiously enough, in this latter comet the second perturbations almost exactly reversed the first, and sent the comet back to its former path.

Space forbids a full account of all the members of the Jupiter family; two of the more interesting members are selected as specimens. The first is Biela's comet; this was seen in 1772 and 1805, but its orbit was not definitely fixed till Biela and Gambart found it independently in 1826. Its period was found to be six and three-fourths years, and its orbit intersected that of the earth, a fact which caused much groundless alarm at its return in 1832; this, however, was the occasion of a useful popular brochure on this comet, and comets in general, by the famous Arago. The return of the comet in 1839 was not seen, the comet being badly placed. In 1846 the surprising discovery was made that it had split into two comets, which travelled side by side at a nearly constant distance. The division of a comet into two equal portions is a very rare occurrence, though several cases of the separation of small fragments are known; it has, however, been conjectured that the family of brilliant sun-grazing comets that appeared in 1843, 1880, 1882, 1887, were separated portions of a single comet. The two portions of Biela's comet appeared again in 1852, somewhat further apart. Their non-appearance in 1859 excited no surprise, since they were badly placed in the sky; but early in 1866 their calculated position was favourable, yet in spite of careful search nothing could be found; nor have they ever again been seen as comets. Their presence has been manifested in the shape of showers of meteors; displays of these, moving in the same path as the comet, occurred on Nov. 27, 1872, and again in Nov. 1885, 1892 and 1898.

The disappearance of Biela's comet is evidence of the transitory nature of short-period comets. Two other comets, Brorsen and Tempel I., have likewise been lost; both were observed at a sufficient number of returns up to 1879 to ensure accuracy in the determination of the orbits and periods, but neither has been seen since 1879.

The other Jupiter comet selected for description is that discovered by Pons in 1819, and found to have a period of 5·6 years; it was not seen again till 1858, when it was found by Winnecke, so that it bears a double designation. It may perhaps be identical with Helfenzrieder's comet of 1766, but this has not yet been proved. The point of interest in this comet is the notable change in its period and perihelion distance, produced by Jupiter's action. The perihelion distance from the sun in millions of miles was 37 in 1766, 72 in 1819, 77 in 1875, 82 in 1886, 86 in 1898, 90 in 1909 and 1915; there was then an abrupt increase of six million miles up to 96½ in 1921 and 1927. The period has now increased to six years, almost exactly half that of Jupiter, and there are large disturbances by Jupiter every alternate revolution. The perihelion point was inside the earth's orbit up to 1915, but then went two million miles outside it. Showers of meteors connected with this comet were seen in June 1916, and June 1927. On June 26, 1927, it approached the earth within three and one-half million miles. This is the second nearest cometary approach on record; the nearest is that of Lexell's comet in 1770 within one and one-half million miles. The comet Pons-Winnecke was clearly visible to the naked eye in 1927, and its nucleus appeared like a small star; its diameter was not greater than some two miles.

Comets of Saturn and Uranus.—The best known member of Saturn's family is Tuttle's comet, discovered in 1858, and then found to be identical with Mechain's comet of 1790. Its period is 13½ years, and it has been seen at every return since 1858.

The more interesting of Uranus's two comets is Tempel's comet, found in 1866. Its period is one-third of a century, and its orbit coincides with that of the "Leonid" meteors, which are seen in November to radiate from the "sickle" of Leo. There were brilliant displays of these in 1833 and 1866, but that of 1899 was much poorer, since perturbations by Jupiter had diverted their course away from the earth. This comet is the first (following the order of increasing period) whose motion is retrograde, or opposed to that of the planets. It has not been seen at any other return, unless it be identical with one seen in China in 1366; if identical, it has greatly diminished in splendour; it was a conspicuous naked-eye object in 1366, but a feeble telescopic one in 1866. Le Verrier has made researches on the previous history of this comet, and concluded that it made a close approach to Uranus in A.D. 126. At present their orbits are separated by 35 million miles. The comet was not seen in 1899. Stephan's comet of 1867 is the other member of the Uranus family; this also has not been observed again.

Neptune's Comets.—Neptune's family is much larger and better observed than that of Uranus. It has nine members, of which five have been observed at a second apparition. Halley's comet heads the list; this has been traced back to 240 B.C. by computing the planetary perturbations. At every return except that of 163 B.C. it has been identified with an actually observed comet. There is a possible identification in 467 B.C.; both the Chinese annals and Aristotle (in *Meteorologica*) record this comet: the latter adds that a large meteor fell (at Aegos Potami) while the comet was visible; this increases the probability that it was Halley's comet, since it is one of those that approach near enough to the earth to give meteor showers. The apparition of this comet in A.D. 1066 is recorded on the Bayeux tapestry. The head of the comet passed across the sun in 1910, but was absolutely invisible, demonstrating the very small amount of matter contained in it. The earth probably passed through the tail at that time; but there was little, if any, evidence of its presence. There was a similar passage of the earth through the tail of the great comet of 1861; no phenomenon was noticeable beyond a diffused glare, demonstrating the very small density of the tails of comets. Four other members of Neptune's family have been seen on their second visit; these are (1) Pons-Brooks, 1812 and 1884; (2) Olbers, 1815 and 1887; (3) Westphal, 1852 and 1913; (4) Brorsen-Metcalf, 1847 and 1919. These are inferior to Halley's comet in brightness, but superior to most of the Jupiter comets. Three of the Neptune family have retrograde motion; these are Halley's comet, the Pons-Gambart comet 1827 II., and Ross's comet 1883 II.

The influence of Neptune on his comet family in the present position of their orbits is very small. The least distances between the orbits of Neptune and the different comets are given in terms of the distance from the earth to the sun:—for de Vico's comet it is four units; for the comets Pons-Brooks and Pons-Gambart six units; for Halley's and the Brorsen-Metcalf comet eight units; for the comet 1921 I. (Dubiago) it is ten units; for the other three comets, Olbers, Westphal and Ross, it is about 18 units. It must, however, be remembered that the influence at a given distance increases as we go further from the sun, since the solar influence is very small in those outer regions. Thus Neptune is never less than ten units from Uranus, yet it disturbs it noticeably. It is probable that disturbances by Jupiter have gradually changed the orbits of these Neptune comets, and that they once came much closer to Neptune.

It is possible to trace evidence of comet families still further from the sun. There are no comets known with periods between about 80 and 120 years; then we have the following group of four comets: (1) 1862 III. (Tuttle), period 119 years; this is the comet associated with the August meteors; (2) Barnard's comet, 1889 III., period 128·3 years; (3) Mellish's comet, 1917 I., period 145·0 years; (4) the comet Grigg-Mellish, 1907 II., identified by E. Weiss with that of 1742, the period being therefore 164·3 years. This last is the only comet outside the Neptune family that has been observed at a second return. There is a possible fifth member of the family; the comets of 1532 and 1661 have such similar orbits, that identity is suspected; if so, the period is 128·3 years. This family gives some ground for suspecting the existence of an extra-Neptunian planet with period about 335 years and distance 48·2 units. It is noteworthy that both Lowell and Gaillot deduced the existence of a planet at about this distance from small unexplained perturbations of Uranus. There is some evidence for another comet family with periods near 400 years, which would give 1,000 years for the associated planet. Prof. G. Forbes strongly supports the existence of this planet from cometary statistics, but it is far more doubtful than the 335-year one.

Comets of Long Period.—We pass on to the comets whose orbits are scarcely distinguishable from parabolas. There has been considerable controversy as to whether these are to be regarded as true members of the solar system or stray wanderers from outside it. The matter is, however, capable of being settled by simple considerations. The relative motions of the stars, including the sun, are of the order of several miles per second; a comet entering the sun's sphere of influence with such a speed would travel not in a parabola, but in a strongly marked hyperbola. No comets have been observed to travel in such orbits, and it is safe to conclude that they do not come to the solar system from outside. The suggestion has been made that the number of comets in interstellar space is very large, and that we see only those exceptional ones that happen to enter the sun's sphere of influence with zero relative velocity, all others passing too far from the sun for us to see them. This suggestion rests on a fallacy. The number of comets with no thwart velocity, but with velocity in the line between them and the sun, would be far greater than the number with zero velocity in both directions; the former would pass through our sphere of vision equally with the latter, and their orbits would be of the markedly hyperbolic form that has never been observed.

This conclusion is strengthened by another consideration. If comets came to the solar system from outside, we should meet more coming from the direction towards which the solar system is moving (not far from the bright star Vega) than from the opposite direction. Now on tabulating all the comets that have appeared since 1700, and excluding those with periods less than 1,000 years (since their orbits have probably been modified by planetary perturbations), it appears that, up to the year 1862, 63 comets came from the hemisphere containing the solar apex, and 76 from the opposite one. Between 1862 and 1927 the numbers are 61 and 96 for the two hemispheres. It should be noted that comets coming from the anti-apex hemisphere are somewhat better placed for northern observers than those from the apex one; but this consideration should have less weight in the more recent period, in which there have been several careful comet-observers in the southern hemisphere. The figures show that there is certainly no excess of comets from the apex hemisphere, and therefore that they do not come from outside the system.

Origin of Comets.—On examining the comets of long period that have appeared since 1700, we find that 139 had *direct* motion (that is, in the same direction as the planets) and 157 had *retrograde* motion; there is thus no preference for direct motion in these comets. This makes it very difficult to form any theory to explain their origin; if they date back to the same epoch as the formation of the family of planets, we should expect that the direction of motion which is so strongly favoured in the one case (there are no exceptions among the planets, but there are a few among the satellites) should prevail in the other likewise. But the statistics show that the preference is slightly in the other direction. It must be admitted that there is no satisfactory theory of the origin of the comets of long period. We may postulate a solar origin for the family of sun grazing comets that appeared in 1843, 1880, 1882, 1887. The phenomena of solar prominences indicate that matter is frequently being driven off from the sun at high speed. If the speed of ejection is less than 383 miles per second (the speed for motion in a parabola) such matter will return to the sun; but planetary perturbations may suffice to cause it to miss the solar surface and continue to circulate round it in a long ellipse. It seems, however, scarcely possible to postulate a solar origin for the numerous comets whose paths do not approach the sun within a distance of 100 million miles; and we must leave the question of their origin as one to which we cannot at present return an answer.

A suggestion is, however, possible in the case of the short-period comets. The explanation generally adopted is that they were formerly long-period comets that happened to pass very near to one of the giant planets, and suffered large perturbations, which reduced their periods to their present value. It is easy to calculate that only a few comets would pass close enough to Jupiter in a million years to suffer such a great change in their orbits. This does not appear to be at all adequate to keep up the supply, in view of the rapid wastage that is going on. In the last century we have witnessed the definite disintegration of Biela's comet, while those of Brorsen and Tempel I. have probably suffered a like fate. An alternative theory was suggested by R. A. Proctor about 1870. He suggested that the comets in question had been expelled from the planets to whose families they belong at a time when these planets were still in a semi-sunlike state. This involves the conclusion that these comets have been travelling in their present orbits for millions of years; it is difficult to accept this, but it does not seem to be impossible that the giant planets may still be in a condition to expel comets. The radiometric researches of Lampland, Coblentz and others have proved that their outer cloud-layers are cold; but since their cloud-mantles are thousands of miles thick, this is not inconsistent with a state of great activity (perhaps of a volcanic character) lower down. In fact many of the disturbances seen in their atmospheres, such as the great red spot on Jupiter and the bright spots on Saturn in 1876 and 1903, are proofs of the existence of sources of energy at a great depth in their atmospheres, where solar energy could not penetrate. There does not appear to be any impossibility in the hypothesis that occasional discharges of torrents of matter may take place at speeds sufficient to carry the matter away from the planet. The necessary speed in miles per second is $37\frac{1}{2}$ for Jupiter, $22\frac{1}{2}$ for Saturn, $13\frac{1}{4}$ for Uranus, $13\frac{3}{4}$ for Neptune. Such speeds may appear improbable, but the capture theory involves much greater improbabilities. The expulsion theory gives a possible explanation of the non-occurrence of retrograde orbits in the Jupiter family, while we meet them in the Uranus and Neptune families. The speed of expulsion necessary for retrograde motion would be 50 miles per second from Jupiter, but only a third of this for the outer planets. It may be noted that the outer planets would soon cease to be the controllers of the families of which they were the parents. The paths of such of them as came into our sphere of visibility would necessarily approach that of Jupiter; on the occasions of such approaches, the powerful attraction of Jupiter would modify the comets' orbits by degrees, till they no longer made near approaches to the orbits of their parent planets. On this view the year A.D. 126, assigned by Le Verrier as the date of capture of Tempel's comet of the Leonid meteors, would be the date of the expulsion of the comet and the meteors from Uranus.

THE PHYSICAL NATURE OF COMETS

When predicting the circumstances of the return of a periodic comet, the assumption is made that no force is acting upon it except the gravitational attraction of the sun and planets. The assumption is justified by the fact that in all such cases where the previous appearances of the comet have been well observed, and where the perturbations have been carefully computed, the prediction is close to the truth. On the other hand, study of the tails of comets shows that they are acted on by a repulsive force from the sun, which is in many cases much stronger than the gravitational force. It is concluded that the tail is composed of matter in a much more finely divided state than the head, and that the head is made up of fairly large lumps, for which the repulsive force is negligible compared with the gravitational. We are led to the same conclusion in two other ways.

First, the matter driven out into the tail is clearly lost to the comet, whose attraction is quite inadequate to bring it back from the great distances to which it is sent; but large comets, like that of Halley, continue to emit new tails at each approach to the sun. Hence the head must have reservoirs to contain this gas, and give some of it off at each approach. Meteoric masses, when analysed, are often found to contain hydrogen and other gases, so that it is reasonable to conclude that a comet's head is formed of similar masses.

Secondly, when orbits were calculated for the leading showers of meteors, it was found in many cases that they agreed closely with the orbit of some comet, and in the case of the Leonid meteors the year of maximum display, 1866, coincided with the perihelion passage of the comet. Since we do not see meteors unless they enter the earth's atmosphere, we can see only the meteors belonging to those comets whose orbits approach that of the earth; but we may infer their existence in other cases. The meteoric lumps are probably some feet in diameter, comparable with those large meteoric masses that have fallen to earth from time to time; specimens are exhibited at the Natural History Museum, South Kensington, and elsewhere. Lumps of a much smaller size would hardly retain a plentiful supply of gas for thousands of years, such as we infer to have been given out by Halley's comet from the accounts of immense tails at many of its returns. We cannot imagine the diameter of the lumps to run into miles since some sign of them would then have been visible when that comet transitted the sun in 1910.

There are two suggestions as to the nature of the repulsive force that drives out the tail; these are radiation pressure and electrical repulsion. The amount of the accelerative action has been measured by taking photographs at short intervals, and noting the outward movement of luminous knots in the tail; estimates as high as 80 times that due to gravity have been obtained, which is higher than the acceleration that radiation pressure could produce. There is another proof that other forces are at work in driving out the tail. It is easy to prove that all matter driven from the comet's head by solar action would leave the head along the line from the sun to the comet; but it is quite common for the tail to consist of several streamers radiating from the head like a fan, the outer ones making a considerable angle with the line from the sun.

The force expelling these streamers must be situated in the head, and electrical repulsion is the most probable solution. Morehouse's comet of 1908 was a specially favourable one for studying tail formation; it would seem that most of the matter leaves the head on the sunward side, but is soon bent back by the solar repulsive action. The action is like that of the jets in a fountain, shot up by water pressure, and curved downwards by gravity. When looking at the congeries of jets in the fountain we see that their outline is parabolic; in just the same manner we frequently see a series of parabolic hoods on the sunward side of the comet's head. These hoods are clearly shown in the photographs of Morehouse's comet of 1908, and in the drawings of those of 1874 and 1881.

The emission of tail matter is not continuous, but intermittent; in Morehouse's comet, and in Halley's (1910) the photographs showed discarded tails, with a space between them and the new tail. Halley's comet also lost its tail on Jan. 24, 1836, and there were rapid changes of appearance, which would seem to have had their seat in the nucleus. Holmes's comet of 1892 exhibited very remarkable changes, which were the more notable since it was distant from the sun, in the middle of the zone of asteroids. It suddenly attained naked eye visibility, though it had been equally well placed for observation for some weeks without anything being seen of it. There must have been something of the nature of an explosion in the nucleus, causing a great outrush of diffused matter which at first was very bright, but grew fainter as it expanded till it could no longer be discerned; then a second outburst took place, repeating the course of the first on a smaller scale. The comet was seen again in 1899 and 1906, but it never repeated the remarkable outbursts of its first apparition.

The comet of 1744 had six divergent tails; this was looked on at that time as very abnormal, and those who did not see the comet received the accounts with incredulity. But photographs show that multiple tails are quite common, though the outside ones are seldom so conspicuous as in 1744.

Comets in the Spectroscope.—The spectroscope indicates that most of the light of the nucleus is reflected sunlight; but most of that from the gaseous envelopes gives a spectrum of bright bands. These have been identified with those of carbon monoxide, cyanogen and hydrocarbons. At a moderate distance from the sun (half the earth's distance, or less) the spectrum of sodium usually becomes visible; it was conspicuous in Wells's comet of 1882, and gave the comet a yellowish colour. When a comet comes very near the sun, as in the great comet of 1882, the spectrum of metals, including iron, becomes visible. It will be remembered that iron is an important constituent of many meteors. The Russian astronomer, Theodore Bredichin, published a theory of comets' tails in which he postulated a hydrogen composition for long straight tails, a hydrocarbon one for those of intermediate type, and iron or other heavy substance for short, highly curved tails. The spectroscope hardly confirms this in details, since it does not reveal the presence of pure hydrogen; moreover, spectroscopic photographs taken with a prismatic camera do not indicate notable difference between the compositions of neighbouring tails.

Gradual Diffusion of Cometary Matter.—There are two distinct ways in which cometary material becomes scattered; the tails evidently consist of very finely-divided matter, either gas or fine dust, since here the non-gravitational forces predominate over gravitation. But meteors continue to follow gravitational orbits; hence they consist of much larger particles, similar to those forming the comet's head, on which we have seen that gravitation is in control. The large dispersion of the meteors away from the comet's head is surprising, and must have taken a long time to complete. Thus in both the November Leonid shower (Tempel's comet), and the August Perseid one (Tuttle's comet), the meteors form a complete ring round the whole orbit, though they are more densely packed in the neighbourhood of the comet. So also the Aquarid meteors of May, whose connection with Halley's comet is admitted, travel in paths separated from that of the comet by many millions of miles. The cause of the beginning of this scattering action is obscure, but once it had started it would proceed with accelerated pace, since the attraction of the sun and planets on the different portions would henceforth be appreciably different. We become aware of the existence of meteors only when they enter the earth's atmosphere; hence only a small minority of comets yield visible meteors; but from analogy we may infer their existence with confidence in the case of all the periodic comets. It is more doubtful whether comets with sensibly parabolic orbits are accompanied by meteor swarms.

There are two ways in which comets may cease to exist as such. Either the meteors in the head may lose all their gas (this appears to be the case with Biela's) or these meteors may become so diffused and scattered as to lose all semblance of unity and coherence. We have no actual experience of the dissolution of a comet in the latter manner; in fact the coherence of the heads of some comets is surprisingly great, and seems to indicate some unknown force holding the constituents together. Thus the comet Pons-Winnecke has been known since 1819, and has made several close approaches to Jupiter; further it has given rise to a meteor shower, which was well seen in June 1916. Yet when the comet approached very near the earth, in June 1927, its nucleus was seen to be very small, not more than two miles in diameter according to Prof. V. Slipher and M. Baldet.

Bibliography.—Practically all handbooks of astronomy have chapters on comets; reference can be made here only to books dealing specially with them; the first two books are of a popular character:—

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J. G. Galle, *Verzeichniss der Elemente der bisher Berechneten Cometenbahnen* (1894), contains orbits of comets from 372 B.C. to A.D. 1893, with copious notes in German. A sequel to Galle's *Cometenbahnen,* continuing it to A.D. 1925, published as vol. xxvi. part 2, of Memoirs of British Astronomical Association (Perth, 1925).

Bengt Strömgren, *Tables for a motion in parabolic orbits,* vol. xxvii. part 2, of Memoirs of British Astronomical Association (Perth, 1927).

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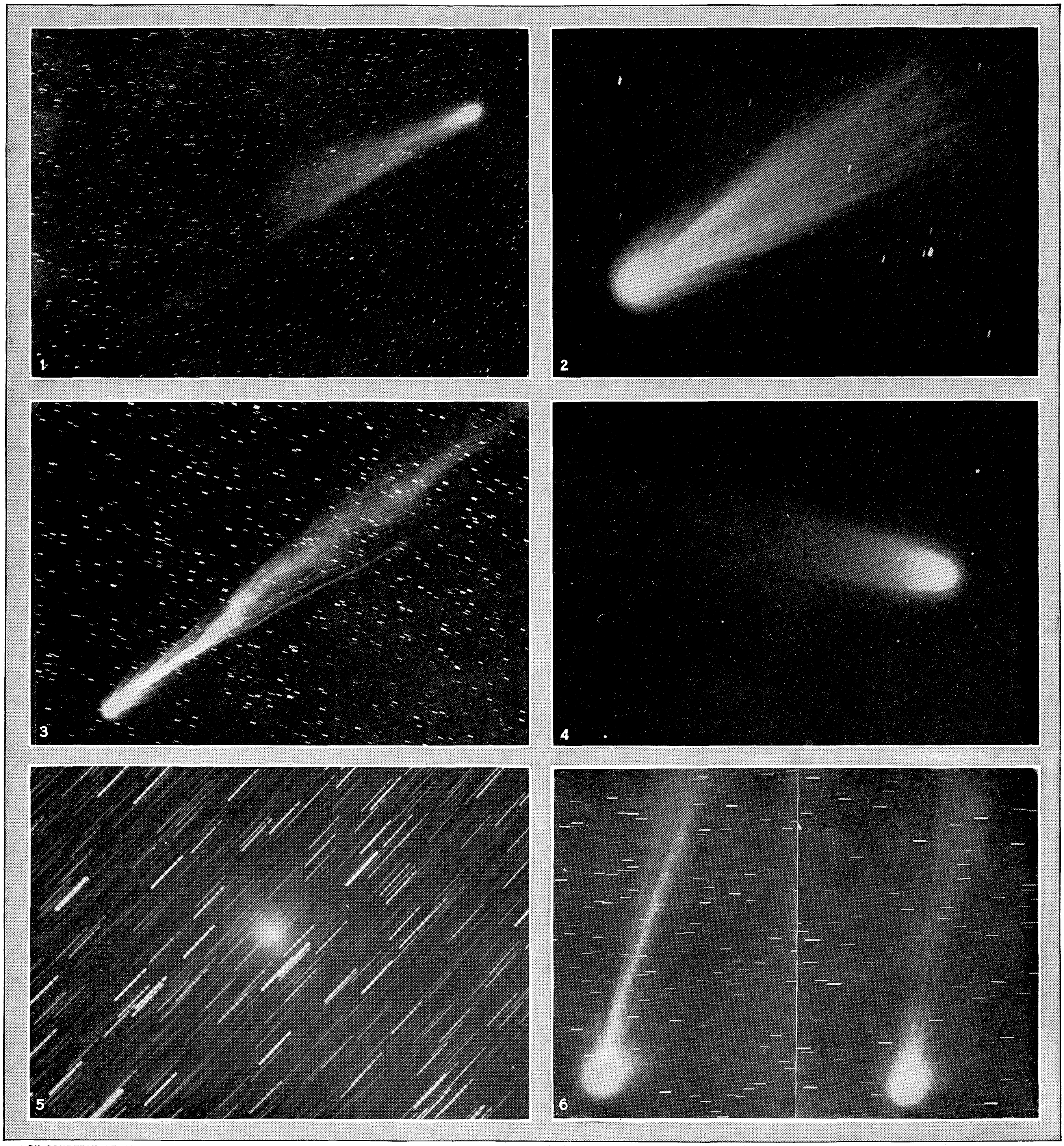
Prof. Charles P. Olivier, *Meteors* (Baltimore, 1925). The association of meteors to comets is very close; there is much relating to comets in this book.

John Williams, *Observations of comets (in China) from 611 B.C. to A.D. 1640* (1871). A. Pingré, *Cométographie; ou Traité historique et théorique des Comètes* (1783), contains much interesting matter relating to ancient and mediaeval comets, but is probably accessible only in libraries.

A full and simple description of the method of finding orbits, both elliptical and parabolic, was given by Dr. G. Merton in the Monthly Notices of the Royal Astronomical Society for June 1925. Nothing is needed with it beyond a nautical almanac and logarithm tables (or, if preferred, a calculating machine). (A. C. D. C.)



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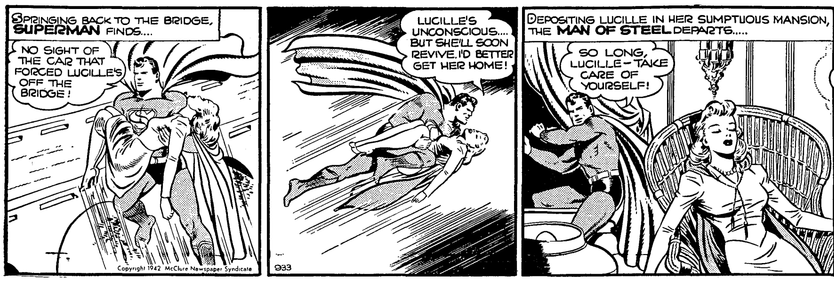
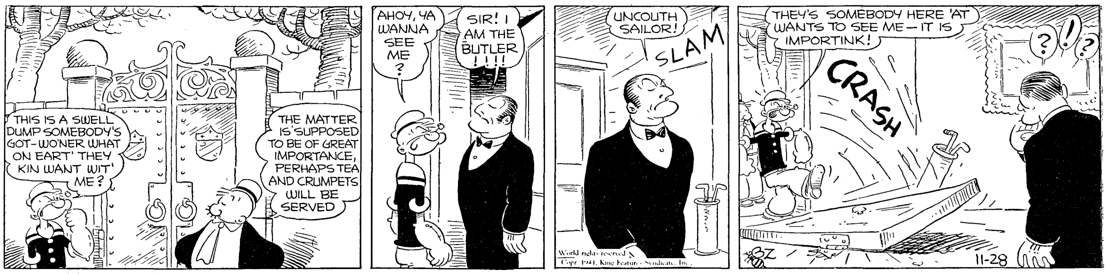
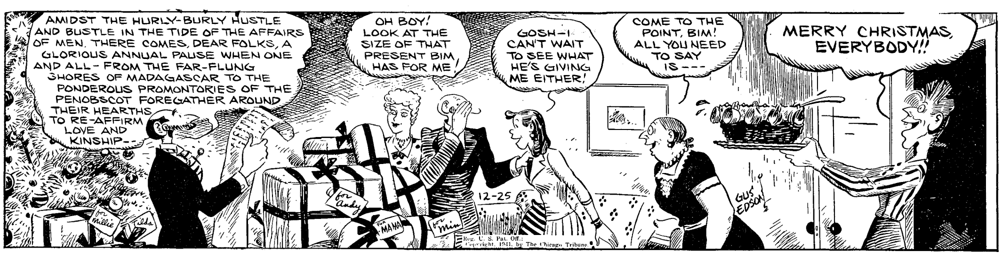
RECENTLY OBSERVED COMETS

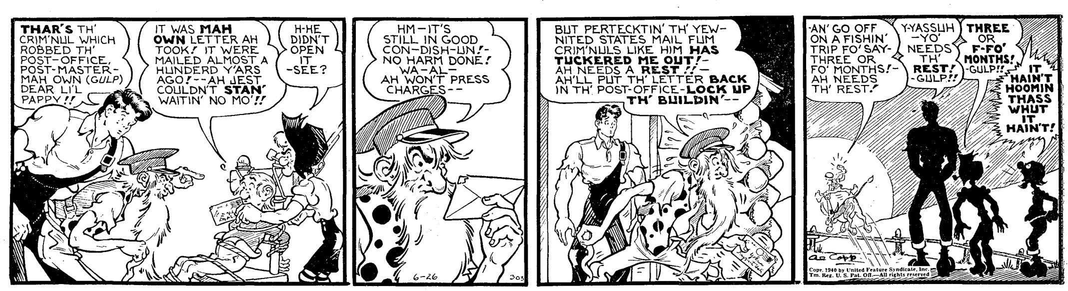
1. Halley's comet, May 4, 1910. Halley in 1704 was the first astronomer to establish the fact of a comet's periodic return and to calculate its elliptical orbit. His calculations were verified by the reappearance of the comet in the years 1759, 1835 and 1910
2. Brooks's comet, November 11, 1911. In 1911 this comet was easily visible to the naked eye and had a long tail
3. Morehouse's comet, November, 1908. Discovered in that year by Daniel Walter Morehouse, then of the Yerkes observatory. The tail formation of the comet is clearly shown here; a series of parabolic hoods may be seen on the sunward side of the head of the comet
4. Halley's comet as seen on April 27, 1910. This comet, called by its discoverer, because of its short period, the "Mercury among comets," is a member of the Neptune family. Its history can be traced in Chinese annals as far back as the year 240 B.C.
5. Pons-Winnecke comet, June 23, 1927. A member of the Jupiter family of comets, named after Pons, who discovered it in 1819, and Winnecke, who rediscovered it in 1858. The photograph shows the comet at a distance of four million miles from the earth. Stars are visible through the transparent cometic envelope. This comet's orbit is changed every alternate revolution
6. Comet Finsler, photographed with the 24-inch reflector of the Yerkes Observatory by Dr. G. Van Biesbroeck on August 5 and 6. This comet was discovered in the morning of July 4, 1937 by Dr. P. Finsler of Switzerland. It reached its closest approach to the earth on August 9 when the distance was forty-five million miles.

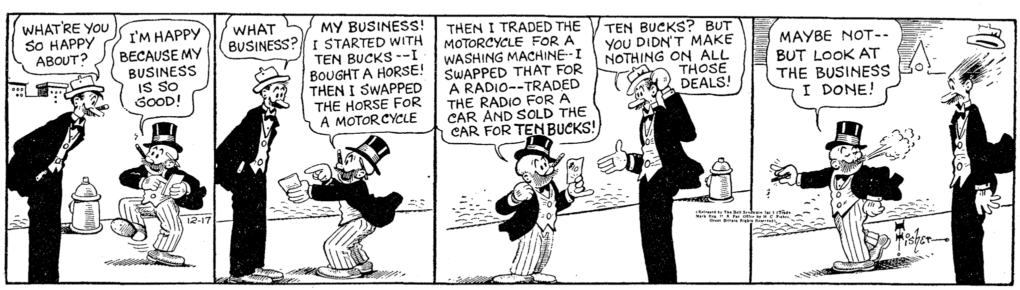
COMIC STRIP

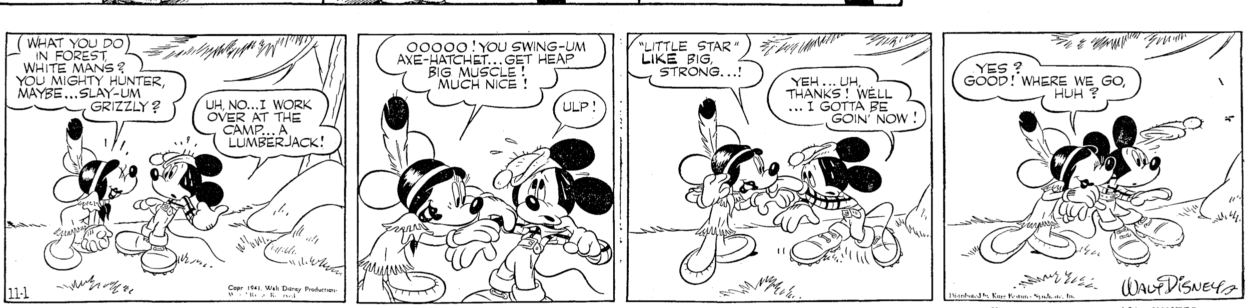












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POPULAR U.S. COMIC STRIPS

1. "Superman," by Jerry Siegel and Joe Shuster
2. "Popeye," created by Elzie Segar
3. "The Gumps," originated by Sidney Smith and continued after his death by Gus Edson
4. "Li'l Abner," by Al Capp
5. "Mutt and Jeff," by Bud Fisher
6. "Mickey Mouse," by Walt Disney

COMET-SEEKER, a small telescope adapted especially to searching for comets: commonly of short focal length and large aperture, in order to secure the greatest brilliancy of light.

COMIC OPERA, which in its broadest significance may be regarded as including any kind of opera or musical play of a humorous character, in its more restricted and more commonly received meaning, implies an opera light in character, based on an amusing subject and having spoken dialogue. (*See* MUSICAL COMEDY.)

COMIC STRIP. The remote ancestry of the American serial comic would include the figures of "The Rake's Progress" and "Marriage à la Mode" of Hogarth, the work of Rowlandson and Cruikshank, and the "Robert Macaire" of Daumier and Philipon. The indigenous product first found expression in the back pages of the American magazines of the latter half of the 19th century. Conspicuous and enduring examples of this early work were Palmer Cox's "The Brownies," a series of drawings depicting the astonishing adventures of a race of benevolent little people, akin to the fairies; and the sketches of A. B. Frost. It was in the '90s that the comic serial found its way into the newspapers. "The Yellow Kid," a creation of that decade, contributed to the coinage of the term "Yellow Journalism." "The Yellow Kid" is generally credited to R. F. Outcault. Frederick Burr Opper, E. M. Hawarth, T. E. Powers, Gene Carr, creator of "Lady Bountiful," and Carl Schultz, creator of "Foxy Grandpa," were other outstanding comic artists of the period. Somewhat later came the "Bird Center" cartoons of John T. McCutcheon, racy of the soil of the Mid-West. Many successful comic strips have been reproduced as animated cartoons (*see* MOTION PICTURES: *Animated Cartoons*). "Bud" Fisher's "Mutt and Jeff" has been a striking example of the longevity of comic strips, as is Sidney Smith's "The Gumps," continued after his death in 1935 by other artists. Among well-known contemporary comic serials are, or have been, "Mr. and Mrs." started by the late Clare Brigg and continued by others; H. T. Webster's "The Timid Soul," "Poker Portraits," and "Trailer Tintypes"; "The Thimble Theatre," with its famous character "Popeye," by Elzie Segar (1894–1938); Fontaine Fox's "The Toonerville Trolley"; Frank Willard's "Moon Mullins" and William De Beck's "Barney Google."

COMINES, PHILIPPE DE, SIEUR D'ARGENTON (*c.* 1445–1509), French statesman and historian, was born at the castle of Comines, in Flanders. He was brought up at the court of his godfather, Philip V., duke of Burgundy, and in 1464 was taken into the service of Charles the Bold, count of Charolais. When in 1468 Charles, now duke of Burgundy, detained Louis XI., king of France, at Péronne, Comines brought about a reconciliation between the two princes; in 1472 Louis persuaded him to desert the duke's service for his own, made him chamberlain, loaded him with honours and estates and in 1476 appointed him seneschal of Poitou. After Louis's death in 1483 Comines was at first one of the counsellors of the regent, Anne of Beaujeu, but he was justly suspected of intriguing against the regency, with the dukes of Bourbon and Orleans, was banished from court, and in 1486 was imprisoned at Loches for some months in one of the cages used by his old master, Louis XI. On March 24, 1488, he was sentenced to the confiscation of a quarter of his property and was confined to one of his estates for ten years; but he was soon taken into favour again by Charles VIII., and employed as ambassador on various missions. He died in Oct. 1509 at Argenton, an estate acquired through his marriage with Hélène de Chambes.

The *Mémoires,* which he wrote in his latter years, earn for Comines the title of one of the greatest historians of his age; his portrait of Louis XI. is one of the classics of history.

The first part of the *Memoires, Cronique et hystoire du roy Louis onziesme, faicte et composée par Philippe de Comines,* written between 1489 and 1491, was first printed in 1524; the second part, *Croniques du roy Charles huytiesme,* was written between 1495 and 1498, and printed in 1528. Seven mss. are known, derived from a single holograph. Later editions were issued by D. Sauvage (1552), D. Godefroy (1649) and Lenglet Dufresnoy (London 1747). More recent editions are by B. de Mandrot (1901–03) and J. Calmette (3 vols. 1924–25). The first English translation was made by T. Danett, *The Historie of Philip de Commines* (1596, repr. 1897).

See H. Timpe, *Étude sur la vie et les mémoires de Philippe de Comines;* and for a detailed bibliography Ulysse Chevalier, *Répertoire des sources historiques du moyen âge, Bio-bibliographie.*

COMITIA, the name applied to the most formal types of gathering of the sovereign people in ancient Rome, is the plural of *comitium,* the old "meeting-place," on the north-west of the Forum. The Romans had three words for describing gatherings of the people. These were *concilium, comitia* and *contio.* Of these *concilium* could be applied to any kind of meeting and might be employed to denote an organized gathering of a portion of the Roman people such as the *plebs,* and in this sense is contrasted with *comitia,* which when used strictly should signify an assembly of the whole people.

Popular phraseology did not conform to this canon, and *comitia,* which gained in current Latin the sense of "elections" was sometimes used of the assemblies of the *plebs.* The distinction between *comitia* and *contio* was more clearly marked. Both were formal assemblies convened by a magistrate; but while, in the case of the *comitia,* the magistrate's purpose was to ask a question of the people and to elicit their binding response, his object in summoning a *contio* was merely to bring the people together either for their instruction or for a declaration of his will as expressed in an edict. The earliest *comitia* was organized on the basis of parishes (*curiae*) of patricians only, and was known in later times as the *comitia curiata.* The *curia* voted as a single unit and thus furnished the type for that system of group-voting which is found in the popular assemblies. The organization which gave rise to the *comitia centuriata* was the result of the earliest steps in the political emancipation of the plebs. Three stages in this process may be traced. In the first place the plebeians gained rights of ownership and transfer, and could thus become freeholders of land and of the appurtenances of this land (*res mancipi*). This legal capacity rendered them liable to military service as heavy-armed fighting men, and as such they were enrolled in the military units called *centuriae.* When the enrolment was completed the whole host (*exercitus*) was the best organized and most representative gathering that Rome could show. It therefore became invested with voting powers, and for two centuries (508–287 B.C.) was the dominant assembly in the state. But its aristocratic organization, based on property qualifications which gave the voting power to the greater landowners, prevented it from being a fitting channel for the expression of plebeian claims. Hence the plebs adopted a new political organization of their own. The tribunate called into existence a purely plebeian assembly, the *concilium plebis,* firstly, for the election of plebeian magistrates; secondly, for jurisdiction in cases where these magistrates had been injured; thirdly, for presenting petitions on behalf of the *plebs* through the consuls to the *comitia centuriata.* This right of petitioning developed into a power of legislation. The Hortensian law (287 B.C.) recognized the right of resolutions of the *plebs* (*plebiscita*) to bind the whole community. The plebeian assembly was organized on the basis of the territorial tribes in 471 B.C. This change suggested a renewed organization of the whole people for comitial purposes. The *comitia tributa populi* was the result and appears as a legislative body in 357 B.C.

In spite of the formal differences of these four assemblies and the fact that patricians were not members of the plebeian body, the people expressed its will equally through all, although the mode of expression varied with the channel. This will was in theory unlimited. It was restricted only by the conservatism of the Roman, by the condition that the initiative must always be taken by a magistrate, by the *de facto* authority of the Senate, and by the magisterial veto which the Senate often had at its command (*see* SENATE). There were no limitations on the legislative powers of the *comitia* except such as they chose to respect or which they themselves created and might repeal. In spite of the creation of *quaestiones perpetuae* (permanent commissions), they never lost the right of criminal jurisdiction, derived mainly from the right of appeal (*provocatio*) against the decisions of magistrates. Finally, the assemblies elected to every magistracy, with the exception of the Dictator and the Interrex. The distribution of these functions amongst the various *comitia,* and the differences in their organization were as follows:—

The *comitia curiata* in the later republic became a merely formal assembly. Its main function was that of passing the *lex curiata* necessary for the ratification both of the *imperium* of the higher magistracies of the people, and of the *potestas* of those of lower rank. This assembly also met, under the name of the *comitia calata,* and under the presidency of the pontifex maximus, to perform certain religious functions. For the purpose of passing the *lex curiata,* this *comitia* was in Cicero's day represented by but thirty lictors. The *comitia centuriata* could be summoned and presided over only by the magistrates with *imperium.* The consuls were its usual presidents for election and for legislation, but the praetors summoned it for purposes of jurisdiction. It elected the magistrates with *imperium* and the censors, and alone had the power of declaring war. According to the principle laid down in the Twelve Tables, capital cases were reserved for this assembly. It was not frequently employed as a legislative body after the two assemblies of the tribes, which were easier to summon and organize, had been recognized as possessing sovereign rights. The internal structure of the *comitia centuriata* underwent a great change during the republic. In the early scheme the First Class and the *equites* together could always outvote the rest, having 98 centuries against 95. The newer plan has been interpreted in different ways but the essential fact was that it reduced the combination of *equites* and *prima classis* to a minority by a fresh distribution of the classes and centuries over the tribes. In 88 B.C. a return was made to the more aristocratic system by a law passed by the consuls Sulla and Pompeius. But this change was not permanent.

The *comitia tributa* was in the later republic the usual organ for laws passed by the whole people. Its presidents were the magistrates of the people, usually the consuls and praetors and, for purposes of jurisdiction, the curule aediles. It elected these aediles and other lower magistrates of the people. Its jurisdiction was limited to monetary penalties.

The *concilium plebis,* although voting, like this last assembly, by tribes, could be summoned and presided over only by plebeian magistrates, and never included the patricians. Its utterances (*plebiscita*) had the full force of law; it elected the tribunes of the *plebs* and the plebeian aediles, and it pronounced judgment on the penalties which they proposed. The right of this assembly to exercise capital jurisdiction was questioned; but it possessed the undisputed right of pronouncing outlawry (*aquae et ignis interdictio*) against anyone already in exile.

There was a body of rules governing the *comitia* which were concerned with the time and place of meeting, the forms of promulgation and the methods of voting. The *comitia curiata* and the two assemblies of the tribes met within the walls, the former in the Comitium, the latter in the Forum (*q.v.*), or on the Area Capitolii; but the elections at these assemblies were in the later Republic held in the Campus Martius outside the walls. The *comitia centuriata* was by law compelled to meet outside the city, and its gathering place was usually the Campus. Promulgation was required for the space of 3 *nundinae* (*i.e.,* 24 days) before a matter was submitted to the people. The voting was preceded by a *contio* at which a limited debate was permitted by the magistrate. In the assemblies of the *curiae* and the tribes the voting of the groups took place simultaneously, in that of the centuries in a fixed order. In elections as well as in legislative acts an absolute majority was required, and hence the candidate who gained a mere relative majority was not returned.

The *comitia* survived the republic. The last known act of comitial legislation belongs to the reign of Nerva (A.D. 96–98). After the essential elements in the election of magistrates had passed to the Senate in A.D. 14, the formal announcement of the successful candidates (*renuntiatio*) still continued to be made to the popular assemblies. Early in the 3rd century Dio Cassius still saw the *comitia centuriata* meeting with all its old solemnities (Dio Cassius, lviii. 20).

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COMITY: *see* INTERNATIONAL LAW, PUBLIC.

COMMA, originally, in Greek rhetoric, a short clause, something less than the "colon"; hence a mark (,), in punctuation, to show the smallest break in the construction of a sentence (Gr. κόμμα, something stumped or cut off, κόπτειν to strike). The mark is also used to separate numerals, mathematical symbols, and the like. Inverted commas, or "quotation-marks," are placed at the beginning and end of a sentence or word quoted, or of a word used in a technical or conventional sense; single inverted commas are used for quotations within quotations.

In music, comma is the name for the extremely small and purely theoretical intervals of sound resulting from the slightly different vibration numbers which may be possessed by one and the same note, according to the different ways in which it is arrived at by the process of tuning up or down from some other note.

COMMAND, in military engineering, the height measured vertically of the crest of a fortified work above the natural surface of the surrounding ground. In military organization it is used, in a general sense, to mean the whole number of troops under a particular officer's command, *e.g.,* "General A's command," especially when comprised of fractions of different units or formations. In a specific sense it is applied in the British and Indian armies to the highest and largest nature of commands which exist in peace time. These are on a territorial basis, and in them are stationed a varying number of divisions and brigades. The troops at home are distributed among the Aldershot, Eastern, Northern, Scottish Southern and Western Commands, besides certain "districts." The commands are usually sub-divided territorially into "areas." The army in India is divided territorially into the Northern, Western, Eastern and Southern Commands.

COMMANDANT. A military commander of a place or body of men, irrespective of his substantive rank, which varies with the size and importance of the place or force. Sometimes "commandant" forms part of a title, *e.g.,* "colonel-commandant." In the French army a commandant is the battalion commander (*see* OFFICERS).

COMMANDEER (from the South African Dutch *kommanderen,* to command), properly, to compel the performance of military duty in the field, especially of the military service of the Boer republics (*see* COMMANDO); also to seize property for military purposes; hence used of any peremptory seizure for other than military purposes.

COMMANDER. Any officer vested with the command of a force, formation, unit or detachment of troops, whether in the navy or in the army.

COMMANDERY, a division of the landed property in Europe of the Knights Hospitallers (*see* ST. JOHN OF JERUSALEM). The property of the order was divided into "priorates," subdivided into "bailiwicks," which in turn were divided into "commanderies"; these were placed in charge of a "commendator" or commander. The word is also applied to the emoluments granted to a commander of a military order of knights.

COMMANDO, a Portuguese word meaning "command," adopted by the Boers in South Africa for military and semi-military expeditions against the natives. More particularly a "commando" was the administrative and tactical unit of the forces of the former Boer republics, "commandeered" under the law of the constitutions, which made military service obligatory on all males between the ages of 16 and 60. Each "commando" was formed from the burghers of military age of an electoral district.

COMMEDIA DELL' ARTE, name given to the mediaeval Italian comedy in which the plot was written out, but the dialogue was improvised by the actors. The name *commedia dell' arte all' improvviso* means, therefore, a comedy improvised by the actor gild (*arte*) or profession. Certain characters recur almost invariably in these plays (*e.g.,* Arlecchino, the Captain, the Doctor), and are the prototypes of the Punch and Judy show, and the Clown, Harlequin, Columbine and Pantaloon of the pantomime. The influence of the *commedia dell' arte* can, indeed, be traced throughout European art and literature. (*See* DRAMA: *The Modern National Drama: Italy.*)

See Winifred Smith, *The Commedia dell' Arte* (New York, 1912).

COMMEMORATION, a celebration of some past event, especially the ceremonial closing of the academic year at Oxford university. This consists of a Latin oration in commemoration of benefactors and founders; of the recitation of prize compositions in prose and verse, and the conferring of honorary degrees upon English or foreign celebrities. "Commencement" is the term for the equivalent ceremony at Cambridge, and this is also used in the case of American universities.

COMMENDATION, approval, a recommendation of one person to the favour of another. *Commendatio* is the liturgical term for the office commending the souls of the dying and departed to the mercies of God. In feudal law it was applied to the act by which a freeman placed himself under the protection of a lord (*see* FEUDALISM). In ecclesiastical law the commendation, or grant *in commendam* of benefices was made temporarily until a vacancy was filled up, and frequently to persons who, by defect of age or orders, were for the time being debarred from receiving institution. The practice of granting benefices *in commendam* to laymen, or, in the case of monasteries, to secular clerks who enjoyed their revenues and privileges for life, or to bishops to hold with their sees, became very general in the later middle ages, especially on the continent. In 1836 the tenure of benefices *in commendam* in England was forbidden by act of parliament.

COMMENTARII, notes to assist the memory, memoranda. This original idea of the word gave rise to a variety of meanings: notes and abstracts of speeches for the assistance of orators; family memorials, the origin of many of the legends introduced into early Roman history from a desire to glorify a particular family; diaries of events occurring in their own circle kept by private individuals—the day-book, drawn up for Trimalchio in Petronius (*Satyricon,* 53) by his *actuarius* (a slave to whom the duty was specially assigned) is quoted as an example; memoirs of events in which they had taken part drawn up by public men—such were the "Commentaries" of Caesar on the Gallic and Civil wars, and of Cicero on his consulship. Different departments of the imperial administration and certain high functionaries kept records, which were under the charge of an official known as *a commentariis* (cf. *a secretis, ab epistulis*).

The *Commentarii Principis* were the register of the official acts of the emperor. These must be distinguished from the *commentarii diurni,* a daily court-journal. At a later period records called *ephemerides* were kept by order of the emperor; these were much used by the Scriptores Historiae Augustae (*see* AUGUSTAN HISTORY). The *Commentarii Senatus,* only once mentioned (Tacitus, *Annals,* xv. 74) are probably identical with the *Acta Senatus* (*q.v.*). There were also *Commentarii* of the priestly colleges. Mention should be made of the *Commentarii Regum,* containing decrees concerning the functions and privileges of the kings, and forming a record of the acts of the king in his capacity of priest.

See the exhaustive article by A. von Premerstein in Pauly-Wissowa, *Realencyklopädie* (1901); Teuffel-Schwabe, *Hist. of Roman Lit.* (Eng. trans.), pp. 72, 77–79; and the concise account by H. Thédenat in Daremberg and Saglio, *Dictionnaire des antiquités.*

COMMENTRY, a town of central France, in the department of Allier, about 7 miles E.S.E. of Montluçon. Pop. (1936) 6,640. Commentry gives its name to a coalfield over 5,000 acres in extent, and has important foundries and forges.

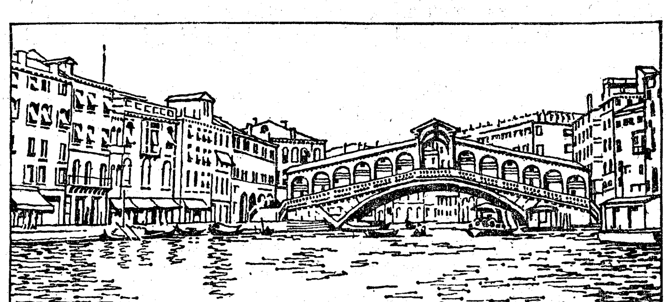
COMMERCE. In the widest sense the term commerce covers the exchange of commodities and all the arrangements necessary for effecting such exchange; but in general usage it is more or less strictly confined to exchanges conducted on a large scale, particularly between distant places. The desire to make an exchange of goods will arise when one area possesses by nature something which another does not, or when it has acquired by skill a relative advantage in the making of particular articles. The extent to which commerce will develop in such circumstances will depend on a number of factors. If the means of transport are primitive the volume of long-distance trade will necessarily be small and the goods which enter into it must be able to bear high costs. If the trade route is dangerous and the trader has no prospect that his enterprise will receive proper protection the heavy risks may seriously discourage him. If methods have not been elaborated for computing, recording and paying debts he has no firm basis for his operations. If the goods have to pass political boundaries and the countries concerned burden it with tolls or taxes the trade will tend to be restricted. The history of the evolution of commerce, therefore, mainly consists of an account of how the tendency towards making exchanges has been limited by defective means of transport, by the perils of the route, by the lack of appropriate mechanism for carrying on trade, and by regulations adopted in the interests of particular States.

Commerce in the Ancient World.—Long-distance trading presented great difficulties in the ancient world. It seems first to have developed along desert routes which had the advantage that comparatively large groups could travel together in caravans and defend themselves against marauders. Oases could be established as ports of call and *entrepôts.* In this way trade sprang up between the civilizations of the Tigris-Euphrates valley and of Egypt. A very large caravan would be required to convey a hundred tons and its progress would be slow. It follows that the goods which entered this trade had to have a high value in proportion to their bulk. They would include such things as oriental spices, drugs and dyes as well as fine textile fabrics and a variety of metal ornaments. But necessaries (for which there was a large and constant demand) would obviously not appear. This caravan trade retained its essential characteristics for centuries. In the course of time the caravan trade became subordinate to sea routes. The first people to make this development of the overland commerce were the Phoenicians. From their bases on the Syrian coast they carried goods by sea to Cyprus and Rhodes and step by step found their way to the western Mediterranean and beyond. The original cities of Tyre and Sidon and the colonies they founded, of which Carthage became the chief, were true commercial centres. Articles wrought in metal, glass ware and textiles were exchanged for tin, copper and silver in the West. The Phoenicians were pioneers in the craft of ship construction, and the wealth which they amassed demonstrated the fact that a long-distance sea trade could be very profitable. Their merchants appear to have made their exchanges on the basis of goods for goods; it remained for their rivals and successors, the Greeks, to spread the use of coined money. Athens, in particular, introduced and maintained an excellent silver currency which won general acceptance because it was not allowed to depreciate. She exported olive oil, figs, honey, pottery and small quantities of metal and textile goods. Her trade with the Black sea is an early example of dependence for essential food supplies on regular communication by sea. The fortified harbour at the Peiraeeus also attracted a considerable volume of *entrepôt* trade, it being used by the merchants of Asia Minor and Syria in their dealings with the rest of Greece and countries to the West. Greek commercial enterprise was offered new opportunities when the conquests of Alexander opened the way into the heart of Asia. The consequent stimulus to long-distance trade was reflected in the growth of Antioch and Alexandria as great commercial cities.

Commerce of the Roman Empire.—In the earlier phases of its history Rome took little interest in commerce. In its origins an agricultural community, it long clung to its traditions. But the series of events which led to the destruction of Carthage (146 B.C.) and the assertion of Roman supremacy over Greece necessarily opened up the possibilities of commercial development. When Augustus put an end to civil dissensions and inaugurated a period of peace these possibilities were fully explored. The main current of trade continued in the direction determined by the Greeks. To Antioch came the chief caravan routes from the East. The commodities thus secured were shipped from its port, Seleucia, to all parts of the Mediterranean. They were the typical articles of this trade—spices, drugs, silks, etc.—and catered for the demands of the wealthier classes. The commerce of Alexandria, however, was of a twofold nature. Oriental luxury goods from Arabia and India reached Egypt by way of the Red sea. Augustus took steps to protect this trade by forcing the Arabs and Ethiopians to desist from piracy and he also had the navigable canals repaired. A sea-captain, named Hippalus, is said to have observed the periodicity of the monsoons about the middle of the 1st century of our era, thus making a direct voyage to India possible and eliminating the need of calling at Arabian ports. There is, indeed, much testimony to the extent of this commerce in the first two centuries. Pliny complains that the demand for Eastern luxuries was so great that it had caused a drain of silver from the West to pay for them. This is partly confirmed by the fact that large quantities of coins of the early Roman emperors have been found in southern India. But there was another side to the trade of Alexandria. The importation of corn from Egypt was essential for the sustenance of the growing population of Rome. Some 20 million bushels were imported annually, part of it being produced on the emperor's domains in Egypt, but most being exacted as tribute from the province. Elaborate precautions were taken to safeguard the supply. Severe penalties were promulgated under Augustus against anyone who delayed the sailing of a corn-ship. The port at Ostia, where the corn was unloaded, was improved by Claudius. Trajan instituted regular sailings and provided granaries for storage. State supervision was necessary not only because the trade was vital to the existence of Rome but because of its very nature. There was no true exchange of goods between Rome and Egypt. Even at its zenith Rome was singularly unproductive; it never had the means of paying for its imports. Little is known of the organization of commerce, as, for instance, of the respective functions of merchants and shippers; but it is obvious that the corn trade was not one in which private enterprise could find a place. The trader was no doubt discouraged in other ways. Ships which were not part of a convoy were in danger of being attacked by pirates. Weather conditions in the Mediterranean made winter sailing perilous. With favourable winds the voyage between Alexandria and Rome could be accomplished in eight or nine days. When winds were contrary recourse had to be had to coasting from point to point and weeks could easily be consumed. A vivid account of such a voyage is given in the 27th chapter of *Acts*, the "ship of Alexandria" and her cargo of wheat being lost. It is not surprising, therefore, that the activities of the private merchant continued to centre in the provinces of the eastern Mediterranean. Some of them found means of extending their trade to the West as the Roman empire promoted the growth of cities where a demand for luxury goods arose. But that commerce had its roots in the East is proved by the fact that in most cases the merchant discovered in the West turns out to be a Greek, a Syrian or a Jew.

The Byzantine Empire.—When the Roman empire in the West collapsed under the successive blows of the barbarian invasions the volume of this trade was greatly reduced. Commerce was virtually confined to the eastern Mediterranean where Constantinople enjoyed pre-eminence as the capital of the east Roman or Byzantine empire. Antioch had been sacked by the Persians in 540 and was captured by the Saracens in 637. The rising tide of Mohammedanism swept over Egypt, and Alexandria itself capitulated in 641. Constantinople, however, did not fall into the hands of a Mohammedan conqueror until the 15th century. She attracted to herself the commerce between Asia and Europe. From the fall of Rome in the 5th century to the age of the Crusades she was the great *entrepôt* of long-distance trade. Unlike Rome, Constantinople and the other cities of the Byzantine empire established a reputation for their manufactures. High quality textile goods, leather work, armour, engraved and enamelled metal articles of exquisite workmanship, carved ivories, mosaics and porcelain were among the exports. Corn, wax, furs, amber, salt fish, unwrought metals and raw wool were secured in exchange from the less advanced peoples whom she did so much to civilize. Merchants had the advantage of good money—the bezant, a gold piece which was generally acceptable. The principles of banking and the use of credit notes were known. Loans could be raised at a moderate rate of interest. Shipping was assisted by the development of insurance. It is true that from the reign of Justinian (528–565) there was a tendency to adopt a commercial policy in the fiscal interests of the empire. There were heavy duties on the import and export of certain commodities, and taxes were levied on purchases and sales. Justinian also introduced the principle of monopoly in favour of the silk industry which he took pains to set up in order that the empire might be independent of the supplies from the East which were controlled by Persia. Against these restrictions must be placed the influence of the great fairs of Constantinople and Thessalonica at which the merchants who resorted to them from all countries enjoyed great freedom of trade. Concessions were also made to alien merchants by granting them special quarters. The most favoured of them, such as the Venetians and the Genoese, had extensive privileges; others were subject to restrictions as to the time they were allowed to stay within the empire and their business had to be conducted under supervision.

The Italian Trading Towns.—The heirs of Constantinople were the Italian trading towns. They had developed under the aegis of the Byzantine empire and they profited from its decline. Venice in particular rose to splendour in the middle ages. Situated amid the lagoons at the head of the Adriatic sea, it was at first a place of refuge in the troubled days of the barbarian invasions. A position could hardly have been better chosen to serve as an *entrepôt* through which the trade of the Levant could pass into central Europe as conditions there became more settled. The merchants of Germany had access to it across the Brenner pass, and goods could also be conveyed along the valley of the Po and by way of the St. Gotthard pass to the growing towns of the Rhineland and the Low Countries beyond. Through Istria and along the Save the countries of the Danube basin could be reached. The Venetians themselves, however, had a predilection in favour of sea routes. It was by sea that they imported oriental commodities. To make the sea route to the eastern Mediterranean secure they aimed at gaining control of the coast-line and the islands. Advantage was taken of the crusades to pursue this policy. Concessions were exacted in return for shipping services. When the leaders of the fourth crusade, for instance, negotiated for their trans-shipment to Egypt—the first proposed objective of the expedition—Venice demanded a payment of 85,000 marks and a share in the conquests. Since they could not satisfy these claims the leaders of the crusade were induced to do Venice a service by capturing for her Zara, a position she coveted on the Adriatic. Although the Venetians were not responsible for the subsequent diversion of this crusade to the capture of Constantinople itself in 1204, they took advantage of the turn of events and claimed large territorial grants. This persistence in strengthening her hold in the Levant indicates the character of her trade. Year by year she was attempting to find new outlets in the West for the goods carried by caravans from the East and the products of Byzantine workshops. As she was pre-eminently a sea-power it was natural that she should consider a sea route to the West.



BY COURTESY OF G.W.H. BRITT

THE RIALTO BRIDGE, IN VENICE, THE WORK OF ANTONIO, OR NOVANNI CONTINO, 1588–91

From the early part of the 14th century a fleet of galleys was despatched to the countries of the western Mediterranean, and it made its way by easy stages through the Strait of Gibraltar as far as the Low Countries. The voyage, which was usually annual, was publicly organized and controlled. The goods, however, were carried on the account of individual merchants to whom opportunity of securing space on the ships was offered by auction. Since Bruges was then the chief mart of north-west Europe most of the cargoes were directed there; but a ship might detach itself from the fleet to call at Southampton, Sandwich or London. By this means such commodities as pepper, cloves, indigo, ginger, etc., were carried to the West at a lower cost than that of the overland route. As a return cargo the galleys took wool, hides and metals which were worked up in Italy for export to the East. Florence, for instance, was the centre of a flourishing cloth industry organized on a capitalist basis, and Lucca had an important silk industry. As the Italian towns were purely commercial some kind of exchange of goods was necessary and consequently the expansion of trade promoted industrial activity. It was also facilitated by the improved mechanism of commerce effected by the Italians in the methods of account-keeping and the organization of credit. Bankers, particularly those of Florence, had connections throughout western Europe. The commercial activities of Venice were rivalled, though not equalled, by those of Genoa and Pisa. Genoa strove not unsuccessfully for a share in the Levantine trade and contended with Pisa for the trade of North Africa and Spain.

The Hanseatic League.—The fact that the Venetians found it worth while to make a direct sea voyage to the Low Countries shows that good markets for long-distance trade had grown up there by the 14th century. These had developed slowly from the 9th century onwards as new kingdoms had arisen out of the ruins of the Roman empire. Merchants began to enjoy some measure of protection. Charles the Great, for instance, assured Offa of Mercia in 796 that any of his subjects lawfully pursuing their business in his dominions would be safeguarded against oppression. The Northmen found their way by river routes from the Baltic to the Black sea and obtained supplies of oriental goods. Progress was slow at first. By the 11th century, however, German towns had taken the initiative and the merchants of Cologne were particularly active. The towns of north Germany also entered into agreements with one another to co-operate in suppressing robbery on the roads and piracy at sea. Out of such understandings the powerful Hanseatic League ultimately emerged. It was a confederation of towns, mostly though not exclusively in Germany, formed to consult their common commercial interests. The League was no less than a great commercial State; it had its regular assemblies, its courts and its treasury, and it entered into treaty relations with foreign States. The main purpose was to gain concessions in its favour from the rulers of other countries. Such privileges it strictly confined to its members. In countries where long-distance commerce had not developed the League negotiated for factories or settlements which were at once residences and warehouses. They were concrete expressions of the treaty privileges gained by the League and the means of supervising the activities of its own members. There was a factory at Bergen from which the trade with Iceland could be carried on, and another at Novgorod where goods could be exchanged for Russian products. In London the League had its settlement called the Steelyard, and it long enjoyed more favourable terms than any other merchants in the payment of customs duties. Still more important was the position which it occupied in Bruges where the merchants of northern Europe and the Mediterranean came into direct contact. It was also the chief market for English wool and Flemish cloth. The Hanseatic merchants, therefore, were chiefly engaged in exchanging the products of the northern countries—furs, salt fish, flax, timber and tar—for wool, leather, cloth and the commodities in which the Italians specialized. They confined their attention to merchandise and did not undertake money-lending. Under the leadership of Lübeck and Hamburg the League established a great prestige which was of first importance in the commercial development of northern Europe.

Characteristics of Mediaeval Commerce.—The total volume of long-distance trade in the middle ages was comparatively small. With respect to the necessaries of life most areas were self-sufficing. The goods which entered into international trade were still mainly articles of luxury for the wealthier classes. Oriental products reached western Europe chiefly through the agency of Venice and Genoa. They were paid for to an increasing extent by the export of high quality woollens. Cloth was the first European product which was carried long distances in considerable quantities. It became worth while for special classes of merchants to devote all their attention to its sale. For the most part, however, merchants dealt in a variety of goods and a wholesale market in any commodity was exceptional. Particular value, indeed, was attached to the right of retail trading. Local merchant gilds tried to monopolize it by forcing outsiders to sell in bulk. The members of the Hanseatic League were extremely jealous of the privilege of retailing where they had secured it. Obviously the retail market was more certain and profitable. The travelling merchant covered a range of articles, and even when he became resident and his business was carried on through agents, it retained its general nature.

Mediaeval commerce was restricted in many directions. Transport remained expensive both by land and sea; by land only small quantities could be carried by pack-horse or some such method and frequent tolls were exacted, and by sea it was customary to arrange common sailings for the sake of convoy and this meant that the relative cheapness of carriage had to be set against the slowness with which the capital invested was turned over. Local organizations of merchants often succeeded in imposing serious restraints on foreigners. The custom of *hosting* was common, usually requiring that aliens should have the period of their sojourn in a country limited to 40 days and that they should stay with a native merchant to whom the details of their business should be revealed. Commerce also frequently suffered from regulations imposed in the fiscal interest of States. The chief goods on which customs were paid had to pass through prescribed staple ports, and the situation and number of such staples were subject to constant change, usually for political reasons. The export of money was often forbidden because special importance was placed on the accumulation of the precious metals within the country. Sometimes alien merchants suffered from popular outcry against the nature of their trade, it being alleged that they were importing useless or harmful luxuries and exporting necessaries. The catalogue of discouragements, whether natural or artificial, seems formidable. It should be remembered, however, that local and Governmental restrictions were often relaxed. Reference has already been made to the privileges enjoyed by organizations of alien merchants such as the Hanseatic League. The fairs (*see* FAIR) also gave opportunity for temporary freedom of trade and were resorted to by merchants engaged in long-distance commerce. Among the most notable fairs in western Europe were those of Champagne, which were held at Provins, Troyes and other centres, and extended over the greater part of the year. Merchants attending them were guaranteed safe journeys and protection in their lawful enterprise. In the conduct of the fairs a common code of mercantile law was evolved to meet the problem of settling disputes between merchants of different countries without delay. The mechanism of trade was improved. Money-changing had to be arranged because of the great variety of coins which were current. From money-changing, money-lending was an easy step. The inconvenience of paying debts at a distance by incurring the risk of sending money, when it was lawful to do so, or by despatching goods which the debtor was willing to accept, was removed by the growing use of the principle of the bill of exchange.

From the Mediterranean to the Atlantic.—The conquests of the Ottoman Turks in the 15th century threatened to close the routes by which oriental goods had reached the Levant. Constantinople fell into their hands in 1453, and although Venice succeeded in her negotiations for the retention of her trading privileges for a time, the Christian powers could not but regard the Turkish advance into Serbia, Wallachia, Bosnia and Greece with apprehension. Venice herself was involved in a series of wars with the Turks in the 16th century and suffered heavily from the exhaustion of her resources and the loss of territory. Prolonged disturbance in the Mediterranean reacted adversely on the long-established and lucrative trade with the East. The question naturally arose whether the commodities could be obtained by some other route. The pioneer work of Prince Henry of Portugal was rewarded by the rounding of the Cape of Good Hope by Bartholomew Diaz in 1486 and by Vasco da Gama's successful voyage from Lisbon to Calicut in 1498. Meanwhile Christopher Columbus, a Genoese sailor in the service of Castile, sought India by sailing west and discovered a "new world" lying across his path.

These two discoveries were destined to effect a revolution in commerce, but their consequences were not apparent for some time. Portugal and Spain claimed exclusive rights in the exploitation of the new routes. The English were not without hope that they would be able to find a northern passage to the East. This would enable them to avoid conflict with the Portuguese and Spaniards, and also to carry on an intermediate trade in woollens for which there was no demand in the tropics. The best-known attempt to find a north-east passage is that of Chancellor and Willoughby in 1553. Chancellor succeeded in reaching Archangel and on the basis of trading concessions made by the tsar of Russia an English joint-stock company—commonly called the Muscovy or Russia Company—was formed. It included in the area with which it proposed to trade Armenia, Media, Hyrcania, Persia and the Caspian sea; in other words, it intended to get into contact with the trade routes of central Asia. That this was possible was demonstrated by the celebrated traveller, Anthony Jenkinson, who in 1557–59 went from Archangel to Moscow, along the Volga to the Caspian sea and then found his way to Bokhara, where he saw great numbers of Indians and Chinese buying and selling. This would seem an impracticable route from England to the East, and yet the fact remains that the Russia Company made good profits from its "Persian Voyages" in the years 1566–81. As to a north-west passage the persistent endeavours of the English to find one are illustrated by the careers of Martin Frobisher, John Davis, Henry Hudson and William Baffin. But the tendency of the Eastern trade to return to its old channels was still strong. An agreement was arrived at with the sultan of Turkey and an English company was formed in 1581 to carry on direct trade with the eastern Mediterranean. It was fully incorporated as the Governors and Company of Merchants of the Levant in 1592. For some years the company did fairly well, particularly by importing currants, but towards the end of the century it met with difficulties.

The Sea Route to India.—Meanwhile Portugal and Spain had been endeavouring to profit from their discoveries. The Portuguese aimed at controlling for their own advantage the existing Indian trade-routes to Africa, the Red sea, the Persian gulf, the Cambay ports and the Spice islands. The centre of their power was Goa, but they had important settlements at Ormuz, Calicut and Cochin. In 1580 the crowns of Portugal and Spain were united in the person of Philip II. This meant that the Portuguese possessions were at the mercy of the enemies of Spain. The position of the Spaniards in the New World had already been challenged by English sea-captains. John Hawkins had tried to gain a footing in the West Indies by supplying the Spaniards there with African negroes to do the field work for them. This breach of her monopoly was strongly resented. Spain had concentrated her main attention on the silver mines of Mexico and Peru. The treasure thus obtained by forced labour was expended in Europe in buying commodities from other countries and in the conduct of wars. It did not strengthen her commercial position; in fact the yield of the plate fleet was often mortgaged to her creditors before it arrived. The one general result of her policy, indeed, was a fall in the purchasing power of money with all the social consequences of a price revolution. Francis Drake in his famous circumnavigation of the world in the years 1577–80 showed at how many points Spain could be attacked by an intrepid adventurer. He returned with a cargo of gold, silver, silk, pearls and precious stones. These were the spoils of a daring exploit and provided no foundation for trade. It was still to be sought in the East.

In the last decade of the 16th century the English and Dutch turned their attention to the Cape passage to India. Sir James Lancaster in the expedition of 1591–94 reached the Indian ocean but then met with a series of disasters. The Dutch voyage of 1595, commanded by Houtman, who had served on Portuguese ships in the East, succeeded in getting a valuable cargo of spices from Bantam. Encouraged by this example, and provoked to action by the high prices the Dutch exacted for spices, the Levant merchants in London took steps to form a new company. A charter was granted to the "Governor and Company of Merchants of London trading to the East Indies" on Dec. 31, 1600. For the first seven years the voyages of the company were directed to the Spice islands. The trade was lucrative, but it presented one serious difficulty—the ships could not take out commodities which the natives wanted. From its inception the company had been given the right to export silver, provided it did not exceed £30,000 in value in any one voyage; but this privilege exposed it to the charge that it was undermining the strength of the country. In the prevailing state of opinion the company could not but be sensitive to this attack. When their factors at Bantam informed them that there was a good market for Indian calicoes there, they naturally explored the possibility of sending English goods to the Cambay ports, where they could be exchanged for calicoes, which were acceptable in exchange for spices in Java. So the company sought and ultimately obtained the right to establish a factory or trading-settlement at Surat. There they found that indigo could be bought at a price which yielded high profits in Europe, and it long remained one of the chief articles of direct trade between England and India. A footing was also gained in Persia where silk was obtained for export to Europe. The English company, in fact, gradually established itself on the mainland, the growing hostility of the Dutch driving it from the Spice islands. In the later years of the 17th century the English woollen industry was complaining that the import of Indian textiles was ruining its trade; and later the use of certain Indian piece-goods was prohibited in Great Britain. They were imported and offered by auction for re-export and mostly shipped to West Africa. This example shows that the costs of carriage were so reduced by the development of the direct sea route to India that fabrics cheap enough to clothe negro slaves could enter into the trade.

Rivalry of England and Holland.—English commerce had been largely in the hands of aliens, chiefly Italians and Germans, during the middle ages. But two groups of native merchants in the course of time won recognition as distinct companies—the Merchants of the Staple who exported wool and the Merchant Adventurers who sought markets for English cloth. With the growth of the woollen industry the latter became the more important of the two. Their origins are obscure, but by the 16th century they enjoyed the monopoly in the export of cloth by English subjects to the Low Countries and Germany. They came into conflict with the merchants of the Hanseatic League, and in 1578 the Germans finally lost the favourable position they had so long held in England. The Merchant Adventurers themselves had their chief seat abroad at Antwerp, which in the 16th century had succeeded to the position previously occupied by Bruges; but the political disturbances in the Low Countries drove them to seek a centre in the north and they eventually settled in Hamburg. The Hanseatic League monopoly in the Baltic was further challenged in 1579 by the formation of the Eastland Company which secured concessions in Elbing at the mouth of the Vistula. This activity in forming trading companies—reference has already been made to the Russia Company, the Levant Company and the East India Company—might seem to indicate a policy of promoting English commerce. That was not necessarily the result. The companies were given exclusive rights as far as English subjects were concerned in the areas assigned to them and they were tempted to exploit this privilege for their own ends. There is good ground for contending that the expansion of trade was due to the interlopers who defied the rights of the companies and tried to break their monopoly. At any rate the 17th century witnessed many attacks on the company system because it was alleged to restrict commerce; and the case against it seemed the stronger since Dutch competition was in so many instances successful in depriving the companies of trade in their special areas. The "endeavours of the industrious Dutch" are the constant theme of English economic writings in the 17th century.

The wealth of Holland rested primarily on the degree of organization she applied to the herring fishery, for it gave her experienced sailors and a commodity for which there was a great demand in the European markets. The fishing season was so arranged that a great fleet was kept constantly at sea and its wants supplied by other ships which brought in the herrings ready salted and packed in barrels. Situated at the mouth of great riverways, the Dutch were able to dispose of this fish on profitable terms. Amsterdam, it was said, was built on herring bones. Fishing led to an improvement in shipping and the building up of the proud position of being the chief maritime carrier in the world. Her towns were intimately connected by waterways and each specialized in some direction. Ships were built appropriate for the different kinds of cargoes and their parts were standardized. With a high net tonnage, and managed by a comparatively small crew, specialized ships following a regular course in quick succession could easily offer freight rates with which other countries could not compete. Writing in 1665 Sir Josiah Child puts down a list of trades which the English had lost—the Russian, the Baltic, the Spanish, that of the Spice islands and the Far East, even that of Scotland and Ireland—all had fallen to the Dutch. They had, according to him, the advantages of better education, better workmanship, better commercial laws, better ship-designing, and above all a better banking system with a lower rate of interest. The English Navigation Act of 1651 was designed to damage the Dutch carrying trade by requiring that, as a general rule, goods should not be imported except in English ships or ships of the country where they originated. Contemporaries supposed that this policy did irreparable harm to the Dutch, but their opinion is not supported by the evidence. The Dutch carrying trade survived with little diminution for many years; its relative decline in the 18th century was due to other causes.

The Mercantile System.—"The ordinary means to increase our wealth and treasure," declared Thomas Mun in the middle of the 17th century, "is by foreign trade, wherein we must ever observe this rule—to sell more to strangers yearly than we consume of theirs in value." This meant that a government should see that the value of the commodities exported was greater than that of those imported; the difference, it was supposed, would have to be paid in treasure, *i.e.*, coin or bullion. The means adopted to secure a favourable balance of trade in this sense constituted the mercantile system. The trade with foreign countries in general and each country in particular was examined to discover whether the general and particular balances were or were not favourable. If a balance was considered to be unfavourable, steps had to be taken to correct it. In France Louis XIV.'s minister, Colbert, set himself to promote French commerce on these principles; he accordingly tried to restrict trade with England and Holland. English mercantilists, on the other hand, regarded trade with France as disadvantageous and it was subjected to the prohibitive tariff of 1678 until Pitt initiated a more liberal policy in the commercial treaty of 1786. It was also found that the importation of naval stores—tar, pitch, resin and timber—from the Baltic meant that England had a permanently unfavourable balance of trade with Sweden and Russia; consequently an attempt was made to stimulate a new source of supply by offering bounties on the production of these commodities in the American colonies. In fact colonization seemed to offer to the countries of western Europe a way of escape from the supposed disadvantages of unfavourable balances of trade. The colonies might either produce the commodities which had otherwise to be imported from a foreign country, such as naval stores, or send to the mother country some staple goods, such as tobacco or sugar, which could be re-exported to foreign countries and thus give it a firmer position in their markets. It was for this reason that the English Navigation Act of 1660 "enumerated" certain articles which had to be sent in the first instance to England, a list which included sugar, tobacco, indigo and ginger. The mother country was to be the *entrepôt* for these goods. It followed that the highest value was put upon the colonies which produced them, *i.e.*, the West Indies, Virginia and Maryland. The New England colonies were looked upon with suspicion because they produced commodities similar to those of the mother country. There is no doubt, of course, that England would have made high profits had she been able to monopolize the new staples which were now entering into long-distance trade. For a time she supplied the European markets with sugar, but in the 18th century Dutch and French producers were able to undersell her. It was to prevent the New England colonies from trading with the foreign West Indies and thus assisting in their development that the Molasses Act of 1733 was passed. For 30 years the act was almost a dead-letter, and then the declared intention of the mother country to enforce it contributed to the beginnings of revolutionary agitation in the colonies. The history of tobacco is different. It was overproduced in the British colonies and prices fell; but since so much credit had been advanced to the planters their position of heavy indebtedness was also an element in estrangement from the mother country. The aims of mercantilism had been defeated by the course of events. The revolt of the American colonies in 1776 made a serious breach in the system, and the publication of Adam Smith's *Wealth of Nations* in the same year supplied the classical refutation of its fallacies.

The Industrial Age.—The fact that so much importance was attached to the trade in sugar and tobacco—and, it should be added, the East India Company's monopoly in tea—is an indication of the change which had come over long-distance trade. Commerce was now supplying the necessaries of the many rather than the luxuries of the few. Since these necessaries were only to be obtained in exchange for other goods, the increasing demand promoted industries in the trading countries. This was particularly the case in Great Britain where commercial expansion led to an industrial revolution. A country which had attempted to use colonial staples in order to become "a nation of shopkeepers" found herself converted into "the workshop of the world." Her position as a great ocean carrier, the financial system which had been built up, the freedom of movement for persons and goods within her boundaries and the natural resources in coal and iron all contributed to this conversion. Perhaps one of the most significant results was the change in the direction of the flow of textiles. Until the end of the 18th century the trade with India had been looked upon with some disfavour because it involved considerable imports of calicoes and muslins and a comparatively small export of English woollens. The introduction of machinery in the Lancashire cotton industry completely altered the position. Raw cotton was now imported in large quantities from America and machine-made piece goods were sent to India where they were sold at such prices that the native products could not compete with them. The application of steam-power to transport enormously enlarged the scope of commerce. Railways opened up the interior of the continents and so brought to the ports commodities which would not otherwise have entered into long-distance trade, or in many cases indeed would not have come into existence. The steamship reduced the length of voyages and construction in iron—and later in steel—greatly increased its carrying capacity; services were also more regular than in the old sailing days. When the Suez canal was opened in 1869 it provided a much shorter route to the East particularly suited to the steamship.

All these changes naturally reacted on commercial policy. Great Britain between 1820 and 1860 abandoned the restrictive system which had survived from the 18th century. To sell her manufactures in the markets of the world she opened her ports to the raw materials and food stuffs which other countries could supply. She was also able to put her financial resources at the disposal of those who undertook the building of railways and other projects abroad and thereby helped to multiply the goods which entered into commerce. Railways and low ocean freights made it possible for wheat grown in the Mississippi valley to be sold in Great Britain at prices which drove British farmers to reduce arable cultivation. A rapidly growing population depended to an ever greater degree on the import of food from overseas.

World Economy.—In the later decades of the 19th century the process of industrialization made rapid progress in other countries, particularly in the United States of America and Germany. They possessed deposits of coal and iron—the essential prerequisites in the first phase of industrialism—and became great manufacturing centres. A country cannot develop such resources on a large scale and remain independent of other countries; for the ideals of self-sufficiency and industrial development are incompatible. The reasons are obvious enough. An industrialized country is an urbanized country with a growing population; the industries require raw materials and wide markets for manufactured goods and the population needs food supplies which must be sought elsewhere. So there emerged a system which was an uneasy combination of rivalry and interdependence. For while the industrial countries competed with one another in supplying non-industrial countries with manufactured articles and in trying to gain access to the tropical products, such as rubber, which were beginning to assume importance, they also found the widest scope for the exchange of goods in the trade between themselves, because highly organized communities naturally offer the best markets for a great variety of commodities. Before the World War, for instance, Great Britain sold more to Germany than to any country except India, and she bought more from Germany than from any country except the United States.

These commercial ties seemed to some to preclude the possibility of war between the Great Powers. In this they proved to be wrong. Still war revealed the fact of the real interdependence of nations. It showed that great industrial communities cannot inflict damage on one another without suffering themselves in the process and indeed endangering the whole economic structure on the preservation of which the standard of life of their dense populations ultimately depends. A world economy must necessarily mean that it is only a degree less disastrous to win a war than to lose it. The conquered can only be made to bear a proportion of the war costs if the conquerors assist them to re-establish their industries, which is merely to say that the only way to heal the disruption caused by war is to bind the nations together again. The fundamental fact in the modern world is the revolution in the means of transport and communication. Before the industrial age the movement of men and goods was difficult and therefore exceptional; it has become easy and usual. And while modern inventions have greatly speeded up transport it has practically annihilated distance with respect to the sending of information. The sale of goods in large quantities can be effected at great distances. Where grading is possible they can be sold by description even before they have come into existence; for speculators engage to deliver goods at a given price at a future date in the expectation that they will be able to buy at a lower price when the time comes to deliver. In these and other respects the mechanism of modern commerce tends to establish a world market in certain staple commodities.

The Post-War Period.—The post-war period at first presented almost insuperable obstacles to the resumption of normal commercial relations. Financial devices adopted in the course of the war produced a derangement of currencies which made international trade extremely difficult. Some nations, alarmed at the possibility that their markets might be flooded by goods from countries where the depreciation of the currency constituted a bounty on export, tried to safeguard themselves by means of restrictions on trade. Such regulations and the absence of commercial understandings gave a general instability to what trade was available. There was also the real poverty of the populations in the chief countries, which meant a falling off in purchasing power. The lack of a surplus for capital investment in the undeveloped parts of the world reacted on the demand for manufactured goods and also on the supply of food and raw materials. But the instability of the exchanges and the fall in purchasing power were short period consequences of war. The real question was whether in the long run normal trade relations would be resumed.

The war and the terms of the treaties which concluded it promoted a movement which hampered foreign trade. During the war native industries had been stimulated and the plea for self-sufficiency strengthened; the countries which won recognition of their national aspirations, therefore, proceeded to erect tariff barriers along their frontiers. As a result of the peace treaties the number of independent customs administrations was nearly doubled. The prohibitions and restrictions imposed by these States together with the constant changes of tariff rates had serious consequences, particularly in central Europe. A return to a general policy of freer international commerce was recognized by the International Economic Conference, which met at Geneva in May 1927, to be a condition precedent to the restoration of prosperity. The advantages which accrue from the lowering of trade barriers hardly require to be demonstrated in view of the history of commerce. For if it proves anything it is that restrictive regulations have been harmful to those who have adopted them when they have not been entirely futile. But there is always the temptation to try to direct the course of events. The war certainly hastened inevitable changes. Eastern countries, for instance, are supplying their own needs in machine-made textiles to an increasing extent. The exports of British cotton piece-goods to India declined 57% between 1913 and 1923, a decline due in unequal proportions to a fall in consumption, increased local production and more severe foreign competition. It is also clear that coal is no longer the only practical means of producing power and that this fact must embarrass the countries which have excess productive capacity. Changes such as these make the future uncertain and often lead to the adoption of short-sighted policies.

A few simple principles stand. There is a mutual advantage in the exchange of commodities between different areas. Modern means of transport and communication make such exchange easy where no hindrances are imposed. To industrial communities such exchange is vital. A country in the position of Great Britain, for instance, can only secure food and raw materials if it can find markets for its manufactures. Should markets be lacking it will be impossible to maintain the present population with the standard of living to which it has become accustomed. The loss of some markets must be compensated for by the discovery of others and a falling off in the demand for the heavier commodities, such as coal, or the coarser goods, such as cheap cotton piece-goods, must be met by the concentration on the more highly manufactured articles. Whether such compensations can be found will depend on many factors, chiefly on increased efficiency of production. It was the practice of commerce that led to the industrial development of the Great Powers and it is hardly conceivable that its volume will be reduced, though its nature and direction will be changed in the course of the 20th century.

See MACEDONIAN EMPIRE; ROME, *History;* GUILDS; FAIR; HANSEATIC LEAGUE; EAST INDIA COMPANY; DUTCH EAST INDIA COMPANY; PORTUGAL, *History;* SPAIN, *History;* HOLLAND, *History;* etc.

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COMMERCE, DEPARTMENT OF: *see* GOVERNMENT DEPARTMENTS.

COMMERCIAL COURT, in England, a court presided over by a single judge of the king's bench division, for the trial, as expeditiously as may be, of commercial cases. By the Rules of the Supreme Court, Order xviii. *a* (made in Nov. 1893), a plaintiff was allowed under certain circumstances to dispense with pleadings altogether.

Out of this order there grew the commercial court. It is not a distinct court or division or branch of the High Court, and is not regulated by any special rules of court made by the rule committee. It originated in a notice issued by the judges of the queen's bench division, in Feb. 1895, the provisions contained in which represent only "a practice agreed on by the judges, who have the right to deal by convention among themselves with this mode of disposing of the business in their courts" (per Lord Esher in *Barry v. Peruvian Corporation*, 1896, 1 Q.B. p. 209).

The scheme is only applicable to cases in which there is some single issue of law or fact, or the case depends on the construction of some contract or other instrument or section of an act of parliament, and such issue or question is either agreed upon by the parties or at once ascertainable by the judge.

COMMERCIAL EDUCATION, being a recent development of the educational system, is, in most countries, still in a state of transition, no adequate general plan having yet been adopted. The need for this type of education, however, has gradually become recognized, and in Great Britain and the United States considerable progress is being made.

The Education Act of 1918 led to the formation of Continuation schools and classes under the London County Council and other educational authorities in Great Britain, and an association was formed for the advancement of education in industry and commerce. In the United States the Federal Board for Vocational Education has also done active work in this direction. (*See* CONTINUATION SCHOOLS.)

I. GREAT BRITAIN

The Institute.—The beginnings of public commercial education in Britain may largely be ascribed to the activities of the mechanics' institutes in the early and middle periods of the 19th century, in which evening classes in both book-keeping and languages gradually grew up. These were succeeded by technical institutes, such as the Birmingham and Midland Institute and the Manchester High School of Commerce. In fact, up to 1890, and even later, the north of England and the Midlands were, as regards commercial education, in advance of London and the rest of the country. In 1890 the school boards gained the right to undertake evening work. This ultimately led to the country being covered with a network of evening schools. The work at first was of a rather elementary nature, consisting of book-keeping, shorthand, typewriting, English and often French. The Technical Education Act gave a considerable impetus to the spread of commercial education in polytechnics and similar institutions.

Still the movement had to face a good deal of opposition, or at least inertia, mainly from the widespread belief, which has not yet entirely disappeared and which is based on a half-truth, that commerce is best learned in the shop and the counting-house. Again, there was a good deal of muddle-headed thinking on the subject. Mr. Sidney Webb pointed out in a London conference held at the Society of Arts in 1897 that the term commerce covered a multitude of things—a vast number of distinct callings, from accountancy and banking to typewriting. It therefore involved an education of very varying degree, from elementary to university.

Universities.—Mr. Sidney Webb was largely responsible for the creation in 1895 of the London School of Economics and Political Science as an institute for higher commercial work. Beginning largely as a college for evening work, it subsequently developed a flourishing day side, and became a school of London university. Further developments in the course of higher education were the creation of faculties of commerce in the University of Birmingham (1900) and the re-constituted University of Manchester (1904), while London in 1917 established a bachelorship and mastership of commerce. A commercial degree can also be obtained at Newcastle (University of Durham), and at Liverpool a B.A. is awarded for proficiency in certain commercial subjects.

Economics figure as a prominent subject in the syllabus of other universities, but are taught mainly on theoretical lines, and no degree in commerce is obtainable. Probably the most complete choice of subjects for commercial study is offered by the London School of Economics and Political Science, amounting to nearly 270 courses given by some 80 lecturers and assistants. More than half of its departments are concerned wholly or partially with commerce. It prepares for the degrees of Bachelor of Commerce and Master of Commerce, and provides for research work.

Schools of Commerce.—Below the universities come the various day schools of commerce, often forming a section or department of a technical institute. The age of entry is generally 16, and some prepare for the B.Com. Such are for instance, the City of London College, The Regent Street Polytechnic Higher School of Commerce, the West Ham Technical Institute, with its course in commerce (three years), and the Manchester Municipal High School of Commerce. There are also junior commercial schools, where the age of entry is usually 13 and the course is two years (occasionally three).

Secondary Schools.—Certain secondary schools, like Hackney Downs and Holloway (London), prepare their students for degrees in commerce, while at least one of the public schools (Bradfield) has a definite commercial section. A large number of girls' secondary schools also do commercial work, which in many cases is confined to pupils who have passed the first school examination. In others it is begun by pupils of 15 who desire to specialize in commerce. Typewriting, shorthand and book-keeping, with commercial French, history and geography, are the staple subjects.

Higher Elementary Schools.—Up to 1908 the curricula of the higher elementary schools were based on lines giving a general education. In that year, the London schools of this type were reorganized with a dual bias, commercial and technical, and renamed central—a school might have one or both sections. The London central schools largely became the model for other central schools for the rest of the country. In the voluntary day continuation school the teaching, which at the outset was general, became, in London at least, largely commercial.

Evening Work.—Some evening work in the London School of Economics and elsewhere is of university standard. Below this ranks the work of the evening schools, many of which, especially in the country, are situated in technical institutes, notable examples being the Manchester and Birmingham Municipal Schools of Commerce, the Hull Central School of Commerce, the Bradford Commercial College, the City of London College and the 24 London evening institutes.

The range of work is considerable, and, apart from typewriting, shorthand and book-keeping, includes preparation for examinations in accountancy of all kinds, banking, insurance (life, fire, marine), railway administration, civil service (post-office, inland revenue, customs and excise), courses for solicitors' or stockbrokers' clerks, for secretaries or grocers' assistants. This involves classes in economics, including economic history and geography, and the economics of shipping, railways, etc.; the theory and practice of commerce, banking, currency, foreign exchanges, statistics, the machinery of business, secretarial practice, knowledge of commodities, law of all kinds—general, conveyancing, banking, company, commercial, mercantile, marine, joint stock, income tax, etc.

The teaching of languages comprises French, German, Spanish, Italian and other less known languages, and Esperanto by the course system, all students under 18 who have not had a good secondary or central school education are obliged to take a course in which a language often forms a part. Students enter the institutes at sixteen. Below these are the junior institutes, usually entered at 14, where all pupils are obliged to take a course.

Private Initiative.—There also exist a number of schools attached to big business houses, as well as many private institutions, which prepare mainly for the lower and intermediate walks of commerce and the civil service.

Examinations.—In addition to the examinations mentioned above, and some higher commercial certificates, a large number of students in the evening institutes and elsewhere take the examination of the Society of Arts, the Chamber of Commerce and other societies. The Society of Arts held its first practical examination in 1856, and among the subjects were French and book-keeping. The candidates, mainly drawn from mechanics' institutes, numbered 56. In 1927 the number of papers worked was over 88,000. The London Chamber of Commerce, which began in 1890 with 65 candidates and 17 passes (all junior), had, in 1926, more than 25,000 worked papers. (C. BR.)

II. UNITED STATES

The first commercial courses offered in the United States early in the 19th century were for the purpose of training book-keepers. Since 1894 commercial courses have included, besides book-keeping, the subjects of typewriting and shorthand. Retail selling was added about ten years later.

Early commercial training was given almost entirely in private commercial schools which recruited their students chiefly from the graduating classes of public elementary schools. Public pressure for free commercial education, and business pressure for trained office workers possessing more than elementary schooling, put commercial courses in the curricula of urban high schools. In the beginning, the high school courses were mere copies of those offered in the private schools, and were taught, in the main, by teachers drafted from these institutions. In time, however, both teachers and courses were greatly improved. The better high schools now offer both short and long courses in the three following groups of work—(1) secretarial and recording, (2) accounting and (3) selling.

It is interesting to note that in the competition against the public high schools, the private commercial schools are steadily losing ground as the following statistics taken from a 1926 bulletin of the United States Bureau of Education will show.

Year	No. of private schools	Enrolment	Year	No. of high schools	Enrolment
1920	903	336,032	1916.	2,844	243,185
1925	739	188,363	1924.	3,742	430,975

The introduction of commercial courses into high schools did not insure continued adjustment to the changing needs of a business world in which commercial practices were gradually becoming highly specialized. A Congressional commission in 1916 reported "the quality of commercial education might be improved" and the Smith-Hughes act of 1917 placed definitely upon the newly created Federal Board for Vocational Education the responsibility for making surveys to determine the actual commercial education needs of the country. In its survey of commercial occupations in which workers 14 to 18 years of age are employed, the Federal board classified and analysed the following junior commercial occupations—(1) general clerk, (2) shipping clerk, (3) receiving clerk, (4) stock clerk, (5) file clerk, (6) mail clerk, (7) typist, (8) billing clerk, (9) duplicating and addressograph machine operator, (10) calculating machine operator, (11) office boy, (12) collector, (13) assistant book-keeper, (14) entry clerk, (15) ledger clerk, (16) cost clerk, (17) book-keeping machine operator, (18) time-keeper, (19) statement clerk, (20) stenographer, (21) dictating machine operator, (22) junior sales person, (23) messenger, (24) bundle wrapper, (25) cashier and (26) examiner. Following the presentation of the Federal findings, commercial continuation, high and evening schools greatly altered their curricula to meet more adequately the needs of junior workers who, in more cases than not, need training in other commercial courses than book-keeping, typewriting and stenography. The Federal Board has also been very active in assisting national associations of retail grocers, dry goods merchants, laundry owners and others in developing curricula suitable for the training schools of the special commercial interests.

On the university level there is an unusually active development of schools of commerce and business administration. Besides specialized courses, these schools offer general opportunities in economics, business law, finance, marketing and merchandising, and business organization and administration. The most recent addition to the curriculum to receive great attention is business ethics.

In their research investigations, these university schools are focusing their efforts upon the most perplexing problem business is facing—the economical distribution of goods. In the larger centres, also, these schools are affecting co-operative arrangements with business interests. Notable among these is the Meat Packers' institute affiliated with the University of Chicago.

(W. F. R.)

Schools of Business.—The organization of professional schools of business in the United States is part of that broader educational trend which has given us schools of medicine, law, dentistry, agriculture, engineering and journalism. The first school of commerce in the United States which could properly be regarded as of collegiate type was the Wharton school at the University of Pennsylvania, founded in 1881. During more than the first two decades of its existence it could boast little more than the conventional academic course interspersed with economics, political science and sufficient mercantile law and accountancy to meet the stipulation of the school's founder that it afford "training suitable for those who intend to engage in business or to undertake the management of property." No other school was organized until 1898, when the University of California and the University of Chicago entered the lists. In 1900 the University of Wisconsin, Dartmouth college and New York university presented organized courses. The University of Michigan followed in 1901. Beginning with 1908 growth accelerated, and by the end of 1925 no university was without some courses stressing education for business. Many of the colleges of the country, large and small, have imitated this procedure on a minor scale.

Schools of business have often been classified according to conditions set for student admission. In a number of instances, of which the Wharton school is typical, a student may be admitted at the end of his high school career to a course of study which covers four academic years and affords a mixture of general academic and more specific business instruction. In other instances, of which the school at Columbia is a fair example, two pre-business college years must be completed in general academic subjects before a student may pass on to two or more special years of business study, and thence, if he so choose, to more advanced study of graduate character. At Dartmouth and Michigan, three years of college work are required for admission to a two-year business course leading to a master's degree; and at Harvard and Leland Stanford the schools of business require college graduation for admission to a course leading to a master's degree. Most of the urban institutions have developed continuation courses, often highly specialized, for students not interested in an academic degree.

Owing to varying maturity of students resulting from divergent entrance requirements, and other more local reasons, school objectives as well as curricula show considerable diversity. In many instances the aim has been loosely expressed as "training for business," and the resulting curriculum is a loose collection of business courses adapted to immediate practical needs. But among the older and better organized schools there is gradually emerging a conception of objective which stresses preparation for ultimate managerial responsibility. The aim is to afford business knowledge which is transferable and typical of many fields of business enterprise, and gives its possessor freedom and power rather than narrowly focussed skill leading to fixity of occupational status. Resulting curricula, therefore, are tending less to depict business routine, and more to stress fundamentals, at least as a basis for possible subsequent specialization. A background of geographic knowledge and technology, acquaintance with language, accounting and statistics, familiarity with business structure and function, and its place in the broader fabric of society, have all come to be regarded as essentials of instruction. Beyond this there is a growing array of opportunities for study and research in special fields such as production, marketing, finance, transportation and insurance, with increasing emphasis in the larger urban institutions on specialized and technical phases of current practice and experimentation. Methods of instruction for the most part follow the usual college types; but in a few instances distinctive methods have been evolved. At Cincinnati practice in active business is co-ordinated with theory at school on a supervised co-operative basis; and at Harvard a case method of instruction is being perfected, somewhat along law school lines, to give realistic quality to class work and afford a synthetic view of business administrative devices and judgments which by other methods can be treated only hypothetically and as segregated phases of practice. But all of these problems of curriculum and of teaching method are still in a highly fluid state. Business research in a variety of forms is pursued in a number of schools, and in the stronger ones their research activities are guided by regularly organized bureaux. The American Association of Collegiate Schools of Business through its information service promotes co-ordination and avoidance of duplication in research projects. The association likewise affords a forum for discussion of general school problems. Two periodicals, *The Harvard Business Review* and *The Journal of Business* (Chicago), besides irregularly issued publications, furnish scientific discussion of educational and business problems. (R. C. McC.)

COMMERCIAL FEDERATION: *see* CUSTOMS UNION.

COMMERCIAL LAW, a term used rather indefinitely to include those rules and principles which govern commercial transactions and customs. It includes within its compass such titles as principal and agent; carriage by land and sea; merchant shipping; guarantee; insurance; bills of exchange; partnership; limited companies; bankruptcy, etc.

COMMERCIAL PAPER, a term popularly applied to all kinds of short-term negotiable instruments which call for the payment of money and which may be used for borrowing. Strictly, it should be used only for such paper as arises from commercial, as distinguished from investment, speculative, personal, real estate or public transactions. It includes such instruments as short-term notes, drafts, bills of exchange, acceptances, etc.

In the more narrow financial sense, commercial paper signifies only those unsecured promissory notes issued by business borrowers (industrial or mercantile corporations or partnerships) and sold through note brokers to banks, insurance companies and other large investors. Only loans of considerable size are represented by commercial paper, $25,000 being about the absolute minimum, as small issues would not pay the commercial paper house for the cost of the investigating and selling. Such notes usually range in denominations of from $5,000 to $10,000 each, but often, to accommodate the smaller banks, some are issued in denominations of $2,500. Commercial paper notes are signed by the borrower, made payable to himself or order and then endorsed in blank so that they can be transferred easily to whatever customer that note-broker may find. Guarantees or endorsements sometimes appear on such notes, but this is very rare, and makes the notes unpopular with both the commercial paper houses and the banks, for to them it indicates that the credit of the issuing firm was not sufficiently sound to carry the notes alone.

The commercial paper houses which sell the notes do not (although there are exceptions) endorse or guarantee the paper they sell, but stake their futures as brokers upon the continued offering of sound material only. Before accepting an issue of notes the commercial paper house makes a most rigid and exhaustive examination to assure itself of their soundness, and in the event of the borrower's default, frequently assumes the loss itself in order to protect its reputation with its clients. These notes vary in time from one month to one year, the majority of them being for about a four months' period. Business houses which utilize the commercial paper method of borrowing avoid as far as possible frequent short term loans, as they have to pay $\frac{1}{4}\%$ commission to the paper house for each successive issue. Both the length of the issue and the rate of interest paid, however, are necessarily largely governed by the financial condition and needs of the issuing company and by current demands of the banks and other prospective purchasers.

There are several reasons which may influence businesses to sell their paper on the open market rather than borrow directly from banks. Some of them are: (1) They may sell paper on the open market when the available funds of the local bank are insufficient to take care of the desired loan. (2) They may often be able to sell commercial paper at a lower interest rate than is obtainable at the local banks. (3) They may reserve a regular line of credit at local banks to be used, if advisable, upon other occasions. Care must be taken, however, not to pit the open market as a competitor against the bank for the firm's business, otherwise the bank's line of credit may be found to be withdrawn when wanted. (4) A larger line of credit is usually obtainable through the open market than through dealing exclusively with local banks. (5) A wide geographic distribution of a firm's paper, providing the firm makes all payments promptly and regularly, gives the firm a wide reputation as an issuer of "prime paper," and banks in every part of the country are willing to take it up. This makes future borrowing comparatively easy. (6) The open market may be used to obtain funds to settle up bank loans and thus maintain local bank credit. (7) In a loan obtained through the sale of commercial paper no part of the proceeds is tied up, as is the case with bank loans, where a deposit of about 20% of its line of credit is required.

There are also several reasons why banks are glad to purchase commercial paper. Among them are: (1) Banks may thus utilize funds that are not in immediate demand for local loans. (2) They may sometimes procure a higher interest rate on commercial paper than is current on local loans. (3) They may buy only such notes as have maturities fitting in exactly with the bank's expected needs for cash. (4) The bank is under no obligation, moral or otherwise, to renew such notes, and thus avoids embarrassment which sometimes arises over renewal demands on local loans. It is well assured that commercial paper will be paid at maturity without question or quibble. (5) The bank's money is in obligations scattered over a wide territory, which geographical diversification gives assurance that only a small portion may be affected diversely by unfavourable local causes. (6) The bank obtains the advantage of the broker's careful investigation and experienced judgment in the selection of the paper. (7) The bank may rediscount commercial paper through the Federal Reserve banks to provide liquid assets, in case of necessity. (J. H. B.)

British Usage.—The term "commercial paper" is not used in English banking circles. The term implies the obtaining of credit by means of a promissory note issued to a "note-broker," or alternatively, direct to a bank, and the essence of such a document is that it is merely a promise to pay a certain sum at a certain date.

The usual way of obtaining credit in England is either by an advance from a banker, which may or may not be secured, and which may be for a definite sum and run for a definite period, or simply be a running overdraft; or else by means of a bill of exchange (*see* BILL OF EXCHANGE). The bill is the nearest approach in England to an American note, but even so, there are several vital points of difference. The chief is that while a note is but a promise by a single individual, a bill is an order to pay given by one individual to a second. Thus, a note need only bind one person, while a bill must bind at least two. A bill, too, can be secured. Thus, if it is endorsed D/P, the goods against which it is drawn are only delivered to the purchaser after he has paid the bill.

In general, the bill is used extensively in international trade, where the case of the note would be impracticable. Take the case of a shipment of goods from Hamburg to New York. The seller may draw his bill upon a bank in London, which has arranged to accept on behalf of the New York buyer. The seller may then discount it at his Hamburg bank who, in turn, endorse it and send it to London for acceptance and for sale in the London market. Thus the bill carries the "names" of the seller himself, of his Hamburg bank, and of the accepting London bank, and the holder has two banks and a private individual to fall back upon; whereas if the buyer simply gave a note, all the holder of the note would have would be the name of an individual on the other side of the Atlantic. (N. E. C.)

COMMERCIAL TREATIES. A commercial treaty is a contract between states relative to trade. It is a bilateral act whereby definite arrangements are entered into by each contracting party towards the other—not mere concessions. As regards technical distinctions, an "agreement," an "exchange of notes," or a "convention" properly applies to one specific subject; whereas a "treaty" usually comprises several matters, whether commercial or political.

In ancient times foreign intercourse, trade and navigation were in many instances regulated by international arrangements. The text is extant of treaties of commerce and navigation concluded between Carthage and Rome in 509 and 348 B.C. Aristotle mentions that nations were connected by commercial treaties; and other classical writers advert to these engagements. Under the Roman empire the matters thus dealt with became regulated by law, or by usages sometimes styled laws. When the territories of the empire were contracted, and the imperial authority was weakened, some kind of international agreements again became necessary. At Constantinople in the 10th century treaties cited by Gibbon protected "the person, effects and privileges of the Russian merchant"; and, in western Europe, intercourse, trade and navigation were carried on, at first tacitly by usage derived from Roman times, or under verbal permission given to merchants by the ruler to whose court they resorted. Afterwards, security in these transactions was afforded by means of formal documents, such as royal letters, charters, laws and other instruments possessing the force of government measures. Instances affecting English commercial relations are the letter of Charlemagne in 796, the Brabant Charter of 1305, and the Russian ukase of 1569. Mediaeval treaties of truce or peace often contained a clause permitting in general terms the renewal of personal and commercial communication as it subsisted before the war. This custom is still followed. But these mediaeval arrangements were precarious: they were often of temporary duration, and were usually only effective during the lifetime of the contracting sovereigns.

The Modern System Begins.—Passing over trade agreements affecting the Eastern empire, the modern commercial treaty system came into existence in the 12th century. Genoa, Pisa and Venice were then well-organized communities, and were in keen rivalry. Whenever their position in a foreign country was strong, a trading centre was established, and few or no specific engagements were made on their part. But in serious competition or difficulty another course was adopted: a formal agreement was concluded for the better security of their commerce and navigation. The arrangements of 1140 between Venice and Sicily; the Genoese conventions of 1149 with Valencia, of 1161 with Morocco, and of 1181 with the Balearic Islands, the Pisan conventions of 1173 with Sultan Saladin, and of 1184 with the Balearic Islands, were the earliest Western commercial treaties. Such definite arrangements, although still of a personal character, were soon perceived to be preferable to general provisions in a treaty of truce or peace. They afforded also greater security than privileges enjoyed under usage; or under grants of various kinds, whether local or royal. The policy thus inaugurated was adopted gradually throughout Europe. The first treaties relative to the trade of the Netherlands were between Brabant and Holland in 1203, Holland and Utrecht in 1204, and Brabant and Cologne in 1251. Early northern commercial treaties are those between Riga and Smolensk in 1229, and between Lübeck and Sweden in 1269. The first commercial relations between the Hanse Towns and foreign countries were arrangements made by guilds of merchants, not by public authorities as a governing body. For a long period the treaty system did not entirely supersede conditions of intercourse between nations dependent on permission.

The earliest English commercial treaty is that with Norway in 1217. It provides *ut mercatores et homines qui sunt de potestate vestra liberè et sine impedimento terram nostram adire possint, et homines et mercatores nostri similiter vestram* (that merchants and men who are of your power may freely and without impediment visit our territory, and our men and merchants similarly visit yours). These stipulations are in due treaty form. The next early English treaties are:—with Flanders, 1274 and 1314; Portugal, 1308, 1352 and 1386; Baltic Cities, 1319 and 1388; Biscay and Castile, 1351; Burgundy, 1417 and 1496; France, 1471, 1497 and 1510; Florence, 1490. The commercial treaty policy in England was carried out systematically under Henry IV. and Henry VII. It was continued under James I. to extend to Scotland English trading privileges. The results attained in the 17th century were—regularity in treaty arrangements; permanent instead of personal nature; the conversion of permissive into perfect rights; questions as to contraband and neutral trade stated in definite terms. Treaties were at first limited to exclusive and distinct engagements between the contracting states; each treaty differing more or less in its terms from other similar compacts. Afterwards by extending to a third nation privileges granted to particular countries, the *most favoured nation article* began to be framed, as a unilateral engagement by a particular state. The Turkish capitulations afford the earliest instances; and the treaty of 1641 between the Netherlands and Portugal contains the first European formula. Cromwell continued the commercial treaty policy partly in order to obtain a formal recognition of the commonwealth from foreign powers. His treaty of 1654 with Sweden contains the first reciprocal "most favoured nation clause":—Article IV. provides that the people, subjects and inhabitants of either confederate "shall have and possess in the countries, lands, dominions and kingdoms of the other as full and ample privileges, and as many exemptions, immunities and liberties, as any foreigner doth or shall possess in the dominions and kingdoms of the said confederate." The government of the Restoration replaced and enlarged the Protectorate arrangements by fresh agreements. The general policy of the commonwealth was maintained, with further provisions on behalf of colonial trade. In the new treaty of 1661 with Sweden the privileges secured were those which "any foreigner whatsoever doth or shall enjoy in the said dominions and kingdoms on both sides."

In contemporary treaties France obtained from Spain (1659) that French subjects should enjoy the same liberties as had been granted to the English; and England obtained from Denmark (1661) that the English should not pay more or greater customs than the people of the United Provinces and other foreigners, the Swedes only excepted. The colonial and navigation policy of the 17th century, and the proceedings of Louis XIV., provoked animosities and retaliatory tariffs. During the War of the Spanish Succession the Methuen Treaty of 1703 was concluded. Portugal removed prohibitions against the importation of British woollens; Great Britain engaged that Portuguese wines should pay one-third less duty than the rate levied on French wines.

At the peace of Utrecht in 1713 political and commercial treaties were concluded. England agreed to remove prohibitions on the importation of French goods, and to grant most favoured nation treatment in relation to goods and merchandise of the like nature from any other country in Europe; the French general tariff of Sept. 18, 1664, was again to be put in force for English trade. The English provision was at variance with the Methuen Treaty. A violent controversy arose as to the relative importance in 1713 of Anglo-Portuguese or Anglo-French trade. In the end the House of Commons, by a majority of 9, rejected the bill to give effect to the commercial treaty of 1713; and trade with France remained on an unsatisfactory footing until 1786. The other commercial treaties of Utrecht were very complete in their provisions, equal to those of the present time; and contained most favoured nation articles—England secured in 1715 reduction of duties on woollens imported into the Austrian Netherlands; and trading privileges in Spanish America. Moderate import duties for woollens were obtained in Russia by the commercial treaty of 1766. In the meanwhile the Bourbon family compact of Aug. 15, 1761, assured national treatment for the subjects of France, Spain and the Two Sicilies, and for their trade in the European territories of the other two states; and most favoured nation treatment as regards any special terms granted to any foreign country. The first commercial treaties concluded by the United States with European countries contained most favoured nation clauses: this policy has been continued by the United States, but the wording of the clause has often varied.

In 1786 France began to effect tariff reform by means of commercial treaties. The first was with Great Britain, and it terminated the long continued tariff warfare. But the wars of the French Revolution swept away these reforms, and brought about a renewal of hostile tariffs. Prohibition and differential duties were renewed, and prevailed on the Continent until the sixth decade of the 19th century. In 1860 a government existed in France sufficiently strong and liberal to revert to the policy of 1786. The bases of the Anglo-French treaty of 1860, beyond its most favoured nation provisions, were in France a general transition from prohibition or high customs duties to a moderate tariff; in the United Kingdom abandonment of all protective imposts, and reduction of duties maintained for fiscal purposes to the lowest rates compatible with these exigencies. Other European countries were obliged to obtain for their trade the benefit of the conventional tariff thus established in France, as an alternative to the high rates inscribed in the general tariff. A series of commercial treaties was accordingly concluded by different European states between 1861 and 1866, which effected further reductions of customs duties in the several countries that came within this treaty system. In 1871 the Republican government sought to terminate the treaties of the empire. The British negotiators nevertheless obtained the relinquishment of the attempt to levy protective duties under the guise of compensation for imposts on raw materials; the duration of the treaty of 1860 was prolonged; and stipulations better worded than those before in force were agreed to for shipping and most favoured nation treatment. In 1882, however, France terminated her existing European tariff treaties. Belgium and some other countries concluded fresh treaties, less liberal than those of the system of 1860, yet much better than anterior arrangements. Great Britain did not formally accept these higher duties; the treaty of Feb. 28, 1882, with France, which secured most favoured nation treatment in other matters, provided that customs duties should be "henceforth regulated by the internal legislation of each of the two states." In 1892 France also fell out of international tariff arrangements; and adopted the system of double columns of customs duties—one, of lower rates, to be applied to the goods of all nations receiving most favoured treatment; and the other, of higher rates, for countries not on this footing. Germany then took up the treaty tariff policy; and between 1891 and 1894 concluded several commercial treaties.

During the succeeding 20 years the world's tariffs and concomitant treaties were remodelled again and again, and at the outbreak of the World War, nearly all the nations were linked together by a close network of commercial treaties, by means of which it was attempted to reconcile three very different objects, (1) the gathering of customs revenue, (2) the protection of home industries, and (3) the furtherance of export trade. Each such treaty represented a compromise in the pursuance of these objects, but each, nevertheless, formed a link of real commercial importance.

Scope.—The scope of commercial treaties is well expressed by Calvo in his work on international law. They provide for the importation, exportation, transit, trans-shipment and bonding of merchandise; customs tariffs; navigation charges; quarantine; the admission of vessels to roadsteads, ports and docks; coasting trade; the admission of consuls and their rights; fisheries; they determine the local position of the subjects of each state in the other country in regard to residence, property, payment of taxes or exemptions, and military service; nationality; and a most favoured nation clause. They usually contain a termination, and sometimes a colonial article. Some of the matters enumerated by Calvo—consular privileges, fisheries and nationality—are now frequently dealt with by separate conventions. Contraband and neutral trade are not included as frequently as they were in the 18th century.

The preceding statement shows that commercial treaties afford to foreigners, personally, legal rights and relief from technical disabilities; they afford security to trade and navigation, and regulate other matters comprised in their provisions. In Europe in 1914 the general principles established by a series of treaties (1860–66) held good, viz., the substitution of uniform rates of customs duties for prohibitions or differential rates. The disadvantages urged are that these treaties involve government interference and bargaining, whereas each state should act independently as its interests require; that they are opposed to free trade, and restrict the fiscal freedom of the legislature. It may be observed that these objections imply some confusion of ideas. All contracts may be designated bargains, and some of the details of commercial treaties in Calvo's enumeration enter directly into the functions of government; moreover, countries cannot remain isolated. If two countries agree by simultaneous action to adopt fixed rates of duty, this agreement is favourable to commerce, and it is not apparent how it is contrary even to free trade principles. Moreover, security in business transactions, a very important consideration, is provided.

COMMERCIAL TREATIES AFTER THE WAR

The War made a serious breach in the commercial treaty system. It is true it did not alter the basic principles of the policy of concluding commercial treaties, but it brought financial and protectionist interests so strongly into the foreground that the interest in international trade was extraordinarily restricted and is only now beginning to receive greater recognition. Two forms are characteristic for all modern commercial treaties: tariff rates and the most favoured nation clause. By tariff rates are meant the concessions in the rates of the customs tariffs on both sides. Treaties which embrace both forms are called tariff treaties and are preferred by states which carry on a very active commerce with one another. By far the greatest number of all commercial treaties are restricted to the most favoured nation (M.F.N.) clause; they are called most favoured nation treaties, for, although the first type also include M.F.N. treatment, this is subordinated to the tariff rates which constitute their chief feature. Treaties of a different type, merely comprising tariff rates without M.F.N. treatment, were of rare occurrence and were mostly a survival of an earlier period.

Most Favoured Nation Clause.—M.F.N. treatment secures to the treaty state equality of position with those foreign countries which receive most favourable treatment. In the form in which it has developed since the year 1860, it secures for this state not merely all the privileges which any other state has received in the past and still enjoys, but also those which it will receive in future, and moreover immediately and without additional compensation.

There is, it is true, a still more favourable treatment than the foreign parity given by the M.F.N. clause, viz., inland parity or national treatment, which places the persons and goods of the country concerned on an equality, not with those of other foreign countries, but with those of the nationals of the country itself; but its sphere of application is a different and at the same time a more limited one. By its nature it only applies to such economic measures as are not confined to foreign goods and persons, such as import duties, admission of consuls, etc., but may affect both domestic and foreign goods and persons, so that discrimination in their treatment would constitute a new and arbitrary protection for the home country; *e.g.*, taxes on consumption, admission to trade and settlement, conditions for the use of railways and roads, etc. In oriental countries in which foreigners received special privileges, it sometimes occurred that the foreign parity was more favourable than the inland parity.

Reciprocity, by virtue of which a favour is only accorded to the treaty state in return for an equivalent compensation, is less favourable than M.F.N. treatment or foreign parity. This principle was to be found in many commercial treaties down to the middle of the 19th century and still exists in later commercial treaties, in cases where it is not merely a matter of passive permission, but of an active intervention on the part of the state; *e.g.*, the admission of joint-stock companies, privileges for commercial travellers, the granting of benefits of workers' insurance, etc.

There are several varieties of M.F.N. treatment. The unconditional is to-day the most common, but the conditional is also to be found, by virtue of which the treaty state has a right to a privilege granted to another country if it was given without compensation, but can only secure it for an equivalent compensation if this privilege has been acquired by the other country as a result of a concession on its part. This latter form is distinguished from reciprocity by the fact that it contains an obligation to grant equality of position when the necessary condition is fulfilled, which is not the case with reciprocity. Unconditional M.F.N. treatment has, it is true, the disadvantages (1) that it diminishes the value of every concession, because the area to which this applies is extended, (2) that it hinders a concession to one treaty state, because this would subsequently benefit automatically a stronger competitor, (3) that by adapting the concession to the special conditions of the treaty state, its extension to the other most favoured countries can in practice be excluded. It has, however, the great merit that it guarantees to the treaty state equal competitive conditions in the territory of the other for the whole period of the treaty and greatly facilitates the conclusion of commercial treaties.

Conditional M.F.N. treatment involves fresh negotiations with the other states on the conclusion of each tariff treaty, and may give rise to technical and political difficulties which may endanger the whole treaty structure. The post-War period has brought about an interesting and characteristic change; while the United States, in contrast to the European countries, maintained before the War conditional M.F.N. treatment which, by its nature, is relatively unfavourable to the treaty method, they have gone over in the later commercial treaties, *e.g.*, the treaty with Germany of Dec. 8, 1923, to unconditional M.F.N. treatment. This change is attributable to an alteration in their commercial interests. Formerly they supplied mainly raw materials (cotton, copper, etc.), which the European states needed urgently for industries, while they constituted an important market for European manufactures and therefore were in a strong position when treaties were negotiated. Now, however, the export interests of their industries have come into greater prominence and demand a modification of their foreign commercial relations. On the other hand, France, which before the War had not favoured the treaty method, is now contemplating, in accordance with the law of July 20, 1919, the conclusion of commercial treaties in which reciprocal tariff concessions are granted, and has thus in theory returned to the principle of reciprocity. This policy has, it is true, been substantially modified in practice, for France has not merely allowed the former M.F.N. treaties to continue in force, but has also adopted M.F.N. treatment in newly concluded commercial treaties, though subject to considerable restrictions.

M.F.N. treatment as a rule binds both contracting parties to reciprocal treatment, but this is not a necessary condition, for in the treaties with countries in the East it only applies unilaterally in favour of the European states. The victorious states also chose the unilateral form for the Peace Treaties of 1919, but only for a period of five years; the Council of the League of Nations has made no use of the power granted to it to extend the application of this clause. In many commercial treaties of the former enemy states, the limitation was already set aside at an earlier date.

M.F.N. treatment can, however, be restricted not only in its form, but in its contents. In its widest scope it covers all matters of trade and shipping, but in all cases it applies to the customs tariff and customs procedure. In the post-War period some states have restricted it to certain customs items or parts of the customs tariff. On the other hand, the commercial treaty between England and Germany concluded on Dec. 2, 1924, contains reciprocal, unconditional, unlimited M.F.N. treatment.

Tariff Systems.—Tariff treaties depend largely on the tariff system which is at the basis of the tariffs of the treaty states. We can distinguish the single-line tariff, which has only one tax for each article for all countries, from the double tariff, which consists of two columns of tariff rates of which the one with the lower rates is applicable to the most favoured countries, and the other with the higher rates to remaining countries. Depending on the origin of the lower column, the double tariff can be a general-conventional tariff in which only the higher general tariff is fixed by an autonomous law of the country concerned, while the conventional tariff is composed of the concessions or binding rates granted to other countries by commercial treaties. By a binding rate is meant the transfer of a tariff rate from the general tariff to the conventional tariff at the same figure, in order to secure its application for the whole period of the treaty, since an autonomous tariff can at any time be modified by the country concerned, by a new law. The double tariff can, however, also be a maximum-minimum tariff, in which the column with the lower rate is also fixed by autonomous legislation and therefore provides the limit to which tariff concessions can be granted to foreign countries.

The single-line tariff which Great Britain and some countries of northern Europe have applied, necessarily involves M.F.N. treatment, because it leaves no room for tariff concessions; but there is the possibility, of which formerly Belgium has taken advantage, of granting tariff concessions by commercial treaties which are then taken over into the single-line tariff and thereby extended to all countries, whether or not they have granted M.F.N. treatment by treaty. In the general-conventional tariff which is predominant in Germany and other Central European states, the chief emphasis lies in tariff treaties with M.F.N. treatment. The maximum-minimum tariff is less favourable to the treaty method. This, although of Spanish origin, can to-day be described as the French tariff system, because the unilateral and therefore relatively high minimum rates offer small inducement to the conclusion of commercial treaties, and their autonomous regulation affords no security against subsequent increases. In its most extreme form it might result in the same article being subject to divergent tariff rates according to the country of origin, which would naturally exclude any M.F.N. treatment. Even if France herself has never gone so far as this, her commercial treaties in the post-War period exhibit great specialization. In these treaties she grants some tax rates of the minimum tariff, then some rebates from the tariff rates of the maximum tariff and applies elsewhere the maximum tariff.

Post-War Changes.—The pre-War commercial treaties corresponded to the normal market conditions in which production outran demand so that it was the concern of the seller to find a market for his goods and not of the purchaser to obtain the goods he required. The state only sought to facilitate the path of trade in foreign countries; whether and how far advantage was taken of this was the concern of the merchant. The scarcity of goods brought about by the War, however, upset the normal market conditions; instead of the purchaser, the seller had the stronger position, and it was not the man who wanted the goods who dictated conditions, but the man who controlled their supply. Commercial treaties of the old type were temporarily pushed into the background by two new types; the compensation treaties and the treaties based on quotas, which are distinguished from the ordinary forms by the fact that the contracting states pledge themselves, not merely to permit movement of private trade, but to a definite undertaking.

In the compensation treaties the state declares that it will supply specified quantities of certain goods, in return for which it receives others of which it is urgently in need. Here the obligation to deliver is in the foreground, since it is mainly a matter of essential goods, such as wheat, coal, etc. Occasionally, as for example in the case of France in relation to Switzerland, there was also an obligation to accept delivery, when the other party was at pains to secure at least part of a market for its high-grade luxury products (embroideries) which it had lost as a result of the War. A condition of these treaties was the suppression of private trade and the setting up of state *Centrales* for the most important goods, because the state administration can only deliver goods which are under its own control.

The treaties with quotas which arose later are distinguished from the above by the fact that the treaty states do not pledge themselves to the delivery of goods against goods, but merely agree to the issue of export licences for specified quotas of goods, for which it was also necessary that an import licence should be granted by the receiving state, but whose actual delivery, where the goods were not still subject to state control, remained in the hands of private trade. Such treaties were often not published at all but only communicated to the government departments and the undertakings concerned.

After the War, normal market conditions gradually returned, though less owing to a rise in production than to a general fall in purchasing power. The consequence of this equalization of supply and demand on a lower level was that the struggle for foreign markets gave place to a struggle for the retention of the home market. Protection came so strongly to the fore that even England had to sacrifice part of its traditional free-trade policy. The protectionist tendency was appreciably strengthened by the currency depreciation in many countries, which results in an export bounty for the products of the country concerned. The countries with high exchanges protected themselves against such exchange dumping by raising their import duties or by special additional duties (*e.g.*, Spain, Czechoslovakia). The countries with weak exchanges in turn were forced to prohibit imports of luxury goods, and to hinder payments to foreign countries by controlling exchange transactions, in order to prepare for stabilization by improving the balance of payment. Hence it resulted that the protectionist system was even accentuated by a system of prohibitions such as people had believed to have finally disappeared with mercantilist ideas by the middle of the 19th century.

It is true that gradually the need for normal commercial treaties with M.F.N. treatment and tariff rates has been receiving great recognition, but the after-effects of the conditions of political and commercial war have by no means vanished. The commercial treaties concluded before the War were determined by the belligerent Powers contrary to former custom, when their operation used merely to be suspended for the period of the War. Negotiations entered into since then have been confronted with such great conflicts of interest and uncertainty of conditions, that often agreements could only be made for a year, terminable at three months' notice, whilst formerly they used to hold good for ten years and more. M.F.N. treatment amongst the European states has often been only conditionally granted, and restricted to certain categories of goods. Further, events in Russia have caused a severe dislocation of the old-established trade relations, for she demanded the recognition of her state monopoly of the export trade and of the abnormal political institutions of the Soviet régime.

On the other hand, owing to the economic crisis and the political unrest of Europe, endeavours have been made to join certain states into a customs union by abolishing the customs duties between them. Thus abortive proposals were made that Austria, whose continued existence appeared hopeless, should be united to Germany or should join with other neighbouring states into a Danubian Federation. Schemes for economic union have also been discussed in the Balkans and between the Baltic states. But such preferential relations arouse political objections, because the union of economic interests may also bring about political ties, and are also impeded by the fact that the states receiving M.F.N. treatment are not willing to be excluded from the advantages of preferential relations. Up to the present these ideas have nowhere been realized. (*See* also TREATIES.)

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COMMERCY, a town of north-eastern France, capital of an arrondissement in the department of Meuse, on the left bank of the Meuse, 26 mi. E. of Bar-le-Duc. Pop. (1936) 7,748. It dates from the 9th century, when its lords were dependent on the bishop of Metz. In 1544 it was besieged by Charles V. For some time the lordship was in the hands of François Paul de Gondi, cardinal de Retz, who lived in the town for a number of years, and there composed his memoirs. From him it was purchased by Charles IV, duke of Lorraine. In 1744 the castle became the residence of Stanislas, king of Poland, as whose guest Voltaire visited the town in 1747. The château is now used as cavalry barracks. The industries include iron-working and the manufacture of boots and hosiery.

COMMERS, the German term for the students' social gatherings held on occasions such as the breaking-up of term and the anniversary of the university's founding (Lat. *commercium*). A Commers consists of speeches and songs and the drinking of beer. Strict rules as to drinking exist, and the chairman after each speech calls for what is called a salamander.

COMMISSAR, or **COMMISSARY,** an official in the Union of Socialist Soviet Republics entrusted with the guidance of a separate branch of the administration, as the People's Commissary for Foreign Affairs, for War and Marine, etc.

COMMISSARIAT, the department of an army charged with the provision of supplies, both food and forage, for the troops. The supply of military stores such as ammunition is not included in the duties of a commissariat. In almost every army the duties of transport and supply are performed by the same corps of departmental troops.

COMMISSARY, generally, a representative, *e.g.,* the emperor's representative who presided in his absence over the imperial diet; and especially, an ecclesiastical official who exercises in special circumstances the jurisdiction of a bishop (*q.v.*); in the Church of England this jurisdiction is exercised in a consistory court (*q.v.*), except in Canterbury, where the court of the diocesan as opposed to the metropolitan jurisdiction of the archbishop is called a commissary court, and the judge is the commissary general of the city and diocese of Canterbury. When a see is vacant the jurisdiction is exercised by a "special commissary" of the metropolitan. Commissary is also a general military term for an official charged with the duties of supply, transport and finance of an army. In the 17th and 18th centuries the *commissaire des guerres,* or *Kriegskommissär* was an important official in continental armies, by whose agency the troops, in their relation to the civil inhabitants, were placed upon semi-political control. In French military law, *commissaires du gouvernement* represent the ministry of war on military tribunals, and more or less correspond to the British judge-advocate (*see* COURT-MARTIAL).

COMMISSION, the act of committing or entrusting any charge or duty to a person, and the charge or trust thus committed, and so particularly an authority, or the document embodying such authority, given to some person to act in a particular capacity. The term is thus applied to the written authority to command troops, which the sovereign or president, as commander-in-chief of the armed forces, grants to officers, or to the similar authority issued to justices of the peace. For the various commissions of assize *see* ASSIZE OR ASSISE. The word is also used of the order issued to a naval officer to take the command of a ship of war, and when manned, armed and fully equipped for active service she is said to be "put in commission."

In the law of evidence (*q.v.*) the presence of witnesses may, for certain necessary causes, be dispensed with by the order of the court, and the evidence be taken by a commissioner. Such evidence in England is said to be "on commission" (*see* R.S.C. Order XXXVII.). In the United States such evidence is taken by "deposition." Where the witness is out of the jurisdiction of the court, and his place of residence is a foreign country where objection is taken to the execution of a commission, or is a British colony or India, "letters of request" for the examination of the witness are issued, addressed to the head of the tribunal in the foreign country, or to the secretary of State for the colonies or for India.

Where the functions of an office are transferred from an individual to a body of persons, the body exercising these delegated functions is generally known as a commission and the members as commissioners; thus the office of lord high admiral of Great Britain is administered by a permanent board, the lords of the admiralty. Such a delegation may be also temporary, as where the authority under the great seal to give the royal assent to legislation is issued to lords commissioners. Similarly bodies of persons or single individuals may be specially charged with carrying out particular duties; these may be permanent, such as the Charity Commission or the Ecclesiastical and Church Estates Commission, or may be temporary, such as international commissions of inquiry (*see* ARBITRATION; DOGGER BANK), or such as the various commissions of inquiry, royal, statutory or departmental, of which an account is given below.

In the United States there are many commissions in both the Federal and State Governments. The U.S. Interstate Commerce, Federal Trade and Civil Service commissions are examples. Many States have public utilities and civil service commissions. Municipalities also have commissions in many instances.

Internationally, commissions often are appointed to settle claims between different nations on behalf of their subjects, and sometimes to define boundaries, and also for other purposes.

A commission may be granted by one person to another to act as his agent, and particularly in business; thus the term is applied to that method of business in which goods are entrusted to an agent for sale, the remuneration being a percentage on the sales. This percentage is known as the "commission," and hence the word is extended to all remuneration which is based on a percentage of the value of the work done. The right of an agent to remuneration in the form of a "commission" is always founded upon an express or implied contract between himself and his principal. Such a contract may be implied from custom or usage, from the conduct of the principal or from the circumstances of the particular case. Such commissions are only payable on transactions directly resulting from agency and may be payable though the principal acquires no benefit. In order to claim remuneration an agent must be legally qualified to act in the capacity in which he claims remuneration. He cannot recover in respect of unlawful or wagering transactions, or in cases of misconduct or breach of duty.

Commissions of Inquiry, *i.e.,* commissions for the purpose of eliciting information as to the operation of laws, or investigating particular matters, social, educational, etc., are distinguished, according to the terms of their appointment, as royal, statutory and departmental. A royal commission in England is appointed by the Crown, and the commissions usually issue from the office of the executive government which they specially concern. The objects of the inquiry are carefully defined in the warrant constituting the commission, which is termed the "reference." The commissioners give their services gratuitously, but where they involve any great degree of professional skill compensation is allowed for time and labour. The expenses incurred are provided out of money annually voted for the purpose. Unless expressly empowered by Act of parliament, a commission cannot compel the production of documents or the giving of evidence, nor can it administer an oath. A commission may hold its sittings in any part of Great Britain, or may institute and conduct experiments for the purpose of testing the utility of invention, etc. When the inquiry or any particular portion of it is concluded, a report is presented to the Crown through the home department. All the commissioners, if unanimous, sign the report, but those who are unable to agree with the majority can record their dissent, and express their individual opinions, either in paragraphs appended to the report or in separately signed memoranda.

Statutory commissions are created by Acts of parliament, and, with the exception that they are liable to have their proceedings questioned in parliament, have absolute powers within the limits of their prescribed functions and subject to the provisions of the Act defining the same. By the Tribunals of Inquiry (Evidence) Act 1921, where it has been resolved by both houses of parliament that a tribunal be established for enquiring into a definite matter described in the resolution as of urgent public importance and in pursuance thereof a tribunal is appointed either by the king or a secretary of State, it may be provided that the act shall apply, and in such case the tribunal shall have all the powers, rights and privileges that are vested in the high court, or in Scotland the court of session, for enforcing the attendance of witnesses and examining them on oath, compelling the production of documents, and the issue of commissions or requests to examine witnesses abroad. Departmental commissions or committees are appointed either by a Treasury minute or by the authority of a secretary of State, for the purpose of instituting inquiries into matters of official concern or examining into proposed changes in administrative arrangements. They are generally composed of two or more permanent officials of the department concerned in the investigation, along with a subordinate member of the administration. Reports of such committees are usually regarded as confidential documents.

In the United States commissions are established through authority of acts of Congress or the State legislatures. Internationally they are created by treaties or conventions.

See A. Todd, *Parliamentary Government in England,* vol. ii.; Charles A. Beard, *American Government and Politics.*

COMMISSION AGENT: *see* Agents in Business.

COMMISSIONAIRE, the designation of an attendant, messenger or subordinate employee in hotels on the Continent of Europe, whose chief duty is to attend at railway stations, secure customers, take charge of their luggage, carry out the necessary formalities with respect to it and have it sent on to the hotel. They are also employed in Paris as street messengers, light porters, etc.

The Corps of Commissionaires.—In England this is an association of pensioned soldiers of trustworthy character, founded in 1859 by Captain Sir Edward Walter, K.C.B. (1823–1904). Its headquarters are at 419a Strand, London, W.C. It was first started in a very small way, with the intention of providing occupation for none but wounded soldiers. The nucleus of the corps consisted of eight men, each of whom had lost a limb. The demand, however, for neat, uniformed, trusty men, to perform certain light duties, encouraged the founder to extend his idea, and the corps developed into a large self-supporting organization. In 1927 there were over 4,600 members of the corps, nearly 3,000 of whom served in London. There are local divisions of the corps at Belfast, Birmingham, Bristol, Edinburgh, Glasgow, Leeds, Liverpool, Manchester and Newcastle.

COMMISSIONER, in general an officer appointed to carry out some particular work, or to discharge the duty of a particular office; one who is a member of a commission (*q.v.*). He is legally defined as a person authorized by letters patent, act of parliament or other lawful warrant to execute any public office. The Commissioners Clauses Act of 1847 provides that commissioners executing undertakings of a public nature under an act of parliament are immune from personal liability. In this sense the word is applied to members of a permanently constituted department of the administration, as civil service commissioners, commissioners of income tax, commissioners in lunacy, etc. It is also the title given to the heads of or important officials in various governmental departments, as commissioner of customs. In some British possessions in Africa and the Pacific the head of the Government is styled high commissioner. In India a commissioner is the chief administrative official of a division which includes several districts. The office does not exist in Madras, where the same duties are discharged by a board of revenue, but is found in most of the other provinces. The commissioner comes midway between the local government and the district officer. In the regulation provinces the district officer is called a collector (*q.v.*), and in the non-regulation provinces a deputy-commissioner. In the former he must always be a member of the covenanted civil service, but in the latter he may be a military officer.

A chief commissioner is a high Indian official, governing a province inferior in status to a lieutenant-governorship, but in direct subordination to the governor-general in council. Of the 15 provinces of British India, nine are administered by lieutenant-governors and the remaining six by chief commissioners.

A commissioner for oaths in England is a solicitor appointed by the lord chancellor to administer oaths to persons making affidavits for the purpose of any cause or matter. The Commissioner for Oaths Act 1889 (with an amending act 1891), amending and consolidating various other acts, regulates the appointment and powers of such commissioners. Under the Rules of the Supreme Court (R.S.C. O. 37 r. 5) the High Court may order that any witness, whose attendance in court ought for sufficient cause to be dispensed with, be examined on oath by an officer of the court or a commissioner appointed for that purpose. In such cases the evidence is said to be taken "on commission."

COMMISSION INTERNATIONALE DE RAVITAILLEMENT. This commission was established as the result of an agreement concluded at a meeting held on Aug. 13, 1914, between delegates of the French ministries of finance, war and marine and representatives of the British Foreign office, Treasury, Admiralty, War Office and Board of Trade. The functions of the commission were to co-ordinate purchases of munitions, military and naval equipment and food supplies by the two Governments, to prevent competition in the same markets and consequent inflation of prices, and to help the French Government to purchase efficiently and economically.

In due course delegates of the Russian, Belgian, Serbian, Japanese, Italian, Portuguese, Rumanian, Greek, Brazilian and United States Governments were appointed on the commission, and its scope was accordingly extended to cover purchases for all the Allied and Associated Governments.

Organization.—The commission comprised: (a) Representatives of British Government departments, (b) representatives of the Allied and Associated Governments, and (c) a British executive staff.

(a) The British representatives included members of the Foreign office, Admiralty, War Office, Board of Trade, Board of Agriculture, Ministry of Munitions, Ministry of Food and Committee of Imperial Defence. The functions of each of these representatives was to act as the official mouthpiece of the department which he represented in expressing its views as to the effect of an Allied Government demand upon the supply of the materials in which the department was interested and in conveying its advice as to the method by which the demand could best be met. In course of time it was found more convenient for the duties originally undertaken by these delegates to be performed by special "allied sections" of the departments concerned, established to receive and take action on Allied demands received from the British staff.

(b) The representatives of the Allied and Associated Governments comprised upwards of 50 accredited delegates, including military and naval officers, civil officials and commercial experts, together with large technical, financial, shipping and clerical staffs, numbering in all some 1,500 persons.

Function of Delegates.—The primary function of these delegates was to formulate to the British Government the requirements of their own Governments and to ascertain how they could be met from the point of view of supplies, finance and tonnage; to advise as to the priority of manufacture and shipments of the materials which it might be found possible to supply; and to discuss technical details, sign or approve contracts, authorize payments by the British Government on Allied Government account, carry out inspection of materials, and the like.

(c) The British executive staff consisted of civil servants and temporary assistants, including a number of military officers and business men, and numbered in 1918 approximately 550 persons. It was at first under the direction of Mr. U. F. Wintour, C.B., C.M.G., and, on his becoming director of army contracts, his place was taken by Mr. (afterwards Sir) Edmund Wyldbore Smith.

The functions of the British executive staff were:—

(1) To receive and examine the demands formulated by the delegates of the Allied and Associated Governments, and to collate them with information obtainable from diplomatic, military or other sources and obtain further details and specifications which might be required.

(2) To examine and report to the Treasury upon all proposals which involved the expenditure of the British credits granted to the Allies.

(3) To enquire into the available supply of tonnage for the transport of the various materials concerned and the relative order of priority in which it should be utilized, and to keep the ministry of shipping, the marine department of the Board of Trade and any other departments concerned in close touch with the needs of the Allied and Associated Governments.

(4) To present the Allied demands in proper form to the different British supply departments concerned, making sure that every department was consulted, and to see that the demands were given prompt attention and that steps were immediately taken by those departments to place contracts, to supply from British stocks or to advise the Allied delegates with what firms, and also upon what conditions contracts might be placed by the delegates.

(5) To carry out all the official business involved in connection with the formal authorization of the supply of material by British Government departments to the Allies; the arrangement of railway and shipping facilities, the issue of export permits under the authority of the president of the board of trade for materials the export of which was prohibited; the preparation of statistics as to contracts placed, deliveries made, total quantities of materials bought and shipped, and the like.

The total value of the war material supplied to the Allies from the United Kingdom, through the Commission Internationale de Ravitaillement, amounted to approximately £672,000,000 of which some 48% went to France, 20% to Russia and 15% to Italy. The commission had its offices in London and was highly effective during the period of its activity.

COMMITMENT, in common law a warrant in writing of a magistrate, justice, or other official having police jurisdiction, directing the conveyance of a person named or sufficiently described therein to a prison or other legal place of custody, and his detention therein for a time specified, or until the person to be detained has done a certain act specified in the warrant, *e.g.*, paid a fine imposed upon him on conviction. An interval must necessarily elapse between the decision to commit and the making out of the warrant of commitment, during which interval the detention in custody of the person committed is undoubtedly legal. A commitment differs also from a warrant of arrest, in that it is not made until after the person to be detained has actually appeared, or has been summoned, before the court which orders committal, to answer to some charge.

It is ordinarily essential to a valid commitment that it should contain a specific statement of the particular cause of the detention ordered. To this the chief, if not the only exception, is in the case of commitments by order of either house of parliament. Commitments by justices of the peace must be under their hands and seals. Commitments by a court of record if formally drawn up are under the seal of the court.

In the case of superior courts no statutory forms of commitment exist, and the same formalities are not so strictly enforced. Committal of a person present in court for contempt of the court is enforced by his immediate arrest by the tipstaff as soon as committal is ordered, and he may be detained in prison on a memorandum of the clerk or registrar of the court while a formal order is being drawn up. And in the case of persons sentenced at assizes and quarter sessions the only written authority for enforcement is a calendar of the prisoners tried, on which the sentences are entered up, signed by the presiding judge.

Commitments are usually made by courts of criminal jurisdiction in respect of offences against the criminal law, but are also occasionally made as a punishment for disobedience to the orders made in a civil court, *e.g.*, where a judgment debtor having means to pay refuses to satisfy the judgment debt, or in cases where the person committed has been guilty of a direct contempt of the court. (*See* HABEAS CORPUS.)

The term is used in substantially the same sense in the United States Federal and State courts.

COMMITTEE, a person or body of persons to whom something is entrusted (Lat. *committere,* to entrust); also a person or persons to whom the charge of the body ("committee of the person") or of the property and business affairs ("committee of the estate") of a lunatic is committed by the court. (*See* INSANITY IN LAW.) The common meaning is that of a body of persons appointed to deal with business matters. For parliamentary committee, *see* PARLIAMENT.

COMMITTEE FOR INDUSTRIAL ORGANIZATION: *see* CONGRESS OF INDUSTRIAL ORGANIZATIONS.

COMMODE, originally, a tall head-dress with a fan-shaped frame covered with lace or silk. It was introduced by Mlle. de Fontanges, the red-haired mistress of Louis XIV. The term is now more commonly applied to a piece of furniture that is closely related to the chest of drawers, the chest, the bureau, and the sideboard. Because of this wide application of its use, the commode has been the object of various modifications. It is of French origin, having come into notice about the latter part of the 17th century, when it was known as a commode table. Some had lids, and opened up in a way similar to that of a chest; others had drawers, which gave opportunity for more ornamentation, with metal handles and escutcheons. The commode was at first confined to very fashionable drawing-rooms, but Chippendale contemplated its use in other places, especially the bedroom. This type is usually made with drawers and set upon legs, resembling in many ways a wash-stand. Another bedroom commode that came into use about the beginning of the 18th century was very similar to the chest, and still another was not unlike a travelling trunk, each being only about 2ft. high, 2ft. long, and 1½ft. deep. These bedroom commodes are rare, however, and the larger, drawing-room types should be considered first because of their wider use and greater quantity. Besides the variety of styles, sizes, and uses of such commodes, all kinds of finishes were applied: mahogany, lacquer, marquetry, and paint. Carving is perhaps the most outstanding feature; in fact, the preponderance of carving and ornamentation is often the only thing that distinguishes them from the sideboard and other pieces of furniture similar in use. (*See* also BUREAU; CHEST; SIDEBOARD.)

COMMODIANUS, a Christian Latin poet, who flourished about A.D. 250. Commodianus is supposed to have been an African. As he himself tells us, he was converted to Christianity when advanced in years, and felt called upon to instruct the ignorant in the truth. He was the author of two extant Latin poems, *Instructiones* and *Carmen apologeticum*. The *Instructiones* consist of 80 poems, each of which is an acrostic (with the exception of 60, where the initial letters are in alphabetical order). The initials of the 80, read backwards, give Commodianus Mendicus Christi. The first part is addressed to the heathens and Jews, and ridicules the divinities of classical mythology; the second contains reflections on Antichrist, the end of the world, the Resurrection, and advice to Christians, penitents and the clergy. In the *Apologeticum* all mankind are exhorted to repent, in view of the approaching end of the world. To the classical scholar the metre alone is of interest. The rules of quantity are sacrificed to accent. The first four lines of the *Instructiones* may be quoted by way of illustration:

> Praefatio nostra viam erranti demonstrat,
> Respectumque bonum, cum venerit saeculi meta,
> Aeternum fieri, quod discredunt inscia corda:
> Ego similiter erravi tempore multo.

These *versus politici* (as they are called) show that the change was already passing over Latin which resulted in the formation of the Romance languages. The use of cases and genders, the construction of verbs and prepositions, and the verbal forms exhibit striking irregularities.

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COMMODITY, in economics, a portion of wealth, a thing which being desired as possessing the power to satisfy human wants, is limited in supply and has therefore value in exchange. Every commodity which satisfies a want is said to possess "utility"; conversely, everything possessing utility is a commodity. The economic expression "utility" does not mean usefulness, and has no moral significance. The economic touchstone is the satisfaction of human want, from whatever cause arising. Thus, an alcoholic beverage may or may not be useful, but it is wanted and in demand and is therefore in the economic sense a commodity. In the same way, the autograph manuscript of a book already printed may be a commodity. (*See* ECONOMICS.)

COMMODUS, LUCIUS AELIUS AURELIUS (161–192), also called Marcus Antoninus, emperor of Rome, son of Marcus Aurelius and Faustina, was born at Lanuvium on Aug. 31, 161. At the age of 15 he was associated by his father in the government. On the death of Aurelius, whom he had accompanied in the war against the Quadi and Marcomanni, he hastily concluded peace and hurried back to Rome (180). In 183 he was attacked by an assassin at the instigation of his sister Lucilla and many senators, and from this time be became tyrannical. Many distinguished Romans were put to death as implicated in the conspiracy, and others were executed for no reason at all. The treasury was exhausted by lavish expenditure on gladiatorial and wild beast combats and on the soldiery, and the property of the wealthy was confiscated. Plots against his life naturally began to spring up. That of his favourite Perennis, praefect of the praetorian guard, was discovered in time. The next danger was from the people, who were infuriated by the dearth of corn. The mob repelled the praetorian guard, but the execution of the hated minister Cleander quieted the tumult. The attempt also of the daring highwayman Maternus to seize the empire was betrayed; but at last Eclectus the chamberlain, Laetus the praefect of the praetorians, and the emperor's mistress Marcia, finding their names on the list of those doomed to death, had the emperor murdered on Dec. 31, 192. During his reign the frontier of Dacia was successfully defended against the Scythians and Sarmatians, and a tract of territory reconquered in north Britain. In 1874 a statue of Commodus was dug up at Rome, in which he is represented as Hercules—a lion's skin on his head, a club in his right and the apples of the Hesperides in his left hand.

See Aelius Lampridius, Herodian, and fragments in Dio Cassius; H. Schiller, *Geschichte der römischen Kaiserzeit;* J. Zürcher, "Commodus" (1868, in Büdinger's *Untersuchungen zur römischen Kaisergeschichte,* a criticism of Herodian's account); Pauly-Wissowa, *Real-encyklopädie,* ii. 2,464 ff. (von Rohden); Heer, "Der historische Wert des Vita Commodi" (*Philologus,* Supplementband, ix.).

COMMON FIELD SYSTEM: *see* CULTIVATION; LAND TENURE, PRIMITIVE.

COMMON GOOD, in Scotland, the name of ancient corporate property owned by the royal burghs and held by them for the communal benefit of their citizens. These properties consist for the most part of land and buildings. The communal funds derived from the Common Good are spent upon objects to which expenditure out of rates cannot be applied. Thus, the Royal Observatory at Edinburgh, an institution of much distinction, is maintained out of the Common Good.

COMMON LAW means the law common to the whole realm, as distinct from the law peculiar to certain classes of persons such as, in the middle ages, the "Law Merchant." This is the sense in which the term comes into general use in the reign of Edward I. The term, which has often been used in many senses, is best defined by contrast. It is contrasted with statute law, as law not promulgated by the sovereign body; with equity, as a kind of "supplemental law," which, in Maitland's words, is in the nature of "a gloss" upon the common law, corrective of it and auxiliary to it; and again with local customary law, as the general law for the whole realm, tolerating variations in certain districts and under certain conditions. It is also sometimes contrasted with civil, or canon, or international law, which are foreign systems recognized in certain special courts only and within limits defined by the common law. When so contrasted with foreign systems of law or with statute law, it is used to include equity itself, and since the "fusion" of common law in equity, which was finally consummated by the Judicature Act of 1873, common law and equity are administered in the High Court "concurrently" and indeed conjointly. As the universal law of the realm it has often been described as the national inheritance or "birthright" of Englishmen which English settlers carry with them when they occupy or colonize a new country. It was defined by Lord Wensleydale in *Mirehouse* v. *Mennell* 8 Bing. 515, as "a system which consisted in applying to new combinations of circumstances those rules which we derive from legal principles and judicial precedents." Its sources are therefore to be found in the law reports of cases actually decided, and it was said with perfect truth by Burke that "to put an end to reports is to put an end to the law of England."

Blackstone divides the civil law of England into *lex scripta* or statute law, and *lex non scripta* or common law. The latter, he says, consists of (1) general customs, which are the common law strictly so called, (2) particular customs prevailing in certain districts, and (3) laws used in particular courts. The first is the law by which "proceedings and determinations in the king's ordinary courts of justice are guided and directed." That the eldest son alone was heir to his ancestor, that a deed is of no validity unless sealed and delivered, that wills shall be construed more favourably and deeds more strictly, are examples of common law doctrines, "not set down in any written statute or ordinance, but depending on immemorial usage for their support." The validity of these usages is to be determined by the judges—"the depositaries of the law, the living oracles who must decide in all cases of doubt, and who are bound by an oath to decide according to the law of the land." Their judgments are preserved as records, and "it is an established rule to abide by former precedents where the same points come again in litigation." Thus Blackstone, a decision of the supreme court of appeal, namely the House of Lords, is consequently final, and the question at issue can never be raised and re-argued again. "Nothing," as Lord Halsbury remarked, "but an act of parliament can set right that which is alleged to be wrong in a judgment of this House." (*London Street Tramways*

v. *L.C.C.,* 1898, A.C. 375.)

Deference to Precedents.—The extraordinary deference paid to precedents is the source of the most striking peculiarities of the English common law. It was the rigid adherence of the common law courts to established precedent which caused the rise of an independent tribunal administering justice on more equitable principles—the tribunal of the chancellor, the court of chancery. The old common law courts—king's bench, common pleas and exchequer—were always, as compared with the court of chancery, distinguished by a certain rigidity of ideas and their whole system of practiced pleading was highly technical. At the same time the common law judges showed extraordinary ingenuity in extending the scope of the "original" writs, with which a common law action began, to meet the changing circumstances of society. The common law by the free use of fictions swallowed the law merchant and digested the greater part of Admiralty law.

Two great defects of form long disfigured the English law. One was the separation of common law and equity. The Judicature Act of 1873 remedied this by merging the jurisdiction of all the courts in one supreme court, and causing equitable principles to prevail over those of the common law where they "conflict." As a matter of fact there had been little conflict between the two systems of law since the 17th century. As Maitland has happily put it, "equity had come not to destroy but to fulfil." Equity was not a self-sufficient system whereas the common law was. Another defect is the overwhelming mass of precedents in which the law is embedded. This can only be removed by some well-conceived scheme of the nature of a code or digest. To some extent this difficulty has been overcome by such acts as the Bills of Exchange Act 1882, the Sales of Goods Act 1893 and the Law of Property Act of 1925. The last act was no mere codification, but revolutionary in the very doctrine of the law. The former acts were, however, little more than a reproduction in statute form of doctrines already established by the courts, and in spite of the modern growth of legislation, mainly social and administrative, what Dicey wrote many years ago is still true, namely that "nine-tenths of the law of contract and nearly the whole of the law of torts are not to be discovered in any volumes of the statutes."

In the early 16th century most countries in Europe underwent the influence of what was known as the "Reception," *i.e.,* the reception of Roman Law which, with the revival of the study of jurisprudence, was "received" into various European countries and displaced their old customary or "common law," or as it was sometimes expressively called "folk-law." England alone escaped this invasion by an alien system of law, and Maitland ascribed her immunity to the fact that "Mediaeval England had schools of law," in other words Inns of Court which preserved the traditions of the common law. "What is distinctive of mediaeval England," he wrote, "is not parliament, for we may everywhere see in Europe assemblies of estates, nor trial by jury, for this was but slowly suppressed in France; but the Inns of Court, and the Year Books (*i.e.,* the mediaeval law reports) that were read therein, and we shall hardly find their like elsewhere." And to any reception of Roman law the Inns of Court offered a stout and successful resistance. The constitutional importance of their victory was enormous, for the absolutist doctrines of Roman law found little or no place in the common law of England, and it was no accident that the greatest champions of the liberties of the subject against the despotic claims of the Stuart kings were the common lawyers, headed by the redoubtable Coke. Indeed most of our constitutional law, more particularily that which relates to the liberty of the subject, to the liability of servants of the Crown to answer for their wrongful acts, and other such fundamental principles, is to be found in the common law and nowhere else.

Judicial Legislation.—Coke held that the common law was the very incarnation of human wisdom and that not only was it superior to the king, in that the king "hath no prerogative but that which the common law allows him," but also that Parliament itself could not change it—a doctrine the second proposition of which, however, was already becoming obsolete with the growth of the modern principle of the sovereignty of parliament. In earlier times, unquestionably, the judges regarded the common law as supreme and unchangeable by any authority other than themselves—a view in which earlier parliaments were only too ready to acquiesce, as innumerable statutes, limiting the arbitrary jurisdiction of the king's council and asserting the right of the subject to claim the jurisdiction of the common law courts with trial by jury, abundantly testify. Magna Carta, which was regarded as simply a declaration of the common law and was granted long before parliament came into existence, represented to the mind of Coke "such a sovereign that he hath no fellow"; in other words it was a kind of fundamental law which parliament itself could not alter. And in the middle ages it was the judges rather than parliament who legislated in the matter of civil rights and criminal liabilities, sometimes avowedly (*e.g.,* Beresford C. J. in the reign of Edward II. [1310], who said "by this decision . . . we shall *make a law* throughout the land"), sometimes by the use of those transparent fictions by which the original action of trespass was extended to cover the whole field of contract and tort. The development of the criminal law was entirely judicial, the most notable example in this respect being the judicial doctrine of "constructive treason." To-day judges disavow the office of "judicial legislation" and, in theory, observe Bacon's monition that their office is *jus dicere* not *jus dare,* in other words to declare the law and not to make it. But in practice the judges undoubtedly legislate, if only by the extension of old rules to new sets of circumstances, or even by laying down a new rule where there is no precedent. The invention of the doctrine of "common employment" in the case of *Priestly* v. *Fowler* (1837) 3 M. and W. 1. is an example of the latter; the extension of petition of right to a claim to recover unliquidated damages for breach of contract by the Crown, in *Thomas* v. *the Queen* (1874) 44 L.J.Q.B. 9., may be legitimately regarded as an example of the former. Equity itself was originally a form of judicial legislation and nothing else, supplementing the defects or correcting the injustices, morally speaking, of the common law. The minds of English judges are certainly still receptive to common usage—*cf.* the words of Vaughan Williams L.J. in *Harrowing Steamship Co.* v. *Thomas and Sons* (*The Times,* March 15, 1913): "The courts have modified the natural construction to make decisions accord with commercial practice and convenience which I have heard described as commercial equity." So too the common law will take note of commercial usage in expanding the legal definition of negotiable instruments.

There is also the possibility of the invocation by judges of what is known as the principle of "public policy"—once defined as "the prevailing opinion of wise men as to what is for the public good"—whereby the judges have innovated freely, as, for example, by declaring certain kind of contracts unenforceable as contrary to the public interest, of which the most familiar example is contracts in restraint of trade. The rule of policy is avowedly a rule susceptible of constant change to suit the changing conditions of society. It would therefore be quite a mistake to regard the fact that our common law is based upon precedent as meaning that it is rigid, inflexible and incapable of expansion. And although a statute can, of course, abolish any rule of common law, it can only do so by express words or necessary intendment. In the absence of such a manifest intention, the common law remains, and is the "key to unlock" the meaning of the statute which will always be construed by the light of it.

In its freedom from the infection of foreign influences, the common law is as much a national possession as the English language itself. It is instinct with the English genius for practice as opposed to theory and of no other system of law can it be said so truly, in the language of Mr. Justice O. W. Holmes that "the life of the law is not logic but experience." The Pilgrim Fathers took it with them to America, even as they took the English speech, with the result that it is the foundation of the law of the United States and nowhere has it been more admirably studied.

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COMMON LODGING-HOUSE, a house or part of a house in which persons of the poorer classes are harboured or lodged for hire for a single night or for less than a week at a time (*Daley* v. *Lees,* 1926, 1 K.B. 40), and in which there is community of accommodation for either eating or sleeping (*London C.C.* v. *Hankins,* 1914, 1 K.B. 490). This definition is very generally accepted as embracing those houses which, under the Public Health and other Acts, must be registered and inspected. The provisions of the Public Health Act, 1875, which extends to the country generally, excluding the metropolis, are that every urban and rural district council must keep registers showing the names and residences of the keepers of all common lodging-houses in their districts, the situation of every such house, and the number of lodgers authorized by them to be received therein. The whole of the house must be open at all times to the inspection of any officer of a council. The county of London (except the City) is under the Common Lodging Houses Acts 1851 and 1853. The administration of these Acts was in the hands of the chief commissioner of police from 1851 to 1894, when it was transferred to the London County Council. The county council has authority to make regulations as to common lodging-houses, subject to confirmation by the minister of health to whom the powers of the Local Government Board were transferred on July 1, 1919 (Ministry of Health Act, 1919, ss. 3 and 5). As to Scotland, *see* the Public Health (Scotland) Act, 1897, ss. 89–100. The term common lodging-house is not in use in the United States, although cheap rooming houses frequently are called "lodging-houses." Such lodging-houses are not licensed as are hotels.

COMMON ORDER, BOOK OF, sometimes called *The Order of Geneva* or *Knox's Liturgy,* a directory for public worship in the Reformed Church in Scotland. In 1557 the Scottish Protestant lords in council enjoined the use of the English Common Prayer, *i.e.,* the Second Book of Edward VI. Meanwhile, at Frankfort, among British Protestant refugees, a controversy was going on between the upholders of the English liturgy and the French Reformed Order of Worship, respectively. By way of compromise John Knox and other ministers drew up a new liturgy based upon earlier Continental Reformed services, which was not deemed satisfactory, but which on his removal to Geneva in 1556 he published for the use of the English congregations in that city. The Geneva book made its way to Scotland, and was used here and there by Reformed congregations. Knox's return in 1559 strengthened its position, and in 1562 the General Assembly enjoined its use as the "Book of Our Common Order" in "the administration of the Sacraments and solemnization of marriages and burials of the dead." In 1564 a new and enlarged edition was printed in Edinburgh, and the Assembly ordered that "every Minister, exhorter and reader" should have a copy and use the Order contained therein not only for marriage and the sacraments but also "in Prayer," thus ousting the hitherto permissible use of the Second Book of Edward VI. at ordinary service.

The rubrics of the Scottish portion of the book are somewhat stricter, and, indeed, one or two of the Geneva rubrics were made more absolute in the Scottish emendations; but no doubt the Book of Common Order is best described as a discretionary liturgy. The Westminster Directory which superseded the Book of Common Order, like it, enjoined interment "without any ceremony," such being stigmatized as "no way beneficial to the dead and many ways hurtful to the living." Civil honours may, however, be rendered.

Between 1606 and 1618 various attempts were made under English and Episcopal influence, by assemblies afterwards declared unlawful, to set aside the Book of Common Order. The efforts of James I., Charles I. and Archbishop Laud proved fruitless; in 1637 the reading of Laud's draft of a new form of service based on the English prayer book led to riots in Edinburgh and to general discontent in the country. The General Assembly of Glasgow in 1638 abjured Laud's book and took its stand again by the Book of Common Order, an act repeated by the assembly of 1639, which also demurred against innovations proposed by the English separatists, who objected altogether to liturgical forms, even to the Lord's Prayer. The following years witnessed a counter attempt to introduce the Scottish liturgy into England, especially for those who in the southern kingdom were inclined to Presbyterianism. This effort culminated in the Westminster Assembly of divines (1643), at which six commissioners from the Church of Scotland were present, and joined in the task of drawing up a Common Confession, Catechism and Directory for the three kingdoms. The General Assembly of 1645 after careful study approved the new order. An act of Assembly on Feb. 3, and an act of parliament on Feb. 6 ordered its use in every church, and henceforth, though there was no act setting aside the Book of Common Order, the Westminster Directory was of primary authority. The act of parliament recognizing the Directory was annulled at the Restoration and the book has never since been acknowledged by a civil authority in Scotland. But General Assemblies have frequently recommended its use, and worship in Presbyterian churches is largely conducted on the lines of the Westminster Assembly's Directory.

Contemporary Scottish worship, during the period (1564–1645) when the Book of Common Order was in use, is described by W. Cowper, Bishop of Galloway, in his *Seven Days' Conference Between a Catholic Christian and a Catholic Roman* (1615), and A. Henderson in *The Government and Order of the Church of Scotland* (1641).

COMMONPLACE, a passage or argument appropriate to several cases; a "common-place book" is a collection of such passages or quotations arranged for reference under general heads. To such a book the name *adversaria* was given, which is an adaptation of the Latin *adversaria scripta,* notes written on one side, the side opposite (adversus) of a paper or book. From its original meaning the word came to be used for a platitude or truism, being equivalent to trivial or ordinary. It was first spelled as two words, then with a hyphen, and so is still—in the sense of a "common-place book."

COMMON PLEAS, COURT OF, was the first of the three common law courts to emerge as a distinct judicial body from the *Curia Regis.* Owing to the increase of pleas between subject and subject (*communia placita*) before the *Curia Regis,* Henry II. appointed five justices to sit permanently in that court —*in banco residentes*—to hear such causes, and if any could not be determined by them it should be reserved for the hearing of the king himself and his wise men, i.e., *coram rege* in his council. But as yet there was no clear division. The justices sat now in one division of the *Curia Regis,* now in another. Both before and after John's reign the court of common pleas, although generally stationary at Westminster, followed the king from place to place as part of the *Curia Regis.* This constituted one of the grievances of the barons, and accordingly by Art. 17 of Magna Carta it was provided that it should not do so but should be held in some certain place. This eventually became a particular spot in Westminster Hall. During Henry III.'s minority there could not be a court held *coram rege,* and so one court tried all causes; but upon his majority in 1224 the division again appeared, and from that date the court of common pleas and the court held *coram rege*—which later became the court of King's bench (*q.v.*) —had separate rolls. In 1272 the court of common pleas had its own chief justice, and the separation might be said to be complete. By the Judicature Act, 1873, the jurisdiction of the court was transferred to the king's bench division of the high court of justice.

See Holdsworth, *Hist. Eng. Law,* vol. i. (H. H. L. B.)

COMMONS, the term for the lands held in commonalty, a relic of the system on which the lands of England were for the most part cultivated during the middle ages. The country was divided into vills, or townships—often, though not necessarily, or always, coterminous with the parish. In each stood a cluster of houses, a village, in which dwelt the men of the township, and around the village lay the arable fields and other lands, which they worked as one common farm. Save for a few small enclosures near the village—for gardens, orchards or paddocks for young stock—the whole township was free from permanent fencing. The arable lands lay in large tracts divided into compartments or fields, usually three in number, to receive in constant rotation the triennial succession of wheat (or rye), spring crops (such as barley, oats, beans or peas) and fallow. Low-lying lands were used as meadows, and there were sometimes pastures fed according to fixed rules. The poorest land of the township was left waste—to supply feed for the cattle of the community, fuel, wood for repairs and any other commodity of a renewable or practically inexhaustible character. This waste land is the *common* of our own days, and this system of farming is known as the *common-field* or *open-field* system.

So far back as accurate information extends the arable land is found to be parcelled out, each householder owning strips in each field. These strips are always long and narrow, and lie in sets parallel with one another. The plough for cultivating the fields was maintained at the common expense of the village, and the draught oxen were furnished by the householders. From the time when the crop was carried till the next sowing, the field lay open to the cattle of the whole vill, which also had the free run of the fallow field throughout the year. But when two of the three fields were under crops, and the meadows laid up for hay, it is obvious that the cattle of the township required some other resort for pasturage. This was supplied by the waste or common. Upon it the householder turned out the oxen and horses which he contributed to the plough, and the cows and sheep, which were useful in manuring the common fields,—in the words of an old law case: "horses and oxen to plough the land, and cows and sheep to compester it." Thus the use of the common by each householder was naturally measured by the stock which he kept for the service of the common fields; and when, at a later period, questions arose as to the extent of the rights on the common, the necessary practice furnished the rule, that the commoner could turn out as many head of cattle as he could keep by means of the lands which were parcelled out to him, —the rule of levancy and couchancy, which has come down to the present day. (*See* below: *Rights of Common.*)

In the earliest post-conquest times the vill or township is found to be associated with an overlord. (*See* MANOR.) At whatever date the overlord first appeared, there can be hardly any doubt that the village lands, whether arable, meadow or waste, were substantially the property of the villagers and the use regulated among themselves. The idea that the common was the "lord's waste," and that he had the power to do what he liked with it, subject to specific and limited qualifying rights in others, was, there is little doubt, the creation of the Norman lawyers.

Statutes of Merton and Westminster the Second.—One of the earliest assertions of the lord's proprietary interest in waste lands is contained in the Statute of Merton, a statute which, it is well to notice, was passed in one of the first assemblies of the barons of England, before the commons of the realm were summoned to parliament. This statute, which became law in the year 1235, provided "that the great men of England (which had enfeoffed knights and their freeholders of small tenements in their great manors)" might "make their profit of their lands, wastes, woods and pastures," if they left sufficient pasture for the service of the tenements they had granted. Some 50 years later, another statute, that of Westminster the Second, supplemented the Statute of Merton by enabling the lord of the soil to enclose common lands, not only against his own tenants, but against "neighbours" claiming pasture there. These two pieces of legislation undoubtedly mark the growth of the doctrine which converted the overlord's territorial sway into property of the modern kind, and a corresponding loosening of the hold of the rural townships on the wastes of their neighbourhood. To what extent the two acts were used, it is very difficult to say. By the Tudor period enclosures had made greater progress in some counties than in others. T. Tusser, in his eulogium on enclosed farming, cites Suffolk and Essex as enclosed counties by way of contrast to Norfolk, Cambridgeshire and Leicestershire, where the "open" or "champion" (champain) system prevailed. The Statutes of Merton and Westminster may have had something to do with the progress of enclosed farming; but it is probable that their chief operation lay in furnishing the lord of the manor with a farm on the new system, side by side with the common fields, or with a deer park.

The first event which really endangered the village system was the coming of the Black Death. This scourge is said to have swept away half the population of the country after the middle of the 14th century. The disappearance, by no means uncommon, of a whole family gave the overlord of the vill the opportunity of appropriating, by way of escheat, the holding of the household in the common fields. The land-holding population of the townships and the persons interested in the commons were thus sensibly diminished.

During the Wars of the Roses the small cultivator is thought to have again made headway. But his diminished numbers, and the larger interest which the lords had acquired in the lands of each vill, no doubt facilitated the determined attack on the common-field system which marked the reigns of Henry VIII. and Edward VI.

This attack, which had for its chief object the conversion of arable land into pasture for the sake of sheep-breeding, was the outcome of many causes. It was no longer of importance to a territorial magnate to possess a large body of followers pledged to his interests by their connection with the land. On the other hand, wool commanded a high price, and the growth of towns and of foreign commerce supplied abundant markets. At the same time the confiscation of the monastic possessions introduced a race of new overlords who were not bound to their territories by any family traditions, and also tended to spread the view that the strong hand was its own justification. Of this viewpoint there is abundant evidence both from the complaints of writers such as Latimer and Sir Thomas More, and from the statutes and royal commissions of the day, that large enclosures were made at this time, and that the process was effected with much injustice and accompanied by great hardship. "Where," says Bishop Latimer in one of his courageous and vigorous denunciations of "enclosers and rent raisers," "there have been many householders and inhabitants, there is now but a shepherd and his dog." In the full tide of this movement, and despite Latimer's appeals, the Statutes of Merton and Westminster the Second were confirmed and re-enacted. Both common fields and commons no doubt disappeared in many places; and the country saw the first notable instalment of enclosure.

Rights of Common.—The distinguishing feature in law of common land is that it is land the soil of which belongs to one person, and from which certain other persons take certain profits—for example, the bite of the grass by the mouth of cattle, or gorse, bushes or heather for fuel or litter. The right to take such a profit is a right of common; the right to feed cattle on common land is a right of common of pasture; while the right of cutting bushes, gorse or heather (more rarely of lopping trees) is known as a right of common of *estovers* (*estouviers*) or *botes* (respectively from the Norman-French *estouffer,* and the Saxon *botan,* to furnish). Another right of common is that of *turbary,* or the right to cut turf or peat for fuel. There are also rights of taking sand, gravel or loam for the repair and maintenance of land. The persons who enjoy any of these rights are called commoners.

From the sketch of the common-field system of agriculture which has been given, we shall readily infer that a large proportion of the commons of the country, and of the peculiarities of the law relating to commons, are traceable to that system. Thus, common rights are mostly attached to, or enjoyed with, certain lands or houses. A right of common of pasture usually consists of the right to turn out as many cattle as the farm or other private land of the commoner can support in winter; for, as we have seen, the enjoyment of the common, in the village system, belonged to the householders of the village, and was necessarily measured by their holdings in the common fields. The cattle thus commonable are said to be *levant* and *couchant, i.e.,* uprising and down-lying on the land. But it has now been decided that they need not in fact be so kept. At the present day a commoner may turn out any cattle belonging to him, wherever they are kept, provided they do not exceed in number the head of cattle which can be supported by the stored summer produce of the land in respect of which the right is claimed, together with any winter herbage it produces. The animals which a commoner may usually turn out are those which were employed in the village system—horses, oxen, cows and sheep. These animals are termed commonable animals. A right of pasture attached to land in the way we have described is said to be *appendant* or *appurtenant* to such land. Common of pasture appendant to land can only be claimed for commonable cattle; and it is held to have been originally attached only to arable land, though in claiming the right no proof that the land was originally arable is necessary.

The characteristic of connection with house or land also marks other rights of common. Thus a right of taking gorse or bushes or of lopping wood for fuel, called *fire-bote,* is limited to the taking of such fuel as may be necessary for the hearths of a particular house, and no more may be taken than is thus required. The same condition applies to common of *turbary,* which in its more usual form authorizes the commoner to cut the heather, which grows thickly upon poor soils, with the roots and adhering earth, to a depth of about 9in. So, also, a right of digging sand, gravel, clay or loam is usually appurtenant to land, and must be exercised with reference to the repair of the roads, or the improvement of the soil, of the particular property to which the right is attached.

To the manorial lord the law assigned the ownership of the soil of the common of the vill; and the common has for many centuries been styled the waste of the manor. The trees and bushes on the common belong to the lord, subject to any rights of lopping or cutting which the commoners may possess. The ground, sand and subsoil are his, and even the grass, though the commoners have the right to take it by the mouths of their cattle. To the overlord, also, was assigned a seignory over all the other lands of the vill; and the vill came to be termed his manor. At the present day it is the manorial system which must be invoked in most cases as the foundation of the curiously conflicting rights which coexist on a common. (*See* COPYHOLD, MANOR.)

Manorial Commons.—Within the bounds of a manor, speaking generally, there were three classes of persons possessing an interest in the land, viz.:—(*a*) Persons holding land freely of the manor, or freehold tenants. (*b*) Persons holding land of the manor by copy of court roll, or copyhold tenants. (*c*) Persons holding from the lord of the manor, by lease or agreement, or from year to year, land which was originally demesne, or which was once freehold or copyhold and has come into the lord's hands by escheat or forfeiture.

Amongst the first two classes were found the majority of the commoners on the wastes or commons of the manor. To every freehold tenant belonged a right of common of pasture on the commons, such right being "appendant" to the land which he holds freely of the manor. This right differed from most other rights of common in the characteristic that actual exercise of the right need not be proved. "Common appendant," said the Elizabethan judges, "is of common right, and commences by operation of law and in favour of tillage." It seems almost necessarily to follow that the freehold tenants of the manor were the representatives of the householders of the vill. Copyholders' rights were generally of the same character. They did not, however, exist as of common right, without proof of usage, but by the custom of the manor, but by the Real Property Act (1922) every copyhold is now enfranchised and converted into freehold, and all the manorial incidents connected with that form of tenure disappear. Rights of common enjoyed by the tenants are specifically preserved.

Rights of Common Not Connected with Manorial System.—So far we have considered common rights as they have arisen out of the manorial system, and out of the still older system of village communities. There may, however, be rights of common quite unconnected with the manorial system. Such rights may be proved either by producing a specific grant from the owner of the manor or by long usage. It is seldom that an actual grant is produced, although it would seem likely that such grants were not uncommon at one time. But a claim founded on actual user is by no means unusual and there are special rules applicable to each kind of claim.

A remarkable instance of such a common attached to the survival of an archaic community may be seen at Malmesbury in Wiltshire. Of this an account by Maitland is to be found in his *Collected Essays,* vol. ii., p. 328. Here a tract of 500 acres, named King's Heath, alleged to have been originally granted by King Athelstan to the town for service in battle against the Danes, was, in 1821, set out by a private act among the members of the old corporation, who till 1885 also governed the town, according to which every person in the borough is entitled to possess one allotment and every capital burgess a plot of from 8 to 15 acres.

There are still to be found, here and there, a group of arable common fields, and occasionally a piece of grass land with many of the characteristics of a common, which turns out to be a common field or meadow. The Hackney Marshes and the other so-called commons of Hackney are really common fields or common meadows, and along the valley of the Lea a constant succession of such meadows is met with. They are still owned in parcels marked by metes; the owners have the right to grow a crop of hay between Lady day and Lammas day; and from Lammas to March the lands are subject to the depasturage of stock.

Some of the largest tracts of waste land to be found in England are the waste or commonable lands of royal forests or chases. The thickets and pastures of Epping forest, now happily preserved for London under the guardianship of the city corporation, and the noble woods and far-stretching heaths of the New Forest, will be called to mind. Cannock Chase, unhappily enclosed according to law, though for the most part still lying waste, Dartmoor, and Ashdown forest in Sussex, are other instances; and the list might be greatly lengthened. It is enough in this connection to say that the common rights in a forest were usually enjoyed by the owners and occupiers of land within its bounds (the class may differ in exact definition, but is substantially equivalent to this) without reference to manorial considerations. Epping forest was saved by the proof of this right.

Enclosure.—We have seen that in the case of each kind of common there is a division of interest. The soil belongs to one person; other persons are entitled to take certain products of the soil. This division of interest preserves the common as an open space. The commoners cannot enclose, because the land does not belong to them. The owner of the soil cannot enclose, because enclosure is inconsistent with the enjoyment of the commoners' rights. At a very early date it was held that the right of a commoner proceeded out of every part of the common, so that the owner of the soil could not set aside part for the commoner and enclose the rest. The Statutes of Merton and Westminster the Second were passed to get over this difficulty. But under these statutes the burden of proving that sufficient pasture was left was thrown upon the owner of the soil; such proof can very seldom be given. Moreover, the statutes have never enabled an enclosure to be made against commoners entitled to *estovers* or *turbary.* It seems clear that the statutes had become obsolete in the time of Edward VI., or they would not have been re-enacted. And we know that the zealous advocates of enclosure in the 18th century considered them worthless for their purposes.

When, therefore, the common-field system began to fall out of gear, and the increase of population brought about a demand for an increased production of corn, it was felt to be necessary to resort to parliament for power to effect enclosure. The legislation which ensued was based on two principles. One was that all persons interested in the open land to be dealt with should receive a proportionate equivalent in enclosed land; the other, that enclosure should not be prevented by the opposition, or the inability to act, of a small minority. Assuming that enclosure was desirable, no more equitable course could have been adopted, though in details particular acts may have been objectionable. The first act was passed in 1709; but the precedent was followed but slowly, and not till the middle of the 18th century did the annual number of acts attain double figures. The high-water mark was reached in the period from 1765 to 1785, when on an average 47 acts were passed every year. From some cause, possibly the very considerable expense attending upon the obtaining of an act, the numbers then began slightly to fall off. The first General Enclosure Act was passed in 1801. This act would at the present day be called an Enclosure Clauses Act. It contained a number of provisions applicable to enclosures, which could be incorporated by reference, in a private bill. Under the stimulus thus applied enclosure proceeded apace. In the year 1801 no fewer than 119 acts were passed, and the total area enclosed probably exceeded 300,000 acres. Three enclosures in the Lincolnshire fens account for over 53,000 acres. As before, the movement after a time spent its force, the annual average of acts falling to about 12 in the decade 1830–40. Another parliamentary committee then sat to consider how enclosure might be promoted; and the result was the Enclosure Act 1845, which, though much amended by subsequent legislation, still stands on the statute-book. The chief feature of that act was the appointment of a permanent commission to make in each case all the enquiries previously made (no doubt capriciously and imperfectly) by committees of the two Houses. The commission, on being satisfied of the propriety of an enclosure was to draw up a provisional order prescribing the general conditions on which it was to be carried out, and this order was to be submitted to parliament by the Government of the day for confirmation. It is believed that these enclosure orders afford the first example of the provisional order system of legislation, which has attained such large proportions.

Again enclosure moved forward, and between 1845 and 1869 (when it received a sudden check) 600,000 acres passed through the hands of the enclosure commission. Taking the whole period of about a century and a half, when parliamentary enclosure was in favour, we shall probably not be far wrong in concluding that about one acre in every seven in England was enclosed during the period in question. It seems likely that, on the whole, England would have gained, had enclosure stopped in 1845.

Open Space Movement.—As a fact it stopped in 1869. Before the enclosure commission had been in existence 20 years the feeling of the nation towards commons began to change. The rapid growth of towns, and especially of London, and the awakening sense of the importance of protecting the public health, brought about an appreciation of the value of commons as open spaces. Naturally, the metropolis saw the birth of this sentiment. An attempted enclosure in 1864 of the commons at Epsom and Wimbledon aroused strong opposition; and a select committee of the House of Commons was appointed to consider how the London commons could best be preserved. Fortunately a small knot of men, who afterwards formed the Commons Preservation Society, took the question up. Chief amongst them were George Shaw-Lefevre, afterwards Lord Eversley, chairman of that society since its foundation, Henry Fawcett and Sir Charles Dilke. On the committee's report of the Commons Preservation Society the Metropolitan Commons Act 1866 was passed, which prohibited any further parliamentary enclosures within the metropolitan police area, and provided means by which a common could be put under local management. The lords of the manors in which the London commons lay felt that their opportunity of making a rich harvest out of land, valuable for building, though otherwise worthless, was slipping away; and a battle royal ensued. Enclosures were commenced, and the Statute of Merton prayed in aid. The public retorted by legal proceedings taken in the names of commoners. These proceedings—which culminated in the mammoth suit as to Epping forest, with the corporation of London as plaintiffs and 14 lords of manors as defendants—were uniformly successful; and the London commons were saved. By degrees the manorial lords, seeing that they could not hope to do better, parted with their interest for a small sum to some local authority; and a large area of the common land, not only in the county of London, but in the suburbs, is now in the hands of the representatives of the ratepayers, and is definitely appropriated to the recreation of the public.

The movement to preserve commons as open spaces soon spread to the rural districts. Under the Enclosure Act of 1845 provision was made for the allotment of a part of the land to be enclosed for field gardens for the labouring poor, and for recreation. But those who were interested in effecting an enclosure often convinced the enclosure commissioners that for some reason such allotments would be useless. To such an extent did the reservation of such allotments become discredited that, in 1869, the commission proposed to parliament the enclosure of 13,000 acres, with the reservation of only one acre for recreation, and none at all for field gardens. This proposal attracted the attention of Henry Fawcett, who, with his characteristic intrepidity, opposed the annual enclosure bill (which had come to be considered a mere form) and moved for a committee on the whole subject. The ultimate result was the passing, seven years later, of the Commons Act 1876. This measure, introduced by a Conservative Government, laid down the principle that an enclosure should not be allowed unless distinctly shown to be for the benefit, not merely of private persons, but of the neighbourhood generally and the public. It imposed many checks upon the process, and following the course already adopted in the case of metropolitan commons, offered an alternative method of making commons more useful to the nation, viz., their management and regulation as open spaces. The effect of this legislation and of the changed attitude of the House of Commons towards enclosure has been almost to stop that process, except in the case of common fields or extensive mountain wastes. It can be quite truly said that every struggle to protect commons from unlawful enclosure originated in the desire that the threatened area should be preserved as an open space in the public interest for use and enjoyment. But the public interest as such, although the motive of the action of the Commons Preservation Society was not an interest which the court of law would at that time recognize, being considered too vague and indefinite, and the long struggle in parliament, of which the successive acts of parliament, already mentioned, mark the different stages, was really a struggle to obtain such recognition, far more than for the protection of the commoners themselves. But public opinion during the past 50 years has entirely veered round, and gradually insisted that commons, with due regard to all existing rights, should be preserved as open spaces and protected as such. Owing further to the influence of the Commons Preservation Society, aided by the growth of public opinion, in the year 1893 Lord Thring carried through parliament the Commons Law Amendment Act, which provided that in future no enclosure under the Statute of Merton should be valid, unless made with the consent of the Board of Agriculture, which was to consider the expediency of the enclosure from a public point of view.

Regulation.—We have alluded to the regulation of commons as open spaces. The primary object of this process is to bring a common under the jurisdiction of some constituted authority, which may make by-laws, enforceable in a summary way before the magistrates of the district. Outside the metropolitan police district a provisional order for regulation may be made under the Commons Act 1876, with the consent of the owner of the soil and of persons representing two-thirds in value of all the interests in the common. And under an act passed in 1899 the council of any urban or rural district may, with the approval of the Board of Agriculture and without recourse to parliament, make a scheme for the management of any common within its district, provided no notice of dissent is served on the board by the lord of the manor or by persons representing one-third in value of such interests in the common as are affected by the scheme. There is yet another way of protecting a common. A parish council may, by agreement, acquire an interest in it, and may make by-laws for its regulation under the Local Government Act 1894. The acts of 1894 and 1899 undoubtedly proceed on right lines. For, with the growth of efficient local government, commons naturally fall to be protected and improved by the authority of the district.

The acreage of the remaining common land in England at the beginning of the 20th century was roughly estimated at somewhere between 1,500,000 and 2,000,000 acres. It is most capriciously distributed. In the Midlands there is very little to be found, while in a county of poor soil, like Surrey, nearly every parish has its common, and there are large tracts of heath and moor. In the metropolitan police district nearly 12,000ac. of common land have been put under local management.

The evidence of the change of policy referred to above is shown by the manner in which during the last 20 years the public interest in common lands has been protected in many acts of parliament relating to other subjects. Thus the Town Planning Acts prohibit the taking of common land under a town-planning scheme, unless an equal area be given in exchange to the satisfaction of the Ministers of Agriculture and Public Health. Similar restrictions appear in other Housing Acts, including the act of 1925; and also in the Development and Roads Improvements Act 1909, in the case of new roads in urban areas. So too the Small Holdings Acts of 1908–26 save all existing commons from appropriation or compulsory purchase under those acts, unless local enquiries are first held under the Commons Act of 1876 and the consent of parliament to any such scheme is obtained. Various large areas of common land acquired under water schemes, especially in the Lake district, have been made, subject to public right of access. The Law of Property Act of 1925, ss. 102 and 103, for the first time gives to the public a statutory right of access for air and exercise on every common or piece of manorial waste and to any rural common to which the section may hereafter be applied and provides that no enclosure or appropriation of land on and after Jan. 1, 1926, shall hereafter be lawful without the consent of the Minister of Agriculture, who may not consent to any enclosure unless satisfied that the interests of the public, as distinguished from those of the owners of the soil, will be benefited. These clauses have been aptly described as the "coping-stones" of the edifice which it has taken the Commons Preservation Society 60 years to build.

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COMMON SENSE nowadays usually signifies the intelligence of normal people as distinguished from the views more or less peculiar to those who belong to special schools of thought. The contrast intended is sometimes that between the views of average people as against the views of peculiar or exceptional people, and sometimes that between the attitude of those who have just a general education and the attitude or outlook of those who have specialized in some way or other. The term, or rather its Greek equivalent (*κοινὴ αἴσθησις*) was first introduced by Aristotle, who seems to have been prompted by a variety of considerations. The five senses of popular psychology are each of them a special sense —visual only, or auditory only, or tactual only, and so on. As the organs for each of them are distinct and separate it seems remarkable that the visible, auditory, tactual and other sense qualities of an object should be localized in one and the same object. Hence the postulation of a "common" sense in addition to the "special" senses in order to account for the synthesis in question. Again, there are some things apprehended in sense perception which are not peculiar to any one of the special senses but are common to two or more of them—such are, for instance, motion, rest, number, size, shape. It seemed, therefore, reasonable to Aristotle to assume a common sense for the apprehension of such "common sensibles" as they were called. Once more, the different special sense-impressions are frequently compared and commonly differentiated. This likewise seemed to be the function of a common sense capable of comparing the reports of the several special senses. It is not quite certain whether Aristotle regarded the special senses as special functions of the common sense which included them all and more, or whether he regarded common sense as something separate from each of them but co-operating with them. In any case, he was led by the aforementioned and other considerations to formulate the existence of a common sense which he also credited with the function of memory, imagination and even of awareness of the fact that we are having sense-experiences. It is this last function, probably, that prompted some later writers to substitute an "inner" sense for Aristotle's "common" sense. Having regard to the kind of functions which Aristotle attributed to "common sense" it is not strange that the term should eventually have come to acquire the meaning of something like the general intelligence of the ordinary person.

COMMON SENSE PHILOSOPHY, or "the philosophy of common sense," is the usual designation of the Scottish philosophy or the Philosophy of the Scottish school consisting of Thomas Reid (1710–1796), Adam Ferguson (1723–1816), Dugald Stewart (1753–1828) and others. This trend of thought was a reaction or revolt against the scepticism of Hume and the subjective idealism of Berkeley, both of which were regarded as the consequences of a false start, namely an excessive stress on ideas, and as reductions to absurdity of the premises from which they started. For the false start Descartes and Locke were held to be chiefly responsible inasmuch as they gave to ideas an importance that inevitably made everything else succumb to them. "Ideas (says Reid) seem to have something in their nature unfriendly to other existences . . . they have by degrees supplanted their constituents, and undermined the existence of everything but themselves. First, they discarded all secondary qualities of bodies; and it was found out by their means that fire is not hot, nor snow cold, nor honey sweet; and, in a word, that heat and cold, sound, colour, taste and smell, are nothing but ideas or impressions. Bishop Berkeley advanced them a step higher, and found out, by just reasoning from the same principles, that extension, solidity, space, figure and body, are ideas, and that there is nothing in nature but ideas and spirits. But the triumph of ideas was completed by the *Treatise on Human Nature,* which discards spirits also, and leaves ideas and impressions as the sole existences in the universe" (*Works,* i. p. 109). In the actual perception of the normal unsophisticated man, sensations are not mere ideas or subjective impressions but carry with them the belief in corresponding qualities as belonging to external objects. Such beliefs, Reid insists, "belong to the common sense and reason of mankind," and in matters of common sense "the learned and the unlearned, the philosopher and the day-labourer, are upon a level." Kant was too much under the influence of idealism to respect the philosophy of common sense, which is the natural enemy of idealism, and so we find him speaking contemptuously of common sense as "one of the subtlest inventions of modern times, by which the emptiest talker may coolly confront the profoundest thinker, and hold out against him" (*Prolegomena,* Introduction). That, however, did not kill the philosophy of common sense. Not only was it adopted as the official philosophy of France from 1816 till 1870, but in one form or another it has survived to this day, and contemporary thinkers still oppose certain subjective and idealistic tendencies by an appeal to common sense.

See J. McCosh, *The Scottish Philosophy* (1875) and the articles on the philosophers named. (A. Wo.)

COMMONWEALTH, a term generally synonymous with commonweal, *i.e.,* public welfare, but more particularly signifying a form of government in which the general public have a direct voice. "The Commonwealth" is used in a special sense to denote the period in English history embracing the Protectorate of Oliver Cromwell, between the execution of Charles I. in 1649 and the Restoration in 1660. Commonwealth is also the official designation in America of the States of Massachusetts, Pennsylvania, Virginia and Kentucky. The Commonwealth of Australia is the title of the federation of Australian colonies carried out in 1900. The associated self-governing communities of the British empire are also described as the British Commonwealth of Nations.

COMMONWEALTH EDISON COMPANY, supplying substantially all of the electric light and power service in Chicago, is the successor by consolidation and merger to a number of electric utility companies the first of which (the Chicago Edison Company) was incorporated in 1887. It now controls, through direct stock ownership, important electric and gas utilities which supply service to 563 communities in 11,000 sq.mi. of territory in northern Illinois.

In 1892, the generating capacity of the Chicago Edison Company was 3,180 kilowatts. At the 1939 year-end, the generating capacity of Commonwealth Edison Company and subsidiaries was nearly 2,000,000 kilowatts. They were then serving over 1,365,000 electric customers and 279,000 gas customers. The system electric maximum demand for the winter of 1939–40 was approximately 1,542,000 kilowatts. The property, plant, and equipment of the company and subsidiaries (consolidated) at Dec. 31, 1939, was $681,122,806; total assets, $841,424,013; capital stock (including minority interests), $262,014,833; and funded debt, $377,270,900 which includes $82,332,900 of debentures, convertible into stock.

COMMUNE, in its most general sense, a group of persons acting together for purposes of self-government, especially in towns. (*See* Borough, and *Mediaeval,* below.) "Commune" (Med. Lat. *communia,* Lat. *communis,* common), is now the term generally applied to the smallest administrative division in many European countries.

"The Commune" is the name given to the Béla Kun régime in Hungary (*see* Hungary: *History*) and more generally to the Parisian insurrection of March 18 to May 29, 1871. Short-lived communes appeared at the same time in Marseilles, St. Étienne, Lyons and Narbonne. During the Franco-Prussian War the complete separation between Paris and the provinces had led to a total division of political sentiment; the peasant districts, disliking the prolongation of the war by the republic, returned a majority of monarchist deputies to the new assembly which was elected on Feb. 8, while Paris, which had ardently desired a continuance of the war, returned extreme Republicans. Adolphe Thiers (*q.v.*) who was selected as premier concurred with the assembly in believing that the disarmament and crushing of the armed National Guard of Paris was a necessary preliminary to the restoration of order. On the night of March 17–18 by his orders General Vinoy made an attempt to seize the cannon of the National Guard parked in Montmartre. This miscarried in the early morning owing to Vinoy's regular soldiers revolting and joining the Guard. In the ensuing tumult two generals were killed and the Government with the exception of Jules Ferry precipitately fled from Paris. The elective "Central Committee" of the Guard was thus unexpectedly left as the only effective authority: it negotiated elaborately with the local mayors (as the remaining legal authorities) and secured their consent to holding on March 26 an election for a commune, which resulted in a heavy "Red Republican" and Socialist majority. Despite the memories of 1793 called up by this name, it was intended by a majority of the members to mark only the assumption by Paris of the municipal powers previously denied her, and on this basis negotiations were privately opened with Thiers. He, however, adhered to his original policy and on April 2 bombarded Paris. A communard sortie next day was repulsed and thenceforward war was unceasing.

The policy of the Commune was only partly Socialist: the most advanced department in this respect being Leo Frankel's department of labour. Other departments were disorganized by the absence of Blanqui (a prisoner in Thiers' hands) whose followers comprised the majority and were accustomed to work only under his immediate direction. The Commune, which afterwards was regarded as the first "workers' republic," had hardly begun to carry out its semi-Socialist programme, largely adapted from the International, when the military situation became untenable.

Disorganization and unequal odds had led to the loss of Forts Issy and Vanves and the breaching of the wall at Porte Maillot and Auteuil. Thiers' troops entered by the latter on May 22 and occupied the west end, shooting a number of prisoners. Certain of the members of the Commune fled; others, after ordering the shooting of 67 hostages in their hands, conducted an embittered resistance which only ended with the capture of Fort Vincennes on May 29. The victors executed most of their prisoners out of hand: 20,000 Parisians without distinction of sex or age are generally supposed thus to have perished, though some writers put the figure as high as 36,000. The survivors were mostly deported to New Caledonia. The scene of the greatest slaughter, a wall in Père Lachaise cemetery, is the site of an annual international Socialist celebration.

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MEDIAEVAL

A short account is here given of the rise and development of towns in central and western Europe since the downfall of the Roman empire. All these arose under similar conditions, economic, legal and political, irrespective of local peculiarities. Kindred economic conditions prevailed in all the former provinces of the Western empire, while new law concepts were everywhere introduced by the Germanic invaders. It seems advisable to begin with an account of the German towns, for their development was least affected by foreign interference, and it may also be said that their constitutional and economic history has been more thoroughly investigated than any other.

Germany.—The German towns should be considered from three points of view, as jurisdictional units, as self-administrative units and as economic units. One of the chief distinguishing features of early as opposed to modern town-life is that each town formed a jurisdictional district distinct from the country around. Another trait, more in accordance with modern conditions, is that local self-government was more fully developed in the towns than without. And, thirdly, each town in economic matters followed a policy as independent as possible of that of any other towns or of the country in general. The problem is, how this state of things arose.

The German towns may be divided into two main classes: those that arose on the ruins of former Roman cities in the Rhine and Danube countries, and those that were newly founded at a later date in the interior. Foremost in importance among the former stand the episcopal cities. Most of them had never been entirely destroyed during the Germanic invasion. Roman civic institutions perished; but probably parts of the population survived, and small Christian congregations with their bishops in most cases seem to have weathered all storms. Much of the city walls presumably remained standing, and within them German communities soon settled.

In the 10th century it became the policy of the German emperors to hand over to the bishops full jurisdictional and administrative powers within their cities. The bishop henceforward directly or indirectly appointed all officers for the town's government. The chief of these was usually the *advocatus* or *Vogt,* some neighbouring noble who served as the proctor of the church in all secular affairs. It was his business to preside three times a year over the chief law-court, the so-called *echte* or *ungebotene Ding,* under the cognizance of which fell all cases relating to real property, personal freedom, bloodshed and robbery. For the rest of the legal business and as president of the ordinary court he appointed a *Schultheiss, centenarius* or *causidicus.* Other officers were the *Burggraf* or *praefectus* for military matters including the preservation of the town's defences, walls, moat, bridges and streets, to whom also appertained some jurisdiction over the craft-gilds in matters relating to their crafts; further the customs-officer or *teleonarius* and the mint-master or *monetae magister.* It was not, however, the fact of their being placed under the bishop that constituted these towns as separate jurisdictional units. The chief feature rather is the existence within their walls of a special law, distinct in important points from that of the country at large. The towns enjoyed a special peace, as it was called, *i.e.,* breaches of the peace were more severely punished if committed in a town than elsewhere. Besides, the inhabitants might be sued before the town court only, and to fugitives from the country who had taken refuge in the town belonged a similar privilege. This special legal status probably arose from the towns being considered in the first place as the king's fortresses or burgs (*see* Borough), and, therefore, as participating in the special peace enjoyed by the king's palace. What struck the townless early Germans most about the Roman towns was their mighty walls, which were to them the main feature distinguishing a town from a village; and the fact of the town being a fortified place likewise necessitated the special provisions mentioned for maintaining the peace.

The New Towns.—The new towns in the interior of Germany were founded on land belonging to the founder, some ecclesiastical or lay lord, and frequently adjoining the cathedral close of one of the new sees or the lord's castle, and they were laid out according to a regular plan. The most important feature was the market-square, often surrounded by arcades with stalls for the sale of the principal commodities and with a number of straight streets leading thence to the city gates. As for the fortifications, some time naturally passed before they were completed. Furthermore, the governmental machinery would be less complex than in the older towns. The legal peculiarities distinguishing town and country, on the other hand, may be said to have been conferred on the new towns in a more clearly defined form from the beginning.

An important difference lay in the mode of settlement. There is evidence that in the former Roman towns the German new-comers settled much as in a village, *i.e.*, each full member of the community had a certain portion of arable land allotted to him and a share in the common. Their pursuits would at first be mainly agricultural. The new towns, on the other hand, general economic conditions having meanwhile begun to undergo a marked change, were founded with the intention of establishing centres of trade. Periodical markets, weekly or annual, had preceded them, and already enjoyed the special protection of the king's ban, acts of violence against traders visiting them or on their way towards them being subject to special punishment. The new towns may be regarded as markets made permanent. The settlers invited were merchants and handicraftsmen. The land now allotted to each member of the community was just large enough for a house and yard, stabling and perhaps a small garden. These building plots were given as free property or, more frequently, at a merely nominal rent with the right of free disposal, the only obligation being that of building a house. All that might be required besides would be a common for the pasture of the burgesses' cattle.

The example thus set was readily followed in the older towns. The necessary land was placed at the disposal of new settlers, either by the members of the older agricultural community, or by the various churches. The immigrants were of widely differing status, many being serfs who came either with or without their lords' permission. The necessity of putting a stop to belated prosecutions on this account in the town court led to the acceptance of the rule that nobody who had lived in a town undisturbed for the term of a year and a day could any longer be claimed by a lord as his serf. But even those who had migrated into a town with their lords' consent could not very well for long continue in serfdom. When, on the other hand, certain bishops attempted to treat all new-comers to their city as serfs, the emperor Henry V. in charters for Spires and Worms proclaimed that in these towns all serf-like conditions should cease. This ruling found expression in the famous saying: *Stadtluft macht frei,* "town-air renders free." As may be imagined, this led to a rapid increase in population, mainly during the 11th and 13th centuries. There would be no difficulty for the immigrants to find a dwelling, or to make a living, since most of them would be versed in one or other of the crafts in practice among villagers.

The most important further step in the history of the towns was the establishment of an organ of self-government, the town-council, with one, two or more burgomasters at its head. As *units of local government* the towns originally stood on the same legal basis as villages, with the responsibility for all common interests below the cognizance of the public courts or of those of their lord. In the towns, however, this right was strengthened at an early date by the *jus negotiale.* At least as early as the beginning of the 11th century, mercantile communities claimed the right, confirmed by the emperors, of settling mercantile disputes according to a law of their own. Furthermore, in the rapidly developing towns, opportunities for the exercise of self-administrative functions constantly increased. The new self-governing body soon began to legislate in matters of local government, imposing fines for the breach of its by-laws. Thus it assumed a jurisdiction, partly concurrent with that of the lord, which it further extended to breaches of the peace. And, finally, it raised funds by means of an excise-duty. In the older and larger towns it soon went beyond what the bishops thought proper to tolerate; conflicts ensued; and in the 13th century several bishops obtained decrees in the imperial court, either to suppress the council altogether, or to make it subject to their nomination, and more particularly to abolish the excise as detrimental to episcopal finances. In the long run, however, these attempts proved of little avail.

The Craft-gilds.—Meanwhile the tendency towards self-government spread even to the lower ranks of town society, resulting in the establishment of craft-gilds. From a very early period there is reason to believe that merchants among themselves formed gilds for social and religious purposes, and for the furtherance of their economic interests. On the other hand, the most important commodities offered for sale in the market had been subject to official examination already in Carolingian times. Bakers', butchers', shoemakers' stalls were grouped together in the market-place to facilitate control, and with the same object in view a master was appointed for each craft as its responsible representative. By and by these crafts or "offices" claimed the right of electing their master and of assisting him in examining the goods, and even of framing by-laws regulating the quality of the wares and the process of their manufacture. The bishops at first resented these attempts at self-management, as they had done in the case of the town council, and imperial legislation in their interests was obtained. But each craft at the same time formed a society for social, beneficial and religious purposes, and, as these were entirely in accordance with the wishes of the clerical authorities, the other powers could not in the long run be withheld, including that of forcing all followers of any craft to join the gild. It is not suggested that in each individual town the rise of the gilds was preceded by an organization of crafts on the part of the lord and his officers; but that voluntary organization could hardly have proceeded on such orderly lines as on the whole it did, unless the framework had in the first instance been laid down by the authorities. The principle of compulsory association would have found still less ready acceptance both on the part of the authorities and on that of the men, had it not previously been in full practice and recognition under the system of official market-control.

External Relations.—From an early date the towns, more particularly the older episcopal cities, took a part in imperial politics. Legally the bishops were in their cities mere representatives of the imperial government. This fact found formal expression mainly in two ways. The *Vogt,* although appointed by the bishop, received the "ban," *i.e.,* the power of having justice executed, which he passed on to the lesser officers, from the king or emperor direct. Secondly, whenever the emperor held a general assembly, or diet, in one of the episcopal cities, and for a week before and after, all jurisdictional and administrative power reverted to him and his immediate officers. The citizens on their part clung to this connection and made use of it whenever their independence was threatened by their bishops, who strongly inclined to consider themselves lords of their cathedral cities, much as if these had been built on church-lands. As early as 1073, therefore, we find the citizens of Worms successfully rising against their bishop in order to provide the emperor Henry IV. with a refuge against the rebellious princes. Those of Cologne made a similar attempt in 1074. But a second class of imperial cities (*Reichsstädte*), much more numerous than the former, consisted of those founded on demesne-land belonging either to the empire or to one of the families who rose to imperial rank. This class was largely reinforced after the extinction of the royal house of Hohenstaufen, when a great number of towns founded by them on their demesne successfully claimed immediate subjection to the crown. During the interregnum, a federation of more than 100 towns was formed, spreading from the Rhine as far as Bremen in the north, Zurich in the south and Regensburg in the east, with the object of helping to preserve the peace. In the following centuries the imperial cities in south Germany, where most of them were situated, repeatedly formed leagues to protect their interests against the power of the princes and the nobles, and destructive wars were waged; but no great political issue found solution, the relative position of the parties after each war remaining much what it had been before. On the part of the towns this was mainly due to lack of leadership and of unity of purpose. At the time of the Reformation the imperial towns, like most of the others, stood forward as champions of the new cause and did valuable service in upholding and defending it. After that, however, their political part was played out, mainly because they proved unable to keep up with modern conditions of warfare. It should be stated that seven among the episcopal cities, viz., Cologne, Mainz, Worms, Spires, Strasbourg, Basle and Regensburg, claimed a privileged position as "Free Cities," but neither is the ground for this claim clearly established, nor its nature well defined. The general obligations of the imperial cities towards the empire were the payment of an annual fixed tax and the furnishing of a number of armed men for imperial wars, and from these the above-named towns claimed some measure of exemption. Some of the imperial cities lost their independence at an early date, as unredeemed pledges to some prince who had advanced money to the emperor. Others seceded as members of the Swiss Confederation. But a considerable number survived until the reorganization of the empire in 1803. At the peace in 1815, however, only four were spared, namely, Frankfurt, Bremen, Hamburg and Lubeck, these being practically the only ones still in a sufficiently flourishing and economically independent position to warrant such preferential treatment. But finally Frankfurt, having chosen the wrong side in the war of 1866, was annexed by Prussia, and only the three seaboard towns retained the style of *Freie und Hansestädte*. But until modern times most of the larger *Landstädte* or mesne-towns for all intents and purposes were as independent under their lords as the imperial cities were under the emperor. They even followed a foreign policy of their own, concluded treaties with foreign powers or made war upon them. Nearly all the *Hanseatic towns* belonged to this category. With others like Bremen, Hamburg and Magdeburg, it was long in the balance to which class they belonged. All towns of any importance, however, were for a considerable time far ahead of the principalities in administration. It was largely this fact that gave them power. When, therefore from about the 15th century the princely territories came to be better organized much of the *raison d'être* for the exceptional position held by the towns disappeared. The towns from an early date made it their policy to suppress the exercise of all handicrafts in the open country. On the other hand, they sought an increase of power by extending rights of citizenship to numerous individual inhabitants of the neighbouring villages. By this and other means, *e.g.,* the purchase of estates by citizens, many towns gradually acquired a considerable territory. These tendencies both princes and lesser nobles naturally tried to thwart, and the mediate towns or *Landstädte* were finally brought to stricter subjection in the greater principalities such as Austria and Brandenburg. Besides, the less favourably situated towns suffered through the concentration of trade in the hands of their more fortunate sisters. But the economic decay and consequent loss of political influence among both imperial and territorial towns must be chiefly ascribed to inner causes.

Commercial Policy.—The period of the rise of cities till well on in the 13th century was naturally a period of expansion and of a considerable amount of freedom of trade. Afterwards, a protectionist spirit gained the upper hand, and each town made it its policy to restrict as far as possible the trade of strangers. In this revolution the rise of the lower strata of the population to power played an important part. The craft-gilds had remained subordinate to the council, but by-and-by they claimed a share in the government of the towns. Originally any inhabitant holding a certain measure of land, freehold or subject to the mere nominal ground-rent abovementioned was a full citizen independently of his calling, the clergy and the lord's retainers and servants of whatever rank, who claimed exemption from scot and lot, to use the English formula, alone excepted. The majority of the artisans, however, were not in this happy position. Moreover, the town council, instead of being freely elected, filled up vacancies by co-optation, with the result that all power became vested in a limited number of rich families. Against this state of things the crafts rebelled, alleging mismanagement, malversation and the withholding of justice. During the 14th and 15th centuries revolutions and counter-revolutions, sometimes accompanied by considerable slaughter, were frequent, and a great variety of more democratic constitutions were tried. Zurich, however, is the only German place where a kind of *tyrannis,* so frequent in Italy, came to be for a while established. On the whole it must be said that in those towns where the democratic party gained the upper hand an unruly policy abroad and a narrow-minded protection at home resulted. An inclination to hasty measures of war and an unwillingness to observe treaties among the democratic towns of Swabia were largely responsible for the disasters of the war of the Swabian League in the 14th century. At home, whereas at first markets had been free and open to any comer, a more and more protective policy set in, traders from other towns being subjected more and more to vexatious restrictions. It was also made increasingly difficult to obtain membership in the craft-gilds, high admission fees and so-called masterpieces being made a condition. Finally, the number of members became fixed, and none but members' sons and sons-in-law, or members' widows' husbands were received. The first result was the formation of a numerous proletariat of life-long assistants and of men and women forcibly excluded from following any honest trade; and the second consequence, the economic ruin of the town to the exclusive advantage of a limited number. From the end of the 15th century population in many towns decreased, and some once important centres of trade sank to the level almost of villages. Those cities, on the other hand, where the mercantile community remained in power, like Nuremberg and the seaboard towns, on the whole followed a more enlightened policy, although even they could not quite keep clear of the ever-growing protective tendencies of the time. Many even of the richer towns, notably Nuremberg, ran into debt irretrievably, owing partly to an exorbitant expenditure on magnificent public buildings and extensive fortifications, calculated to resist modern instruments of destruction, partly to a faulty administration of the public debt.

One of the principal achievements of the towns lay in the field of *legislation.* Their law was founded originally on the general national law, or custom, and on special privilege. New foundations were regularly provided by their lord with a charter embodying the most important points of the special law of the town in question. This miniature code would thenceforth be developed by means of statutes passed by the town council. The codification of the law of Augsburg in 1276 fills a moderate volume in print (ed. by Christian Meyer, Augsburg, 1872). Later foundations were frequently affiliated by their founders to the nearest existing town of importance, though that might belong to a different lord. Afterwards, if a question in law arose which the court of a younger town found itself unable to answer, the court next senior in affiliation was referred to, which in turn would apply to the court above, until at last that of the original mother town was reached, whose decision was final. This system was chiefly developed in the colonial east, where most towns were affiliated directly or indirectly either to Lubeck or to Magdeburg; but it was by no means unknown in Germany proper.

Italy.—To turn to *Italy,* the country for so many centuries in close political connection with Germany, the foremost thing to be noted is that here the towns grew to even greater independence, many of them in the end acknowledging no overlord whatever after the yoke of the German kings had been shaken off. On the other hand, nearly all of them in the long run fell under the sway of some local tyrant-dynasty.

From Roman times the country had remained thickly studded with towns, each being the seat of a bishop. From this arose their most important peculiarity. For it was largely due to an identification of diocese and municipal territories that the nobles of the surrounding country took up their headquarters in the cities, either voluntarily or because forced to do so by the citizens, who made it their policy thus to turn possible opponents into partisans and defenders. In Germany, on the other hand, nobles and knights were carefully shut out so long as the town's independence was at stake, the members of a princely garrison being required to take up their abode in the citadel, separated from the town proper by a wall. In consequence of this, municipal life in Italy was from the first more complex, the main constituent parts of the population being the greater nobles, the lesser nobles (knights) and the people. Furthermore, the bishops being in most cases the representatives of the imperial power, the struggle for freedom from the latter ended in emancipation from all temporal episcopal government as well. Foremost in this struggle stood the cities of Lombardy, most of which all through the barbarian invasions had kept their walls in repair and maintained some importance as economic centres, and whose *popolo* largely consisted of merchants of some standing. As early as the 8th century, the laws of the Lombard King Aistulf distinguished three classes of merchants (*negotiantes*), among whom the *majores et potentes* were required to keep themselves provided with horse, lance, shield and a cuirass. The valley of the Po formed the main artery of trade between western Europe and the East, Milan being besides the point of convergence for all Alpine passes west of the Brenner. Lombard merchants soon spread all over western Europe, a chief source of their ever-increasing wealth being their employment as bankers of the papal see.

The struggle against the bishops, in which a clamour for ecclesiastical reforms and a striving for local self-government were strangely interwoven, had raged for a couple of generations when King Henry V., great patron of municipal freedom as he was, legalized by a series of charters the *status quo* (Cremona, 1114, Mantua, 1116). But under his weak successors the independence of the cities reached such a pitch as to be intolerable to an energetic monarch like Frederick I. Therefore in 1158 a commission was appointed embracing four Roman legists as representatives of the emperor, as well as those of 14 towns, to examine into imperial and municipal rights. The claims of the imperial government were acknowledged, only such rights of self-government being admitted as could be shown to be grounded on imperial charters. But when it came to carrying into effect these Roncaglian decrees, a general rising resulted. Milan was besieged by the emperor and destroyed in 1162 in accordance with the verdict of her rivals. Nevertheless, after a defeat at Legnano in 1176 Frederick was forced to renounce all pretensions to interference with the government of the cities, merely retaining an overlordship that was not much more than formal (peace of Constance in 1183). All through this war the towns had been supported by Pope Alexander III. Similarly under Frederick II. the renewal of the struggle between emperor and pope dovetailed with a fresh outbreak of the war with the cities, who feared lest an imperial triumph over the church would likewise threaten their independence. The emperor's death finally decided the issue in their favour.

Municipal Government.—Municipal freedom in Italy was based on the formation of a commune headed by elected consuls, usually to the number of 12 representing the three orders of *capitani, valvassori* and *popolo*. Frequently, however, the number actually wielding power was much more restricted, and their position altogether may rather be likened to that of their Roman predecessors than to that of their German contemporaries. In all important matters they asked the advice and support of "wise men," as a body called the *credenza*, while the popular assembly (*parlamentum, concio, consilium generale*) was the true sovereign. The consuls with the assistance of *judices* also presided in the law-courts; but besides the consuls of the commune, there were *consules de placitis* specially appointed for jurisdictional purposes. In spite of these multifarious safeguards, family and political factions early destroyed the fabric of liberty. Party government was impossible and resort was often had to the appointment as chief magistrate of a *podestà* from among the nobles or knights of a different part of the country not mixed up with the local feuds. But the end was in most cases the establishment of the despotism of some leading family, such as the Visconti at Milan, the Gonzaga at Mantua, the della Scala in Verona and the Carrara in Padua.

In Tuscany, the historic rôle of the cities, with the exception of Pisa, begins at a later date, largely owing to the overlordship of the powerful margraves of the house of Canossa and their successors, who here represented the emperor. Nevertheless, communes with consuls at their heads were formed in Tuscany much as elsewhere. On the other hand the Tuscan cities managed to prolong the reign of liberty to a much later epoch, no *podestà* ever quite succeeding here in his attempts to establish the rule of his dynasty. Even when in the 15th century the Medici attained to power in Florence the form at least of a republic was still maintained, and not till 1531 did one of them, supported by Charles V., assume the ducal title.

Long before the last stage, the rule of *signori*, was reached, the commune as originally constituted had everywhere undergone radical changes. As early as the 13th century the lower orders in Florence formed an organization under officers of their own, side by side with that of the commune, which was controlled by the great and the rich. Its establishment was followed by numerous constitutional experiments which led to constant disorder and to an occasional reign of terror like that of the Signore Gauthier de Brienne, duke of Athens (1342–43). It was not till after a rising of the lowest order of all, the industrial labourers, had been suppressed in 1378 (*tumulto dei Ciompi*, the wool-combers), that quieter times ensued under the wise leadership, first of the Albizzi and finally of the Medici.

The history of the other Tuscan towns was equally tumultuous, all of them save Lucca, after many fitful changes, finally passing under the sway of Florence, or the grand-duchy of Tuscany, as the State was now called. Pisa, one time the mightiest, had been crushed between its inland neighbour and its maritime rival Genoa (battle of Meloria, 1282).

Venice.—Apart in its constitutional development from all other towns in Italy, and, it might be added, in Europe, stands Venice. Almost alone among Italian cities its origin does not go back to Roman times. It was not till the invasions of Hun and Lombard that fugitives from the Venetian mainland founded a number of small communities under elected tribunes, acknowledging as their sovereign the emperor at Constantinople. Just before or after A.D. 700 the young republic seems to have thrown off the rule of the Byzantine *dux Histriae et Venetiae* and elected a duke (*doge*) of its own, in whom was vested the executive power, the right to convoke the popular assembly (*concio*) and appoint tribunes and justices. Political unity was thus established. In 1032 it was provided that no duke might appoint his successor or procure him to be elected during his own lifetime. Besides this two councils were appointed without whose consent nothing of importance was to be done. After the murder by the people of Duke Vitale Michiel in 1172, the ancient popular meeting was replaced by a great council of from 450 to 480 members elected annually by special appointed electors in equal proportion from each of the six wards. One of the functions of this body was to appoint most of the State officials or their electors. There was also an executive council of six, one member from each ward. Besides these, the duke, who was henceforward chosen for life by a body of 11 electors from among the aristocracy, would invite persons of prominence (the *pregadi*) in order to secure their assent and co-operation whenever a measure of importance was to be placed before the great council. Only under extraordinary circumstances was the *concio* to be summoned. In order to control the executive the *avvogadori di commune* were appointed. After 1310, this body developed into the Council of Ten (*Consiglio dei Dieci*), from which the State inquisition arose in the 16th century. The general tendency of constitutional development in Venice henceforward ran in an exactly opposite direction to that of all other Italian cities, towards a growing restriction of popular rights, until in 1296 the great council was for all future time closed to all but the descendants of a limited number of noble families, whose names were in that year entered in the Golden Book.

The marked steadiness in the evolution of the Venetian constitution is no doubt largely due to the fact that in Venice the nobility was entirely commercial. Elsewhere the presence of large numbers of turbulent country nobles furnished the first germ for the unending dissensions which ruined such promising beginnings. In Venice, on the contrary, its businesslike habits of mind led the ruling class to make what concessions might seem needful, while both the masses and the head of the State were kept in due subjection to the laws. Too much stability, however, finally changed into stagnation, and the constitution proved too rigid to deal effectively with the many problems which confronted the government under the changed conditions of the 16th century.

The cities of southern Italy do not here call for special attention. Several of them developed a certain amount of independence and free institutions, and took an important part in trade with the East, notably so Amalfi. But, after incorporation in the Norman kingdom, all individual history for them came to an end. (For Rome, *see* separate article.)

France.— In no other country is there such a clear grouping of the towns on geographical lines as in *France,* these geographical lines, of course, having in the first instance been drawn by historical causes. Another feature is the extent to which, in the unruly times preceding the civic movement, serfdom had spread among the inhabitants even of the towns throughout the greater part of the country, and the application of feudal ideas to town government. In some other respects the constitution of the cities in the south of France has more in common with that of the Italian communes, and that of the northern French towns with those of Germany, than the constitutions of the various groups of French towns have with each other.

In the group of the *villes consulaires,* comprising all important towns in the south, the executive was, as in Italy, in the hands of a body of *consules,* whose number in most cases rose to 12. They were elected for the term of one year and re-eligible only after an interval, and they were supported by a municipal council which, however, as a rule was far from comprising the whole body of citizens. Another feature which these southern towns had in common with their Italian neighbours was the prominent part played by the native nobility. The relations with the clergy were generally of a more friendly character than in the north, and in some cases the bishop or archbishop even retained a considerable influence in the management of the town's affairs. Dissensions among the citizens, or between the nobles and the bourgeois, frequently ended in the adoption of a *podestat.* In several cities of the Languedoc, each of the two classes composing the population retained its separate laws and customs. The influence of Roman law is shown by the *statuts municipaux* of many southern towns. In the improvement and expansion of these statutes a remarkable activity was displayed by means of an annual *correctio statutorum* carried out by specially appointed *statutores.* In the north, on the other hand, the *carta communiae,* forming as it were the basis of the commune's existence, seems to have been considered almost as something sacred and unchangeable.

The constitutional history of the communes in northern France in a number of points widely differed from that of these *villes consulaires.* Their origin was often the result of a revolution. These revolutions were in the first place directed against the bishops; but the higher clergy and the nobility were here distinctly more hostile to the aspirations of the citizens than in the south. As a result the clergy and the nobles were excluded from all membership of the commune, except that those residing in the town might be required to swear not to conspire against it. The commune was formed by an oath of mutual help. The members were usually described as *jurati* although in some communes that term was reserved for the members of the governing body. None but men of free and legitimate birth, and free from debt and contagious or incurable disease were received. The members of the governing body were styled *jurés pairs* or *échevins.* The last was, however, as in Germany, more properly the title of the jurors in the court of justice, which in many cases remained in the hands of the lord. In some cases the town council developed out of this body; but in the larger cities, like Rouen, several councils worked and all these names were employed side by side. The number of the members of the governing body proper varies from 12 to 100, and its functions were both judicial and administrative. The most striking distinction, however, as against the *villes consulaires* was the elevation of the president of the body to the position of *maire* or *mayeur* (sometimes also called *prévôt, praepositus*). As elsewhere, at first none but the civic aristocracy were admitted to take part in the management of the town's affairs; but from the end of the 13th century a share had to be conceded to representatives of the crafts. Dissatisfaction, however, was not easily allayed; the lower orders applied for the intervention of the king; and that effectively put an end to political freedom. This tendency of calling in State help marks a most striking difference from the policy followed by the German towns, where all classes appear to have been always far too jealous of local independence. The result for the nation was in the one case despotism, equality and order, in the other individual liberty and an inability to move as a whole. At an early stage the king had frequently come to the assistance of the communes in their struggle with their lords, and his confirmation came to be considered necessary for their lawful existence. This proved a powerful lever for the extension of the king's authority. It is strange that in France the towns never had recourse to those inter-urban leagues which played so important a part in Italian and in German history.

The Villes Franches.—These two varieties, the communes and the *villes consulaires,* together form the group of *villes libres.* As opposed to these stand the *villes franches,* also called *villes prévotales* after the chief officer, *villes de bourgeoisie* or *villes soumises.* They make up by far the majority of French towns, comprising all those situated in the centre of the kingdom, and also a large number in the north and the south. They are called *villes franches* on account of their possessing a franchise, a charter limiting the services due by the citizen to their lord; but political status they had little or none. According to the varying extent of the liberties conceded them, there may be distinguished towns governed by an elective body and more or less fully authorized to exercise jurisdiction; towns possessing some sort of municipal organization, but no rights of jurisdiction, except that of simple police; and, thirdly, those governed entirely by seignorial officers. To this last class belonged some of the most important cities in France, wherever the king had power enough to withhold liberties deemed dangerous and unnecessary. On the other hand, towns of the first category often came close to the *villes libres.* A strict line of demarcation, however, remained in the mutual oath which formed the basis of the civic community in both varieties of the latter, and in the fact that the *ville libre* stood to its lord in the relation of vassal and not in that of an immediate possession. But however *complètement assujettie* Paris might be, its organization, naturally, was immensely more complex than that of hundreds of smaller places which, formally, might stand in an identical relationship to their lords. Like other *villes franches,* under the king, Paris was governed by a *prévôt* (provost), but certain functions of self-government for the city were delegated to the company of the *marchands de l'eau,* that is, the gild of merchants whose business lay down the river Seine, to the citizens as such. At their head stood a *prévôt des marchands* and four *échevins de la marchandise.* Other *prud'hommes* were occasionally called in, and from 1296 *prèvôt* and *échevins* appointed 24 councillors to form with themselves a *parloir aux bourgeois.* The crafts of Paris were organized in *métiers,* whose masters were appointed, some by the *prévôt de Paris,* and some by certain great officers of the court. In the tax rolls of A.D. 1292 to 1300 no fewer than 448 names of crafts occur, while the *Livre des métiers* written in 1268 by Étienne de Boileau, then *prévôt de Paris,* enumerates 101 organized bodies of tradesmen or women and artisans. Among the duties of these bodies, as elsewhere, was the *guet* or night-watch, which necessitated a military organization under *quartainiers, cinquantainiers* and *dixainiers.* This gave them a certain power. But both their revolutions, under the *prévôt des marchands,* Étienne Marcel, after the battle of Maupertuis, and again in 1382, were extremely short-lived, and the only tangible result was a stricter subjection to the king and his officers.

Flanders.—An exceptional position among the cities of France is taken by those of Flanders, more particularly the three "Great Towns," Bruges, Ghent and Ypres, whose population was Flemish, *i.e.,* German. They sprang up at the foot of the count's castles and rose in close conjunction with his power. On the accession of a new house they made their power felt as early as 1128. Afterwards the counts of the house of Dampierre fell into financial dependence on the burghers, and therefore allied themselves with the rising artisans, led by the weavers. These, however, proved far more unruly, bloody conflicts ensued, and for a considerable period the three great cities ruled the whole of Flanders with a high hand. Their influence in the foreign relations of the country was likewise great, it being in their interest to keep up friendly relations with England, on whose wool the flourishing state of the staple industry of Flanders depended. It is a remarkable fact that the historical position taken up by these cities, which politically belonged to France, is much more akin to the part played by the German towns, whereas Cambrai, whose population was French, was the only city politically situated in Germany, where a commune came to be established.

In the *Spanish peninsula,* the chief importance of the numerous small towns lay in the part they played as fortresses during the unceasing wars with the Moors. The kings therefore extended special privileges (*fueros*) to the inhabitants, and they were even at an early date admitted to representation in the Cortes. Of greater individual importance than all the rest was Barcelona. Already in 1068 Count Berengarius gave the city a special law (*usatici*) based on its ancient usages, and from the 14th century its commercial code became influential all over southern Europe.

The constitutions of the *Scandinavian* towns were largely modelled on those of Germany, but the towns never attained anything like the same independence. Their dependence on the royal government most strongly comes out in the fact of their being uniformly regulated by royal law in each of the three kingdoms. In Sweden particularly, German merchants by law took an equal share in the government of the towns. In Denmark their influence was also great, and only in Norway did they remain in the position of foreigners in spite of their famous settlement at Bergen. The details, as well as those of the German settlement at Wisby and on the east coast of the Baltic, belong rather to the history of the Hanseatic League (*q.v.*). Denmark appears to be the only one of the three kingdoms where gilds at an early date played a part of importance.

Bibliography.—For Germany it is best to consult Richard Schröder, *Lehrbuch der deutschen Rechtsgeschichte* (5th ed. Leipzig, 1907), ss. 51 and 56, where a bibliography as complete as need be is given, both of the monographs dealing with various aspects of the question, and of works on the history of individual towns. As a sort of complement to Schröder's chapters may be considered, F. Keutgen, *Urkunden zur städtischen Verfassungsgeschichte* (1901), a collection of 437 select charters and other documents, with a very full index. There is an excellent succinct account for general readers by Georg von Below, "Das ältere deutsche Städtewesen und Bürgertum," *Monographien zur Weltgeschichte,* vol. vi. (Bielefeld and Leipzig, 1898, illustrated). As for Italy, the most valuable general work for the early times is still Karl Hegel, *Geschichte der Städteverfassung von Italien seit der Zeit der römischen Herrschaft bis zum Ausgang des zwölften Jahrhunderts* (2 vols. Leipzig, 1847), in which it was for the first time fully proved that there is no connection between Roman and modern municipal constitutions. For the period from the 13th century it will perhaps be best to consult W. Assmann, *Geschichte des Mittelalters,* 3rd. ed., by L. Viereck, dritte Abteilung, *Die letzten beiden Jahrhunderts des Mittelalters: Deutschland, die Schweiz, und Italien,* by R. Fischer, R. Scheppig and L. Viereck (Brunswick, 1906). In this volume, pp. 679–943 contain an excellent account of the various Italian States and cities during that period, with a full bibliography for each. For France, there are the works by Achille Luchaire, *Les Communes françaises à l'époque des Capétiens directs* (1890), and Paul Viollet, "Les Communes françaises au moyen age," *Mémoires de l'Académie des Inscriptions et Belles-lettres,* tome xxxvi. (1900). A valuable account for France north of the Loire is that contained in the great work by Karl Hegel, *Städte und Gilden der germanischen Völker im Mittelalter* (2 vols. Leipzig, 1891). Of course, there are also numerous monographs, among which the following may be mentioned: Édouard Bonvalot, *Le Tiers État d'après la charte de Beaumont et ses filiales* (1884); and A. Giry, *Les Établissements de Rouen* (2 vols. 1883–85); also a collection of documents by Gustave Fagniez, *Documents relatifs à l'histoire de l'industrie et du commerce en France* (2 vols. 1898, 1900). Some valuable works on the commercial history of southern Europe should still be mentioned, such as W. Heyd, *Geschichte des Levantehandels im Mittelalter* (2 vols. Stuttgart, 1879; French edition by Furcy Raynaud, 2 vols. 1885 *seq.,* improved by the author), recognized as a standard work; Adolf Schaube, *Handelsgeschichte der romanischen Völker des Mittelmeergebietes bis zum Ende der Kreuzzüge* (Munich and Berlin, 1906); Aloys Schulte, *Geschichte des mittelalterlichen Handels und Verkehrs zwischen Westdeutschland und Italien mit Ausschluss Venedigs* (2 vols. Leipzig, 1900); L. Goldschmidt, *Universalgeschichte des Handelsrechts* (vol. i. Stuttgart, 1891). (F. K.)

COMMUNICATION: *see* Railways: *Signalling;* Signal Communication; Wireless Telegraphy; Telegraph; Telephone; Broadcasting; Television; Semaphore; Fathometer.

COMMUNICATIONS. In military language, the system of communication for supply, reinforcement, evacuation of wounded, etc., by road, rail, navigable waterways and air, between an army and its base (*q.v.*) or bases of operation inclusive.

COMMUNISM, a term often loosely used to denote different systems of social organization aiming at common property of the means of production, or at an equal distribution of wealth and income, or at both. Historically the term was frequently used as identical with socialism, as was done by Karl Marx and Friedrich Engels in their famous *Communist Manifesto* (1848). In earlier times there were many communist movements, most of them formed on a religious basis, generally under the inspiration of a literal interpretation of passages in the Scripture. These early communists founded communities in which, as a rule, articles of production and consumption were held in common property and the reform of society was advocated on ethical grounds. The early or "Utopian" socialists of the 19th century followed, on the whole, a similar course, though they replaced the religious emphasis by a rational and philanthropic motivation. Best known among them are Robert Owen (1771–1858), who founded the community of New Harmony in 1825 in Indiana, and François Fourier (1772–1837), whose disciples organized a number of settlements in the United States after the model of Fourier's original "phalanx." The most famous of these American settlements was Brook Farm, established in 1841 at West Roxbury, Mass. With the writings of Karl Marx, communism and socialism gained a new meaning.

The communalization was confined to the means of production; the basis of the movement was no longer sought in religious or ethical assumptions, but in the social sciences and in a historical and economic analysis of the forces at work in society; the industrial working class was regarded as the bearer of the new order which would no longer be confined to small groups but would become worldwide as the result of an immanent historical process which uses the class war as its vehicle.

In recent times the meaning of the word communism has been narrowed down to denote that interpretation of Marxian doctrine proposed by Lenin when he came to power in Russia as a result of the revolution in Nov. 1917, and on the basis of which he and his followers have tried to transform society in Russia. Communism in that sense is only one of the possible interpretations of Marxian socialism, and leading socialists from the beginning have attacked Lenin's theory and its realization in Russia. While socialism put its faith in an evolutionary development and in democratic means of attaining the liberation of all men from economic servitude, communism regarded revolution and an ensuing dictatorship of the proletariat as a necessary period of transition to the future free and equalitarian society in which everyone would contribute to the common good according to his abilities and would receive according to his needs. Lenin's communistic interpretation of Marxian socialism goes back to the year 1903, when at the second party congress the Russian Social Democratic party split into two factions, one representing the majority and therefore called bolsheviks (which means "majority group") under Lenin, and a minority group (mensheviks) under Martov. Against his opponents who proposed the formation of a mass party after the example of the German Social Democrats, Lenin insisted upon the necessity of founding a party of picked and selected men, entirely devoted to the socialist cause, who would be able to act in revolutionary situations as a closely-knit, disciplined and resolute group, and seize power, though only a minority. Lenin's group opposed any co-operation with bourgeois democratic or moderate socialistic parties; during the war of 1914–18 it assumed an intransigent attitude against any form of "patriotism" and concentrated its efforts on the transformation of the national war into a social war. After the outbreak of the Russian revolution in March 1917, the bolsheviks under the leadership of Lenin (whose real name was Vladimir Ilyich Ulyanov, 1870–1924) were the only group with strict discipline and definite purpose and thus were able to direct the amorphous and leaderless revolutionary discontent of the masses. After having seized power in Nov. 1917, the bolsheviks established their dictatorship as a dictatorship of the proletariat, renamed the party communist party, and defeated (thanks to the leadership and gift of organization of Leon Trotsky) the counterrevolution and kept themselves in power against great initial odds.

According to communist theory, the social revolution—accomplished in the interests of the proletariat and, after the abolition of class society, of all men—must be conducted by the "proletariat's advance guard," the communist party, because the people as a whole and even large parts of the proletariat, educated in the presocialist era in the bourgeois concepts of life, are unable to grasp and to realize the new order immediately. The communists insist upon the activization of the masses and their growing participation in the establishment of the new order. As the instrument of this participation they accepted the workers', soldiers' and peasants' councils (the Russian word for council is *soviet*) which had been formed during the Russian revolution in 1905. In these soviets only the working classes were represented, not the "capitalists" or "exploiters"; the mode of election was so carefully regulated that only deputies belonging to or approved by the party were chosen. But communism, differing in that respect from fascism, regards dictatorship as a transitional institution, and full democracy as the goal. It believes that true democracy cannot be realized in capitalistic society on account of the economic exploitation imposed upon the economically weaker elements of society, and that the generally accepted forms of parliamentary democracy only veil the control of society by capitalists. While fascism believes in the unalterable and beneficial inequality of men and races and appeals to the instincts of man which have their origins in the past, communism believes in the equality of all men and races, and its outlook is based on reason as a common element in all men and as a guide for the construction of the future. To this future the happiness of the present generation and the traditions of the past are ruthlessly sacrificed. Theoretically a classless society of free individuals will emerge as a result of the dictatorship. Marxism regards the state as an organ of class rule, and as the struggle for the emancipation of the proletariat is the last of all possible class conflicts (because after its emancipation there will remain no lower class to be emancipated), the communist state in suppressing the class basis destroys its own basis or, as it has been expressed, the state withers away and a system of complete freedom emerges. What has happened so far in reality, however, is the opposite. The state in Russia under communist dictatorship has not yet begun to wither away, but is the first example of the truly totalitarian state in which no sphere of individual life is allowed to remain outside its all-inclusive grip.

In trying to create a true democracy of free and equal individuals, terror was ruthlessly employed, all humanitarian considerations and individual rights were disregarded, and the assumption of the class character and economic determination of all intellectual and moral life led to a complete relativization of all standards of truth and of ethics.

In its practical application in Russia, communism has passed through several stages. By the end of 1920, after a long struggle against external and internal enemies, the communist power appeared consolidated within Russia. At the same time, it had to abandon the expectations of world revolution which had animated Lenin and his followers in 1917. They had looked upon the Russian revolution as the first stage of a worldwide process; for them socialism or communism were international movements which could only succeed, and were destined to succeed, on a worldwide basis. In 1919 Lenin had founded the Communist or Third International, but it proved unable to make any progress outside Russia, and the several communist parties existing abroad soon became instrumental to the policy of the communist state in Russia. With the practical abandonment of all hopes for an immediate world revolution and with the complete exhaustion of Russia's resources as a result of the war of 1914–18 and its own civil wars, Lenin was forced to replace the policy of "war communism" in March 1921, by the so-called "new economic policy" (NEP). It represented a compromise between nationalized and private economy, an interim providing for the education of the Russian people to that initiative and efficiency which is needed for the functioning of modern industrial civilization. Large-scale industry remained nationalized and foreign trade was a government monopoly; but small-scale industry, domestic trade, and especially agriculture, reverted to private enterprise, and a new class of prosperous peasants (kulaks) and urban middle-men (nepmen) developed, whose wealth, however, gave them neither political rights nor social standing. During the NEP period (1921 to 1928) a struggle for leadership in the communist party (after the death of Lenin) developed between Trotsky, his nearest collaborator in the decisive years of the conquest of power, and Joseph Stalin, who as secretary-general had succeeded in bringing the party machine under his control. In this struggle Stalin was victorious. During the NEP Russia's constitutional structure was also fundamentally changed. Communism, firmly believing in the equality of all races and peoples, abandoned the concept of the Russian Empire in which the Russian element had ruled over many different racial and ethnical groups, some very considerable in size and some tiny, some highly literate and some most primitive. In its place it created in 1924 the Union of Soviet Socialist Republics (USSR), a federation of a number of equal sister-republics within which smaller ethnical groups and all minorities enjoy autonomy and fully equal rights. All precedence of the Russian element or of the Russian language has been abolished; the soviet government made a great effort to create or promote literatures in the vernacular tongues and to make the non-Russian population share in the activities of the party and of the administration.

The period of the NEP was followed in 1928 by a renewed drive for the "realization of socialism" in the soviet union. The aim of the new policy was defined in retrospect by Stalin in his report to the Seventeenth Party congress in Jan. 1934, when he pointed out that the USSR "has become radically transformed; it has discarded the features of backwardness and mediaevalism. From an agrarian country it has become transformed into an industrial country. From a land of small individual agriculture it has become a land of collective, large-scale mechanized agriculture. From an ignorant, illiterate and uncultured country it has become—or rather it is becoming—a literate and cultured country covered with a network of higher, middle and elementary schools operating in the languages of the nationalities of the USSR." This speedy drive toward socialism called for advance planning in all branches of the economic and cultural life of the country; the so-called Five-Year Plan. In a poor and backward country like Russia the excessive tempo of the planning, the lack of managerial and engineering talent and of skilled labour, naturally resulted not only in frequent maladjustments and tremendous waste, but could be financed only by a general reduction of the standard of living. The "advance towards socialism" proceeded on three lines: industrial, agricultural and educational. In the first field the Five-Year Plan was devoted to the better exploitation of natural resources and to the building up of heavy industry; in the second field to the collectivization of individual farms and to the introduction of machinery and more efficient methods of cultivation; in the third field to the fight against illiteracy and traditionalism, and to a change of the ways of life and thought-habits of the population. The first Five-Year Plan dating from Oct. 1, 1928, was declared successfully terminated at the end of 1932, and was then followed by further similar plans.

In its foreign policy the soviet union, after having abandoned the hope of a European revolution, concentrated for some years upon the expectation of stirring up revolutionary movements in the Orient. The communists supported the nationalist movements in the colonial and semi-colonial countries, in Turkey and Persia, in India and China. Their hopes were frustrated by the defeat suffered in China in 1927. After that time the soviet government pursued a policy of making Russia secure against any foreign invasion. With the growth of fascism in Japan and Germany, and with the conclusion of the anti-communist pact by Germany, Italy and Japan, the soviet union, which had joined the League of Nations in 1934, stressed its willingness to co-operate with other nations in a system of collective security. Similarly, the communist parties outside the soviet union, who until then had violently opposed all bourgeois democracies and moderate socialistic parties, and who had seen their main purpose less in a struggle against conservative or reactionary parties than in violent abuse of democratic and social democratic groups, changed their tactics after 1933 and declared themselves ready to co-operate in creating a "popular front" against fascism. For a short time they gained thereby some influence in several countries. Before this they had been unable to gain a strong position anywhere in the western world, even in times of great economic stress. Deeply imbued with the Russian example which, peculiar to the character of a backward and undeveloped country, had very little to offer to progressive and highly developed societies, the communist parties outside Russia remained a sect essentially foreign to the environment in which they proposed to function, and their doctrinaire terminology carried no conviction. Their negative policy helped rising fascism to undermine democracy, and the bogey of communism frightened many members of the upper classes in democratic countries and drove them to a closer co-operation with fascism. The influence of communism was further weakened by the great purges of the party in the years 1937 and 1938, to which many high officials of the political and economic administration, old and trusted leaders of the party, and the most experienced and renowned officers of the armed forces, fell victims. A complete overhauling of the personnel and even of the doctrines of the communist revolution strengthened the personal position of Stalin, and the regime in the soviet union took on more and more the character of his personal dictatorship. In the light of this new development the history of the Russian revolution and all doctrinal manuals were rewritten. Stalin's position became more and more akin to that of the leaders in the fascist dictatorships and a similar Byzantine exaltation was accorded to his person. "Progressive" tendencies regarding marriage and divorce, abortion and high natality, education and family, which had been characteristic of the first period of communism, were abandoned, and replaced by more conservative attitudes. A new stress was laid upon the national past.

During the period of the co-operation of the soviet union with the democratic nations, a new democratic constitution was introduced on Nov. 25, 1936, which stressed the principles of democracy without abandoning the firm grip of the dictatorship upon the country. But in 1939 communism again performed a complete about-face in its international and in its general policy. The communists had until then demanded energetic and armed resistance against every case of fascist aggression anywhere. This policy was completely reversed at the end of Aug. 1939, when the soviet union signed a nonaggression and friendship treaty with national socialist Germany, which was followed in April 1941 by a similar treaty with Japan. During the first 20 months of the war which began in 1939, the soviet union was bent upon keeping aloof from the war itself, but at the same time extended its own territory. By a war against Finland certain minor but strategically important slices of that country were added to the soviet union; without military opposition, the soviet union incorporated the three Baltic republics, Esthonia, Latvia and Lithuania, occupied eastern Poland and attached it to the existing soviet republics of Ukraine and of White Russia, and annexed Bessarabia and northern Bukovina from Rumania. In all these new acquisitions the communist regime and way of life were immediately introduced. Hand in hand went a regime of ever-increasing military preparedness within the soviet union. On May 9, 1940, the soviet army, in order to achieve higher efficiency, abandoned some of the principles of communism. The vast powers of the political commissioners in the army were ended and full authority was restored to the military officers.

Outside the soviet union all communist activities are forbidden in fascist and semi-fascist countries. Some democracies like Switzerland have lately adopted similar measures. Communist parties were of some importance at the end of the '30s in France and in Czechoslovakia, but with the end of the democratic regimes there they have ceased to exist. Internationally their activities were of importance only in Spain and in China. The civil war in Spain, which lasted from July 1936 to March 1939, provided the numerically weak communists with an opportunity to influence in various ways the policy of the Spanish republican government, especially in view of the fact that the soviet union was the only power which supplied the Spanish government, though insufficiently, with war materials to enable it to maintain its authority against the fascist military uprising of General Franco and his followers, who were fully supported by the Italian and German governments. In China communist groups established themselves in the western provinces and fought for agrarian reform and for better educational and sanitary standards. Long hostile to the national government of Generalissimo Chiang Kai-shek, they finally made common cause with him against Japanese invasion. Communism in China seemed more an indigenous agrarian revolutionary movement born of the backward conditions of the country and the exploitation of the masses, than an integral part of the worldwide communist movement which has its centre in Moscow.

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COMMUNISM, PRIMITIVE. Many societies which are classified as primitive or as belonging to the lower culture, exhibit features which have given rise to the view that communistic principles regulate their economic system. Thus, among the Lhota Nagas of Assam "land can be held either by the village, a *morung*—men's house—a clan, or an individual. The land close to a village is usually waste land and common property, as are the rights of 'poisoning' in certain pools. Every *morung* owns land which is the property of the *morung* as a whole and not of any individuals in it. It is worked by the boys of the *morung*. . . . A very large proportion of the land in the Lhota country is clan land, which is held in common by all members of that particular clan in the village. . . . Heirlooms such as the ancient *doos* and spears which a Lhota so prizes are held in trust by the senior member of the clan in the village" (J. P. Mills, *Lhota Nagas*, 1922, p. 97). Corporate ownership by clans or *morungs*, and common rights over waste land cannot fairly be called communistic. They indicate—what is already true of the majority of lower culture societies—that the kindred, or biologic, groups of which those societies are composed (*see* TRIBE and CLAN) have economic functions in the sum of social life. It is asserted emphatically by Rivers (*History of Melanesian Society*, 1914, vol.

ii. p. 146 *seq.*) that "it is clear that definite communism of property still flourishes in one form or another throughout Melanesia." He states in support of this that "at Pentecost, not long ago, all property was owned by the *verana* or social group within the moiety, and that this communistic ownership still persists in the case of canoes." He saw in certain features of ceremonial in the Banks Islands survivals of communism, and found at Eddystone "a large degree of community in the ownership of land" which "belongs to a group of persons brought into relationship with one another by kinship." In a later chapter (*ibid.* p. 384 *seq.*) he argued that a communistic people would need money, not for internal economic functions, but only for external transactions, and associated the use of money with the disappearance of communism. In elaborating the theory of culture movements in Polynesia he found that the communism in Polynesia was characteristic of the earlier settlers, who accepted the later immigrants as chiefs—"endowed with Divine attributes" and "able to obtain all they needed for the asking." People enjoying these ample privileges would need no money. The picture is incomplete because it raises the suspicion that the chiefs—licensed plunderers—kept their booty to themselves.

The intimate investigations made by Malinowski in the Trobriands, disclose facts which warrant the conclusion that "there is a strict definition in the rights of everyone, and this makes ownership anything but communistic" (*Crime and Custom,* 1926, p. 19). Clearly, therefore, we must distinguish between control, exploitation, utilization and ownership—and we must be prepared to find that social groupings which sometimes coincide and are identical with, and at other times cut right across, biologic groupings such as the clan, are endowed with economic functions which constitute their unity and give them their value. That primitive ownership, as we now know it, is tempered by rights of others, is hardly a proof of prior communism. Among the Ba-Ila (*Ila-speaking Peoples,* vol. i., p. 339), "My collateral grandfather's property is mine potentially. I may enter my grandfather's brother's village, spear his oxen, or rob his fields with impunity." Elsewhere, in the Torres Straits (*Report,* vol. v., p. 146), "The nephew, even if quite a small boy, could take, lose, spoil or destroy anything belonging to his (maternal) uncle and the uncle would utter no word of reproach or anger." The fact is that "reciprocity, the give and take principle, reigns supreme also within the clan, nay within the nearest group of kinsmen. As we have seen already, the relation between the maternal uncle and his nephews, the relations between brothers, nay the most unselfish relation, that between a man and his sister, are one and all founded in mutuality and the repayment of services." (B. Malinowski, *Crime and Custom,* 1926, p. 47.)

It is suggestive of the difficulties of this topic, some of which are, perhaps, due to awkward uses of a terminology which has specialized connotations, that in his account of the Andaman islanders (1922, p. 41) Prof. Radcliffe-Brown states that "The economic life of the local group, though in effect it approaches to a sort of Communism, is yet based on the notion of private property." Land is sometimes in common, but there is private ownership of trees of economic value. Priority of labour entails ownership, but the custom of constantly exchanging presents, and the strong feeling that no request should be refused, result in the constant circulation of "almost every object" which they possess. Every man is expected to do his share in providing both himself and others with food, and in its distribution regard is had to seniority. E. T. Man (*Andaman Islanders,* 1880, p. 29) records that the *oko-pai-ads,* dreamers of dreams, who are credited with the possession of supernatural powers, often arrange with those who lavish gifts upon them to keep available for them articles not immediately needed, which are thereby bespoken and not available as gifts to others. Therefore, at a low level of culture, individual ownership is recognized but is tempered by the sense of solidarity and mutuality, which places generosity high as a virtue. Here, too, as throughout the lower culture, when viewed closely, personality and individuality are factors in the economic as in all other aspects of social life. The subjective character of the lower culture attitude towards property finds its expression in the sentimental value attached by modern communities to the old and venerable. The economic attitudes of the lower culture comprise respect of heirlooms, but in their normal working exhibit the principle of reciprocity of service—a far different thing from Communism, however defined—just as the social order of lower culture groups is based on the ultimate facts of inequality of men, leaving theories of equality and rights to purblind theorists. (*See* works quoted in text.)

COMMUNIST INTERNATIONAL: *see* INTERNATIONAL, THE.

COMMUNITIES, INDUSTRIAL, group systems of housing employees and their families near isolated factories, provided by the factory owners. Although employers' housing in the United States is as old as industry itself, it was not until the latter part of the 19th century, when economic conditions following the Civil War made it necessary for owners to provide, if not completely control, the living conditions of employees, that industrial communities came into any great prominence. Since that time, when the Pullman and southern mill villages were established, such communities have become common all over the United States, especially in the regions of the Western coal fields, New England textile mills and the Ohio rubber factories. The degree to which the company owns and controls the village activities varies considerably, but often the employees have a voice in the Municipal Government. In the better type of industrial communities streets are laid out, houses constructed, water supply and sewage systems constructed and stores are operated where food, clothing and fuel may be bought at reduced prices. Physicians and visiting nurses are maintained by the factory officials, while education is conducted through clinics, day nurseries and hygiene classes. Often the company helps to support the public schools and to conduct night classes, and it frequently provides gymnasium and recreation facilities. Working further on the theory that good living conditions result in increased production, there is a growing tendency among some of the more progressive factory owners to plant trees, set aside parks and generally to combine the aesthetic with the utilitarian in the make-up of industrial communities.

COMMUNITY CENTRES, a phrase used in the United States to describe rooms or buildings, often public school buildings, in which all residents of a village, small town, or neighbourhood of a city may meet for entertainment, recreation, educational pursuits, cultural, civic, or other activities. Groups of women, agricultural organizations, religious associations, or community societies representative of the major social groups in the community, administer the buildings not owned by governmental agencies.

Community centres have developed largely in the United States since 1910 and are steadily increasing in number. Community solidarity became a matter of public interest during the World War, but in general the complexity of group organization and differentiation in social, civic and industrial life have created a feeling of need for co-ordination and common understanding among the residents of a district. Community centres are the chief result of this desire for neighbourhood unity. Thirty-two States and the District of Columbia have laws providing for community use of school buildings. Community centres are encouraged by State departments of education, university extension departments, farm organizations and at least three national associations. (L. E. Bo.)

COMMUNITY CHEST, a term used largely in the United States to describe a co-operative organization of citizens and social welfare agencies in a community. Its general functions are (1) to raise funds each year, by community-wide appeal, for affiliated voluntary social welfare and health agencies, and to distribute those funds in accord with a mutually agreed-upon budget procedure, and (2) to promote the social welfare and health of the community by co-ordinating existing programs and improving standards of social work, preventing duplication, conducting research, administering common services, and developing better public understanding and support. Closely allied with the community chest is the central planning group, known as the Council of Social Agencies. In 1940 there were 552 community chests or funds. Of these, 534 were in the United States (mainland), eleven in Canada, two in South Africa, one in the Virgin islands, and two in Hawaii. The areas in which community chests are organized include a total population of about fifty millions, nine million of whom annually contribute. All but six cities of 100,000 and over in the United States have community chests. In 1940, 552 chest campaigns raised $86,186,466.

The history of the modern community chest movement is traced from the organization in Cleveland, Ohio, in 1913, of a Federation for Charity and Philanthropy, which not only raised money for its member agencies but introduced the principle of budgeting to determine needs and resources. Denver, Colorado, has had joint financial campaigns for its social agencies since 1887, but Cleveland first used the community chest principle as it is known today. Community Chests and Councils, Inc., national organization of community chests on a voluntary membership basis, was organized in Feb. 1918, as a clearing house for information for the 21 local chests then existing. First called the American Association for Community Organization, and later the Association of Community Chests and Councils, in 1933 it was incorporated and adopted its present name. An advisory committee of local chest and council executives guides the staff in carrying out policies decided upon by a board of directors. The association is financed by dues from its corporate members.

To give nation-wide backing to the money-raising efforts of local community chests and voluntary social work generally, the Community Mobilization of Human Needs was organized in 1932. It is administered by Community Chests and Councils, Inc., for 36 national social agencies which co-operate in an annual "Mobilization." The Mobilization chairman is assisted by a National Citizens' Committee of nearly 150 members. (G. E. V.)

COMMUNITY DRAMA AND COMMUNITY THEATRE: *see* LITTLE THEATRE MOVEMENT.

COMMUNITY FOUNDATION, or **COMMUNITY TRUST, THE,** in the United States is an agency organized for the permanent administration of funds placed in trust for public educational, charitable, scientific, or benevolent purposes. The first of such trusts to be organized was the Cleveland Foundation, brought into existence in Jan. 1914 by the Cleveland Trust Company, of Cleveland, O. (*q.v.*). Its founder was Frederick Harris Goff, then president of the Cleveland Trust Company. The fundamental plan of organization of the Cleveland foundation has been closely followed by nearly all subsequent community foundations. It has four characteristic features: (1) Its funds are not the gift of a single individual or family, but the union of numerous large and small gifts left at different times by various donors and designed to promote the well-being of mankind. (2) These funds are placed in the custody of banks and trust companies charged with the duty of safeguarding and investing them, but having no voice in directing their expenditure. (3) The income of the funds is disbursed by a committee, changing through rotation of appointments, chosen for their knowledge of the educational, charitable and benevolent needs of the time, and selected in major part by public officials. (4) This distribution committee must respect and observe the expressed desire of the founder of a trust as to the particular purpose for which it shall be applied, subject to the condition that if it shall appear that circumstances have so changed since the execution of the will or deed of trust as to render unnecessary, undesirable, impractical or impossible a literal compliance with its terms, a resolution adopted by the committee may operate to free the instrument of gift from any specific restriction or provision. The fundamental characteristics of the community foundation may be summarized as providing for the union of numerous gifts instead of a single large one; arranging for the business control of the investments, and the social control of the expenditures; and the attempt to substitute contemporary wisdom for foresight in the use of the income.

In the years since the Cleveland Foundation was organized there have been established more than 75 such trusts, with about 250 banks and trust companies as their trustees. In some cases there is only one trustee, and in others several. This latter arrangement is known as the multiple trusteeship. In nearly all cases the objectives are broadly stated as being the promotion of the well-being of mankind, and especially that of the inhabitants of the city where the foundation is located.

In 1945 there were 11 community foundations each of which had active principal funds in excess of $1,000,000. The aggregate resources of community trusts in the United States and Canada rose to $67,000,000 at the end of 1944 compared with $57,000,000 at the close of 1943. The community foundations having the largest resources were located in New York, Chicago, Boston, Cleveland, Indianapolis, Winnipeg, Los Angeles, Buffalo, New Haven and Minneapolis. In the case of each of these cities, and also in that of many others, it was known that wills of certain persons were in existence that would bring bequests to the organizations in later years, and in some of the instances in very large sums of money.

In 1925 some 16 different community foundations distributed nearly $450,000 of income. In the year 1938 there were 43 which disbursed about $1,750,000. In 1944 the number that had begun to distribute funds had increased to 76, and the distributions to more than $1,900,000. (L. P. A.)

COMMUNITY KITCHEN. In the United States there has been, since 1910, an increasing tendency on the part of Americans to take their meals outside of their homes, with the growth of the community kitchen and its corollary the community dining room.

Community Kitchens and Dining Rooms.—Many reasons may be assigned for this movement. In the first place it was a natural step in view of the changes in the home itself: the urban home had become smaller, for every square inch of floor area, every cubic inch of space, cost money in rent, and consequently the functions of the home were limited so as to effect a reduction of space. The home kitchen shrank first to the kitchenette, and is now in process of vanishing entirely. Even where the space for an elaborate kitchen is available, the problem of getting suitable servants is so troublesome as to induce many to get along with a minimum of domestic service, and, as the mistress of the house is herself less willing to be a kitchen drudge than formerly, many meals are taken outside the home, particularly those of an elaborate nature. Private hospitality is more and more offered in hired hotel space in preference to the home. Banquets and other special functions are easily handled in public dining rooms, and involve little responsibility on the part of the host and hostess. The emancipation of women is another factor. Many women have succeeded in establishing themselves, professionally or commercially, before marriage. They prefer financial independence to keeping house. The small, compact, efficiently arranged apartment is the result, with meals away from the home.

These factors are intensified by the constantly rising standards of living and by the greatly improved marketing technique which has stimulated a demand for many possessions previously non-existent or rare. Demands upon the family income have advanced, encroaching upon the former budget allotment for rent and servants. Small and servantless homes come as a natural sequence. If even then the income is too meagre, the modern woman has no hesitation in aiding her husband to double it by taking a position herself. Another blow to the home as the chief or sole source of prepared food has been dealt by the automobile and touring habit. It is estimated that in 1910 there were, in the United States, less than 350,000 automobiles; in 1925 over 17,000,000 were registered. Such an increase in the use of a personal means of conveyance with a day's travel radius of, say, 200m. could not but have its effect on the food habits of the nation. "Automobile" business is considered a substantial part of the total business of hotels and restaurants.

The hotel kitchen, like its domestic counterpart, has had its troubles with its personnel, and for similar reasons. Working, however, on a larger scale and increasingly on standardized products, it can make readier use of machines as a substitute for labour. The modern quantity kitchen is thinly staffed but splendidly equipped. Washing-machines for dishes, glassware, and silver, each adapted to the task in hand, enable two men to do the work of ten and to do it better. There is less breakage, the silver bears an enhanced sheen, and the bacteria count is reduced 90%. Dirt and filth, once the bugbears of any but the most expensive dining places, are now, perhaps, more rare in hotels than in the home. There are also the great mixers which, for example, beat up a bushel of mashed potatoes or a gallon of cream with equal facility, the steam-cookers, the potato-peelers and a host of smaller indispensables that save time, labour, and space where food is cooked on a wholesale scale. Electricity has helped in cookery and is now applied to refrigeration. (H. B. M.)

COMMUNITY SINGING is mass singing by groups or crowds, or in a more advanced stage, singing by a community chorus meeting regularly for training and instruction in four part chorus singing. Some of the best renditions of the oratorios and choral works come from these community choruses. For community singing in Great Britain *see* CHORAL SINGING.

The community chorus movement in the United States was launched in Rochester, N.Y., in 1912 by Harry Barnhart, a singer, musician, conductor and a pupil of Maestro Cortezze and Verdi, trained for the concert and operatic stage. For some time before 1912, Mr. Barnhart was filling engagements in vaudeville. A feature of his "act" had been to get the audience to join in the chorus of his songs. Discovering that everybody wanted to sing and could sing under proper encouragement and direction, he determined to develop the idea. While filling an engagement in Rochester, N.Y., he secured permission from the mayor to appear with the municipal band in Convention hall and have the people sing. The audience responded most enthusiastically and there was formed the first community chorus. The idea spread to other surrounding communities. In 1914 many of these choruses came together for a great festival in the Rochester Exposition buildings, forming a trained chorus of some 1,500 singers. They began with unison singing and evolved into well trained choral groups.

Arthur Farwell, U.S. composer and exponent of American Indian lore, became deeply interested in the movement and induced Mr. Barnhart to come to New York once each week to conduct a community chorus. During this time Claude Bragdon, architect and author, then resident in Rochester, saw the possibility of combining light and colour with the outdoor singing. Crowds up to 15,000 gathered in a public park led by the trained community singing group. This became known as "Song and Light." The New York city community chorus grew rapidly with Arthur Farwell as president and W. K. Brice as treasurer. Weekly public sings and rehearsals were held. Soon a great chorus was developed which culminated in giving Handel's "Messiah" in Madison Square Garden and three annual "Song and Light Festivals" in Central Park with 100,000 people singing antiphonally across the lake in the night. At about this time community choruses started in many cities. When the United States entered World War I Gen. Franklin Bell, then in command of the eastern division, commandeered Mr. Barnhart to take charge of singing in the army. Singing was organized in every camp under the direction of competent song leaders. At the close of the war, there was a song leader in every community in the U.S. but the movement did not go forward as it should have because of a lack of competent conductors. There were, however, in 1945, many fine community choruses throughout the country. (H. BT.)

COMMUTATION, a process of exchanging one thing for another, particularly of one method of payment for another, such as payment in money for payment in kind or by service, or of payment of a lump sum for periodical payments. (*See* ANNUITY; COPYHOLD and TITHES.) In law, the substitution of a lesser sentence on a criminal for a greater. In electrical engineering, the reversal of the course of an electric current, by means of a contrivance known as a "commutator" (see ELECTRIC GENERATOR; MOTOR, ELECTRIC). In the U.S. a "commutation ticket" on a railway is the equivalent of an English season-ticket, and the ticket-holder is known as a "commuter."

COMMUTATIVE LAWS. Two laws relating to numbers, one with respect to addition and the other with respect to multiplication. The symbolical forms for these laws are respectively $a+b=b+a$ and $ab=ba$. Thus they are equivalent to the statement that a finite sum or product is unaltered by reordering the terms or factors. The laws, however, do not hold everywhere in mathematics. For example, the commutative law does not necessarily hold for conditionally convergent series such as $1-\frac{1}{2}+\frac{1}{3}-\frac{1}{4}+\ldots$ unless no term in the rearrangement is displaced more than a fixed number of places from its original position. Also there are numbers, such as quaternions, for which the commutative law of multiplication is invalid. The vector product obeys the law $a\times b=-b\times a$ instead of the usual law. (R. W. BD.)

COMMUTATOR, a switch by means of which the current in a circuit is reversed. (*See* also ELECTRIC GENERATOR.)

COMMUTER: *see* COMMUTATION.

COMNENUS, the name of a Byzantine family which occupied the throne of Constantinople 1081–1185 and originally came from Paphlagonia. Its first member in Byzantine history is MANUEL EROTICUS COMNENUS, an able general serving Basil II in the east. The increasing unpopularity of the Macedonian dynasty culminated in a revolt of the nobles and the soldiery of Asia against its feeble representative Michael VI Stratioticus, who abdicated after a brief resistance. Manuel's son Isaac was crowned emperor in St. Sophia on Sept. 2, 1057. For the rulers of this dynasty *see* ALEXIUS I; ALEXIUS II; ISAAC I; JOHN II; MANUEL I, COMNENUS; ROMAN EMPIRE, LATER. With Andronicus I (1183–1185) the rule of the Comneni proper at Constantinople ended. A younger line of the original house, after the establishment of the Latins at Constantinople in 1204, secured possession of a fragment of the empire in Asia Minor, and founded the empire of Trebizond (*q.v.*), which lasted till 1461, when David Comnenus, the last emperor, was deposed by Mahommed II.

COMO (anc. COMUM), a city and episcopal see of Lombardy, Italy, capital of Como province, at the south end of the west branch of the Lake of Como, 32 mi. by rail N.W. of Milan. Pop. (1936) 42,569 (town); 56,304 (commune). Mountains enclose the city. The old town, with rectangular Roman plan, is enclosed by walls with 12th century towers. The marble cathedral on the site of an earlier church has a nave of 1396, the façade belongs to 1457–86, while the exterior of the east end was altered into the Renaissance style, and decorated with sculptures by Tommaso Rodari in 1487–1526. The dome is an unsuitable addition of 1730–70 by Filippo Juvara. In the same line as the façade of the cathedral are the Broletto (in black and white marble), dating from 1215, the seat of the original rulers of the commune, and the massive clock-tower. The Romanesque church of S. Abbondio outside the town (11th century) has two fine campanili at the ends of the aisles close to the apse. The churches of S. Giacomo (1095–1117) and S. Fedele (12th century) are also Romanesque. Como is a tourist resort, and the steamboat traffic on the lake is largely for travellers. The hill station of Brunate (2,350 ft.) above the town to the east is reached by a funicular railway. The Milanese possess many villas here. Como has large silk factories and other industries. (*See* LOMBARDY.) It is connected with Milan by two lines of railway, one via Monza the other via Saronno, and also with Lecco and Varese.

Of the Roman Comum little remains above ground; the southeast gate, flanked by two octagonal towers, was found in 1914, and a portion of the southeast wall may be seen: later fortifications, largely constructed with Roman fragments, had been superimposed on it. *Thermae* have also been discovered. Comum belonged to Gallia Cisalpina; in 196 B.C. M. Claudius Marcellus conquered the Insubres and the Comenses. In 89 B.C., having suffered damage from the Raetians, it was restored by Cn. Pompeius Strabo, and given Latin rights with the rest of Gallia Transpadana; 5,000 colonists were sent by Caesar in 59 B.C., and the place received the name Novum Comum. The place had an important iron industry; and the banks of the lake were, as now, dotted with villas. It was also the starting point for the journey across the lake in connection with the Splügen and Julier passes. (*See* CHIAVENNA.) The elder and younger Pliny were born here, the latter founded baths and a library and gave money for the support of orphan children. There was a *praefectus* *classis Comensis* (a commander of the Como flotilla) under the late empire, and it was regarded as a strong fortress.

During the early barbarian invasions many inhabitants took refuge on the Isola Comacina off Sala, but Como recovered in Lombard times. It became subject to the archbishops of Milan, but gained its freedom towards the end of the 11th century. In 1118 war broke out with Milan; Como was taken and its fortifications dismantled in 1127. From 1154 it gave its allegiance to Barbarossa throughout the war of the Lombard League. After frequent struggles with Milan, it fell under the Visconti in 1335. Thenceforth it shared the fortunes of Milan, becoming in the Napoleonic period the chief town of the department of the Lario. It bore a considerable part in the national risings of 1848–59 against Austrian rule. Pope Innocent XI. and Alessandro Volta were born here.

COMO, LAKE OF, in Lombardy, north Italy, due north of Milan (its ancient name was *Lacus Larius* and it is still sometimes called Lario, though already termed *Lacus Comacinus* in the 4th century). It is formed by the Adda, flowing through the Valtelline to the north end of the lake (here falls into the Mera, *see* CHIAVENNA) and flows out of it at the south-east end. The area is 55⅓sq.m.; it is about 30m. from end to end, ½ to 2½m. in breadth, surface 650ft. above the sea, greatest depth 1,345ft. A railway runs along its eastern shore from Colico to Lecco (24½m.), while on its western shore Menaggio is reached by rail from Porlezza on the Lake of Lugano (8 miles). Colico, at the northern extremity, is by rail 17m. from Chiavenna and 42m. from Tirano, while at its southern end Como is 32m. from Milan, and Lecco the same distance. The lake fills a remarkable depression cut through the limestone ranges that enclose it, and once doubtless extended as far as Chiavenna, the Lake of Mezzola being a witness of its ancient bed. The Bellagio promontory divides the south-east arm, the true exit ending at Lecco, from the enclosed south-west arm ending at Como. The north, *Tivano,* wind blows during the morning, the south, *Breva,* in the afternoon. Violent storms occur suddenly. Virgil and Claudian sang Como's beauty and the two Plinys are associated with the lake. The shores are bordered by splendid villas, while perhaps the most lovely spot on it is Bellagio. Varenna, to the east, and Menaggio, to the west, are nearly opposite each other, while Cadenabbia, to the west, faces Bellagio.

COMORIN, CAPE, a headland in the state of Travancore, forming the extreme southern point of the peninsula of India. It is situated in 8° 4′ 20″ N., 77° 35′ 35″ E., at the end of the Western Ghats. The village of Comorin, with the temple of Kanniyambal, the "virgin goddess," on the coast at the apex of the headland, is a frequented place of pilgrimage.

COMORO ISLANDS, a group of volcanic islands belonging to France, in the Indian Ocean, at the northern entrance of the Mozambique Channel between Madagascar and the African continent. The islands of Mayotte and Comoro have an area of 849 sq.mi.; a total population (1936) of 128,608 inhabitants. These have adopted Islamism but continue, nevertheless, to practise Fetichism. They earn their living mostly from navigation and trade between the islands. Their chiefs, known as sultans, are Arabs. There are besides a large number of islets of coral formation. Particulars of the four principal islands follow:

1. Great Comoro, or Angazia, the largest and most westerly, has a length of about 38 mi., with a width of about 12 mi. Pop. (1936) 66,265. Near its southern extremity it rises into a fine dome-shaped active volcano, Kartola (Karthala), which is over 8,500 ft. high, and is visible for more than 100 mi. Up to about 6,000 ft. it is clothed with dense vegetation. Eruptions are recorded for the years 1830, 1855, 1858 and 1904. In the north the ground rises gradually to a plateau some 2,000 ft. above the sea; from this plateau many regularly shaped truncated cones rise another 2,000 ft. The centre of the island consists of a desert field of lava streams, about 1,600 ft. high. The chief towns are Moroni (pop. [1936] 5,108), Itzanda and Mitsamuli; the first being the seat of the French administrator.

2. Anjouan, or Johanna, next in size, lies E. by S. of Great Comoro. Pop. (1936) 39,010. It is some 30 mi. long by 20 at its greatest breadth. The land rises in a succession of richly wooded heights till it culminates in a central peak, upwards of 5,000 ft. above the sea in 12° 14′ S., 44° 27′ E. The former capital, Mossamondu, on the N.W. coast, is substantially built of stone, surrounded by a wall, and commanded by a dilapidated citadel; it is the residence of the sultan and of the French administrator. There is a small but safe anchorage at Pomony, on the S. side, formerly used as a coal depot by ships of the British navy.

3. Mayotte, pop. (1936) 17,477, about 21 mi. long by 6 or 7 mi. broad, is surrounded by an extensive and dangerous coral reef. The principal heights on its extremely irregular surface are: Mavegani Mountain, which rises in two peaks to a maximum of 2,164 ft., and Uchongin, 2,100 ft. The French headquarters are on the islet of Zaudzi, which lies within the reef in 12° 46′ S., 45° 20′ E. There are substantial government buildings and storehouses. On the mainland opposite Zaudzi is Msapéré, the chief centre of trade.

4. Moheli or Mohilla, pop. (1936) 5,256, lies S. of and between Anjouan and Great Comoro. It is 15 mi. long and 7 or 8 mi. at its maximum breadth. Unlike the other three it has no peaks, but rises gradually to a central ridge about 1,900 ft. in height. Fomboni (pop. about 2,000) in the N.W. and Numa Choa in the S.W. are the chief towns.

Except Great Comoro, which is arid, the islands are very fertile. There are forests of coconut palms, and among the products are rice, maize, sweet potatoes, yams, coffee, cotton, vanilla and various tropical fruits, the pawpaw tree being abundant. The fauna is allied to that of Madagascar rather than to the mainland of Africa; it includes some land birds and a species of lemur peculiar to the islands. Large numbers of cattle and sheep are reared. Turtles are caught in abundance along the coasts, and form an article of export. The climate is in general warm, but not torrid nor unsuitable for Europeans. The dry season lasts from May to the end of October, the rest of the year being rainy. The natives are of mixed Malagasy, Negro and Arab blood. Native life owes to Muslim civilization most of its external characteristics. The inhabitants of Madagascar call them *Antalaora* (people from across the sea). The European inhabitants are mostly French. The external trade of the islands has developed since the annexation of Madagascar to France. Sugar refineries, distilleries of rum, and sawmills are worked in Mayotte by French settlers. Cane sugar and vanilla are the chief exports. The islands are regularly visited by vessels of the Messageries Maritimes fleet, and a coaling station for the French navy has been established. The natives live on vegetables, fish, fruit and meat. They are cultivators, sailors and fishermen. They are more advanced than the Malagasy to whom in the past they have furnished many chiefs.

The islands were first visited by Europeans in the 16th century; they are marked on the map of Diego Ribero made in 1527. At that time, and for long afterwards, the dominant influence in, and the civilization of, the islands was Arab. A Sakalava chief who had been driven from Madagascar by the Hovas took refuge in Mayotte *c.* 1830, and, with the aid of the sultan of Johanna, conquered the island. French naval officers having reported on the strategic value of Mayotte, Admiral de Hell, governor of Réunion, sent an officer there in 1841, and a treaty was negotiated ceding the island to France. Possession was taken in 1843, the sultan of Johanna renouncing his claims in the same year. In 1886 the sultans of the other three islands were placed under French protection. The islands, as regulated by the decree of April 9, 1908, are under the supreme authority of the governor-general of Madagascar. The archipelago as a whole is entitled "Mayotte and dependencies." The local administration is in the hands of an official who himself governs Mayotte from his residence at Zaudzi but is represented in the other islands by administrators. On the council which assists the governor are two nominated native notables. In 1910 the sultan of Great Comoro ceded his sovereign rights to France.

The *Îles Glorieuses,* three islets 160 mi. N.E. of Mayotte, with a population of some 20 persons engaged in the collection of guano and the capture of turtles, were in 1892 annexed to France and placed under the control of the administrator of Mayotte.

See *Notice sur Mayotte et les Comores,* by Emile Vienne, one of the memoirs on the French colonies prepared for the Paris Exhibition of 1900; *Le Sultanat d'Anjouan,* by Jules Repiquet (1901), a systematic account of the geography, ethnology and history of Johanna; *Les colonies françaises* (1900), vol. ii., pp. 179–197, in which the story of the archipelago is set forth by various writers; an account of the islands by A. Voeltzkow in the *Zeitschrift* of the Berlin Geog. Soc. (No. 9, 1906), and *Carte des Îles Comores,* by A. Meunier (1904).

COMPANION, a store-room for provisions on board ship (Fr. *chambre de la compagne*); the framed windows over a hatchway on the deck of a ship; also the hooded entrance-stairs to the captain's cabin.

COMPANY. The smallest administrative unit functioning in an infantry battalion; it is usually commanded by a captain or officer of equivalent rank, though in the British service junior majors also command companies (*see* MAJOR). The number of companies in a battalion varies according to the system favoured by each country, and the sub-division of a company into platoons, sections, etc., is dictated by the distribution, and consequently the tactical value, of the arms which it carries. Up to the outbreak of the World War the company was also the tactical unit of the battalion.

Although the expression now refers to a fixed number of officers and men, in the early days of all armies it, or its equivalent, referred loosely to the number of men a lord or knight brought into the field. About the middle of the 14th century "Free Companies" came into being. These were disbanded soldiers, who, having a greater love for war than peace, banded themselves together and plundered France at their pleasure. The greatest leader of these was John Hawkwood. In order to bring about their suppression, a certain number were taken into the service of France against Spain. As their distinctive mark they adopted the white cross, the old English colour of the Crusades, and one company, "The White Company," has been immortalized in literature by Sir Arthur Conan Doyle.

In the 16th century a company of German *landsknechts* was 400 strong, and about the same period a company in the Spanish army varied from 150 to 300 men, whilst in England 100 was the usual strength. In 1650 Gustavus Adolphus made great reforms in military organization. As regards the infantry he made companies of uniform strength, 106 men, distributed in twenty-one *rots* or files, and six corporalships. A corporalship of pikes consisted of three files, and four files of musketeers. Each company had a reserve of eighteen supernumerary men. Eight companies constituted a regiment. Four companies, or half of such a regiment, were called either a squadron or by the Italian name *battaglia,* from which the modern battalion is derived.

The infantry of the Commonwealth "New Model" army bore a close resemblance to the foregoing in that each regiment had ten companies of 110 men apiece. The colonel, lieutenant-colonel and major each had companies, the remaining commanders being seven captains. The privates were divided into an equal number of pikemen and musketeers. At the Restoration in 1660 the number of men in a company was reduced to 80, and sometimes 50, but the number of companies in a regiment was increased to twelve. At his accession in 1685, James II. added a company of grenadiers to every regiment. Towards the end of the 18th century the "Dundas System" (evolved by Colonel David Dundas) was introduced into the British service, under which each company was divided into 2 platoons and each platoon into 2 sub-divisions, but in 1913 this organization was abolished for the present system.

At the present time (1928) the following is the organization of a company in some armies:—*Great Britain*—4 platoons, each platoon subdivided into 4 sections (2 Lewis gun and 2 rifle); *U.S.A.*—company headquarters and 3 platoons, each platoon consisting of section headquarters and 3 squads; *France*—a headquarters section and 4 fighting sections (*sections de combat*), each corresponding to a British platoon; *Germany*—company headquarters and 3 platoons, each divided into 2 light machine gun groups and one or more rifle groups; *Belgium*—3 platoons each of 4 *groupes de combat; Japan and Poland*—company headquarters and 3 platoons; *Netherlands*—company headquarters and 4 platoons on British model; *Baltic States: Estonia*—3 platoons of 4 sections each; *Latvia*—3 platoons of 2 sections each; *Lithuania*—2 platoons of 3 sections each. Several countries also have "headquarter companies," "machine gun companies," etc., the name of which usually indicates their special purpose.

COMPANY LAW. "Company" is one of a number of words like "union," "guild," "society," "corporation," denoting—each with its special shade of meaning—the association of individuals in pursuit of some common object. The taking of meals together was, as the word signifies (*cum,* with, *panis,* bread,) a characteristic of the early company. Guild had a similar meaning: but this characteristic, though it survives in the Livery company (*see* LIVERY COMPANIES), has in modern times disappeared. The word "company" is now monopolized—in British usage—by two great classes of companies—(1) the joint stock company, constituted under the Companies Acts, 1908 to 1917, namely the Companies (Consolidation) Act, 1908 (which consolidated the various Acts from 1862 to 1908) and certain amending acts, and (2) the "statutory company," constituted under a special Act to carry on some work of public utility, such as a railway, docks, etc., and regulated by the Companies Clauses Acts, 1845 and 1863, and amending Acts. (For United States law *see* p. 151.)

I. JOINT STOCK COMPANIES

The joint stock company may be defined as an association of persons incorporated to promote by joint contributions to a common stock the carrying on of some commercial enterprise. Associations formed not for "the acquisition of gain" are referred to below. The joint stock company has had a long history which can only be briefly sketched here. The name "joint stock company" is—or was—used to distinguish such a company from the "regulated company," which did not trade on a joint stock but was in the nature of a trade guild, the members of which had a monopoly of foreign trade with particular countries or places. (*See* Adam Smith, *Wealth of Nations,* bk. v. ch. i. pt. iii.)

The earliest kind of joint stock company is the chartered. (*See* CHARTERED COMPANIES.) The grant of a Charter is one of the exclusive privileges of the Crown, and the Crown has from time to time exercised it in furtherance of trading enterprise. Examples of such grants are the Merchant Adventurers of England, chartered by Richard II. (1390); the East India Co., chartered by Queen Elizabeth (1600); the Bank of England, chartered by William and Mary (1694); the Hudson's Bay Co.; the Royal African Co.; the notorious South Sea Co.; and in later times the New Zealand Co., the North Borneo Co., and the Royal Niger Co. Chartered companies had, however, several disadvantages. A charter was not easily obtainable and was costly. The members could not be made personally liable for the debts of the company: and once created—though only for defined objects—such a company was invested with entire independence and could not be kept to the conditions imposed by the grant, which was against public policy. A new form of commercial association was wanted, free from these defects, and it was found in the common law company—the lineal ancestor of the modern trading company. The common law company was not an incorporated association, but a great partnership with transferable shares. Companies of this kind multiplied rapidly towards the close of the 17th and beginning of the 18th centuries, but they were regarded with strong disfavour by the law, for reasons not very intelligible to modern notions, the chief being that such companies purported to act as corporate bodies, raised transferable stock, used Charters for purposes not warranted by the grant, and were—or were supposed to be—dangerous and mischievous, tending (in the words of the preamble of the Bubble Act) to "the common grievance, prejudice and inconvenience of His Majesty's subjects or great numbers of them in trade, commerce or other lawful affairs." They were too often—and this no doubt was the real ground of the prejudice against them—utilized by unprincipled persons to promote fantastic and often fraudulent schemes. Matthew Green, in his poem "The Spleen," notes how

> "Wrecks appear each day,
> And yet fresh fools are cast away."

The result was that by an Act of 1719, commonly called the

Bubble Act, such companies were declared to be common nuisances and indictable as such. But the Act, though not formally repealed till 1825, proved quite ineffectual to check the growth of joint stock enterprise, and the legislature, finding that such companies had to be tolerated, adopted the wiser course of regulating what it could not repress. One great inconvenience of these common law trading companies arose from their being unincorporated. They were formed of large fluctuating bodies of individuals, and a person dealing with them did not know with whom he was contracting or whom he was to sue. This evil the legislature sought to rectify by empowering the Crown to grant to companies by letters patent without incorporation the privilege of suing and being sued by a public officer. Ten years afterwards—in 1844—a more important line of policy was adopted, and all companies, with some exceptions, were enabled to obtain a certificate of incorporation without applying for a Charter or special Act. The Act of 1862 carried this policy one step farther by prohibiting all associations of more than 20 persons from carrying on business without registering under the Act. The real vitality of joint stock enterprise lies in the co-operative principle, and the natural growth and expansion of this fruitful principle was checked until the middle of the 19th century by the notorious risks attaching to unlimited liability. Failures like those of Overend and Gurney, and of the Glasgow Bank, caused widespread misery and alarm. It was not until limited liability had been introduced that the real potency of the principle of industrial co-operation became apparent. The practical difficulty was how to bring home to persons dealing with the company notice that the liability of the shareholders was limited. This was solved by requiring the company to add to its name the word "Limited," paint it up on its premises, and use it on all documents. While limited companies have been multiplying, the unlimited company has become practically an extinct species. The growth of limited companies is, indeed, one of the most striking phenomena of our day. Their number may be estimated at about 99,000. Their paid-up capital amounts to the stupendous sum of £4,636,000,000 and what is even more significant is that the number of shareholders has grown in a much greater ratio than the colossal growth of the aggregate capital. The profits and risks of nearly every kind of business have been spread over fresh thousands of individuals, and those with moderate incomes are more and more participating in that accumulation of wealth from business which formerly built up the fortunes of individual traders, bankers, or single families.

It is with the limited company then—the company limited by shares—as the normal type and incomparably the most important, that this article mainly deals.

COMPANIES LIMITED BY SHARES

The Companies (Consolidation) Act, 1908 (replacing the Companies Act, 1862) was intended to constitute a comprehensive code of law applicable to joint stock companies for the whole of the United Kingdom. Recognizing the mischief of trading concerns being carried on by large and fluctuating bodies the Act begins by declaring that no company, association or partnership, consisting of more than 20 persons, or ten in the case of banking, shall be formed for the purpose of carrying on any business which has for its object the acquisition of gain by the company, association or partnership or the members thereof, unless it is registered as a company under the Act, or is formed in pursuance of some other Act of parliament or of letters patent, or is a company engaged in working mines within and subject to the jurisdiction of the Stannaries. Broadly speaking, the meaning of the Act is that all commercial undertakings, as distinguished from literary or charitable associations, shall be registered. "Business" has a more extensive signification than "trade." Having thus cleared the ground the Act goes on to provide in what manner a company may be formed under the Act. The machinery is simple, and is described as follows:—

Any seven or more persons, or where the company will be a private company (*see* infra) any two or more persons, associated for any lawful purpose may, by subscribing their names to a memorandum of association and otherwise complying with the requirements of this Act in respect of registration, form an incorporated company with or without limited liability. It is not necessary that the subscribers should be traders, nor will the fact that six of the subscribers are mere dummies, clerks or nominees of the seventh affect the validity of the company.

Memorandum of Association.—The document to be subscribed—the Memorandum of Association—corresponds, in the case of companies formed under the Companies Acts, to the Charter or deed of settlement in the case of other companies. Its form is given in a schedule to the Act, and varies slightly according as the company is limited by shares or guarantee, or is unlimited. It is required to state, in the case of a company limited by shares:

(1) the name of the proposed company, with the addition of the word "limited" as the last word in such name;
(2) the part of the United Kingdom, whether England, Scotland or Ireland, in which the registered office of the company is to be situate;
(3) the objects of the company;
(4) that the liability of the members is limited; and
(5) the amount of share capital with which the company proposes to be registered, divided into shares of a fixed amount.

No subscriber of the memorandum may take less than one share, and each subscriber must write opposite his name the number of shares he takes.

These five matters the legislature has deemed of such intrinsic importance that it has required them to be set out in the company's Memorandum of Association. They are the essential conditions of incorporation, and as such they must not only be stated, but the policy of the legislature has made them with certain exceptions unalterable.

The most important of these conditions is the third, and its importance consists in this, that the objects defined in the memorandum circumscribe the sphere of the company's activities. This principle, which is one of public policy and convenience, and is known as the "*ultra vires* doctrine," carries with it important consequences, because every act done or contract made by a company *ultra vires, i.e.,* in excess of its powers, is absolutely null and void. The policy, too, is a sound one. Shareholders contribute their money on the faith that it is to be employed in prosecuting certain objects, and it would be a violation of good faith if the company, *i.e.,* the majority of shareholders, were to be allowed to divert it to something quite different. So strict is the rule that not even the consent of every individual shareholder can give validity to an *ultra vires* act.

Articles of Association.—The articles of association are the regulations for internal management of the company—the terms of the partnership agreed upon by the shareholders among themselves. A model or specimen set of articles known as Table A was given by the Companies Act, 1862, and is appended in a revised form to the Consolidation Act.

The articles usually contain a complete code for the government of the company, dealing with the company's shares, the issue of certificates, the company's lien on its shares, the making of calls, the transfer, transmission and forfeiture of shares, their conversion into stock, the issue of share warrants, alteration of capital, general meetings and the voting thereat, directors and their qualification, powers, duties, election and proceedings, managing directors, dividends and reserve fund, capitalization of profits by the issue of bonus shares, accounts, audit and notices. They can be altered by special resolution.

Registration.—When a company is to be registered the memorandum of association, generally accompanied by articles, is taken to the registrar of companies at Somerset House, together with (1) a list of persons who have consented to be directors of the company (fee stamp 5s.); (2) a statutory declaration by a solicitor engaged in the formation of the company, or by a person named in the articles as a director or secretary of the company, that the requirements of the Act in respect of registration have been complied with (fee stamp 5s.); and (3) a statement as to the nominal share capital (stamped with an *ad valorem* duty of £1 per £100). If these documents are in order, the registrar registers the company and issues a certificate of incorporation. On registration, the memorandum and articles of association become public documents, and any person may inspect them on payment of a fee of 1s. This has important consequences, because every person dealing with the company is presumed to be acquainted with its constitution, and to have read its memorandum and articles. The memorandum and articles also bind the company and its members to the same extent as if each member had signed and sealed them.

The stamps and fees payable on registering a company with a capital of £1,000 are about £7; £10,000 about £34; £100,000 about £280.

Capital.—The capital, which is required to be stated in the memorandum, and which represents the amount which the company is empowered to issue, is what is known as the nominal capital. This must be distinguished from the subscribed capital, which is the aggregate amount agreed to be paid by those who have taken shares in the company. A "minimum subscription" may be fixed by the articles. If it is, the directors cannot go to allotment on less; if it is not, the whole of the capital offered for subscription must be subscribed. A company may increase its capital, consolidate it into shares of larger amount, and subdivide it into shares of smaller amounts; it may also, with the sanction of the court, reorganize its capital; and the objects can be altered, in certain respects, by special resolution confirmed by the court.

The rights attached to preference shares are sometimes set out in the memorandum, but if this is done, they cannot be altered without the sanction of the court, unless a power of alteration is reserved in the memorandum. The usual practice is, accordingly, either to set out the rights in the articles, when they can be altered by special resolution, or else to set them out in the memorandum, reserving a power of alteration. If this power were to be abused so as to amount to a fraud by the ordinary shareholders on a minority of preference shareholders, the court would interfere by injunction. If the preference rights are set out in the memorandum without power of alteration, they can be altered as part of a scheme of arrangement, involving a resolution passed by a majority in number representing three-fourths in value of the preference shareholders present at the meeting, and the sanction of the court. Preference shares with rights set out in the memorandum can also be consolidated with other shares as part of a reorganization by special resolution, sanctioned by resolution of the preference shareholders, passed by an absolute majority in number and three-fourths in amount of the preference shareholders, whether present or not present at the meeting, confirmed by order of the court. But a limited company cannot reduce its capital, either by direct or indirect means, without the sanction of the court. The inviolability of the capital is a condition of incorporation—the price of the privilege of trading with limited liability and by no subterfuge will a company be allowed to evade this cardinal rule of policy, either by paying dividends out of capital, or buying its own shares, or returning money to shareholders. But the prohibition against reduction means that the capital must not be reduced by the voluntary act of the company, not that a company's capital must be kept intact. It is embarked in the company's business, and it must run the risks of such business. If part of it is lost, there is no obligation to replace it and to cease paying dividends until such lost capital is repaid. The company may in such a case write off the lost capital and go on trading with the reduced amount. But for this purpose the sanction of the court must be obtained.

Shares.—A share is an aliquot part of a company's nominal capital. It may be of any amount. The tendency of late years has been to keep the denomination low (£1, 10s. or even 1s.) and so to appeal to a wider public. Shares are of various kinds—ordinary, preference, deferred, founders' and management. Into what classes of shares the original capital of the company shall be divided, what shall be the amount of each class, and their respective rights, privileges and priorities, are matters for the consideration of the promoters of the company.

Preference Shares.—A company may issue preference shares even if there is no mention of them in the memorandum of association; the preference given may be as to dividends only, or as to dividends and capital. The dividend, again, may be payable out of the year's profits only, or it may be cumulative, that is, a deficiency in one year is to be made good out of the profits of subsequent years. Prima facie, a preferential dividend is cumulative. Preference shareholders have the right to inspect balance sheets.

Founders' Shares—which originated with private companies—are shares which usually take the whole or a portion of the profits after payment of a dividend of 7 or 10% to the ordinary shareholders. They are much less in favour than they used to be.

Stock and Share Warrants.—Paid up shares may be converted into stock, and share warrants to bearer may be issued. A share warrant entitles the bearer to the shares or stock specified in it, and such shares or stock are transferable by delivery of the warrant. The warrant is a negotiable instrument.

Promoters.—The machinery of company formation is generally set in motion by a person known in business, but not in law, as a "promoter," *i.e.*, one "who undertakes to form a company with reference to a given project and to set it going, and who takes the necessary steps to accomplish that purpose." Whether what a person has done towards this end constitutes him a promoter or not, is a question of fact; but once an affirmative conclusion is reached, equity clothes such promoter with a fiduciary relation towards the company which he has been instrumental in creating. This doctrine is now well established, and its good sense is apparent when once the position of the promoter towards the company is understood. Promoters "have in their hands the creation and moulding of the company. They have the power of defining how and when and in what shape and under what supervision it shall start into existence and begin to act as a trading corporation." Such a control over the destinies of the company involves correlative obligations towards it, and one of these obligations is that the promoter must not take advantage of the company's helplessness. A promoter may sell his property to the company, but he must first see that the company is furnished with an independent board of directors to protect its interests and he must make full and fair disclosure of his interest in order that the company may determine whether it will or will not authorize its trustee or agent (for such the promoter in equity is) to make a profit out of the sale. It is not a sufficient disclosure in such a case for the promoter merely to refer in the prospectus to a contract which, if read by the shareholders, would inform them of his interest. They are under no obligation to inquire. It is for the promoter to bring home notice, not constructive but actual, to the shareholders.

When a company is promoted for acquiring property—to work a mine or patent, for instance, or carry on a going business—the usual course is for the promoter to frame a draft agreement for the sale of the property to the company or to a trustee on its behalf. The memorandum and articles of the intended company are then prepared, and an article is inserted authorizing or requiring the directors to adopt the draft agreement for sale. In pursuance of this authority the directors at the first meeting after incorporation take the draft agreement into consideration; and if they approve, adopt it. Where they do so in the exercise of an honest and independent judgment, no exception can be taken to the transaction; but where the directors are nominees of the promoter, perhaps qualified by him and acting in his interest, the situation is open to grave abuse. Indeed the fastening of an onerous or improvident contract on a company at its start, by interested promoters acting in collusion with the directors, has been the principal cause of the scandals associated with company promotion. *See* also Company Promoting.

Prospectus.—Concurrently with the adoption of the contract for the acquisition of the property which is the company's *raison d'être,* the directors have to consider how they will best get the company's capital subscribed. Sometimes this is done by issuing a prospectus inviting the public to subscribe for shares; sometimes the directors prefer to place the capital through the medium of brokers, financial agents and other intermediaries. A company which is not a private company but does not go to the public on a prospectus must file a statement in lieu of prospectus.

A prospectus is an invitation to the public to take shares on the faith of the statements therein contained, and is thus the basis of the agreement to take the shares; there therefore rests on those who are responsible for its issue an obligation to act with the most perfect good faith, and this obligation has been repeatedly emphasized by judges of the highest eminence. (*See* the observations of Kindersley, V.C., in *New Brunswick Railway Co.* v. *Muggeridge,* 1860, 1 Dr. & Sm. 383, also those of Lord Herschell in *Derry* v. *Peek,* 1889, 14 A.C. 376.) Directors must be perfectly candid with the public; they must not only state what they do state with strict and scrupulous accuracy, but they must not omit any fact which, if disclosed, would falsify the statements made. This is the general obligation of directors when issuing a prospectus; but on this general obligation the legislature has engrafted special requirements. The Companies Act, 1867, required the dates and names of the parties to any contract entered into by the company or its promoters or directors before the issue of the prospectus, to be disclosed in the prospectus; otherwise the prospectus was to be deemed fraudulent. This enactment was repealed by the Companies Act, 1900, but only in favour of more stringent provisions incorporated in the Consolidation Act of 1908. Now, not only is every prospectus to be signed and filed with the registrar of companies before it is issued, but it must set forth a long and elaborate series of particulars about the company—the contents of the memorandum of association, the number of founders, management or deferred shares, the share qualification of the directors and the provisions in the articles as to their remuneration, the minimum subscription on which they may proceed to allotment, the shares and debentures issued otherwise than for cash, the names and addresses of the vendors and the amount payable to them, the amount paid for underwriting, the amount of preliminary expenses, of promotion money (if any), the dates of and parties to material contracts, the interest (if any) of every director in the promotion or in property to be acquired by the company, and the voting rights conferred by the several classes of shares. Neglect of this statutory duty of disclosure will expose directors to personal liability. For false or fraudulent statements—as distinguished from non-disclosure—in a prospectus directors are liable in an action of deceit or under the Consolidation Act, s. 84, replacing the Directors Liability Act, 1890. This Act was passed to meet the decision of the House of Lords in *Derry* v. *Peek* (14 A.C. 337), that a director could not be made liable in an action of deceit for an untrue statement in a prospectus, unless the plaintiff could prove that the director had made the untrue statement fraudulently. The section enacts in substance that when once a prospectus is proved to contain a material statement of fact which is untrue, the persons responsible for the prospectus are to be liable to pay compensation to anyone who has subscribed on the faith of the prospectus, unless they can prove that they had reasonable ground to believe, and did in fact believe, the statement to be true. Actions under this section have been rare, but their rarity may be due to directors having become more careful in their statements. Directors who circulate a prospectus containing statements which they know to be false, with intent to induce any persons to become shareholders, may be prosecuted.

Allotment of Shares.—Before the Companies Act, 1900, it was a matter for directors' discretion on what subscription they should go to allotment; this they often made scandalously inadequate, but now the Consolidation Act, replacing the Act of 1900, provides that no allotment of share capital offered to the public for subscription is to be made unless the amount fixed by the articles and named in the prospectus as "the minimum subscription" upon which the directors may proceed to allotment has been subscribed and the application moneys—which must not be less than 5% of the nominal amount of the share—paid to and received by the company. If no minimum is fixed, the whole amount of the share capital offered for subscription must have been subscribed before the directors can go to allotment. A company which is not a private company but does not go to the public is subject to similar restrictions, the statement in lieu of prospectus being substituted for the prospectus. The "minimum subscription" is to be reckoned exclusively of any amount payable otherwise than in cash. If these conditions are not complied with within 40 days, the application moneys must be returned. Any "waiver clause" or contract to waive compliance with the section is to be void. An allotment of shares made in contravention of these provisions is voidable at the option of the applicant for shares within one month after the first or statutory meeting of the company.

Even when a company has got what under the name of the "minimum subscription" the directors deem enough capital for its enterprise, it cannot commence business or make any binding contract or exercise any borrowing powers until it has obtained a certificate entitling it to commence business. To obtain this the company must have allotted shares to the amount of not less than the minimum subscription, every director must have paid up his shares in the same proportion as the other members of the company, and a statutory declaration, made by the secretary of the company or one of the directors, must have been filed with the registrar of companies, that these conditions have been complied with.

Directors.—These conditions fulfilled, the company gets its certificate and starts on its business career, carrying on its business through the agency of its directors, to whom, as we have seen above, considerable responsibilities attach.

The first directors are often appointed by the articles; their consent to act must be filed with the registrar of companies. Directors other than the first are elected at the annual general meeting, a certain proportion—usually one-third—retiring under the articles by rotation each year, their places being filled by election. A share qualification is nearly always required, on the well-recognized principle that a stake in the undertaking is the best guarantee of fidelity to the company's interests. A director once appointed cannot be removed during his term of office by the shareholders, unless there is a special provision for that purpose in the articles; but a company may remove a director if the articles—as is usually the case—authorize removal. The authority and powers of directors are prima facie those necessary for carrying on the ordinary business of the company, but the more important of such powers are usually defined in the articles. For instance, it is commonly prescribed how and when the directors may make calls, to what amount they may borrow, how they may invest the company's funds, in what circumstances they may forfeit shares, or veto transfers, in what manner they shall conduct their proceedings, and what shall constitute a quorum of the board; whenever, indeed, specific directions are desirable they may properly be given by the articles. But, superadded to and supplementing these specific powers, there is usually inserted in the articles a general power of management; the powers, whether general or specific, thus conferred upon directors are in the nature of a trust, and the directors must exercise them with a single eye to the benefit of the company. For instance, in allotting shares they must consult the interests of the company, not favour their friends. So in forfeiting shares they must not use the power collusively for the purpose of relieving the shareholder from liability. To do so is an abuse of the power and a fraud on the other shareholders.

Directors not Trustees.—It would give a very erroneous idea of the position and functions of directors to speak of them —as is sometimes done—as trustees, except in a modified sense. They are "commercial men managing a trading concern for the benefit of themselves and the other shareholders." They have to carry on the company's business, to extend and consolidate it, and to do this they must have a free hand and a large discretion to deal with the exigencies of the commercial situation. This large discretion the law allows them, so long as they keep within the limits set by the company's memorandum and articles. They are not to be held liable for mere errors of judgment, still less for being defrauded; all that the law requires of them is that they should be faithful to their duties as agents—"diligent and honest," to use the words of Sir George Jessel, formerly master of the rolls. A director is not bound to attend all meetings of the board. He must not sign cheques without informing himself of the purpose for which they are given. On the same principle, directors must not delegate their duties to others unless expressly authorized to do so, as where the articles empower the board to appoint a committee, or individual directors to appoint substitutes. Directors may, it is true, employ skilled persons, such as engineers, solicitors, valuers or accountants, to assist them, but they must still exercise their judgment as business men on the materials before them. Then in the matter of honesty, a director must not accept a present in cash or shares or in any other form whatever from the company's vendor, nor must he make any profit in the matter of his agency without the knowledge and consent of his principal, the company. He must not, in other words, put himself in a position in which his duty to the company and his own interest conflict or even may conflict. This rule often comes into play in the case of contracts between a company and a director. There is nothing in itself invalid in such a contract, but the onus is on the director, if he would keep such a contract, to show that the company assented to his making a profit out of the contract, and for that purpose he must show that he made full and fair disclosure to the company of the nature and extent of his interest under the contract. It is for this reason that when a company's vendor is also a director he does not join the board until his co-directors have exercised an independent judgment on the propriety of the purchase.

Misfeasance.—A director must also bear in mind—what is a fundamental principle of company management—that the funds of the company are entrusted to the directors for the objects of the company as defined by the company's memorandum of association and authorized by the general law, and that they must not be diverted from those objects or applied to purposes which are outside the objects of the company (*ultra vires*), or outside the powers of management given to the directors. This does not abridge the large discretion allowed to directors in carrying on the business of the company. The funds embarked in a trading company are intended to be employed for the acquisition of gain, and risk, greater or less according to circumstances, is necessarily incidental to such employment; but it is quite another matter when directors pay dividends out of capital, or return capital to the shareholders, or spend money of the company in "rigging" the market, or in buying the company's shares, or paying commission for underwriting the shares of the company, except to the extent authorized by the articles and Companies Acts. Directors who in these or any other ways misapply the funds of the company are guilty of "misfeasance" (breach of trust), and all who join in the misapplication are jointly and severally liable to replace the sums so misapplied. The remedy of the company for misfeasance, if the company is a going concern, is by action against the delinquent directors; but where a company is being wound up, the legislature has provided a summary mode of proceeding, by which the liquidator, or any creditor or contributory of the company, may take out what is known as a misfeasance summons, to compel the delinquent director or officer to repay the misapplied moneys or make compensation. The court is, however, given a discretionary power to relieve a director from liability if he has acted honestly and reasonably and ought fairly to be excused.

In managing the company's affairs directors must meet together and act as a body, for the company is entitled to their collective wisdom in council assembled. Board meetings are held at such intervals as the directors think expedient. Notice of the meeting must be given to all directors who are within reach, but the notice need not specify the particular business to be transacted. The articles usually fix, or give the directors power to fix, what number shall constitute a quorum for a board meeting. They also empower the directors to elect a chairman of the board. The directors exercise their powers by a resolution of the board, which is recorded in the directors' minute-book. The articles usually provide for the payment of a certain sum to each director for his services during the year. When this is the case, it is an authority to the directors to pay themselves the amount of such remuneration. The remuneration, unless otherwise expressly provided, covers all expenses incidental to the directors' duties. A director, for instance, cannot claim to be paid in addition to his fixed remuneration his travelling expenses for attending board meetings.

Directors are liable criminally for falsification of the company's books, and for this or any other criminal offence the court in winding up may direct a prosecution; but the court will not as a rule interfere with the discretion of directors honestly exercised in the management of the company's affairs. The directors have prima facie the confidence of the shareholders, and it is not for the court to say that such confidence is misplaced. If shareholders are dissatisfied with the management, the remedy is in their own hands—they can call a meeting and elect a new board.

Companies registered since the 22nd November 1916 must in all trade catalogues, trade circulars, showcards and business letters sent to any part of His Majesty's dominions mention the present Christian names or initials, the present surnames, any former Christian names and surnames, and the nationality, if not British, and, if the nationality is not the nationality of origin, the nationality of origin of all the directors. The annual summary sent to the registrar of companies by all companies whenever registered must contain somewhat similar particulars.

When a company is wound up, the directors' powers of management come to an end. Their agency is superseded in favour of that of the liquidator.

Meetings.—Although the Companies Acts treat the directors of a company as the persons in whom the management of its affairs is vested, they also contemplate the ultimate controlling power as residing in the shareholders. A controlling power of this kind can only assert itself through general meetings; and that it may have proper opportunities of doing so, every company is required to hold a general meeting, called the statutory meeting, within three months from the date at which it is entitled to commence business. This meeting acquired new significance under the Companies Act of 1900 and marks an important stage in the history of a company. Seven days before it takes place the directors are required to send to the members a certified report informing them of the general state of the company's affairs—the number of shares allotted, cash received for them, an abstract of receipts and payments, the amount of preliminary expenses, the particulars of any contract to be submitted to the meeting, etc. Furnished with this report the members come to the meeting in a position to discuss and exercise an intelligent judgment upon the state and prospects of the company. Besides the statutory meeting a company must hold one general meeting at least in every calendar year, and not more than fifteen months after the holding of the last preceding general meeting. This annual general meeting is usually called the ordinary general meeting. Other meetings are extraordinary general meetings. Notices convening a meeting must inform the shareholders of the particular business to be transacted; otherwise any resolutions passed at the meeting will be invalid. Voting is regulated by the articles. Generally a vote is given to a shareholder for every share held by him, but sometimes a scale is adopted, for instance, one vote for every share up to ten, with an additional vote for every five shares beyond the first ten up to one hundred, and an additional vote for every ten shares beyond the first hundred. In default of any regulations, every member has one vote only. Sometimes preference shareholders are given no vote at all, or are only allowed to vote in certain events, *e.g.*, if their dividends are unpaid, or on certain matters, *e.g.*, winding up, reduction of capital or matters directly affecting their rights. The articles usually contain provisions regulating the demand for a poll; this may be demanded on an extraordinary or special resolution by three persons, unless the articles require a demand by a greater number of persons, but they cannot require a demand by more than five.

Agreement for Shares.—A contract to take shares is like any other contract. It is constituted by offer and acceptance, communicated to the offerer. The offer in the case of shares is usually in the form of an application in writing to the company, made in response to a prospectus, requesting the company to allot the applicant a certain number of shares in the undertaking on the terms of the prospectus, and agreeing to accept the shares, or any smaller number, which may be allotted to the applicant. An allottee is entitled to rescind his contract where the allotment is irregular, *e.g.*, where the minimum subscription has not been obtained. When an application is accepted the shares are allotted, and a letter of allotment posted to the applicant. Allotment is the usual, but not the only, evidence of acceptance. As soon as the letter of allotment is posted the contract is complete, even though the letter never reaches the applicant. An application for shares can be withdrawn at any time before acceptance. As soon as the contract is complete, it is the duty of the company to enter the shareholder's name in the register of members, and to issue to him a certificate under the seal of the company, evidencing his title to the shares.

Register of Members.—The register of members plays an important part in the scheme of the company system. The principle of limited liability having been once adopted, justice required not only that such limitation of liability should be brought home by every possible means to persons dealing with the company, but also that such persons should know as far as possible what was the limited capital which was the sole fund available to satisfy their claims—what amount had been called up, what remained uncalled, who were the persons to pay and in what amounts. These data might materially assist a person dealing with the company in determining whether he would give it credit or not; in any case they are matters which the public has a right to know. The legislature, recognizing this, has exacted as a condition of the privilege of trading with limited liability that the company shall keep a register and make returns to the registrar of companies containing those particulars, which shall be accessible to the public. In order that the register may be accurate, and correspond with the true liability of membership for the time being, the court is empowered to rectify it in a summary way by ordering the name of a person to be entered on or removed therefrom. This power can be exercised, whether the dispute as to membership is one between the company and an alleged member, or between one alleged member and another, but the machinery of the section is not meant to be used to try claims to rescind agreements to take shares. The proper proceeding in such cases is by action.

Payment for Shares.—The same policy of guarding against an abuse of limited liability requires that shares in the case of a limited company shall be paid for in full. The legislature has allowed such companies to trade with limited liability, but the price of the privilege is that the limited capital to which alone the creditors can look shall at least be a reality. It is therefore *ultra vires* for a limited company to issue its shares at a discount; but there is nothing in the Companies Acts which requires that the shares of a limited company, though they must be paid up in full, must be paid up in cash. They may be paid "in meal or in malt," and it is accordingly common for shares to be allotted in payment for property purchased or for services. The company must, however, file with the registrar of companies a return stating, in the case of shares allotted in whole or in part for a consideration other than cash, the number of the shares so allotted, and the nature of the consideration for which they have been allotted.

Though every share carries with it the liability to pay the full amount in cash or its equivalent, the liability is only to pay when and if the directors call for it. A call must fix the time and place for payment.

Rescission of Agreement.—When a person takes shares from a company on the faith of a prospectus containing any false or fraudulent representations of fact material to the contract, he is entitled to rescind the contract. The company cannot keep a contract obtained by the misrepresentation or fraud of its agents; the misrepresentation, for purposes of rescission, need not be fraudulent, it is sufficient that it is false in fact: fraud or recklessness of assertion will give the shareholder a further remedy by action of deceit, or under sect. 84 of the Consolidation Act; but, to entitle a shareholder to rescind, he must show that he took the shares on the faith or partly on the faith of the false representation; if not, it was innocuous. A shareholder claiming to rescind must do so promptly. It is too late to commence proceedings after a winding-up has begun.

Transfer of Shares.—The shares or other interest of any member in a company are personal estate and may be transferred in the manner provided by the articles. One of the chief objects when joint stock companies were established was that the shares should be capable of being easily transferred; but, though every shareholder has a prima facie right to transfer his shares, this right is subject to the regulations of the company, and it may and usually does by its articles require that a transfer of partly paid shares shall receive the approval of the board of directors before being registered,—the object being to secure the company against having an insolvent shareholder substituted for a solvent one. This power of the directors to refuse a transfer must not, however, be exercised arbitrarily or capriciously. If it were, it would amount to a confiscation of the shares. Directors, for instance, cannot veto a transfer because they disapprove of the purpose for which it is being made (*e.g.*, to multiply votes), if there is no objection to the transferee.

Blank Transfers.—It is a common and convenient practice to deposit share or stock certificates with bankers and others to secure an advance. When this is done the share or stock certificate is usually accompanied by a blank transfer—that is, a transfer executed by the shareholder borrower, but with a blank left for the name of the transferee. The handing over by the borrower of such blank transfer signed by him is an implied authority to the banker, if the loan is not paid, to fill in the blank with his name and get himself registered as the owner.

Dividends.—A company can only pay dividends out of profits—which have been defined as the "earnings of a concern after deducting the expenses of earning them." To pay dividends out of capital is not only *ultra vires* but illegal, as constituting a return of capital to shareholders. Before paying dividends, directors must take reasonable care to secure the preparation of proper balance-sheets and estimates, and must exercise their judgment as business men on the balance-sheets and estimates submitted to them. If they fail to do this, and pay dividends out of capital, they will incur serious liabilities. The onus is on them to show that the dividends have been paid out of profits. The court, as a rule, does not interfere with the discretion of directors in the matter of paying dividends, unless they are doing something *ultra vires*.

Borrowing.—One of the many advantages incident to incorporation under the Companies Acts is found in the facilities which such incorporation affords for borrowing on debentures or debenture stock. Borrowing was not specifically dealt with by the Companies Acts prior to 1900, but that it was contemplated by the legislature is evident from the provision in § 43 of the act of 1862 for a company keeping a register of mortgages and charges. The policy of the legislature in this, as in other matters connected with trading companies, was apparently to leave the company to determine whether borrowing should or should not form one of its objects.

A company is debarred from borrowing unless it is expressly or impliedly authorized to do so by its memorandum of association. In the case of a *trading* company borrowing is impliedly authorized as a necessary incident of carrying on the company's business, but a non-trading company, for instance a company formed to promote art, science, religion or charity, has no implied borrowing power. A company established for the conveyance of passengers and luggage by omnibuses, a company formed to buy and run vessels between England and Australia, and a company whose objects included discounting approved commercial bills, have all been held to be trading companies with an incidental power of borrowing as such to a reasonable amount. A building society, on the other hand, has no inherent power of borrowing (though a limited statutory power was conferred on such societies by the Building Societies Act, 1874). Public companies formed to carry out some undertaking of public utility, such as docks, water works, gas works, etc., have only limited powers of borrowing. It has been found, however, that an implied power of borrowing, even when it attaches, is too inconvenient to be relied on in practice, and an express power is always now inserted in the memorandum. This power is in most general terms. It is left to the articles to define the amount to be borrowed, the nature of the security, and the conditions, if any, such as the sanction of a general meeting, on which the power is to be exercised. A company cannot exercise any borrowing power until it has become entitled to commence business. (*See* supra.) A person who is proposing to lend money to a company must be careful to see (1) that the memorandum authorizes borrowing, and (2) that the borrowing limit in the articles is not being exceeded, for if it should turn out that the borrowing was in excess of the company's powers and *ultra vires,* the company cannot be bound, and the borrower's only remedy is against the directors for breach of warranty of authority, or to be surrogated to the rights of any creditors who may have been paid out of the borrowed moneys.

A company proposing to borrow usually issues a prospectus, similar to the ordinary share prospectus, stating the amount of the issue, the dates for payment, the particulars of the property comprised in the security, the terms as to redemption, and so on, and inviting the public to subscribe. Underwriting is also resorted to, as in the case of shares, to ensure that the issue is taken up. There is no objection to a company issuing debentures or debenture stock at a discount, as there is to its issuing its shares at a discount. The directors must borrow on the best terms the company's credit will enable it to obtain. A prospectus inviting subscriptions for debentures or debenture stock must be filed and contain the same particulars as a prospectus offering shares, and it comes within s. 84 of the Consolidation Act. Further, persons who are parties to it have the onus cast upon them, should the prospectus contain any misstatements, of showing that, at the time they issued the prospectus, they had reasonable grounds to believe, and did in fact believe, that the statements in question were true; otherwise they will be liable to pay compensation to any person injured by the misstatements.

Debentures.—Etymologically, "debenture" is merely the Latin word *debentur,* the first word in a document in common use by the Crown in early times admitting indebtedness to its servants or soldiers. This was the germ of a security which has now, with the expansion of joint stock company enterprise, grown into an instrument of considerable complexity.

Debentures may be classified in various ways. From the point of view of the security they are either (1) debentures (simply); (2) mortgage debentures; (3) debenture bonds. In (1) the security is a floating charge: in (2) there is also a floating charge, but the property forming the principal part of the security is specifically mortgaged by the company to trustees under a trust deed for the benefit of the debenture-holders: in (3) there is no security proper, only the covenant for payment by the company. For purposes of title and transfer, debentures are either "registered" or "to bearer." For purposes of payment they are either "terminable" or "perpetual."

The Floating Debenture.—The form of debenture chiefly in use is that secured by a floating charge. By it the company covenants to pay to the holder thereof the sum secured by the debenture on a specified day, or at such earlier date as the principal moneys become due under the provisions of the security, and in the meantime to pay interest on the principal moneys until payment, or until the security becomes enforceable under the conditions; and the company further charges its undertaking and all its property, with the payment of the amount secured by the debenture; uncalled capital, if included, must be expressly mentioned, because the word "property" by itself will not cover it. This is the body of the instrument; on its back is endorsed a series of conditions, constituting the terms on which the debenture is issued. Thus the debenture-holders are to rank *pari passu* with one another against the security; the debenture is to be transferable free from equities between the company and the holder; the charge is to be a floating charge, and the debenture-holders' moneys are to become immediately repayable and the charges enforceable in certain events: for instance, if the interest is in arrear for (say) two or three months, or in the event of winding-up. Other events indicative of insolvency are sometimes added in which payment is to be accelerated. The conditions also provide for the mode and form of transfer of the debenture, the death or bankruptcy of the holder, the place of payment, etc. The most characteristic feature of the security—the floating charge—grew naturally out of a charge on a company's undertaking as a going concern. Such a charge could only be made practicable by leaving the company free to deal with and dispose of its property in the ordinary course of its business—to sell, mortgage, lease and exchange it as if no charge existed; and this is how the security works. The debenture-holders give the directors an implied licence to deal with and dispose of the property comprised in the security until the happening of any of the events upon which the debenture-holders' money becomes, under the debenture conditions, immediately repayable. Pending this the charge is dormant. The licence extends, however, only to dealings in *the ordinary course of business.* Payment by a company of its just debts is always in the ordinary course of business, but satisfaction by execution levied *in invitum* is not. The lender has a security covering the whole assets for the time being, and can intervene at any moment by obtaining a receiver, if his security is imperilled, even though none of the events in which the principal moneys are made payable have happened. If any of them has happened, for instance default in payment of interest, or a resolution to wind up, the payment of the principal moneys is accelerated, and a debenture-holder can at once commence an action to obtain payment and to realize his security.

Often a proviso is inserted in the conditions endorsed on the debenture, that the company is not to create any mortgage or charge ranking in priority to or *pari passu* with that contained in the debentures. A floating charge created by a company within three months of winding up is invalid, except to the amount of the cash paid and interest at 5%, unless the company is shown to have been solvent at the time.

Trust Deeds.—When the amount borrowed is large, the company commonly executes a trust deed by way of further security. The object of such a trust deed is twofold: (1) it creates a legal mortgage of specific property in favour of the trustees of the deed (the charge contained in the debentures is only an equitable security), and it further charges all the remaining assets by way of floating charge, with appropriate provisions for enabling the trustees, in certain events similar to those expressed in the debenture conditions, to enforce the security, and for that purpose to enter into possession and carry on the business, or to sell it and distribute the proceeds; (2) it organizes the debenture-holders and constitutes trustees who can watch over the interests of the debenture-holders and take steps for their protection, if necessary. In particular it provides machinery for the calling of meetings of debenture-holders, and empowers a majority of (say) three-fourths in value at such meeting to bind the rest to any compromise or arrangement with the company which such majority may deem beneficial. This may save recourse to a scheme or arrangement sanctioned by the court.

Debentures Registered and to Bearer.—Debentures are, for purposes of title and transfer, of two kinds—(1) registered debentures, and (2) debentures to bearer. Registered debentures are transferable only in the books of the company. Debentures to bearer are negotiable instruments and pass by delivery. Coupons for interest are attached. Sometimes debentures to bearer are made exchangeable for registered debentures and vice versa.

Debenture Stock.—Debenture stock bears the same relation to debentures that stock does to shares. "Debenture stock," as Lord Lindley states (*Companies,* 5th ed., 195), "is merely borrowed capital consolidated into one mass for the sake of convenience. Instead of each lender having a separate bond or mortgage, he has a certificate entitling him to a certain sum, being a portion of one large loan." This sum is not uniform, as in the case of debentures, but variable, and is usually made transferable in sums of any amount not involving a fraction of £1. One debenture-stockholder, for instance, may hold £20 of the stock, another £20,000. Debenture stock created by companies under the Companies Acts, unlike that created by statutory companies governed by the Companies Clauses Acts, is created by a contract between the company and the trustees of a debenture-stock trust deed, which is analogous in its provisions to the trust deed above described used to secure debentures. By such deed the company covenants with the trustees, as representing the debenture-stockholders, to pay the amount of the stock, and creates a legal mortgage of specific property, and charges its other assets by way of floating charge, in favour of the trustees, with all requisite powers and provisions for enabling them to enforce the security on default in payment of interest or on the happening of certain specified events evidencing insolvency. The company further covenants to enter the names of the stockholders in a register, and to issue certificates for the amount of their respective holdings. These certificates have, like debentures, the conditions of the security endorsed on their back.

Redemption.—A company generally reserves a right of redeeming the security before the date fixed for repayment; and accordingly a power for that purpose is commonly inserted in the conditions and trust deed, if there is one. But as debenture or debenture-stockholders, who have got a satisfactory security, do not wish to be paid off, the right of redemption is often qualified so as not to arise till (say) five years after issue, and a premium is made payable by way of bonus. Sometimes the number of debentures or the amount of stock to be redeemed each year is limited. The selection is made by drawings held in the presence of the directors, or, if there is a trust deed, of the trustees. A sinking fund is often provided for, and this is especially suitable where the security is of a wasting character such as leaseholds, mining property or a patent. Such a fund is formed by the company setting apart a certain sum each year out of the profits of the company after payment of interest on the debentures. Redeemed debentures and debenture stock may in certain cases be reissued.

Registration of Mortgages and Charges.—A company is bound to keep a register of mortgages and charges, which is open to the inspection of creditors and members of the company. Mortgages and charges of certain specified classes must also be registered within twenty-one days from their creation with the registrar of companies. Otherwise they are void—so far as they are securities—against the liquidator and any creditor of the company, but the holders retain the rights of unsecured creditors. An extension of the time for registering may be granted by the court.

Debenture Scrip.—Debentures and debenture stock are usually made payable by instalments, for example 10% on application, 10% on allotment and the remainder at intervals of a few months. Until these payments are complete the securities are not issued, but to enable the subscriber to deal with his security pending completion the company issues to him an interim scrip certificate acknowledging his title and exchangeable on payment of the remaining instalments for debentures or debenture stock certificates.

Remedies.—When debenture-holders' security becomes enforceable there are a variety of remedies open to them. These fall into two classes—(1) remedies available without the aid of the court; (2) remedies available only with the aid of the court.

1. If there is a trust deed, the trustees may appoint a receiver of the property comprised in the security, and they may also sell under the powers contained in the deed, or under the Law of Property Act, 1925. Sometimes, where there is no trust deed, similar powers—to appoint a receiver and to sell—are inserted in the conditions endorsed on the debentures.

2. The remedies with the aid of the court are—(*a*) an action by one or more debenture-holders on behalf of all for a receiver and to realize the security; (*b*) an originating summons for sale or other relief; (*c*) an action for foreclosure where the security is deficient (all the debenture-holders must be parties to this proceeding); (*d*) a winding-up petition. Of these modes of proceeding, the first is by far the most common and convenient. Immediately on the issue of the writ in the action the plaintiff applies for the appointment of a receiver to protect the security, or if the security comprises a going business, a receiver *and manager*. In due course the action comes on for judgment, when the court directs accounts and inquiries as to what is due to the holders of the debentures and what property is comprised in the security, and gives leave to apply for a sale. If the company has gone into liquidation, leave must be obtained to commence or continue the action, but such leave in the case of debenture-holders is *ex debito justitiae.* The administration of a company's assets in such actions by debenture-holders (debenture-holders' liquidations, as they are called) has encroached very much on the ordinary administration of winding up, and great hardship is often inflicted by the floating security on the company's unsecured creditors, who find that everything belonging to the company, uncalled capital included, has been pledged to the debenture-holders. No doubt such creditors might have inspected the company's register of mortgages and charges, but it is not always practicable to do this.

Auditors.—By the Consolidation Act strict provisions are made for the appointment and remuneration of auditors by a company, and their rights and duties are defined.

Private Companies.—The "private company" may be likened to an incorporated partnership. To be a private company the articles must restrict the right to transfer shares, limit the number of members, and prohibit any invitation to the public to subscribe for shares, debentures or debenture stock of the company. A private company need not consist of more than two members, and enjoys many advantages as regards commencement of business, freedom from the obligation to issue a statement in lieu of prospectus and to make certain returns to the registrar of companies and other matters.

Individual traders and trading firms have become alive to the advantages offered by incorporation; for it gives them the protection of limited liability, prevents dislocation of a business by the death, bankruptcy or lunacy of any of its members, enables a trader to distribute among the members of his family interests in his business on his decease through the medium of shares and facilitates borrowing on debentures or debenture stock; and with a view to secure these advantages thousands of traders have converted their businesses into limited companies. To so large an extent has this been done that private companies now form about 90% of the companies registered.

Although a private company does not appeal to the public to subscribe its capital, in the main features of its constitution it differs little from a public one. It is only in one or two particulars that special provisions are requisite. It is generally desired for instance: (1) to keep all the shares among the members—the partners or the family—and not to let them get into outside hands; and (2) to give the principal shareholders, the original partners, a paramount control over the management. For this purpose it is usual to provide specially in the articles that no share shall be transferred to a stranger so long as any member is willing to purchase it at a fair value; that a member desirous of transferring his shares shall give notice to the company which shall offer the shares to the other members; that if within a certain period the company finds a purchaser, the shares shall be transferred to him, and that in case of dispute the value shall be settled by arbitration or shall be such a sum as the auditor certifies to be the fair value. So in regard to the management it is common to provide that the owners of the business shall be entitled to hold office as directors for a term of years or for life, provided they continue to hold a certain number of shares; or an owner is empowered to authorize his executors or trustees, whilst holding a certain number of shares, to appoint directors. Directors holding office on these special terms are often given very extensive powers and are described as "governing" or "permanent" or "life" directors. This union of interest and management in the same persons gives a private company an unquestionable advantage over a public company.

The so-called "one-man company" is merely a variety of the private company. The fact that a company is formed by one man, with the aid of six dummy subscribers, is not in itself (as was at one time supposed) a fraud on the policy of the Companies Acts, but it is occasionally used for the purpose of committing a fraud, as where an insolvent trader turns himself into a limited company in order to evade bankruptcy; and it is to an abuse of this kind that the term "one-man company" owes its opprobrious signification.

COMPANIES LIMITED BY GUARANTEE

The second class of limited companies are those limited by guarantee, as distinguished from those limited by shares. In the company limited by guarantee each member agrees, in the event of a winding-up, to contribute a certain amount to the assets—£5, £1 or 10s.—whatever may be the amount of the guarantee. The peculiarity of this form of company is that the interests of the members are not expressed in any terms of nominal money value like the shares of other companies, a form of constitution designed to give a superior elasticity to the company. The property of the company simply belongs to the company in certain fractional amounts. This makes it convenient for clubs, syndicates and other associations which do not require the interest of members to be expressed in terms of cash.

COMPANIES NOT FOR GAIN

An association formed to promote commerce, art, science, religion, charity or any other useful object may, with the licence of the Board of Trade, register under the Companies Acts with limited liability, but without the addition to its name of the word "Limited," upon proving to the board that it is the intention of the association to apply its profits or income in promoting its objects, and not in payment of dividends to its members. This licence is revocable. In lieu of the word "Company," the association usually adopts as part of its name some such title as association, chamber, club, college, institute or society. The power given by this section has proved very useful, and many kinds of associations have availed themselves of it, such as medical institutes, law societies, nursing homes, chambers of commerce, clubs, schools and learned societies. The guarantee form (see *supra*) is well adapted for associations of this kind, supported as they usually are, by annual subscriptions. No such association can hold more than two acres of land without the licence of the Board of Trade.

COST-BOOK MINING COMPANIES

These are in substance mining partnerships. They derive their name from the fact of the partnership agreement, the expenses and receipts of the mine, the names of the shareholders, and any transfers of shares being entered in a "cost-book." The affairs of the company are managed by an agent known as a "purser," who from time to time makes calls on the members for the expenses of working. A cost-book company is not bound to register under the Companies Acts but may do so.

Winding-up.—A company once incorporated under the Companies Acts cannot be put an end to except through the machinery of a winding-up, though the name of a company which is commercially defunct may be struck off the register of companies by the registrar. Winding-up is of three kinds: (1) voluntary, (2) by the court and (3) subject to the supervision of the court. Of these voluntary winding-up is by far the most common. Of the companies that come to an end 90% are so wound up; and this is in accordance with the policy of the legislature, that shareholders should manage their own affairs—winding-up being one of such affairs.

Voluntary.—A voluntary winding-up is carried out by the shareholders passing a special resolution requiring the company to be wound up voluntarily or an extraordinary resolution to the effect that it cannot by reason of its liabilities continue its business, and that it is advisable to wind up. The resolution is generally accompanied by the appointment of a liquidator. In a voluntary winding-up there is a power for the liquidator or any contributory or creditor to apply to the court to determine any question arising in the winding-up, or to exercise any powers which the court might exercise if the company were being wound up by the court. The liquidator must summon a meeting of creditors to determine whether an application shall be made to the court for the appointment of a new liquidator or a committee of inspection. When the affairs of the company are fully wound up, the liquidator calls a meeting, lays his accounts before the shareholders, makes a return to the registrar and the company is dissolved by operation of law three months after the registration of the return.

By the Court.—Irrespective of voluntary winding-up, the legislature has defined certain events in which a company may be wound up by the court. These events are: (i.) when the company has by special resolution resolved that the company be wound up by the court; (ii.) when default is made in filing the statutory report or holding the statutory meeting; (iii.) when the company does not commence its business within a year or suspends it for a year; (iv.) when the members are reduced, in the case of a private company, below two, or, in the case of any other company, below seven; (v.) when the company is unable to pay its debts, and (vi.) when the court is of opinion that it is just and equitable that the company should be wound up. A petition for the purpose may be presented either by a creditor, a contributory, or the company itself. Where the petition is presented by a creditor who cannot obtain payment of his debt, a winding-up order is *ex debito justitiae* as against the company or shareholders, but not as against the wishes of a majority of creditors. A winding-up order is not to be refused because the company's assets are over mortgaged.

On a winding-up order being made the official receiver, as liquidator, *pro tem.*, requires a statement of the affairs of the company verified by the directors, and on it reports to the court as to the causes of the company's failure and whether further inquiry is desirable. If he further reports that, in his opinion, fraud has been committed in the promotion or formation of the company by a particular person, the court may order such person to be publicly examined.

A liquidator's duty is to protect, collect, realize and distribute the company's assets in due course of administration; and for this purpose he advertises for creditors, makes calls on contributories, sues debtors, takes misfeasance proceedings, if necessary, against directors or promoters, and carries on the company's business—supposing the goodwill to be an asset of value—with a view to selling it as a going concern. He may be assisted by a committee of inspection, composed of creditors and contributories. When the affairs of the company have been completely wound up the court makes an order that it be dissolved, and it is dissolved accordingly, but the court has power to declare the dissolution void.

Under Supervision.—The court may make an order that a voluntary winding-up shall continue but subject to the supervision of the court. Such an order has the advantage of operating as a stay of any actions or executions pending against the company. Except in these respects, the winding-up remains a voluntary one. The court does not actively intervene unless set in motion.

Reconstruction.—A large number of companies now wind up only to reconstruct. The reasons for a reconstruction are generally either to raise fresh capital, or to get rid of onerous preference shares. Reconstructions are carried out in one of three ways: (1) by sale and transfer of the company's undertaking and assets to a new company, under s. 192 of the Consolidation Act, or (2) by sale and transfer under a power to sell contained in the company's memorandum of association, or (3) by a scheme of arrangement, sanctioned by the court, under s. 120. Usually debenture-holders take debentures in the new company.

Wrongs by a Company.—A company, though a mere legal abstraction, without mind or will, may be made liable in damages for malicious prosecution, nuisance, fraud, negligence, trespass and other wrongs. The sense of the thing is that the "company" is a *nomen collectivum* for the members. It is they who have put the directors there to carry on their business and they must be answerable, collectively, for what is done negligently, fraudulently or maliciously by their agents. A company may be convicted of many kinds of crime.

Later Legislation.—By the Companies Bill now (1928) before Parliament it is proposed to empower companies to issue redeemable preference shares, to tighten up the law as to prospectuses and offers of shares or debentures for sale, to recast the law as to minimum subscription, under certain conditions to allow the issue of shares at a discount, to give creditors more power in a voluntary winding-up, to create various offences on the lines of the law of bankruptcy, to prevent the hawking of shares from house to house, and to amend the Companies Acts in many other ways. The present Acts and the new Act, when passed, are to be consolidated in a new Consolidation Act.

AUTHORITIES.—Buckley on the Companies Acts, Palmer's Company Precedents, Lindley on Companies, Stiebel on Companies.

II. STATUTORY COMPANIES

There is another large class of companies, which for shortness may be called statutory companies, constituted by special Act of Parliament for the purpose of carrying on undertakings of public utility, such as railways, canals, harbours, docks, waterworks, gasworks, bridges, ferries or tramways. The objects of such companies nearly always involve an interference with the rights of private persons, often necessitate the commission of a public nuisance, and require therefore the sanction of the legislature. For this purpose a special Act has to be obtained. A private bill to authorize the undertaking is introduced in Parliament, considered in committee, and either passed or rejected. These private bill committees are tribunals acknowledging certain rules of policy, taking evidence from witnesses and hearing arguments from professional advocates. In many of these special Acts, dealing as they do with a similar subject matter, similar provisions are required, and to avoid repetition and secure uniformity the legislature has passed certain general Acts—codes of law for particular subject matters frequently recurring—which can be incorporated by reference in any special Act with the necessary modifications. Thus the Companies Clauses Acts, 1845 to 1889, supply the general powers and provisions which are commonly inserted in the constitution of such companies, regulating the distribution of capital, the transfer of shares, payment of calls, borrowing and general meetings. The Lands Clauses Consolidation Act, 1845, supplies the machinery for the compulsory taking of land incident to most undertakings of a public character. The Railways Clauses Acts, 1845 and 1863 (as amended by the Mines [Working Facilities and Support] Act, 1923), the Waterworks Clauses Acts, 1847 and 1863, the Gasworks Clauses Act, 1847 and the Electric Lighting (Clauses) Act, 1899, are other codes of law designed for incorporation in special Acts creating companies for the construction of railways or the supply of water, gas or electric light.

The provisions of the Companies Clauses Acts as to shares and stock are, with a few exceptions, analogous to those of the Companies Acts. The capital is divided into shares of a certain number and amount. A share register is kept and certificates are issued to shareholders; power is given to convert paid-up shares into stock; preference shares may be created, but carry dividends only out of the profits of each year; shares and stock may be issued at a discount, but if the old ordinary shares are at a premium, any new shares must be offered first to the old shareholders.

The borrowing powers of these companies, the form of their debenture or debenture stock, and the rights of the holders depend on the conjoint operation of the companies' own special Act and the Companies Clauses Acts. The provisions of these Acts as to borrowing, being express, exclude any implied power of borrowing. The policy of the legislature is to give proper facilities for borrowing, and at the same time to take care that undertakings of public utility which have received legislative sanction shall not be broken up or destroyed, as they would be if the mortgagees or debenture-holders were allowed the ordinary rights of mortgagees for realizing their security by seizure and sale. Hence the legislature has given them only "the fruit of the tree." The debenture or debenture-stock-holders may take the earnings of the company's undertaking by obtaining the appointment of a receiver, but that is all they can do. They cannot sell the undertaking or disorganize it by levying execution, so long as the company is a going concern; but this protecting principle of public policy will not be a bar to a debenture-holder, in his character of creditor, presenting a petition to wind up the company, if it is no longer able to fulfil its statutory objects. Certain statutory companies may now under the Stat. Companies (Redeemable Stock) Act, 1915, issue redeemable debenture stock, and also redeemable preference stock.

Railway Companies.—These have special legislation which will be found in the Railway Companies Powers Act, 1864, the Railways Construction Facilities Act, 1864, and the Railway Securities Act, 1866, and numerous other acts. The more important railways have been amalgamated under the Railways Act, 1921. (*See* GREAT BRITAIN: *Communications.*)

AUTHORITIES: Sutcliffe on Statutory Companies. Browne & Theobald on Railways.

III. BRITISH COMPANIES ABROAD

The status of British companies trading abroad, so far as Germany, France, Belgium, Greece, Italy and Spain are concerned, is expressly recognized in a series of conventions entered into between those countries and Great Britain.

In France.—The value of the convention with France has been much impaired by the interpretation put upon the words of it by the court of cassation in *La Construction Lim.* According to this case the nationality of a company depends not on its place of origin but on where it has its centre of affairs, its principal establishment. The result is that a company registered in Britain under the Companies Acts may be transmuted by a French court into a French company in direct violation of the convention.

In Germany.—The convention with Germany, which is in similar terms to that with France, has also been narrowed by judicial construction. The "power of exercising all their rights" given by the convention to British companies has been construed to mean that a British company will be recognized as a corporate body in Germany, but it does not follow from the terms of the convention that any British company may as a matter of course establish a branch and carry on business within the German republic. It must still get permission to trade and to hold land, register itself in the communal register and pay stamp duties.

Foreign companies may found an affiliated company or have a branch establishment in Italy, provided they publish their memorandum and articles and the names of their directors.

Foreign Companies Generally.—Where no convention exists the status of an immigrant corporation depends upon international comity, which allows foreign corporations, as it does foreign persons, to sue, to make contracts and hold real estate, in the same way as domestic corporations or citizens; provided the stranger corporation does not offend against the policy of the state in which it seeks to trade.

There is a growing practice for states to impose by express legislation conditions on foreign corporations coming to do business within their territory. These conditions are mainly directed to securing that the immigrant corporation shall make known its constitution and shall be amenable to the jurisdiction of the courts of the country where it trades. Thus, by the law of Western Australia—to take a typical instance,—a foreign company is not to commence or carry on business until it empowers some person to act as its attorney to sue and be sued and has an office or place of business within the State, to be approved of by the registrar, where all legal proceedings may be served. New Zealand, Manitoba and many other States have adopted similar precautions; and by the Companies (Consolidation) Act, 1908, s. 274, a foreign company having a place of business within the United Kingdom is required to file with the registrar of companies a copy of its Charter or memorandum and articles, a list of directors, and the names and addresses of one or more persons authorized to accept service of process. Special conditions of a more stringent nature are often imposed in the case of particular classes of companies of a quasi-public character, such as banking companies, building societies or insurance companies. Regulations of this kind are perfectly legitimate and necessary. They are in truth only an application of the law of vagrancy to corporations, and have their analogy in the restrictions now generally imposed by states on the immigration of aliens.

IV. COMPANY LAW OUTSIDE THE UNITED KINGDOM

Australia and New Zealand.—Company law in Australia and New Zealand follows very closely the lines of legislation in the United Kingdom. In New South Wales the law is consolidated by the Companies Act, 1899, amended 1900, 1906, 1907, 1918; in Victoria by an Act of 1915, amended 1920, 1926; in South Australia by an Act of 1892, amended 1893, 1924 and 1926 (two Acts); in Tasmania by an Act of 1920, amended 1922, 1923, 1927; in Western Australia by an Act of 1893, amended 1897, 1898, 1899, 1902, 1922. In Queensland the law is contained in the Companies Act, 1863, amended 1889, 1891, 1892, 1893, 1894, 1896, 1909, 1913. In New Zealand the law is consolidated by an Act of 1908, amended 1910, 1919, 1920, 1921, 1921–22 (temporary), 1924.

Canada.—Companies in Canada can be incorporated either under the Dominion Companies Act (Revised Statutes of Canada, 1927, c. 27) or under the Companies Acts of one or other of the nine Provinces. The Acts of the Provinces of Nova Scotia, Saskatchewan, Alberta and British Columbia in the main follow the English law, incorporation being effected by the registration of a memorandum of association, usually accompanied by articles of association. The Dominion Act and the Acts of the Provinces of Ontario, Quebec, Manitoba, Prince Edward Island and New Brunswick on the other hand provide for incorporation by letters patent granting a Charter. The various Acts and amending Acts are too numerous to refer to here in detail.

Applicants for letters patent for a Dominion company must file an application showing the purposes of incorporation, the place of business, the amount of the capital stock, the number of shares and the amount of each, the names of the applicants, the amount of stock taken by each and the amount and mode of payment. Other provisions may also be embodied. A company cannot commence business until 10% of its authorized capital has been subscribed and paid for. The word "limited" as part of the company's name is to be conspicuously exhibited and used in all documents. The directors are not to be less than three, and must be holders of stock. Borrowing powers may be taken by resolution of a two-thirds majority at a special meeting of the stockholders.

AUTHORITY—Mitchell on Canadian Commercial Corporations.

(H. T. E.)

France.—There are two kinds of limited liability companies in France—the *société en commandite* and the *société anonyme*. The *société en commandite* corresponds in some respects to the British private company or limited partnership, but with this difference, that in the *société en commandite* the managing partner is under unlimited liability to creditors; the sleeping-partner's liability is limited to the amount of his capital. The French equivalent of the English ordinary joint stock company is the *société anonyme*. The minimum number of subscribers necessary to form such a company is seven. The *société anonyme* is not legally constituted unless the whole capital is subscribed and one-fourth of each share paid up. Assets, not in money, brought into a company are subject to verification of value by a general meeting. The minimum nominal value of shares, where the company's capital is less than 200,000 fr., is 25 fr.; where the capital is more than 200,000 fr., 100 fr. The *société* is governed by articles which appoint the directors, and there is one general meeting held every year. A *société anonyme* may issue preference shares. The doctrine that a corporation never dies has no place in French law. A *société anonyme* may come to an end.

Since 1925 a new form of association has been brought into existence under the name of *société à responsabilité limitée*. Its main differences from the *société anonyme* are as follows:—(1) The number of partners or shareholders is not limited and there may be only two partners or shareholders; (2) the capital of the company must be at least 25,000 fr. and it cannot be reduced to less than that amount; (3) the company can only be finally incorporated when all the shares have been allotted and have been fully paid up; (4) the shares are not transferable to persons other than shareholders except with the consent of the majority of the shareholders representing between themselves at least three-quarters of the company's capital; (5) the company must have a fixed nationality which cannot be changed except with the consent of all the shareholders.

Germany.—In Germany the class of companies most nearly corresponding to English companies limited by shares are "share companies" (*Aktiengesellschaften*) and "commandite companies" with a share capital (*Kommanditgesellschaften auf Aktien*). Since 1892 a new form of association has come into existence known by the name of partnership with limited liability (*Gesellschaften mit beschrankter Haftung*), which has largely superseded the commandite company.

In forming this paid-up company certain preliminary steps have to be taken before registration:—(1) The articles must be agreed on; (2) a managing board and a board of supervision must be appointed; (3) the whole of the share capital must be allotted and 25%, at least, must be paid up in coin or legal tender notes; (4) reports on the formation of the company must be made by certain persons; and (5) certain documents must be filed in the registry.

In all cases where shares are issued for any consideration, not being payment in full in cash, or in which contracts for the purchase of property have been entered into, the promoters must sign a declaration in which they must state on what grounds the prices agreed to be given for such property appear to be justified. In the great majority of cases shares are issued in certificates to bearer. The amount of such a share to bearer must as a general rule be not less than the equivalent of £50, but registered shares of £10 may be issued. Balance sheets have to published periodically.

Partnerships with limited liability may be formed by two or more members. The articles of partnership must be signed by all the members, and must contain particulars as to the amount of the capital and of the individual shares. If the liability on any shares is not to be satisfied in cash, this also must be stated. The capital of a limited partnership must amount to £1,000. Shares must be registered. Insolvent companies in Germany are subject to the bankruptcy law in the same manner as natural persons.

For further information *see* a memorandum on German companies printed in the appendix to the *Report of Lord Davey's Committee on the Amendment of Company Law*, pp. 13–26.

Italy.—Commercial companies in Italy are of three kinds:—(1) General partnerships, in which the members are liable for all debts incurred; (2) companies in *accomandita*, in which some members are liable to an unlimited extent and others within certain limits; (3) joint stock companies, in which the liability is limited to the capital of the company and no member is liable beyond the amount of his holding. None of these companies needs authority from the Government for its constitution; all that is needed is a written agreement brought before the public in the ways indicated in the code. In joint stock companies the trustees (directors) must give security. They are appointed by a general meeting for a period not exceeding four years. The company is not constituted until the whole of its capital is subscribed, and until three-tenths of the capital at least has been actually paid up. When a company's capital is diminished by one-third, the trustees must call the members together and consult as to what is to be done. An ordinary meeting is held at least once every year. Shares may not be made payable "to bearer" until fully paid up. A company may issue debentures if this is agreed to by a certain majority. One-twentieth, at least, of the dividends of the company must be added to the reserve fund, until this has become equal to one-fifth of the company's capital. Three or five assessors—members or non-members—keep watch over the way in which the company is carried on. (X.)

THE UNITED STATES

The word "company," which has of recent years acquired a definite meaning in England, retains in the United States all of its original vagueness, being used indiscriminately to designate all sorts of associations of men from a group of volunteer firemen to the Pennsylvania railroad. The modern business organizations which are called in England the joint-stock company and the statutory company, respectively, are in America known as the "corporation," or, when one wishes to differentiate the two, as the "business corporation" and the "public service corporation."

ORDINARY BUSINESS CORPORATIONS

The development of business corporations in the United States has in general been substantially similar to that of joint stock companies in England, but there are a number of important divergencies between the business practices and law of the two countries. The legal differences are in part the consequence of a difference in business practices, in part due to different views of public policy and in part to the peculiarities of the American federal system of government.

State and Federal Corporations.—It is a well settled principle of American law that power to create corporations is vested in the legislature alone, and the word legislature in this connection means, in general, the legislature of some one of the States. The U.S. Congress has implied power to create many kinds of corporations, but it has rarely done so except in the case of national banks. Persons desiring to incorporate for other than banking purposes must therefore look to some State legislature for assistance.

General Corporation Laws.—During the early years of the 19th century, this assistance was given sparingly, the incorporation of every enterprise requiring a special legislative act. During the last 100 years, however, more liberal views have prevailed, and in all the States to-day there are general laws enabling persons desiring to incorporate to do so by performing certain specified acts. In the case of ordinary business corporations, the principal statutory requirements are the payment of certain fees and the signing and filing of a document, called "articles of incorporation" or some similar name, which sets forth the powers which the corporation is to have, and certain other matters, such as the total amount of the authorized capital and whether preferred as well as common stock is to be issued.

Promotion and Organization.—Although the statutes thus determine the legal framework of the enterprise, the actual organization of a business corporation usually involves many things to which the statutes make no reference. Most corporations are formed to develop some particular property or to take over some existing business. Important preliminary agreements are ordinarily entered into by the promoters of the enterprise prior to incorporation. Although these agreements are not in legal theory binding upon the subsequently formed corporation, in practice one of the first acts of the corporation upon its formation is the adoption of them.

Moreover, although incorporation laws frequently provide for the making of a minimum number of subscriptions in some statutory form, they generally permit additional subscriptions to be made either prior or subsequent to incorporation by informal contracts subject only to certain statutory regulations with regard to payment. Furthermore, although it is well settled that a corporation has power to finance itself through the issue of bonds, as well as by subscriptions to stock, the issue of bonds is not as a general rule based upon any provision in the statute but upon the implied power of borrowing money which is possessed by all business corporations.

In addition to the acts which are necessary to incorporation, the statutes generally contemplate the doing of additional acts before the corporation shall be in a position to do business. Thus, most incorporation acts provide that the incorporators shall, before engaging in business, meet together for the purpose of adopting by-laws and electing directors.

Doing Business in Several States.—The laws of the several States differ considerably both as to the manner in which incorporation may be obtained and as to the powers which corporations may have. In view of these differences, the question how far it is possible to become incorporated in a State whose laws are peculiarly favourable to the sort of organization which the promoters of the enterprise desire and to retain the benefits of such incorporation while carrying on business in another State is one of great importance. The courts have held that a corporation formed in one State may engage in business in another State unless expressly forbidden to do so and that, under such circumstances, its internal organization continues to be governed by the laws of the State in which it was created. Nevertheless, except in so far as the corporation's business is interstate commerce, the second State may, by statute, deny it the right to do business therein or may, as the price of permitting it to do so, impose severe restrictions upon it.

In practice, corporations of one State are, with few exceptions, permitted to do business in other States, subject to certain regulations. In some cases these regulations are sufficiently burdensome to make it desirable for the owners of an incorporated enterprise to organize a second corporation under the laws of the second State for the purpose of carrying on the business done in that State. Frequently, however, the situation is such that persons desiring to do business mainly or even wholly in one State deem it for their advantage to incorporate in another.

Stockholders' Liability.—Although the corporation laws of the States differ in a number of important respects, they all possess the common feature of limiting to some extent the liability of the stockholders for the corporate debts, the limit of liability being in most States the amount of the stockholders' subscription. In order to prevent this stockholders' liability from approaching the vanishing point, it was until recently generally provided that all stock issued must have a par value and that the subscribers to the stock should remain liable to the corporation's creditors until they or their transferees had paid either in cash, property or services, a sum equal to this par value. The practical consequences of these laws have been regarded by most persons concerned with the financing of corporations as undesirable and their criticisms have in recent years led to the enactment of laws permitting the issue of stock without par value.

Blue Sky Laws.—No-par stock is a device to insure greater flexibility in capitalization and to relieve stockholders from what may in some cases be regarded as an unfair burden of liability. Permission to use such a device certainly does not diminish the need of surrounding the issue of corporate stock with safeguards designed to protect the investor against being misled by fraudulent or over-optimistic promoters and stock salesmen. In order, if possible, to discourage the activities of such persons, the majority of the States have in recent years enacted so-called "blue sky" laws which make it a criminal offence to sell stock without a licence from a public official, who is under a duty of refusing to grant a licence if he believes the plan of incorporation to be illegal, fraudulent or unfair. Certain classes of securities, such as those listed on a stock exchange, are generally exempted from the requirements of these statutes.

De Facto Corporations.—The enactment of such laws may tend to reduce somewhat the tendency to carelessness with respect to compliance with incorporation laws, which has been a source of considerable difficulty in American corporation law. As a result of such carelessness it not infrequently happens that persons engage in business under what they believe to be a corporate form of organization without being legally incorporated. The courts have treated organizations of this type as having a *de facto* corporate existence, a view of the situation which has no parallel in the law of England.

Corporate Powers and Ultra Vires Acts.—The powers which corporations possess depend in the main upon the provisions in their articles, though there are certain powers which are implied from the mere fact of incorporation, and other powers which are denied to all corporations regardless of what their articles may provide. One important power which is freely granted in some States while rigidly refused in others is the power to hold stock in other companies, a power which enables one corporation to control another through ownership of a majority of its stock. It not infrequently happens that the managing officers of corporations attempt to do in the corporate name acts which the corporation is not authorized to do. In contrast to the English view that such *ultra vires* acts are wholly void, American courts have in general held that they will, in many cases, confer rights and impose liability upon the corporation.

Directors.—The legal principles which govern the activities of an American corporation once it becomes a going concern are, however, in the main, substantially similar to those which govern an English joint-stock company. Both are managed by officers under the supervision of boards of directors, who possess autocratic powers but are liable to their corporations for losses due to *ultra vires* acts or to gross negligence, and are accountable for any profits derived from taking an unfair advantage of their position.

Stockholders' Rights.—The stockholders in American corporations, like those in English companies, have no share in the management of the enterprise but have the right of meeting together, generally at annual intervals, to elect directors, amend the articles of incorporation or the by-laws, and approve or disapprove certain voidable acts of the directors. As a general rule the principle governing such stockholders' action is one of majority control, although devices for obtaining what may amount to minority control, such as the disfranchisement of certain classes of stock or the organization of voting trusts, are permissible in some States.

In addition to the voting rights which he generally possesses, a stockholder's more important rights include the right to share in any dividend paid to the class of stockholders to which he belongs, the right to subscribe to any new stock issued, to share in the assets on dissolution, to transfer his stock and to sue to redress wrongs done to the corporation where the directors fraudulently or unreasonably refuse to act.

Dissolution.—The laws of most States contain elaborate provisions for the dissolution of corporations and the distribution of their assets among stockholders and creditors. In the case of insolvent corporations, however, what practically amounts to a dissolution of the corporation is frequently obtained without resort to these statutes, either by the institution of bankruptcy proceedings against the corporation or by a receivership. Such proceedings often result in a reorganization rather than an abandonment of the enterprise.

OTHER CORPORATIONS

Special Types of Corporations.—In addition to the statutes governing ordinary business corporations, there are in most States separate enactments relating to stock corporations engaged in special kinds of business, such as banking and public service. Banks may be organized under either Federal or State laws, which in general do not differ greatly from those relating to the organization of ordinary business corporations, except with respect to a few matters such as that of stockholder's liability. The activities of banking corporations are, however, subject to a much greater degree of supervision by the State than is the case with respect to ordinary business corporations.

So, too, in the case of public service corporations, the differences between the laws relating to them and those relating to corporations engaged in ordinary business are less with respect to the manner of organization of such corporations than with respect to the amount of regulation to which they are subjected. The regulation of such enterprises is a very important part of the business law of to-day, but since such regulation depends rather upon the nature of the business than on its incorporation, it is not dealt with here.

In addition to these various classes of stock corporations, the laws of the States also provide for the organization of various non-stock corporations, including organizations engaged in business on the mutual or co-operative basis, and non-business corporations, such as charitable, educational, religious, social and fraternal bodies.

UNINCORPORATED ASSOCIATIONS

The unincorporated association is a common form of organization for other than business purposes, and is also occasionally used for the carrying on of business. When used for the latter purpose it is in effect a large partnership with transferable shares and has the serious disadvantage that it results in personal liability on the part of the shareholders. Such liability may, however, be avoided in many States by giving control of the enterprise and legal title to its assets to trustees. This latter form of organization at one time possessed certain advantages over the corporation, but recent statutes have largely done away with these advantages. (E. M. D.)

See S. D. Thompson, *Commentaries on the Law of Private Corporations* (6 vols.); Beach on *Corporations,* and the *American Encyclopaedia of Law.*

COMPANY-PROMOTING. Company-promotion is a recognized branch of financial industry, called into being by the readiness of capitalists, large and small, to take a share or shares in any kind of enterprise, from a government loan down to a mining venture in some obscure part of the earth. Some companies, notably many evolved at the time of the South Sea craze that ended in the bursting of the Bubble, had no more solid foundation than the imagination of the people who promoted them; people who traded upon the eagerness of the greedy, and the innocence of the ignorant, in drawing-up the prospectus of some fantastic scheme that might lure money from the public's pocket and direct it into the hands, farther than which it did not travel, of the fraudulent company promoter. The Limited Liabilities act, 1862, and its supplementary enactments, went far to lay down greatly needed law upon the subject of new companies, and, by slow degrees, company promotion won a place for itself amongst responsible branches of finance. Company-promoting is no longer a synonym for dishonesty and legalized chicanery. It is recognized as an essential cog in the wheel of financial machinery.

Promotion of a Company.—The founder of a successful store, desirous of turning his interest into cash, approaches a company promoter and says how much he wants for the undertaking. Valuations are made, reports drawn up, profit-statements or estimates set out, the proportions settled of what the seller, founder of the business, will accept in cash and shares, preference, ordinary, deferred shares—perhaps debenture stock—of his own property. He asks certain terms: the company-promoter, experienced judge in such matters, suggests variations. By degrees, and by compromise, agreement is reached. Underwriting arrangements, with trust companies and others, are then made. The promotion of the company has thus arrived at that stage where the public can be approached with a prospectus of the undertaking, and investors are thereupon invited to subscribe the money for the purchase of the business, provision of working capital, etc. The company-promoter may buy the whole business outright and re-offer it to the public, making a profit for himself on the transaction. The small-print part of a prospectus, which not everybody takes the trouble to study, often contains information that will enable a prospective subscriber to judge whether an excessive sum has been paid to the intermediaries between the seller of the business and the public who are invited to buy it through application for its shares. There may be a number of businesses which, bought singly by the company-promoter, lend themselves to amalgamation and to issue of their shares in a new, big concern to the public.

Promoters and Promoting.—Company-promoting fulfils a necessary part of the development of the principles governed by the Limited Liabilities Acts. It can be, and is, carried on by an individual, or a firm, or a limited company. It is a business in which the ordinary risks vary a good deal, according to the fluctuating factors of the money market; of political events, domestic and foreign; of natural disturbances. The company-promoter may find prospects of a very successful new issue are marred, on a sudden, by a revolution, an earthquake, the illness or death of a foreign ruler. Company-promoting takes into account these hazards, the unknown as well as the known, and charges its clients accordingly. There is no set scale of profit or commission. There is no set rule as to who may or may not be the promoter. Sometimes a railway or other company, with powers in hand to issue more stock, will give an order to stock exchange firms to sell, at a fixed minimum price, a particular security of its own until a certain amount has been disposed of, and the railway or company has thereby obtained the money it requires. In such a case, the services of a professional company-promoter are dispensed with, while, to instance a foreign government or municipal loan, the borrower frequently sells the whole amount to a single firm, or to three or four firms, who pay one price, and issue the loan to the public at some higher figure. The borrower is thereby secured of getting his money. The issuing firms, out of the profit they make, may pay underwriting, advertising and other expenses. The popularity of the limited liability principle, and of its application to all sorts and conditions of business, have made company-promotion a lucrative branch of business, and have accordingly drawn to its ranks an increasing number of persons though, as has been said above, it is a business by no means without its risks

Share "Introductions."—Before the World War, the usual manner for the company-promoter to approach the investor was through the medium of a prospectus, advertised in the newspapers and circulated, with a certain degree of discrimination, through the post. Since the War, there has sprung up a widespread development of the practice of doing without a prospectus, and, in lieu, of "introducing" shares to the stock exchange markets. The owner of a business which he, the owner, wishes to turn into cash, will take the necessary legal steps to incorporate that business into a public company, the shares of which he will sell outright to a buyer who advertises certain particulars, including various contracts in relation to the company, in newspapers, as being for public information only, and not as an invitation to subscribe for the shares. This is preliminary to the Stock Exchange committee being asked to give their sanction—without which nothing can be done to make a stock exchange market—for dealing in the shares. Public interest is aroused by the advertisement; possibly there may be a few other advance paragraphs that whet curiosity; the buyers of the shares can usually count with confidence upon finding other buyers who will pay a higher price if they, the prospective buyers, have the assurance that the newcomer is a sound concern. By the time that permission to deal is given by the Stock Exchange committee, the people who hold all the shares, and who therefore are the only people able to sell, find themselves armed with a long list of buyers ready-made for the opening of the market: buyers who quite commonly do not know the price at which the shares will be sold to them, but who do know that it will be a reasonable figure, as compared with the lower price that the first buyers had given for the shares. This system of company-promotion had a mild vogue before the War, but it achieved prominence by reason of the difficulties encountered during the War in the way of raising money for fresh enterprises through the medium of the prospectus. Since then the practice, despite obvious disadvantages that have evoked criticism from the thoughtful and the austere, has gained increasing popularity amongst those who have stocks and shares for sale, and who claim for this method that it is more economical than that of issuing and circulating a full prospectus.

Promotion by Offer of Sale.—The main disadvantage, and principal point for criticism, is the fact that less information may appear in an offer for sale than is contained in a prospectus. Reference to the newspapers will show, on many days in a month, the marked differences between the two kinds of invitation offered to the public to subscribe money for the stock, bonds or shares in a new company, in some new loan, or other form of borrowing. The prospectus sets out a good deal of comprehensive detail. It gives (generally in small print) the amount of money or shares payable to the original sellers, and the amount that the intermediary, the promoter, is asking from the public, the difference being, of course, the promoter's profit. The offer for sale, which is a different thing from the introduction of shares to a market, frequently takes the shape of a letter, written by someone connected with the concern—the chairman of a company, or perhaps its managing director—which letter details the same kind of information as a prospectus would give, but from which there will be omitted, in all probability, the intermediate profits that are being made by promoters or others.

Stock Exchange Requirements.—In all cases, the Stock Exchange committee, before granting permission to deal in the new issue, require the assurance that the directors collectively and individually are responsible for the information advertised. The announcements made for "public information only" are generally followed by the shares being introduced to the stock exchange market in the manner described above. The issue must be advertised in two leading London morning papers, and must give all material conditions relating to the formation of a company, as precedent to permission being obtained from the Stock Exchange committee for transactions to take place in the shares. As the object of the people who have bought the shares is to sell the latter again at a profit, it is obvious that the Stock Exchange committee's permission to deal is essential; otherwise, there will be no such free market as shall enable the sale to be easily effected. The sellers, in command of the majority of the issue, can ask what price they please. The buyers, with little to guide them except details required to be advertised, are divided between the fear on the one hand, of paying too high a price, and, on the other hand, of being left out of some good opportunity because it is advertised in a way that certainly saves money. The ordinary prospectus affords the investor a more considerable body of detail, as a general rule, than do the offers of sale or the particulars advertised as being "for public information only." (W. L.)

UNITED STATES

The rôle of the promoter is to take the new idea of the inventive mind and make it feasible for commercial exploitation. Until comparatively recently, he was the only link who brought the dreamer and the practical man together. The promoter's stock in trade is imagination, backed by enthusiasm. He must be able to open the windows of his mind to admit oblique rays of light, to which the common run of mentalities are not yet sensitive. As a figure who makes business more dynamic, more receptive to the inevitable consequences of flux, the promoter serves a useful economic function.

Of late, the financing of new ideas has not rested exclusively with promoters. Established companies have to an ever-increasing extent since the World War recognized the importance of research. Going concerns have in their laboratories consciously sought to extend the frontiers of applied science. The General Electric Company, for example, spends more on research each year than Harvard university. The Bell laboratories of the American Telephone and Telegraph Company appropriate huge sums annually to keep abreast of the newer thought in the field of communications. That relative newcomer, the Radio Corporation of America, is another leader in research. In the field of industrial chemistry, E. I. du Pont de Nemours and Company, of Wilmington, Del., is active in combining science with business. In the purely industrial field, the General Motors Corporation devotes vast energies to engineering research. Accordingly, economic progress is less haphazard than it used to be before the war. New ideas are no longer borne primarily in the minds of casual, outside inventors. To an increasing extent, new methods and new processes are found as a result of deliberate planning. New inventions spring to an increasing extent from a deliberate search in the laboratories for novel means of accomplishing new objectives.

An outstanding characteristic of the management of the best conducted American companies is an open mind. Accordingly, the individual with a new idea no longer finds his only avenue to success through combination with a promoter. Frequently, his best market is with an established company. But changes of viewpoint come gradually. Conservatism in business, though relatively less insistent, still lingers. Some pioneers must still set up new business agencies to exploit their novel conceptions. In the United States, the conditions for starting new companies vary in the 48 States. In general, a vast amount of freedom is given to promoters. Some commonwealths, like Delaware, specialize in granting companies a free hand, and accordingly even companies intending to operate mainly in other States prefer a Delaware charter. Tax exemption features in Florida have encouraged company organization in that State. Ninety per cent of American business is carried on by corporations operating under State charters. Although the nature of the restrictions vary, new companies get a large area of freedom. However, in the last decade, two score States have adopted so-called blue sky laws, which set up standards to safeguard the interests of security buyers. Under the blue sky laws, the vendors of securities must satisfy a State commission of their own integrity and also as to the authenticity of statements made concerning the new company, which is being financed. Of late, there has been a drift away from this paternalistic type of regulation in favour of the fraud law, which has been adopted in New York, New Jersey and Maryland. Under this type of legislation, the law enforcement officers do not deal with all new security issues, but specialize in those which seem tainted with fraud. The blue sky and fraud laws are State enactments, rather than Federal laws. The Federal Government operates to protect investors from fraud largely through the statutes to prevent the use of the mails for fraudulent purposes. The argument used in favour of the newer type of fraud law, as opposed to the blue sky type, is that it is less burdensome to legitimate business. Moreover, it is commonly stated that the blue sky law gives the investor a false sense of security, in that he feels that the State has certified as to the good character of a particular new offering. As a matter of fact, the State only intends to imply an absence of fraud, but to the untrained mind there is an implication that governmental authority stands behind the investment.

In dealing with new promotions, governmental authority is supplemented by the organized effort of honest business to protect its good name. "Better Business Bureaux" have been organized in 44 American cities, and their work in fraud fighting in the financial and merchandise field is co-ordinated through the National Better Business Bureau, whose headquarters are in New York city. Recently, Better Business Bureaux have been organized in Montreal and Toronto. These bureaux are voluntary organizations, supported by subscriptions of individuals, corporations and organized security exchanges. The New York Stock Exchange virtually underwrote the initial expenses of the New York Better Business Bureau, which is the largest and most effective link in the nationwide system. The better business movement originated from a realization that fraudulent practices increased the sales resistance which legitimate business faced. With the rise of the small investor during the war loans, the public became easy prey for crooked promoters. Andrew W. Mellon, secretary of the Treasury, once estimated that the American public squandered a billion dollars a year in fraudulent investments. Unless new ideas are sponsored by established companies, financing becomes difficult. The better grade investment houses are chary of novelties promoted by newcomers without a record of business success behind them. Accordingly, many inventors have been driven into the hands of security charlatans who operate in the shadow of the financial district. Recognizing the economic need of financing promising new ideas, a group of New York capitalists banded together and agreed to put up their own capital to finance new projects during the experimental stage, after which securities would be offered directly to the investment public. Out of thousands of ideas submitted, an extraordinarily small percentage was deemed feasible. Inventors are frequently deluded with the importance of their creation, and are inclined to overvalue it.

Ordinarily the promoter limits himself to finding business opportunities, and to organizing to take advantage of them. Such preliminary work includes the mobilizing of capital, physical property and management. If the individual is a professional promoter, he steps out when the company has been launched, and turns to something else. Charles R. Flint, organizer of the American Chicle Company, was not inclined to continue to manage companies after organizing them. Sometimes, as in the case of O. P. and M. J. Van Sweringen, of Cleveland, real estate and railroad operators, the genius of promoters is combined with a capacity for management. When a promoter deals with established investment bankers, the procedure resembles the English practice. Bankers make their commitments dependent on surveys by engineering concerns and audits by certified public accountants. The work of promoters in recent years has included not only the sponsoring of new ventures, but also the merging of old. In the field of gas and electricity, mergers have been almost universal. Huge holding companies have absorbed increasing numbers of operating companies scattered in various districts at home and abroad. Promoters and brokers have played an active part in persuading the old owners to sell out to the new. The development has been paralleled in industry, where the newest development has been the creation of what Paul M. Mazur, of Lehman Brothers, bankers, has described as the circular trust, which consists of a combination of companies in allied lines, like the cereal, coffee, salad dressing and imitation coffee units banded together by the Postum Company. The alleged advantage of such trusts, which are neither of the old fashioned vertical or horizontal type, is that they become more important factors in dealing with their customers, particularly the powerful chain stores. Moreover, there are supposed to be economies in the saving of executive salaries, in financing, in co-ordinated handling of advertising and in combination of sales and service forces. Frequently, new units are acquired through an exchange of stock. The deal is made attractive to the group selling out because it gets a liquid security for an illiquid one. The public, moreover, is willing to capitalize the earnings behind the liquid security far more liberally. In the railroad field, under the Transportation Act of 1920, railroad mergers are encouraged, and the restraining hand of the anti-trust laws is partially lifted. Progress in the direction of railroad weddings has been slow, partially because of vagaries in the law, but important initial steps have already been taken. These new groupings call for promotion skill of the highest order.

In the case of new companies, the promoter is frequently compensated in stock, and his remuneration depends on the success of the venture. Company-promotion has been facilitated in the United States in recent years by a new public appreciation of the value of common stocks as long term investments. The bulk of industrial financing has not consisted of the launching of brand new companies, but of the turning of hitherto close corporations, like the great department stores, into companies in which outside investors participate. In some transactions, like the sale of Dodge Brothers, to the banking house of Dillon, Read and Company, the former owners completely relinquished their stake in the company. In other deals, like the financing of great department stores, the bankers will buy for the public only a minority interest, and will insist on a continuance of the same management.

Ordinarily new untested securities are not promptly admitted to trading on the New York Stock Exchange, but are first required to go through a seasoning process on the New York Curb Market. Many new issues are unlisted and are dealt in only over the counter. New issues are most economically distributed through the established banks and investment banking houses, with a regular clientele. Newspaper and magazine advertising backs up the efforts of legitimate stock and bond salesmen. The process of financing through less well established finance houses that send out "high-pressure" salesmen to call upon strangers, has repeatedly been demonstrated to be costly and unsatisfactory. Established companies, like the public utilities enterprises, have been able in specific deals to eliminate the middle man—the banker—by selling securities directly to patrons of the companies. Many of the large public utility, industrial and railroad companies have been selling stock directly to employees. (M. S. R.)

COMPANY UNIONS. A labour organization in the U.S.A. in which the employer exerts an influence which interferes with collective bargaining is a "company union." Most frequently it is a union whose membership and officers are restricted wholly to the employees of the special establishment, and differs thus in form from the trade union which enrols in a unified body workers of the same or similar occupations in a large number of plants. Company unions grew with special rapidity during 1919–26 and after the enactment of the National Industrial Recovery Act of 1933, which guaranteed labour's "right to organize."

Since 1935 the National Labor Relations Act has outlawed employer practices which would result in company unions. Principles involved are: (1) whether organization is employer dominated at its inception; (2) the nature and efficacy of collective bargaining by the organization; (3) contrast in the employer's treatment of rival organizations; (4) whether the constitution and by-laws of the organization reveal extensive control by the employer or his agents; (5) whether employer-controlled organizations and public officials in the community have been utilized to secure control over the labour organization. In the establishment of these principles the board followed the assumption that the formation and administration of labour organizations were the concern of the employee and not of the employer.

Since 1937, when the National Labor Relations Act was declared constitutional, company unions have been on an "experimental" retreat. Employers have been attempting to adapt them for legitimacy under the law. Among the techniques of adaptation are reorganization of old company unions, or forming new ones, into "independent" unions; readaptation of company unions by the introduction of dues-paying, written agreements, holding meetings outside of company property, and by incorporation. However, certain basic features, like the discouragement of "outside" unions and membership in only the plant, or plants, of the single company, are still retained. (*See* CLOSED SHOP.) (S. PE.)

COMPARATIVE ANATOMY is a term that is usually applied to the study of the structure of diverse animals, intended to bring out their differences and resemblances. It arose as a separate science in the 16th century, although the most important generalization which has resulted from it was tacitly assumed by those earlier anatomists who, unable to dissect human bodies, made observations on pigs and other domestic animals, applying their results to man. A comparative study of anatomy actively pursued during the 18th and early part of the 19th centuries, led zoologists to the discovery that all animals might be placed in a few great groups, distinguished from one another by fundamental dissimilarities in structure. Of these groups, that which attracted the greatest attention was the group Vertebrata. It was soon realized that all mammals resembled one another in the fundamental structure of their skeletons, that the differences that were discernible could plausibly be regarded as explicable by the loss or alteration of parts, *e.g.*, that the hand of a horse differed from that of man by the complete loss of two outermost digits, and such reduction of the second and fourth that the third alone remained functional. Observations of this type led to the theory of "architypes" invented by Oken, and accepted and much extended by R. Owen.

Comparative anatomy formed the foundation on which the theory of evolution was and is based. Until the community of structure which exists between animals often widely different in appearance, had been discovered, no reasons whatsoever existed for doubt of their separate creation.

Comparative anatomy forms the basis of all work on the classification of animals. The larger groups are established on a basis of knowledge of the complete structure of the animals included in them, and the differences which are used to separate the smaller groups, genera, and species, although they can very often be observed in surface view, are really anatomical in their nature.

The study of comparative anatomy led to the development of the conceptions underlying the terms homology and analogy, and an attempt further to discriminate between these two caused comparative anatomists to begin the study of embryology in order to determine the homologies of structures from their mode of origin. Such combined anatomical and embryological studies have made comparative anatomy, especially as regards the vertebrates, an active branch of zoology, whose aim is to elucidate the evolutionary changes undergone by the various groups of vertebrates and by their organs and organ-systems. Among invertebrates, comparative anatomy is of less importance because of the lack of resemblance between major invertebrate groups. (D. M. S. W.; X.)

COMPARATIVE ETHICS. The comparative study of ethics is concerned with the rules, principles and ideals guiding or inspiring human behaviour, technical rules for sufficiently obvious reasons excluded. Its field is thus nearly coincident with that of philosophical ethics. But while philosophy is at bottom interested in the ultimate validity of moral conceptions, comparative ethics is primarily concerned with the fact that, valid or invalid, they exist, that they play their part in the life of the individual and society and have their affiliations with other factors in human development. It is as much interested in their differences as in their points of agreement, in the conceptions which the student may think absurd or outrageous as in those which he approves as sound, in the customs of the simplest peoples as in those of the most advanced civilizations. Whether the question of validity can in the end be excluded from this study has been a matter of controversy. Some would think that in the last resort it is required as the underlying standard of comparison. Others maintain that there is no such standard and that comparative ethics can very well get on without it. Some seem even to imagine that comparison itself gives the standard, since it shows what ideas prevail and success is the only measure of worth. But such optimism cannot be maintained. The lower ideal may make the stronger appeal to prevailing sentiments, and if prevalence is itself the test we get varying standards with varying times. If it is contended that what prevails anywhere must be best for that time and place, this is contrary to fact, since it is often clear enough to the observer or historian that accepted standards work injuriously, even ruinously. More careful writers agree that comparative treatment does not of itself yield a standard of rationality, but are not agreed on the question whether such a standard is (*a*) attainable, (*b*) required for the purposes of comparative ethics. On the first question it is assumed in this article that such a standard is attainable, and is implied when we use terms like "higher" or "lower" "progress" or "deterioration" in morals. But in strictness its elucidation is the problem of philosophic ethics and will not be attempted here. Nevertheless comparative study both points the way to the philosopher and, in exhibiting the operation of moral ideas in social life, provides a broad basis of experience as the test of his theory.

In any case we should not exaggerate differences. Those who affirm and those who deny a "truth" in the ethical order may follow the same path for a long distance, if not to the end. The same data are before both parties, the same record of customs, laws, religious requirements and moral codes, and they may be compared as historical facts without deciding on their relative values. We may work out a series of historic changes or compare the variations of moral outlook characteristic of one culture with those of another. We may enquire into the causes of such variation and investigate the influence of economic and other factors, all without resort to a philosophical valuation. We may even (and this is important) select any given order of moral ideas as a standard of reference and show the deviations of other accepted orders therefrom without assuming its superior validity. A very simple code is of value for such a purpose, because it enables us to mark the kind of deviations which arise with the greater complexity of life. The code of our own day is also useful (so long as we do not covertly and uncritically assume that it is the highest), because, good or bad, it is the product of the civilization which is latest in point of time and beyond question the most developed in certain forms of human achievement. Combining the two points of reference we can enquire how far ethical codes are correlated with the advance of general culture, a question which, wherever philosophic truth lies, is of great intrinsic importance. This does not affect the right of those who hold to some system as the ideal and the truth to make it the basis of another series of comparisons, and how far the two schemes of comparison would coincide or diverge is a question which for them is of high interest.

The Special Problems of Comparative Ethics.—Thus, whatever our attitude to the final problems of philosophic ethics, we seem to have something to learn from the comparative method. Let us try to state our objective in general terms. We are confronted with divergencies relatively slight as between individuals of the same society, but often very material when we compare one society with another, one class with another, one epoch or one culture with another. Comparative ethics may be said to have taken its rise from the recognition of these differences, and to consist essentially in the endeavour to interpret them. The first question which it raises may be put in this way: (1) Is there behind the specific differences some generic principle common to human societies; (2) if so, are we to think of the differences simply as phases in the development of the common principle or are they due in whole or in part to other factors in social life, economic for example, or religious or intellectual? Some of these appear from the outset to be much more closely bound up with the ethical than others, and it is (3) for comparative investigation to examine the different modes and degrees of correlation and so determine the place of the ethical factor in the cultural history of mankind. In so doing it will have (4) to consider whether a real ethical development is discoverable, and if so how it is related to other developments in society. To the question how far this last point necessitates a philosophic analysis we will not add anything to what has been said above. It is on any view clear that comparative investigation is essential to any theory of development.

Moral Elements Common to All Known Societies.—(1) On the first question comparative investigation has reached some definite results. It shows that as far as our records go the acceptance of some code of conduct is co-extensive with humanity. It has often been questioned whether every society has its religion, but if a very wide induction has any validity it is certain that every society has its code. If exceptions are to be found at all they are not in what appear as the most "primitive" societies but in cases of decadence, where the long-established code of one culture is broken and not replaced by the irruption of another. Everywhere in stable society there is a code which bids men do this and not do that. The codes differ a good deal and the reasons rendered for them are sometimes obscure or to modern minds absurd. Among the simplest peoples the moral and the customary, the legal, the magical, the religious, are barely, if at all, distinguished, but there are customs or laws, oral or written, prescribing or forbidding definite classes of action, upheld by the impartial onlooker and the general judgment of society, which visits a breach with reprobation if not with specific penalty. These are the essential elements of a working moral code and have to be recognized as such, even if some parts of the code are condemned as defective or, as judged by some other standards, immoral.

This is not all. If we run the gamut of culture from the highest to the lowest, we shall find that the codes cover the principal relations of social life. They deal with person and property and specifically with sex, imposing restraints on behaviour which from our point of view may be just or unjust, but which are certainly working rules. These rules rest on, and in turn support, a certain community of life, extending beyond the simple family of parents and young children, where natural feeling might be a sufficient guide. It is true that the moral purview is often seriously limited and that behind it and sometimes even within it economic or political forces or perversities of religious or magical ideas may work havoc with human relations, but such failings do not prevent the code from being effective in its own way and on its own conditions. In particular, it is highly effective among the simplest peoples that we know. We do not within the field of comparative ethics find a people without a working code, and if we are dealing with an evolution, it is within this field not an evolution of morals out of something else but an evolution within morals of clearer, more comprehensive or more powerful principles, which are better fitted to cope with the problems multiplied and intensified by the complex and many-sided developments of human activity.

The Moral as an Aspect of the Rational Development.—This generalization must not be taken for more than it is worth. It does not apply beyond the field of our observation. We know nothing of the social organization or ethics of really primitive men, *a fortiori* nothing of the intermediate forms of life which must have intervened, if we accept the evolution hypothesis, between man and beast. We confine ourselves rigidly to the statement that comparative ethics knows of no pre-moral stage. But if we go beyond comparative ethics to the behaviour of the higher animals and combine the study of institutions with that of psychology we shall discover a perfectly feasible line of advance. On the one hand the simplest societies that we know consist of small groups of families related by the combined links of descent and intermarriage. On the other hand the higher animals give evidence of strong parental attachment and in many cases of herd sympathies as well. Fundamentally their instincts are as much race-preservative as self-preservative in function. If man evolved from an animal, the central psychological change which came about was that, as cause and effect of language and social intercourse, he acquired the rational power of relating the instincts and emotions of the moment to general and permanent needs, could see the past and future in the present, and so transmute the impulses of sex and parenthood into a permanent family tie and the pack instincts into a code of mutual loyalty and co-operation. Morality is essentially the rationalization[1] of primary impulse-feelings, and we find the codes of the simplest peoples to be just such as would be achieved by the rationalization of simple impulse-feelings by a simple intelligence. We do not witness the birth, still less the prenatal history of morals, but what we find is what we should expect as the product of the known causes in operation.[2] In becoming rational, man became moral.

Intimate Relation of Moral and Religious Development.—(2) and (3) So far the generic principle. What of the variations? The social code, always embodying a certain morality, is deeply influenced by religious, economic, political and even environmental factors. As to religion, the attitude that men assume to the agencies controlling human life, its relation to morals, is so close as at times to approach identity. The divine is at certain phases almost an incarnation of the moral law. In other phases the relation is not so close. In some of the lower cultures the spirits recognized are non-moral. In higher phases again morality is often critical of religion, and claims for itself the ultimate sovereignty in the world of conduct. All through there is a possible ground of difference in that morality is essentially concerned with the ordering of human life, religion with the ordering of the universe in which human life is included, and though in the remoteness of final truth the part must harmonize with the whole, in the partial truth that men attain this harmony is yet imperfectly understood and historically the two orders have certainly not always been in sympathy. Men's notions of religion, as above defined, depend not on their moral standing alone but on any or all of their intellectual attainments. For beliefs about the governance of the world seriously affect the view of what is necessary to personal and social well-being, and therewith the moral order. Intellectual advance makes in the end for truth, but may import fresh errors on its way. A tribal god, for example, represents a certain advance in definiteness of conception and even a moral advance in the direction of social unity, yet he may be a Moloch. Human sacrifice is not found in the simplest societies, but rests on conceptions representing a certain advance. It must be subjoined that a scientific conception of the universe may become, as in our own time, a basis of resistance to the developed social conscience, and serve as a justification for unrestricted selfishness. In sum, neither religion nor philosophy is identical with morals and may be in conflict with them.

Influence of Economic and Political Developments.—The political and economic situations of a people again are intimately related to its social code. We may believe that there is a moral principle in the individual, but we cannot fail to realize that the applications of a principle, the working shape that it assumes, are taken by the average man from the society in which he finds himself, and taken without criticism. He distinguishes right and wrong, but what is right he learns, as he grows up, from his teachers and companions. The right for him is what he comes to expect and what he knows will be expected of him. That means that it will be defined by the relations of men in the society to which he belongs and these relations are determined by a complex of political and, more pervasively, of economic relations, and in both of these the physical environment, taken in conjunction with the available skill in dealing with it, is a serious factor. These influences condition the relations of men, shape and reshape them, and the customary system of any period, though it may resist changes, is in the main overborne by the constant pressure of needs. The actual institutions of a society are the results of an adjustment of human relations to the needs of life, and a solution, good or bad, of the problem of living

[1]The word is used in its legitimate sense, in which it means the explicit, consistent, generalized expression of an antecedent impulse, not in the spurious sense now popular in which it means the sophistical justification of an impulse by something plausible but extraneous.

[2]The rise of fundamentally new impulse-feelings is not excluded at any stage, but we should not postulate them so long as we can explain the phenomena by combinations or modifications of elements already known. If any quite new instinct or quasi-instinct arose in the early evolution of man, it was probably of the nature of some restraint on the sex impulse and especially connected with aversion to intercourse between the nearest kin. The controversies that arise on this point cannot be entered into here.

together under given conditions. In higher stages of culture men begin to pose this problem consciously and seek to remedy faults in the existing scheme of solution, or to resist changes making for its deterioration. But in the main social change proceeds on its unreflective course, and in so doing governs rather than obeys the moral conscience. In fact, both political and economic developments involve differentiations and divisions, often gravely affecting the code of moral obligations.

General Character of Ethical Development.—(4) In the end, however, the moral principle reasserts itself by an enlargement of the common good and a fuller insistence on primary rights and duties. Superficially the order which emerges out of a conflict may resemble that which has never been assailed, but in spirit it is quite otherwise. The conflict here in question is not one in which we expect to find a decisive victory for good and all, for the development of human life on all sides goes forward, and every fresh step brings new occasions of discord. To balance such opposites, to select the good in each, to purge the contradictions, refine the crudities and mould the divergencies into a wider harmony, is the standing problem of social ethics, and its solution, with the clarification of moral ideas, the widening of sympathies and the fuller appreciation of human purpose which it involves, is what is meant by ethical development.

Ethics of the Simplest Cultural Stages Known.—Any attempt to sketch this development, even in the roughest outline, encounters great difficulties. The available material, though voluminous, is patchy. Of the civilized peoples we have partial (on the side which interests us, very partial) histories, and their beginnings are lost in antiquity. For the lower cultural stages the only evidence of any great value is derived from the study of contemporary or quite recent peoples. Here materials for history run very short and end in abysses of conjecture. Essentially we are not tracing continuous development, but comparing cultures, reached often on divergent lines, subjected to ubiquitous cross-currents of culture-contact, whereby the products of higher and lower stages come to jostle one another in the same people. Even the most untouched primitives have their long history behind them, a history which has brought some of them to the pinnacle of their own special arts and has given ample time for the adjustment of their institutions to their mode of life. Difficulties and complications of this kind must be borne in mind when we start, as, after all, we must, with peoples as we find them in their various cultures as they stand. We begin then with the lowest grades known, where food is gained from day to day by gathering vegetable products and hunting, or, more rarely, fishing, a state in which we find a large number of peoples now slowly or swiftly passing to extinction under the influence of civilization. There is the great group of Australian aboriginals, and there is a number of scattered peoples in the Malay Peninsula and Archipelago with a few representatives among the most primitive of the Indian hill tribes, in the Andaman and Philippine Islands, in the Central African Forest (Pygmies), in the Kalahari desert (remnants of the Bushmen) and in South America (Botocudos and Fuegians). If we omit the Australian aboriginals, the remainder, in spite of their very wide diffusion, present such remarkable similarities that they have been thought to be the scattered remnants of a race once spread over the whole world. But the suggestion cannot be sustained. If there were an original unity the world over it was a unity not of race—unless in a sense too vague to be of any value—but of culture. Our concern, however, is with their actual culture which presents variations indeed, but variations within a striking identity. They live in little groups of anything from a couple of dozen to five or six score of men, women and children (larger numbers probably represent in the main temporary combinations), generally with a leading man whose powers are what he makes of them, and they hunt and gather in a territory of known boundaries, which is either peculiar to each little group or perhaps common to a number of friendly groups. Unauthorized trespass on this territory is resented, often to the death, and that is the cause of feud with the white man who was unable to grasp that the land was group property. The family is by preponderant practice but rarely by rigid rule monogamous, and the wife has a position which varies but is often one approaching equality and in general better than that which obtains among the cultivating or pastoral peoples. Marriage is stable after the birth of children and sometimes it would seem virtually indissoluble (Vedda, perhaps Andamanese), but conjugal fidelity is not always rated high (Ituri Pygmies). Parental and filial love are strongly marked and the old and weak are cared for unless in times of distress (Bushmen). By practice if not by rule the little groups freely intermarry and courtship is free, subject to varying degrees of parental influence. There is private property in such things as weapons, tools and the hut, and the wife has her own. There is even a queer form of private ownership of trees, wild honey and the like which turns up in oddly coincident forms in very remote regions. Whether this points to identity of origin is doubtful, but an odd thing about it is that it amounts to very little, for not only is the land common to the group, but its produce, the food, is almost always shared and no member of the group who is present goes without.

Peace and Order.—With regard to peace and order we must discriminate. The Semang are peaceable, and in one of their tribes, the Djahai, both murder and theft are said to be unknown. The Punans of Borneo are said not to fight one another unless egged on by stronger tribes. The wild Kubu have never known war. On the other hand, feuds between groups were common among the Andamanese, and blood revenge is said by a good authority to be the basis of the Bushman's code. The Central African Pygmies are renowned fighters under negro leaders, but among those untouched by outer influences feuds between groups seem to be unknown, and the occasions for private vengeance very rare. Some Fuegians fought over trespass, and so, may be, did the extinct Tasmanians. The Philippine Negritos, now very peaceable, seem from the Spanish records not only to have fought doughtily against the encroaching Indians and Spaniards, but also on occasion among one another. The Kubus and Punans, innocent of organized war, know private revenge. In general while crime is rare there is no means of redress outside the group except vengeance, and even within the group the evidences of impartial criminal authority are, for the "wild" tribes, very slight. Adultery and trespass were the two main causes of quarrel. To round off the picture we must point out that the little groups were innocent of slavery, cannibalism (one exception), human sacrifice, prostitution, polyandry (with rare exceptions), large scale polygamy, infanticide (with a few exceptions, *e.g.*, the Bushmen and perhaps the Fuegians) and degradation of women—in fact of the vices which we have been taught to associate with savagery and which are in fact realized among peoples of more advanced material culture. The picture is one of human society with the barest minimum of organization, accumulation and differentiation, and if it only presented the rudiments of cleanliness as well as godliness it would be far from unpleasing.

At the lowest it is quite clear that the moral order at this stage is free from the grave defects which soon become apparent as we follow the political and economic advance. To what is this due? Recent missionary investigators lay great stress on the religious factor wherein they find the elements of ethical monotheism, or something nearly amounting thereto. To examine this opinion would be to embark on endless controversy. All that can be said here is that the best evidence is derived from the Semang. Here, and perhaps among the Fuegians and African Pygmies, we find the fear of a power associated with thunder who kills people. Generally he kills for certain offences, mostly of a morally indifferent sort, but including, among some Semang tribes, adultery (and seemingly practices which might give rise to incest), and in one case murder. If this is a beginning of ethical monotheism it is certainly rudimentary enough, but if it should turn out to be in fact a part of the original Semang tradition we must admit a root of ethical monotheism not previously ascertained.

The Australian Aboriginals.—The other great group of gatherers and hunters, the Australian aboriginals, present a less amiable picture. In important respects the social structure is similar to that described, but there is a complex of marriage prohibitions which has never been satisfactorily explained, but at any rate serves to keep different groups connected by ties of affinity. The position of women is in general less favourable and polygamy is more common. It would seem, however, that the alleged group marriage is rather a logical construction of the investigator than an actual institution. Infanticide is known and so is cannibalism. The idea of blood vengeance underlies the whole juridical system because deaths are imputed to witchcraft and, though peaceful relations are in general maintained between neighbours, it is by an elaborate institution of regulated combats and ordeals in which every effort is made to avoid serious bloodshed. The fear of the feud, however, is always in the background and the reality is far from being unknown. Bloodshed is certainly on a very small scale, but it is to be remembered that we are dealing with groups which can afford to lose very few members. There was no general state of war, but neither was there a state of secure justice and peace.

Advancing Culture and Social Differentiation.—As we ascend from the gatherers to the higher hunters (a few of whom, more properly fishermen, are of relatively advanced culture) and to the lowest and thence to the more advanced agriculturists, or alternatively to the lower and higher pastoral cultures, the organization of society grows. The tribe, originally a barely definable unity, acquires a government and perhaps incorporates other tribes and becomes a little state. Within it the family enlarges into the kindred group which gives organized protection to its members but, as a consequence, often threatens to dissolve society in blood feuds. However, these are brought into some order by the mechanism of composition for crimes, and, as we move towards the upper end of the scale, we more frequently find a government assuming responsibility for the protection of its subjects and controlling or even suppressing vengeance. On the other hand, fighting takes a more organized shape and, by the side of feuds or in place of them, we get real wars which require at first an occasional, but later on a standing, military organization and in which the treatment of the vanquished is often severe. The captive women become inferior wives or concubines, reinforcing the tendency to polygamy; the men may be "adopted" or killed, but with the development of agriculture they become useful as slaves and raids are even organized to obtain them. Cannibalism is not rare, though less common than has been popularly supposed, and human sacrifice is prompted by magicoanimistic conceptions of the effect of blood upon fertility. The chief's power is increased and by his side appears a nobility or upper caste to whom in many cases the ownership of land is restricted. Apart from the institution of slavery we more and more frequently meet with a differentiation of ranks and the contrast of wealth and poverty sets in. Religion, mainly animistic, although admitting of some greater gods, has little to say to morals, and the taboos which protect property and the automatic retribution of the broken oath or the beggar's curse have more of magic in them than of religion. Politically society is organized more efficiently and on a larger scale, but at a cost which, when we compare the resulting order with that of the simplest peoples, seems excessive. On the whole we must admit a moral decadence if we take the series of cultures as successive in time. The truth seems to be that among the gatherers and hunters the lack of all differentiation, the utter absence of ambition, of desire to accumulate and to improve the position of the people, removes the most potent causes of strife and prevents the emergence of anything in the nature of oppression. The wholesale cannibalism and human sacrifice of relatively high cultures could not arise unless there were a helpless population with whom the stronger could deal at his will. Polygamy from first to last seems in the main a matter of wealth and social position. It is not easily tolerated among equals, particularly where women are so few that, if one man has two wives, another must have none. In brief, the early moral code can deal not amiss with uniformity and lack of effort. It is quite unable to cope with the inequalities, the ambitions and fears which are the product of energy of movement.

The Early Civilizations.—In turning from the uncivilized world, best known to us from contemporary or recent evidence, to the peoples who have a recorded history, we have to hark back some 5,000 years or more in time. The character of our evidence changes. We have written codes of law, sacred books, ethical and philosophical treatises. We have large stretches of continuous history in distinct countries and can trace development or deterioration in time and read the narrative of the impacts of culture upon culture. What we call civilization carries the organization of life, of which we have seen the beginnings in barbarism, to a higher pitch. Industry, including improved agriculture, makes the position of man in relation to nature relatively secure, renders the systematic cultivation of arts and sciences a possibility for the more prosperous classes and admits the growth of population and the formation of dense aggregates at trading, political, religious or military centres. States are organized at first, it would seem, on the relatively small scale of the Egyptian Nome, the Sumerian city state, and, perhaps, the early Indian tribal republics, and their tendencies to internecine warfare are apt to end in larger consolidations under the more successful centres which, in their turn, establish vast but insecure empires over peoples of different race and culture. But throughout the earlier part of this history, indeed through the greater part of Oriental history, the stability of civilization seems due rather to the persistence of the archaic organizations of the patriarchal family, the clan and the village, than to the kingdoms or great empires superimposed upon others. The village husbandman goes on with his work—"agricola incurvo terram dimovit aratro"—brings up his children and grandchildren and follows the cult of his ancestors and household gods while empires rise and fall around him, knowing the central power in the person of the tax-gatherer or the corruptible magistrate to whose court, even if wronged, he obstinately prefers the decision of the family council or the village elders. It is not our business to deal with cultural or political history, and, even if we were to confine ourselves to those laws and institutions which are of special interest to ethics, we should find too many differences of detail and too many points of doubt and obscurity to justify summary treatment. So far as the earlier Oriental history is concerned we must confine our attention to a few salient points.

(1) The union of peoples with divergent customs required a codification of law, which is now no longer the spontaneous product, universally accepted, of a homogeneous group, but relies on kingly powers for enforcement. The earliest code that has come down to us is that of Hammurabi, dating from about the close of the third millennium before Christ. Ethically it contains much that is barbaric in the way of retaliation and vicarious punishment, but it contemplates organized courts of justice with rules of procedure and provision for documentary evidence. It protects the debt-slave and limits his servitude to three years, regulates divorce and recognizes a concubine by the side of the fully legitimate wife (more than one such wife being admissible, it would seem, only in some exceptional circumstances). Unfortunately we have no such code of Egyptian law, and we have no evidence of self-help or retaliation as recognized customs, but find organized justice in being in the earliest dynasties. The position of women is known to have been good in many ways, both in Egypt and Babylonia (in the former country in particular it surprised the Greek travellers), but it would seem that the Egyptian bride had to protect herself against the introduction of other wives by a clause in the marriage contract, and the contracts we have are of a late period. Slavery existed both in Egypt and in Babylonia, but it would seem that the majority of the cultivators were personally free, though subject to arbitrary treatment by king, feudal noble and tax-gatherer. Slaves were obtained in large numbers for great works by successful wars or simple slave raids. Prisoners were also sacrificed in Egypt, though neither under the Pharaohs nor under any of the rulers of Sumer and Akkad do we meet with the exaggerations of wholesale barbarity which were the boast of the Assyrian kings.

Early Ethical Documents.—(2) Ethically interesting documents come down to us from both Egypt and Babylonia—from the latter a series of incantation tablets, giving long lists of sins which might involve men in the meshes of demons or witches. The "sins" are partly ceremonial but many belong to the class of offences condemned by commonplace morals, the most interesting ethical feature being that their consequences could be avoided by such magical means as burning them away. With these tablets we may compare the two famous "negative confessions" in the *Book of the Dead,* a list which again is commonplace when not utterly obscure, the interest lying once more in the fact that a formal repudiation, an address to the god specially cognizant of each sin, and a claim of power based on knowledge of the right names of the deities concerned, are the requisites of safety in the trial to which the deceased is subjected. It is here, however, that, primitive as the procedure of the court may be, we have far the earliest systematic exposition of a trial of the dead, and as to the substance of the proper life, it is worth noting that the repudiations end with a claim of merit. "I have given bread to the hungry, and water to the thirsty, and apparel to the naked, and a boat to the shipwrecked mariner." With this assertion of beneficence we must compare the repeated boasts of feeding the hungry, considerate treatment of widows and so forth, on tombs of the Old and Middle Kingdoms.

(3) We have also from Egypt the first moral treatises, such as the precepts of Ptah-Hotep dating from the Middle Kingdom. Their mild platitudes recommend a certain moderation in life, submission to authority and restraint in dealing with inferiors, but on the whole constitute an extremely dull prologue to the later wisdom literature of the Hebrews. There is, however, a real fire in "The Peasant's Complaint" (also Middle Kingdom) which is a sustained invective against the law's delays and the magistrate's neglect.

(4) In the cult of Osiris and the judgment of the dead, Egyptian religion seems to be feeling its way to some relation to ethics. During the 2nd millennium B.C. its own structure began to be criticised. The multiplication of gods had gone too far and the well known attempt at solar monolatry by Akhenaton represented one form of reaction. It does not however appear that the new monolatry had any special interest in ethics and the attempt to establish it was defeated once and for all. The other line of criticism was more subtle and successful, consisting in a mystical identification of the many gods as names, forms or manifestations of one and the same spiritual principle. This tendency is frequently present in religious writings of the new kingdom and may be taken as the best expression of religious thought in Egypt. Whether it was the starting point of the ethico-religious development in Asia from the Jordan to the Hoangho from about the 8th or 9th century onwards there is no evidence to decide.

Ethico-religious Thought in India.—In any case it would appear probable that there were connecting links between movements which took their rise during this period in India, China, Iran and Palestine and finally in Ionia. It is true that they are spread over some centuries, but 200 or 300 years are but a small fraction of the long history of civilization. It is equally true that there is little surface resemblance between the mysticism of the Upanishads, the hard outlines of Zoroastrian dualism, the practicality of Confucius, the ethical monotheism of the prophets and the philosophy of the Greeks. But there is a deeper and far more impressive identity in the stir of thought, and thought about ultimate questions and their bearing on the life of man, which is apparent in them all. Things were said and written in this period which are still of interest; questions were raised which are still unanswered; foundations were laid on which we are still building. It is the real birth-time of thought and it cannot be by mere coincidence that the germination took place at no distant periods in very distant places. Possibly the real beginnings were in India, but in the obscurity of all questions of date it is impossible to speak with certainty. Recent criticism refuses any very high antiquity to the "Vedic Age" and seems to bring the compilation of the Upanishads to within 200 years of the birth of Buddha. Some beginnings of speculation are, however, to be found in the Vedas themselves and are the more striking because they express for the first recorded time man's sense of utter helplessness in the presence of the problem of origins. "Death was not there, nor immortality; there was no distinction of day and night. That One breathed, calmly, self-supported, there was nothing different from or above it . . . from what this creation arose and whether anyone made it or not—he who in the highest heaven is its ruler, he verily knows, or even he does not know." Contrasting such language with that of an ordinary Vedic hymn to Indra we feel that we have passed into a different world—a world in which men are beginning to think and experience for the first time what it is to seek a solution and find none.

The hymn quoted is no unfitting prelude to the constructive efforts put together in the Upanishads where the central conception is that the Reality at the base of all experience is spiritual—smaller than the kernel of a canary seed, but greater than the earth and the sky, greater than all these worlds. This spirit is "the self within my heart," who, though myself, is yet so hard for me to find that I must go through austerities, make sacrifices and, above all, study the law and the truth in order to arrive at that inner knowledge. Ethically the important feature is the conception of life upon two planes, the lower one of the workaday world and the higher reserved for the ascetic and recluse and revealing his union with the spiritual principle of all reality. The system is (in its most orthodox expression) metaphysically monistic and ethically dualistic, and the conflict or adjustment of these divergencies may be said to have dominated all later Indian thought and to have deeply influenced the thought of the West. One line of development may be briefly indicated as of ethical importance. The monistic principle pressed far enough reduced the whole world of ordinary life to an illusion and along with it all plurality, including the distinction of self and self. In reaction from this the Sankhya system, without leaving its anchorage in Vedic orthodoxy, asserted the reality and the permanence, *i.e.,* the immortality, of the personal self. This doctrine could take concrete shape by allying itself with aboriginal non-Vedic notions of transmigration. The self lived before this birth and would live after death in one or other of the transitory forms which did not affect its eternal being. Nevertheless the manner of its life in each incarnation left its effect, the Karma, which determined the subsequent incarnations in such sort that ultimately, though it would seem with no regularity of succession, one paid for one's sins by a lower and was paid for one's virtues by a higher incarnation. This doctrine could be used to justify the slowly germinating distinctions of caste which arose from the union of a multiplicity of tribes, many of low culture, under the conquering Aryan and became by degrees the dominating fact in the Hindu social system. Practically and legally the caste system maintained and fostered divisions and distinctions incompatible with moral unity, but in theory it gave concrete expression to the original principle that life in the highest and lowest is fundamentally one. He who is now a Brahman and godlike, if not actually a god, may have been and may yet be again a pariah, and for that matter an insect. When this conception is pressed as in Jainism all life becomes sacred. The doctrine of Ahimsa, or harmlessness to all that lives, takes the centre of the ethical stage and in milder forms is to influence all subsequent ethics in India.

Buddhism.—But metaphysical discussion rotating endlessly round the same insoluble questions is sure to germinate not only new dogmas but simple scepticism as to ultimate truth. Men who are not content with negative results then fall back on the experience of life and its actualities of happiness and misery. This was the track leading to the Buddhistic system in which in its original form the permanence or substantiality of things was declared to be beyond the reach of our knowledge. All that we know is transitory. Not even our self or our soul is substantial. But life is suffering, and we can in our experience trace the root of suffering, which is desire. Moreover we can extirpate desire not by the violent reaction to extreme austerity but just by abandoning every selfish impulse, which we can learn to do by cultivating restraint of conduct and the higher thought which expresses itself in love and compassion for all that lives. What then of future existence and the doctrine of transmigration? This was too deeply ingrained to be set aside, but an accommodation was reached by regarding Karma not as itself a quasi-substance ingrained upon a substantial soul, but as a mode of causality whereby the doings of one life are carried over into another. The manner of this transference was left wholly unexplained, but one thing was insisted on, that the working of Karma was maintained entirely by desire. Cut this root and the Karma would die. Its Nirvana or total extinction was open to anyone who would tread the noble eightfold path of the Buddha to the end, which would involve cutting himself off from household cares and living not with austerities but with restraint, as a mendicant monk.

Religion in this form is little more or less than ethics. It propounds a life to be led and a salvation to be won therein. This life is that of a higher plane, only attainable by resolutely abandoning the ordinary level of human interests, and it offers no reward except the surcease of unrestful passions and accompanying remorse. It is not obedience to religion, it is religion itself; not a consequence of dogma, but an interpretation of experience; very negative in regard to practical aims, it yet has its positive side in the universalism which would recognize no real distinction of Brahman and non-Brahman, and which fitted it for its place as the oldest of the world religions. But the delicate poise between practicality and mysticism could not be maintained. Buddhism had its day when Magadha united the bulk of the peninsula in one empire and King Asoka set up the pillars intended to educate his people in the mild rules of his faith; but stronger and ruder forces broke upon it, driving it from the land of its birth, and from within transforming it into a theistic system with the founder as a god and reincarnation restored as the centre of belief. In this evolution we cannot attempt to follow it here.

Taoism.—A more prosaic but more practical ethics had its origin in China almost contemporaneously with the teaching of Buddha. Confucius defined his position in the first place in opposition to animistic conceptions and secondarily in opposition to the mysticism of the Tao. Taoism had its roots rather in magic than religion and has tended always to return to the pit from which it was digged. Its traditional founder, Laotse, formerly described as an older contemporary of Confucius and criticized by name in the Confucian records, is now thought of as half legendary and of quite uncertain date. We cannot therefore speak with any certainty of the affiliations between the remarkable Quietism developed in the Taoist schools and the doctrines of universalism, restraint of self and harmlessness that we have seen in India. "The sage governs by ridding the heart of its desires" is the very essence of Buddhism. "The soft and the weak overcome the hard and the strong" goes a little farther. On the other hand the parallel is close between "I would return good for good. I would also return good for evil," which we read in *The Simple Way,* and "Let a man overcome anger by kindness, evil by good," which is a verse from a Buddhist Sutta. It is a pity that such phrases should have degenerated into platitudes, for as a fact they express an exceedingly subtle law of moral causation which needs the cool scientific explanation and definition which it has never received. At best in quite modern times the underlying truth has been approached from different sides in the appreciation of the value of error to truth, of the stability of unions founded on freedom, and of the backstroke of success in war upon the victor.

The Chinese Classics.—Laotse, however, pushed his ideas to an extreme from which the practical sense of Confucius revolted. A Conservative Radical, he stood for the integral Chinese social tradition, in particular for the solidarity of the Patriarchal family, without the supernatural support of the spirit world. The social order was good in itself and the moral life which served it honestly was good in itself and needed no reward. Moral innovations are not sought, so what Confucius has to tell us sounds a little too obvious, but the Golden Rule was no platitude when he first enunciated it, and his later disciples, particularly Mencius, had a good deal of serious criticism to make on the working of political institutions and did much to develop the national dislike of militarism. In any case the autonomy of ethics, its emancipation from theology and from political authority, the conception of a good social order as an end in itself and of its service as inherently the best life for the individual, are as much Chinese as Greek in their origin, and have had a wider and more continuous influence in China than in the West.

Ethical Teaching of the Prophets.—When we turn from the Far East to the Western World we find it true, when all indirect and secondary influences have been allowed for, that the main sources of European ethics and religion are Hebrew or Greek. During the period that we have been considering, the Hebrew prophets set up a national deity for exclusive worship in opposition to the native polytheism. With this monolatry they came to associate something more important, a humane social code for all Hebrews which they actually succeeded in incarnating in a new code of law, and they finally extended the authority of their God, now conceived as a spiritual being to be worshipped in spirit and truth, from the land of Palestine to the surface of the earth and from the surface of the earth to Heaven and Sheol. We have vague outlines of a supreme god among the simpler peoples. We have seen such a god punishing certain acts, including some in which morality is concerned. We have had no such clear-cut personality controlling a systematized moral law, nor do we find anything approaching it in the cult of Atum, while the Indian philosophy sought spiritual unity in an immanent principle rather than a transcendent personality. In the light of these comparisons the work of the prophets, which is too well known to need detailed illustration, stands out as one of the original contributions of the world and the religious source alike of Christianity and Mohammedanism.

The Development of Ethics in Greece.—On the ethical side however this influence is fairly matched by that of the Greek thinkers who first turned the light of systematic analysis on the passions of men and the rules that bind them. The far-reaching scepticism of knowledge, religion, morals and law which developed in the 5th century was met by a great effort of reconstruction in which a thoroughgoing attempt was made to place the obligations of man as a thinking and social being on the basis of a reasoned system of values. The attempt might suggest too intellectual a view of morals, but especially in the hands of Aristotle other elements in the formation of character obtain full recognition, and the function of reason is seen to lie not in the dictatorial imposition of abstract principles but in the harmonization of the fundamental needs of personal and social life. Man must be in harmony with himself, and the inner harmony, as Plato was the first to show, would express itself in the social harmony of which it might be regarded as both cause and effect. Without a well ordered state man could not obtain the education or the environment in which he could make the most of himself, and without the co-operation of the best men the state could not be well ordered. On the lower levels of human nature there are conflicts of interest between society and the individual, but there is a deeper and more real self whose interests include those of society. Thus the rationality of the moral life lies in its necessity to the harmonious fulfilment of human nature in personal and social relations. Here lies the true rationality of Ethics. Yet there runs throughout this school the sense of a final discrepancy at the highest stage of development. For the ideal of the thinker is to think, and thought is above and in many directions removed from practice. The Guardian having attained philosophy only returns to the care of human affairs from a sense of burdensome obligations. The Aristotelian sage will as far as possible put off his mortality, and the ultimate value to him of practical wisdom and statesmanship is that it sets the speculative reason free. The social life with its duties after all appears rather as a means to ends above society, than as itself the fullest expression of the rational good—and there is a premonition here of the withdrawal of the Stoic from a social order which is no longer free to the inner shell of his own virtue, or even of the saint from a corrupted world to the cell in which he can meditate on heavenly things. But the earlier thinkers, including Aristotle, rested their work on the tradition of free city states in which the good citizen was one who could both rule and be ruled with a view to life at its best. Plato, the revolutionary aristocrat, saw clearly enough that the social harmony which he desired was fatally split by internal divisions. The state of actuality was not one state but two, fatally divided by what we now call class conflict, what was for the Greek the ever threatening shadow of faction which at any time might overwhelm patriotism and open the gates to the enemy. Plato's ideal solution was to sweep away private property and the family life, at least for the ruling class, as the foci of obstruction to the perfect unity in which he saw salvation. As a practical reformer he set out more moderate proposals, but his method was still essentially Utopian, starting with the supposition of a new city to be erected and a free hand for the philosophic statesman in the framing of its institutions. Aristotle, the Conservative moderate, is opposed to the destruction of institutions of long standing which seem to meet deep-seated human needs and fears the excess of unity as a distortion of the real meaning of happiness. He is the founder of comparative politics, but for a moral rationalist he is too ready to find specious reasons for the established fact—slavery for instance—instead of resolutely submitting the traditions of society to the test of reason; and he could so far ignore the changes that were going on before his eyes as to treat the decaying city state as the last word of political development.

The Stoics.—The need for a broader basis was in fact most clearly conceived by some of those writers contemptuously dismissed as "incomplete Socratics." The cosmopolitanism of the Cynics bore fruit in the generation which followed the establishment and witnessed the wars of the military monarchies, in the Stoic school, whose teaching has had a wider influence on law and government than that of the much greater philosophers who preceded them. For Stoicism the true community was neither the city state nor any actual political organization to which a man is subject, but nothing short of the entire cosmic system ordered by the universal reason, as his own life is or should be ordered by his private reason, whereby he shares in the universal. How, if all things are so governed, evil and error arise is no easier for the Stoic to explain than for others who place perfect wisdom and goodness in the seat of final authority. But however explained it was the fact, and man has to steer a course disturbed by his own passions in a world often awry from the same cause. He has however two fixed points to guide him. The first and foremost is that he must keep himself erect. This he can do by following the inner light of his own rationality and as long as he does so it is fundamentally well with him, though he perish on the rack. But this implies consistent disregard of outward circumstances, and among outward circumstances he must include other persons —even his father, wife or child. To say that neither their misfortunes nor their death nor their disgrace can affect the inner citadel of his being so long as he has done his best for them would be to reduce the Stoic Wise Man to a cold-hearted prig, but logical consequences often produce caricatures, and the sensible Stoic would confine himself to maintaining that whatever you have to bear you save yourself from the worst by bearing it well—*non quid feras interest, sed quemadmodum feras.* But how does this heightened claim of personality square with social obligations? This brings us to the second point, the law of nature, proceeding from the cosmic reason which the private reason will recognize. This law is above positive law, which may depart from it. Thus by the law of nature all men are equal, while the laws of the State may countenance slavery. The duty of the Stoic as lawyer or ruler is to bring the law of the State into harmony with the law of nature, and the influence of the Stoic jurisprudence on the imperial legislation in this regard bore fruit not unworthy of Stoic pretensions. We saw the first-fruits of ethical religion in Deuteronomy. Here we find those of an ethical theory which has become a religion, but was soon to be overshadowed by a religion of a different order.

Ethics in the Mediaeval Church.—Much of Greek philosophy, ethical as well as metaphysical, was embodied in the fabric of Christian doctrine, but the core is, as in Buddhism, a life rather than a theory of the universe. This life resembles that of original Buddhism in its selfless unworldliness, but adds to it a fuller sense of personality and a more optimistic outlook. Its ideal is not confined to the extinction of selfishness, but includes the unimpeded fellowship with God and man for which the way is thus prepared. It is not a code, still less a theology. One would have said that it must be killed by organization but for the historic fact that it has endured to re-inspire successive impulses of revival. However, Christianity like Buddhism was from the first propagandist and like all successful propaganda had to make its terms with the world, becoming thereby an elaborate theology and a widespread organization, which soon lost its democratic elements and became a vast hierarchy. Finally converting the State it had to find means of reconciling its ethics with law, government and social life—an adjustment more easily made plausible in form than genuine in spirit. However, there came into being a system undertaking the supreme direction of life on all sides, personal and political, educational and moral, economic, literary, artistic and even sportive, seeking moreover by arduous missionary effort to extend its sway over all mankind. The system was essentially authoritarian; in fact it conceived human nature as steeped in original sin, from which it was to be redeemed only by the blood of Christ acting through the sacraments of the Church. The moral law is not educed from so corrupt a nature by the analysis of its true needs and the rational investigation of the means to their fullest and most harmonious expression. It is imposed on our reluctant being as the divine command interpreted by the divinely appointed authority. Whatever place charity may hold in theory it is faith, unquestioning acceptance and implicit obedience, which will in the fabric of such an ethics constitute the keystone, and, if all men are the sons of God, and brothers accordingly, the line between those within and without the fold will be as deeply marked as in any primitive moral order. To the outsider the supreme duty is to convert him, and to this end strong measures will be justified. Still stronger ones will be in order to save the backslider or punish the perverter of the faithful. Among the faithful it is the sins of the flesh that are the most feared, for their attack is subtle and dangerous even to the godly. The flesh wars against the spirit and its gratification is only saved from polluting us by the Sacrament of Marriage, available only in strict indissoluble monogamy and only so for laymen. The experience of the joys of marriage and parenthood is incompatible with spiritual functions. The degree in which the control of sex takes the centre of the moral stage is in fact a distinguishing mark of the theological as compared with other systems, and seems at bottom to be a part of that repression of the natural man which is the essence of a supernatural law. It is for the same reason that pride is the chief of the deadly sins and that the moral appeal is not to a proper self-respect but to a humble and contrite heart. Indeed, contrition borders upon a virtue. This rigid code none can keep at every point, but for the gravest lapse there is room for repentance in penance done with sincerity of contrition. Such forgiveness meets a genuine human need, but its systematic organization not only brings relief to the stricken heart after the event but can hardly avoid suggesting to the tempted man that if he yields he will be at worst incurring a debt which he can pay off. In fine, the functions of the confessor seem to take upon themselves what is elsewhere left to the stirrings of the individual conscience, and the regularization of confession allows no moral privacy. Finally, worldly well-being for the community as for the individual falls into a very secondary place. It is not necessary to salvation that man should conquer nature or control the conditions of racial development. Neither can any of the truths of science matter greatly, since the one essential truth is known. To expound and defend it is the one great intellectual duty and to have the intelligence necessary to follow the exposition is the measure of the education required for the layman. For the rest it may be better that he should abstain from things which except in the hands of the appointed experts may be dangerous to the faith.

Protestantism and Ethics.—On the ethical side the Reformation acted in the first instance as an astringent. In its opposition to Sacramentalism it brought the ethical to the front and placed each man's salvation ultimately in his own personal relation to God. Its interpretation of Christian duty could be hard and austere. In its insistence on the Mosaic Law as a genuine revelation of God it might overlook the admitted superiority of the New Dispensation. But it was faithful to its lights and unambiguous in its demands on its followers. That it was directly responsible for the withdrawal of moral control from economics has been recently and conclusively shown to be a false charge; but its strength was in the industrial and commercial classes and it gave a certain religious sanction to the industrial virtues. A deeper influence on individuality emerged as it developed, for even against its will it was forced to appeal to the individual conscience, and in the end to set it as a judge above all traditional authority. The exercise of private judgment became not only a right but a duty and, as the social implications of the principle became apparent, was seen to lie at the centre not only of personal religion but of social progress. The central position of liberty which is the characteristic contribution of modern ethics had its birth in the religious struggles of dogmas which long waged war without quarter.

But there was more to come. The literalness of Biblical interpretation led to more than one revival of the Christian life. The doctrine of non-resistance revived in more than one quarter and found persistent and influential expression in Quakerism, which gave the lead to modern ethics in opposition to war, slavery, a barbarously cruel penal system and the irrational subjugation of women. The wider appeal of Methodism and Evangelicalism not only reformed manners but, cultivating the arts of the platform and the press, made an appeal to elementary Christianity the touchstone of political issues and for the first time established an organized body of moral conviction as a driving force in public affairs on a great scale. The moral influence of Christianity was probably never so great as in the 19th century, which was the time of the most serious intellectual attack on its foundations.

Modern Ethical Theory.—For in the meantime a rationalizing movement was gathering strength. The revival of science, which dates back to the contact with the Arabic schools in the 13th and even the 12th and 11th centuries, achieved its first spectacular success with Galileo, and between his time and that of Newton a great "physical synthesis" was established, which set scientific method on the footing from which it could advance upon the series of discoveries that have given its distinctive character to the modern world. Philosophers might ally themselves with theologians in criticizing the mechanistic assumptions on which science relied, but too often they found that the definite results obtained by these methods survived attack and, what was even more, that where error came about science could repair it without loss of temper or damage to its main fabric. It was not till physical science had achieved the final triumph of the later 19th century that it began to doubt its own assumptions and a reconstruction set in, of which the end is not in sight, but which has gone far enough to shake the apparent simplicity and seemingly axiomatic character of mechanistic principles and to justify those who study the world of mind, of ethics, politics, religion and art in pursuing their course without the uneasy belief that their ultimate results can be nothing but superficial appearance, the underlying causes of which must be ultimately traceable to the mechanical interaction of physical particles.

As a fact the application of rational methods to ethics—that is to say the use of critical analysis in the ascertainment of data, defined principles in their elucidation, and the check of experience upon the results—has gone on from the first great days of science. Of its history we can here mention only certain central conceptions which are closely related to ethical development in general. Its beginning may be regarded as a development of the idea of the law of nature which came down from the Stoics and had been preserved in the foundations of the Canon Law. What ground could be found for morals in the nature of man and society? Hobbes thought that men were by nature enemies and that society was an artifice of restraint which they imposed on themselves through mutual fear. Locke, with more reason and with some knowledge of the life of American Indians without organized government, found a social principle in man and a sense of obligation which would bind where no constraint of law existed. The 18th century could find natural rights which organized society might enforce but did not create, and Adam Smith could argue that the system of natural liberty would give us an economy that was more often hampered than improved by collective regulation. That personality has rights which written law does not create and may violate has become an integral part of modern ethics, but the antithesis of nature and society was not a happy basis for their affirmation. Rights are social obligations viewed from one end as duties are social obligations viewed from the other end, and though they are valid whether required by law or not they cannot be laid down as so many independent absolute truths, but must be taken in relation to one another and to the social well-being to which they contribute. The true right is in fact a condition of social well-being, and it is because this is the fact, whether we know it or not, that it has a validity which is independent of enactment or opinion. On the other hand, as a condition of the very complex whole which makes up the common weal, its definition is a much more arduous matter than appeared when we approached it light-heartedly in isolation, and indeed though we may be confident in the direction we are taking we are still seeking and probably shall long seek better and more inclusive definitions of liberty and equality. These drawbacks in the theory of natural rights were clearly seen by Bentham and were among the causes urging him to put forward his conception of the greatest happiness of the greatest number as the ethical and political end. This standard had in his opinion the great advantage of being determinable by experience. We can find out what makes people happy or miserable, and our morals, laws, institutions and executive government should be shaped thereby. Ethically his doctrine performed the service of convincing people first that there is in morals and law an end to be attained, which is what makes them worth having; secondly that this end is concerned with human happiness and misery—the happiness or misery of every single person affected being brought into the account; thirdly, that we may be mistaken as to the things that make for happiness and must submit our judgment in this as in other matters to the test of experience. For these reasons the Benthamite dictum formed a useful theoretic basis for the democratic changes of the Reform period. Its weakness was that in taking happiness as the sum of pleasures minus pains it deserted the real fact, which is, that it lies in qualitative conditions of personal and social life which can be but very imperfectly rendered in any numerical terms. Even the practical difficulties in working democracy come back to the inadequacy of numerical majorities to measure the effective will in a community.

Ethics and Religion in the Modern World.—A remedy was sought by Green in the conception of a common good which was the harmonious realization of personality in the members of the community. In such realization there is happiness and in the thwarting of it misery and failure, so that Bentham's principle was rather to be supplemented than altogether set aside, but it could be seen that instead of reckoning in indefinite millions of individuals extending through generations we must look for the general causes of social development and deterioration, and that what was right would come finally to be recognized as that which would make for the development of humanity, whether by giving larger freedom of scope for the expression of personality or by facilitating mutual aid and collective achievement. The ethical thus takes its place as the governing condition of human development, and to understand it is to have the key to the future of all that man can do to shape his own destiny. The moral impulses arose through heredity in response to vital needs. They were shaped by experience into standards accepted with little criticism and sometimes distorted by the gnarled forms assumed by different societies in response to their environment. By selection of those which are consistent with human needs and the rejection of the inharmonious we can form a feasible conception of the goal of human effort and arrive at a reasoned analysis of that which we have hitherto pursued without fully knowing it, and therefore without clear conceptions either of our true ends or of the ways and means thereto.

In spite of all differences of method and outlook there was a great deal in common between the rationalistic movement in ethics and the applied ethics of the religious movements described above. In fact some of the most severe critics of the speculative basis of Christianity were concerned to uphold the moral validity of the Christian ethics. On both sides the simplest and most universal sentiments and obligations of humanity were put in the place of authority, and a similar humanitarianism was reflected in the dominant literary influences of the 19th century.

Materialistic Cross-currents.—On the other hand there have been cross-currents of no small importance. Historical materialism, which has gained a wide hold in Europe, treats the entire ethico-religious history of man as a secondary result of the economic life of society. The theory of natural selection has been held to justify might as against right, whether as between individuals or nations. A strongly developed strain in the semi-philosophical literature of the last generation from Nietzsche to many contemporary writers makes the self the centre of something approaching worship and is highly disparaging of anything like altruism. The World War and the subsequent political and industrial upheavals have weakened confidence in the social order and relaxed the inhibitions on violent self-assertion. So while much has been done in practical legislation to give effect to the ideals referred to above, the moral basis of these ideals seems to have lost some of its hold upon men. On the other hand the materialist assumptions that lie behind the reaction are themselves shaken, and scepticism has been turned on scientific as well as theological dogma. The way is opened to wider applications of scientific method and a more liberal interpretation of scientific principles, from which humanistic and in particular ethical studies have all to gain. (L. T. Ho.)

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COMPARATIVE NERVOUS SYSTEM. Feeling, thinking, and acting depend upon the nervous system. In man the sense organs, the central nervous organs, and the muscles form a combination by which we feel, think, and act. It is usual to limit the term nervous system to the first two of these three sets of organs. All three, however, are linked together as a unit in performance.

The sense organs, such as the eye and the ear, receive external stimuli, light and sound, and originate nervous messages or impulses that are sent over the appropriate nerves to the brain. In this central organ these impulses awaken the sensations of sight and of hearing and are switched over outgoing nerves to the appropriate muscles whereby a specified act may be performed. Thus if very strong light is thrown on the eye we experience the sensation of great brightness and certain muscles respond in that the eye winks.

Since sense organs are the means of receiving external changes they are commonly called receptors. They include in addition to the eye and the ear, the organs of taste and of smell, of touch and of pain, of cold and of heat, and of a score or more other senses. The central organs, such as the brain, are not only the seat of the sensations, but, like the central office in a telephone system, they switch the impulses to the proper terminals. Hence they are often called adjustors. The terminals of the various animals may be not only muscles but glands, electric organs, luminous organs, colour organs and the like. They are the effective parts of the combination by which a given animal responds to changes about it. Hence they have been called effectors. By the combined working of receptors, adjustors, and effectors all animal behaviour is carried out. It is by means of these three sets of organs that the worm retreats from danger into its burrow, the ant carries food to its hill, the frog jumps for a fly, the bird builds its nest, and man writes a page. In short these are the organs that underlie all animal behaviour.

Many of the acts of the higher animals are carried out with almost invariable uniformity, *e.g.,* the withdrawal of the foot when it is pricked or the watering of the mouth when food is smelled. Such acts are called reflex, for the sensory impulse seems to be turned back to the exterior by the central organ in almost the mechanical way in which light is reflected from a mirror. Other acts, *e.g.,* the crying of a newborn child or the suckling of a young mammal, are more complicated than reflexes and yet are inborn in that they are not learned and need only an appropriate stimulus to start them going. Such acts are called instinctive and rest upon a structural basis preformed in each individual. Finally there is the large body of daily performance acquired by learning and including those plastic activities that, under the influence of memory and other stored experience, are moulded into the acts of everyday life. These range from such simple performances as walking, running, or flying, to the enormously complex operations in the intellectual life of the higher animals including man. Here belong the capacity for memory, for imagination, for voluntary action with its moral implications, and the like. Here too occur those important modifications, which, essentially pathological, lead to abnormal mental conditions and insanity.

When an attempt is made to arrange normal animal activities under the three classes of reflexes, instincts, and higher acts, it is found that they are not always conveniently so placed. Walking is not only learned, but is in part instinctive if not reflex. The so-called reflexes themselves are often open to profound change. Thus the sneeze of a yokel, an almost purely reflex act, can through the social training of the well-bred be brought under control and even completely extinguished. Hence reflexes, instincts, and habits are really not classes of acts in themselves but rather phases of behaviour that qualify almost all performances. In the vertebrates, from fishes to man, the nervous organization includes a large variety of plastic operations which thus favour active habit formation. In the insects and other like creatures, on the contrary, the nervous organization, though including plasticity, leans strongly toward the instinctive side. Bees like men may learn to find their way about and are helped in this by their fellows, but they build their comb and do a thousand other things instinctively and without training. Much of the life of an insect is thus semi-automatic, and in this respect it is in strong contrast with that of a vertebrate, where freedom of action and learning play predominant parts.

The structure of the various types of nervous systems by which the behaviour of the higher animals is carried out shows great individuality, and yet each such type exhibits a certain uniformity in that it is made up of a combination of nerve-cells or neurones. A neurone commonly consists of a cell-body and one or more lengthy processes or nerve-fibres. Ordinarily the cell-bodies mass together and thus establish what are called nerve-centres whereas the nerve-fibres are assembled in the form of nerve tracts by which one centre is put into connection with another. These relations can be easily seen in the nervous system of such an animal as the earthworm.

The nervous system of this creature consists of a small brain in its head from which a long strand of nervous material passes backward along the under side of its body to the tail. In each of the hundred or more segments in the worm this strand enlarges into a nerve-centre from which nerves pass out to the adjacent parts, muscles and skin. In the skin are lodged a large number of nerve-cell bodies whose outer ends reach the external surface of the worm as fine bristle-like terminals and whose inner ends become attenuated into delicate nerve-fibres that make their way as constituents of a nerve to their terminations in the ventral nerve-centre. Each of these peripheral cells with its attached fibre is a neurone and since these neurones are concerned with the reception of stimuli that impinge upon the skin they are called receptor neurones. In the ventral nerve-centre these neurones come into contact with the cell-bodies of a second set of neurones whose nerve-fibres make their way out from the centre to terminate in the worm's muscles. Neurones of this kind, in consequence of their connection with muscles, are known as effector neurones. When the skin of an earthworm is stimulated and the animal responds by muscular movement, receptor and effector neurones are active in carrying out such a simple nervous operation.

Beside these two classes of neurones there is in the nervous system of the earthworm a third class, the internuncial neurones. These are neurones the whole of whose extent lies within the central organs and which serve as a means of uniting one nerve-centre with another. They extend for the most part up and down the length of the central nervous organ.

In worms generally the three types of neurones already described are about equally abundant, but in the crabs, insects and other higher invertebrates the internuncial neurones increase disproportionately till finally in the vertebrates they make up a very large part of the central nervous organs. In these animals the central organs consist of a brain in the head and a spinal cord extending backward through the body. These nervous parts are located on the dorsal aspect of the animal, not on its ventral face as in insects, crabs, and worms. The cord and brain in the vertebrates include receptor and effector neurones as in the invertebrates but these two classes of elements together do not make up more than a few per cent of the central organs, the great bulk of which is composed of internuncial neurones. In fact some of the most important organs in man and the higher vertebrates, such for instance as the cerebral hemispheres, are composed exclusively of this type of neurone.

In all animals from the worms and insects to the higher forms the brain is a conspicuous and very characteristic part of the central system. It is always located at the anterior end of the creature and is the nervous centre with which the chief sense organs of the body are connected. In man and in other higher animals the brain is thus associated with the organs of taste and of smell, with the ears and the eyes. The development of these important receptors and of the brain has progressed hand in hand in an evolutionary way. This progress has involved the change of several of the head sense organs from what may be called surface-receptors to distance-receptors. The nature of these two kinds of receptors may be illustrated by certain human sense organs. We refer our sensations of touch to the spot on the outer surface of the skin where the foreign body impinges. We believe we taste our food where it is in contact with the surface of our tongue. Receptors that are thus concerned with the surfaces of our bodies are called surface-receptors and represent a very primitive type of such organ. There is good reason to assume that all the receptors of an earthworm or other lowly creature are of this type. But in higher animals there is a second kind of receptor. We see the surrounding landscape through the eye but we do not think of seeing it on the sensitive surface of the eye where the image is really formed but in the distant exterior. In a similar way the sound of the noon bell does not seem to be in the ear but comes from the distant clock tower. With such sense organs as the eye and the ear we project the disturbance that excites us to a distant point and think of it as being far away from us and not in contact with our bodies. Hence such sense organs are appropriately called distance-receptors.

In the evolution of sense organs there are ample grounds to believe that distance-receptors have evolved from the relatively more primitive and simpler surface-receptors. Those sense organs in the skin of the earthworm that are concerned with the reception of odours, of light, and of vibrations are without doubt surface-receptors of the kind from which have evolved the distance-receptors of the higher animals.

In the evolutionary changes whereby surface-receptors have been converted into distance-receptors there has gone on hand in hand in the higher animals a corresponding growth of the brain. Thus in a way the transformations undergone by the sense organs have made possible a corresponding transformation of the brain. In this growth, however, the brain has assumed a rôle of its own and has developed peculiar and characteristic functions that have carried it far beyond what is merely needed for increased sensory action. This growth has placed the brain at the apex of nervous development. For the brain of the higher animals and especially of man is not only a most complicated switching station for nerve impulses, but has become a repository of past experiences, and a centre for all those higher nervous activities that make up mental life, and that we regard as most characteristic of our personal selves. In this way the brain has come to serve as the seat of those remarkable performances of memory, volition, imagination and the like that are looked upon as the distinguishing features of the individual man.

As already shown the ordinary nervous activities of the higher animals depend upon the three-fold organization of sense-organ, central organ, and effector. In animals simpler than crabs and worms this degree of nervous organization is greatly reduced or even lacking. In many lowly creatures, especially in jelly-fishes and sea-anemones, the nervous system is represented chiefly by receptors which are often directly connected with the muscles. These receptors are located in the outer skin of the animal but are seldom specialized enough to be easily distinguishable as such. They connect with the muscle below them either immediately or through a delicate nervous net-work. This net-work spreads over much of the animal's body following the distribution of receptors and muscles. It is nowhere sufficiently concentrated to form a central organ and the system may therefore be described as diffuse. It is an arrangement of receptors and effectors without an adjustor.

Since this diffuse system very generally permeates the bodies of these lower animals their parts show remarkable independence of action. Thus the tentacles of a sea-anemone which surround the mouth of the animal and are very effective in the appropriation of its food, will respond to bits of meat with great efficiency even after they have been cut from the animal. The creeping foot of the sea-anemone will continue to creep after the rest of the animal has been cut away. This autonomy of the parts demonstrates the all-sufficiency of the nerve and muscle contained in each particular portion and shows that a given activity is not dependent upon some distantly located central organ. The leg of a crab, an insect, or a frog, if cut off, shows no such powers. It no longer moves as it formerly did because it lacks nervous connection with a central adjustor. The tentacle of the sea-anemone contains within itself the nerve and muscle necessary for its own type of response.

The receptors of the sea-anemone and other such animals serve as delicate triggers to set their muscles in action. As this seems to be their one function they are more appropriately designated receptors than sense organs for they are apparently not concerned with sensations.

Collectively the receptors and underlying nerve-net of these simple creatures constitute a type of nervous system quite distinct from that seen in the higher forms. Not only does such a nervous system lack centralization but its nerve-net has the remarkable property of transmitting nervous impulses in any direction. Its diffuse character is not only structural but also functional. In the centralized nervous system of one of the higher animals it is possible to send a nervous impulse over a succession of neurones from the receptor to the effector side. When the attempt is made to send the impulse in the reverse direction the transfer fails. In the region where one neurone touches the next there is a valve-like device which will allow the impulse to pass in one direction but not in the reverse. No such impediment occurs in nerve-nets where impulses spread with the utmost freedom, and in any direction. It is interesting to observe that although the nerve-net is a type of nervous organization characteristic of the lower animals, it has been retained in part at least in many higher forms. Thus the vertebrate digestive tube has a nervous organization closely resembling that of a sea-anemone, and many details in the movements of the vertebrate digestive organs are repetitions of those found in animals whose nervous systems are wholly of the nerve-net type.

Simple receptors and nerve-nets such as those described apparently mark the first step in the evolution of true nervous organs, for in animals lower in the scale than sea-anemones, *e.g.*, sponges, no nervous structures at all have been identified nor do the activities of these animals suggest such parts. Sponges grow almost plant-like from a submerged base and show scarcely any movements. By means of a system of minute lashes they draw through their bodies a current of water from the floating contents of which they extract their food. Their chief movements are the opening and closing of inlet and outlet pores for this system of water circulation. These movements are accomplished by very simple muscles which apparently act through direct stimulation and without the intervention of nerves. Such muscles since they act of themselves may be designated independent effectors.

In the protozoans, the simplest of all animals, each individual as a rule is a single cell. Within the bodies of some of these forms fibrous systems have been discovered which connect the central part of the cell with locomotor lashes on the exterior. These systems have been regarded by some as nervous in character but it is by no means certain that such is the case.

Apart from these possible traces of nervous origins in the protozoans, true nervous elements appear first in the trigger-like receptors of the sea-anemones and jelly-fishes. Organs of this type were doubtless the forerunners of the true sense organs of the higher animals. To these in the course of time were added central nervous parts, especially the brain, that organ of paramount importance in the life of the higher animals and especially of man.

See C. S. Sherrington, *The Integrative Action of the Nervous System* (1906); C. J. Herrick, *Introduction to Neurology* (1918) and *Brains of Rats and Men* (1926); G. H. Parker, *The Elementary Nervous System* (1919); C. U. A. Kappers and A. B. D. Fortnyn, *Vergleichende Anatomie des Nervensystems* (1920). (G. H. P.)

COMPARATIVE PHYSIOLOGY. Physiology as defined in the medical curriculum of most institutions of higher learning confines its enquiries pre-eminently to man and his nearest allies, focussing attention on those activities of the body which are of special interest to the problems of health and disease and those which can be conveniently studied within a narrow range of animal material. From a practical point of view this preoccupation with clinical objectives has its drawbacks: for medicine has been repeatedly enriched by the more catholic approach which makes no restriction on its materials or problems. This more embracing attitude to the scope of physiological science is referred to by the terms general physiology and comparative physiology. In practice there is no hard and fast distinction between these two terms, though some authors have endeavoured to define one.

Modern comparative physiology represents a *rapprochement* between the teaching of physiology and zoology which is really a return to the practice of an earlier period, when morphology and physiology were not as yet divorced. Many of the zoologists of the earlier half of the 19th century regarded morphology as the handmaid of physiology. To men like Milne-Edwards it is clear that the ultimate problems of the biologist were physiological. With the rising influence of the evolutionary theory the purely architectural approach of the Cuvierian school received a strong impetus. Structural details of little or no significance as aiding an understanding of the properties of living matter came to be cherished for their historical interest as a possible means of throwing light on the ancestry of man and the pageant of life in preceding geological epochs. The 20th century has witnessed a strong reaction against this tendency. This is partly because progress in palaeontology and in the morphology of recent animals has made it clear that the extent of parallel and convergent evolution presents unsurmountable difficulties to the task of constructing a classification of living beings which expresses in all its minutiae their family relationships. It has arisen also through the recognition that the ultimate justification of the evolutionary hypothesis is bound up with the understanding of the machinery of heredity and variation. The awakened interest in experimental problems which has resulted from Mendelian research has exerted its influence over the whole field of zoology, so that morphology is taking second place in current investigation. Morphology, the study of structure as a separate issue, has completed its task. It has placed the principle of geological succession on a firm foundation. It has laid down as far as it is possible, at least for some time to come, those major associations in systematic zoology which can with any legitimate confidence be considered to indicate ancestral relationships. Further than that it cannot progress to any considerable distance except in so far as fresh relics of extinct animals may be unearthed from time to time. Here and there lacunae remain. Certain practical problems in relation to parasitic forms of life justifiably continue to absorb a considerable measure of attention. But there is no likelihood that morphology divorced from physiology will contribute to the building up of another generalization of the magnitude of the evolutionary hypothesis. In short the study of the lower organisms is likely to receive its chief driving force from comparative physiology.

The practical justification for extending the scope of physiological science to the study of the lower animals resides partly in the fact that many phenomena of universal biological significance can be more conveniently studied in species only remotely related to man; partly also because it is sometimes easier to approach the latter with the detachment and objectivity which are essentials of scientific method. Thus, on the one hand, the phenomena of reproduction in its most fundamental aspects and the physical properties of the cell as a physiological unit present almost unsurmountable difficulties in the case of viviparous warm-blooded animals like man and his nearer relatives: but rapid progress can be made in dealing with simpler aquatic forms of life which spawn their reproductive cells into the sea; and such progress suggests methods which may direct fruitful enquiry into the investigation of more difficult material. Again, it is at present impossible to think about human behaviour in purely objective terms; yet considerable progress has been made in the acquisition of predictable knowledge about behaviour in more lowly organisms, and from such enquiries have emerged habits of treatment which are paving the way to a scientific study of behaviour in more complex beings. One might say that the business of the comparative physiologist is to find the right animal for the solution of a particular problem. In no field is the value of the comparative method emphasized in a more striking manner than in the experimental study of inheritance, which, rightly conceived, is an essential compartment of physiological science, though frequently discussed under the separate heading Genetics (*q.v.*). For rapid advance in genetics, it is necessary to deal with organisms that breed prolifically, attain sexual maturity in the least possible time, and present well-defined true-breeding varieties for study. The fruit-fly *Drosophila melanogaster* passes through its life-cycle in a few days, breeding prolifically and has a great number of discrete varieties which breed true to type (*see* CYTOLOGY). It would hardly be an exaggeration to say that more could be found out in a year's research on inheritance in *Drosophila* than in several thousand years of study of human material. Yet many of the generalizations derived from the study of the fruit-fly and other low organisms apply to the problems of inheritance in man himself, though the principles themselves would never have been elucidated if no other forms had been accessible.

Within the limits of space available it is only possible to select a few lines of enquiry in which the comparative method has proved especially illuminating. First and perhaps foremost the physiology of the fertilization and early development of the egg may be mentioned. The reader who is not familiar with the nature of the fertilization process is referred to the article CYTOLOGY. From the physiological standpoint the problem of absorbing interest is the material nature of the stimulus imparted by the sperm to the egg, by which a phase of active cell-division is initiated in the latter, culminating in the production of a new individual. A new epoch dawned in the closing year of the 19th century, when Loeb, perhaps the most distinguished pioneer of the comparative method in physiology, found it possible by means of purely physicochemical stimuli to induce eggs of the sea-urchin to develop in a normal manner without contact with the sperm or male element. By placing the eggs in certain solutions of organic acids and subsequently treating them with concentrated sea-water, the content of which in dissolved material had been raised by adding such substances as sugar or salts, eggs of the sea-urchin can be induced to segment and to grow into larvae, though free of any contamination by sperm. This discovery initiated a large volume of research, the net result of which has been to show that the physical changes produced by these artificial agencies are similar to the internal events that precede active development in normally fertilized eggs: and it has now been possible to produce fertilization by physicochemical means in eggs of species of most groups of cold-blooded animals whose eggs are fertilized externally. Modern work on tissue culture (*q.v.*) encourages the anticipation that this may be achieved in the near future in warm-blooded animals, possibly ultimately in man himself. A fuller exposition of this work would lead into technical issues, but one feature of the development of the sea-urchin's eggs discovered by Loeb is of the utmost interest, namely the immense increase of respiratory activity that accompanies fertilization. Warburg found that the oxidation process was proportional to the iron content of the egg, and that by carefully drying the egg-substance a powder might be prepared that would continue to absorb oxygen and burn up organic compounds, as does the living cell. Not only did he separate the functions of respiration from what would be ordinarily called "living matter," but succeeded in making suspensions of charcoal containing iron capable of facilitating the spontaneous oxidation of organic substances such as occur in animal food, and these physical respiratory models were shown to be affected by various types of reagents which reduce oxygen consumption in the living body in a precisely analogous manner.

In the study of behaviour from the physiological standpoint the progress that has been achieved illustrates in a convincing manner the intellectual discipline to be derived from dealing with animals that can be approached readily without the bias towards the traditional anthropomorphic attitude that is inevitable in dealing with man's nearer relatives. Thus the analysis of behaviour of jelly-fishes and sea-anemones by Romanes, Parker and others, can be discussed without difficulty in terms of the properties of the conducting (nervous) tissues without recourse to terms like memory or will, like or dislike. In the behaviour of the more complex animals notable advance has been made by studying bodily orientation in relation to group stimuli such as light and gravitation. Thanks to the labours of Loeb, Mast and others the old meaningless statement that the moth moves towards the candle because it likes the light, has given place to an understanding of how light stimulating certain parts of the retina discharges nervous impulses to particular groups of muscles whose contraction brings the body into such a position that it must move along the path of the incident rays. The new interpretation makes possible predictions that are actually verifiable, as for instance the fact that, if one eye is blackened, the moth will fly in circles. The application of the comparative method to the study of animal behaviour has been one of the main contributing influences to the development of the modern school of *behaviourist* psychology (*see* PSYCHOLOGY, COMPARATIVE; ANIMAL BEHAVIOUR).

Examples of chemical co-ordination in animal responses are set forth in the article ENDOCRINOLOGY, where the rôle of internal secretion in the developmental processes is also indicated. It can be said that everything of any general significance that is known about the physiology of development has been based on the study of lower forms of life, more especially those which display phases of abrupt development (metamorphosis, *q.v.*), as do sea-urchins, salamanders, etc. (*see* EXPERIMENTAL EMBRYOLOGY). Of recent developments in comparative physiology, one field in which the comparative method has proved invaluable is the physiology of the cell or microscopic units of the animal body (*see* CYTOLOGY: *Experimental Cytology*). The germ cells of marine organisms, worms, starfishes, and the like have provided much of the most favourable material for manipulation in experimentation on isolated cells. The researches of Pantin, Chambers and others on the movements of the Amoeba are worthy of mention in this connection. In the study of nervous co-ordination and muscular activity the most favourable materials have hitherto been found among animals dealt with by the medical physiologist. But considerable attention has been paid of recent years to the mechanism of ciliary activity, bioluminescence, colour change and other forms of response which are specially illustrated by the lower organisms. One field in which significant advance has been made through the researches of Krogh, Barcroft and their co-workers, is in the study of the variety of respiratory pigments which in different groups of the animal kingdom serve, like the haemoglobin or red colouring matter of human blood, as a means of taking up oxygen and transporting it to the tissues.

Though the influence of comparative physiology has largely been manifest in relation to human physiology, it is probable that it has unrealized possibilities of practical application in relation to agriculture, fisheries and other applied sciences. At present the experimental study of breeding is the only branch of comparative physiology which has notably contributed to the solution of commercial problems. Comparative physiology has still to shoulder the task of interpreting the mechanism of animal distribution in terms very different from the teleological assumptions of the evolutionists of the 19th century. (*See* ECOLOGY, ANIMAL; DISTRIBUTION OF ANIMALS.)

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(L. T. H.)

COMPARATIVE PSYCHOLOGY. Comparative sciences generally are concerned with the co-ordination of differences in a common subject matter. Comparative psychology attempts this task in the world of Mind. Now in the expressions of mental activity the range of difference is enormous, extending from very low phases of animal life to the highest achievements of civilized culture, and all these differences must be regarded as significant for the student of Mind and its function in the world of life. Are we then to infer that they all belong to the field of comparative psychology? A critic will object that this would be to create an impossible science. The study of culture, for instance, is sociological or historical. It requires quite different methods from those of the study of an ape or a beetle or a decerebrated frog. We must in mere mercy to our student put a limit. Shall we then say that the concern of psychology is with faculty rather than performance? The difficulty here is that in the last resort faculty can only be measured by performance. Thus a popular explanation of the immense divergencies of human culture refers them to what is known as racial psychology, *i.e.,* to supposed inherent differences in the faculties of different races. Psychology can only test this supposition by calling in the aid of sociology to determine how much difference can be effected by the cumulative effect of social inheritance, operating on a common groundwork of capacity. But it cannot wash its hands of the problem. Whether through some extension of innate faculty or through the social causes suggested, the actual achievements of thought are indutiably greater in the civilized than in the uncivilized world, and the function of Mind in the direction of life proportionately enlarged. The significance of mental development would be missed if these chapters in its story were cut out.

Nevertheless, the student, forced to economize his energies, must limit his field. He may hope to become an expert in one method, but not in a dozen, so he chooses one for his speciality. Unfortunately the demands of specialization are progressive. He might choose, say, animal psychology as his field, but there is still an immense difference between the study of chimpanzees and that of starfish, an immense difference between the methods of a physiological laboratory, which may be applied to any animal and to man himself, and those of the systematized observation of the normal animal. Cruelty barred, all methods are legitimate, but it is a familiar fact that he who follows one exclusively will tend to take that one alone as the universal solvent. Now it is precisely the business of the comparative psychologist to accept evidence from all quarters and all methods, and try to piece them together into a coherent whole. We cannot then make any such division as would destroy the unity of the comparative view, but we may recognize that with development methods change; the changes determine the lines of specialization.

Behaviour and Behaviourism.—In all fields the principal data are contained in behaviour. This is easily seen in regard to the higher fields, as soon as we recollect that the use of words and therefore the writing and reading of books, to say nothing of the execution of works of art, are forms of behaviour. In the last analysis the phenomena of our own consciousness are also the behaviour of those complex wholes which are ourselves and this radical Behaviourism is the one and only method of all psychology. It is also the one and only method of physical science, for if Mind is the unity which we conceive to run through certain forms of behaviour, so Matter is the unity which runs through other forms of behaviour. This truth is now fully recognized in physics, which conceives matter as a form of energy. Radical behaviourism applies impartially to "matter" and "mind." The world of our experience is material in so far as it acts in certain generic ways known roughly to commonsense and more elaborately to physical sciences. But we also find many objects, which while behaving in some ways like matter, being *e.g.* visible and tangible, nevertheless reveal differences which are the more striking the more rigidly physics delineates the material world as essentially indifferent in all its changes to the later outcome of such changes. For throughout the world of living things we find behaviour so correlated with circumstances as to contribute to the maintenance of an individual organism and its race, and among many organisms we find the correlation wider, more efficient, and making not only for racial life but for certain qualities of life. The factors at work in this correlation are many, but there is something running through them all which stands in marked contrast with our conception of matter and we call it generically Mind. It is still for psychology to give more precision to that term, as it is for physics to give the precision to the conception of matter. And it is for philosophy to explain how one and the same reality can exhibit these differences of aspect.

What is at present known as Behaviourism would sweep the whole field of direct consciousness out of psychology in the name of the strict requirements of observable fact as a basis of science. We do not know what facts we observe more directly and immediately than that, for example, we are sometimes cold or hot, angry, pleased, grieved or joyous. But, says the behaviourist, all these are physical states. That is a confusion between *e.g.*, a sensation and its stimulus. Science has only two rules about observation. One is that our inductions must be founded on it, and the other is that we must treat all observations impartially.

At the same time, it should be recognized (a) that introspection as a technical method is full of difficulties which increase with refinement; (b) that when we come to beings not altogether like ourselves, and with no language to correct our errors, the imputation of processes like our own is risky, and in extreme cases impossible; (c) that it is possible, though more laborious, to build up and state a comparative psychology without using terms derived from the direct consciousness of mental process, merely by analysing modes of correlation; (d) that when we observe correspondence, say between an animal's response to external things and our own, we must infer in the animal a function corresponding to that of which we are conscious though it may be that what performs the function is not in all respects the same as in us. We are sure that our dog "recognizes" us, but it is equally apparent that he does so in terms of scent, a mode which to us is alien and almost incomprehensible. When describing animal behaviour in terms implying conscious process we must always have this limitation in mind. On this condition we shall use such terms in the sequel.

The Structural Basis of Correlation.—All living things inherit a psycho-physical structure which lays the foundation of a self-sustaining and race-preserving life. One way in all organisms in which the structure acts is by response to a stimulus, and some hold that all behaviour can in the last resort be reduced to responses to stimuli, external or internal. This theory is difficult to disprove because the internal stimuli are beyond the reach of exhaustive observation, but an hypothesis resting on vague possibilities is of no value. There is no apparent reason why a structure should not be formed to act of itself in determinate ways, or why internal changes should not take place which at some point give rise to recognizable forms of behaviour. The real contrast, as experience shows us, lies between the specific response to specific stimulus and the subordination of passing or partial responses to a broad and relatively enduring line of behaviour.

Structures may be purely mechanical and give accurately predictable response to external influences. In the case of a man-made machine, the external influence often resembles a stimulus in that it bears no quantitative or qualitative relation to its results, *e.g.* when a lightly-turned handle sets a powerful engine in motion. The condition is simply that all the mechanical connections must be intact. But the working of the machine is in no way dependent on its successful execution of the result for which it was designed, and any part which is itself intact may work separately from the whole, as when a repairer having taken a machine to pieces works a part by hand and gets the responses normally given to the operation of the other parts. The parts then are in essentials indifferent to one another and work in the same way in or out of the machine. Some organic responses appear to be of this type. They seem to be governed neither by their results nor by the condition of the organism as a whole, but to depend purely on the integrity of communication between the part stimulated (the receptor) and the muscle, gland or other "effector." The contraction of the iris and the blinking of the eyelids on the approach of a body to the face seem to be of this type. These are the true unconditioned reflexes. We get in these cases a vivid impression of a definite mechanism which, once set going, proceeds to its specific conclusion without any of the variations in accordance with circumstances and consequences which suggest the operation of mind. More often however the reflex is not so completely unconditioned. Other parts of the organism may inhibit it. Other stimuli may modify it, and finally it may depend on what we can only call the general condition of the organism. Thus, sucking in young mammals is a reflex response to a body placed within the lips, but the replete infant ceases to suck.

Acquired Response.—Reflexes play a large part in animal life from the protozoön which withdraws its pseudopodium on contact with a blunt needle to a man who is set coughing by a crumb in the windpipe. Generally they are hereditary, and many are perfect from birth while others, like the pecking of newly hatched chicks, need a little time to perfect them. With practice however a new element comes in, the continued influence of the results of action by which the hereditary reflex acquires perfection. But a good deal more may be acquired than this polish of a rough-hewn response. The newly hatched chick will peck at the edible and inedible indiscriminately at first, but very few experiments suffice to quell the response to inedible things like bits of orange peel and concentrate them on grains and the like. Here results operate at a slightly higher remove. At some point in or after the contact with the peel the chick will try to reject the peel and thereafter avoids it. Our natural interpretation is that the taste is nasty, while that of the grain is acceptable. This raises the whole question discussed above of the interpretation of behaviour in terms derived from our consciousness. Following the principle there laid down, we shall say that something in the chick performs just the same function as pleasant or unpleasant feeling in us. Whether, apart from this function, it is the same thing in a chick as in us we cannot say. If we use a term importing feeling, in this case "bad taste," of the chick, it is solely to express this identity of function.

But there is a further point. In ourselves we should say that we avoided certain food because we expected the bad taste. Probably this would not be true of the chick. It is more likely that the unpleasant reaction operates directly on the responding mechanism, and that the chick never has the act and its consequence before it as two distinct objects. The result changes the whole character of the response, but by a process which we may call *inarticulate* as compared with that *articulate* forecast which we can make. All the lower grades of learning depend on these inarticulate correlations. In the case taken, experience of results inhibited response, but it may also engender positive responses, *e.g.*, to "signals" where none previously existed. Pavlov, who has studied such responses elaborately under the title "Conditioned Reflexes," makes the time factor a centre of importance, and this is probably true wherever the correlation is inarticulate. The signal must overlap the access to the food and must precede it. (Some qualifications of this general statement need not be considered here.) All sorts of arbitrary signals can be used and a dog will come to react to them by salivation in from three to 20 trials. Secondly, reflexes may be established by applying a new stimulus not less than 10 seconds before one to which response was already made, and in some cases even a third reflex was established in the same way. Beyond this it was not found possible to go. The acquired reflex, generally a measured salivation, could be easily distinguished by withholding the food, and, if a brief interval of time were allowed between signal and food, the appearance of the reflex would be proportionately delayed. It is evident that this behaviour closely resembles that which in man we call expectancy. How are we to decide by behaviour whether such an element is present or not?

Conation.—The answer must be found in Conation, to which expectancy, so far as affecting action, belongs. Conation can be best understood in its developed form of deliberate purpose. In psychological terms purpose is that which directs action towards an end defined in an idea and guided by judgments of the relation of each act to the end. The objection made that the end is not always clear from the beginning, and is sometimes modified as we approach it, is not relevant. The facts on which it rests indicate, sometimes that the purpose is not fully developed, sometimes that we only come to understand its conditions by trial and error, sometimes that it is inspired by some larger want which we have not ourselves understood. Purpose as such is that which directs action to ideal ends. The distinction between this and the reflex appears clearly in behaviour, for the reflex is the specific type response of a pre-formed structure, whether founded on heredity or acquirement. But in purpose we are free to vary our responses indefinitely as the bearing of the act upon the end may require. Outer objects become important which otherwise stimulate no response whatever. We make adjustments and combinations that have never occurred before and may never occur again; we may vary our actions in the progress of the effort, discarding or correcting one that turns out useless and substituting methods which suit the case. All this, which can be easily amplified, but is of course familiar, may be summed up in the simple formula that in purpose behaviour is subject to continuous direction towards an end. Now this is the direct antithesis of the conception of mechanism, which is founded on the total exclusion of ends, and which would be revolutionized if we were to allow that the relation of a mechanistic change to some ultimate outcome were to be imported as a factor into our calculations.

But there are forms of conation which fall short of true purpose. There are efforts towards an end of which there is no articulate idea. These are expressed in behaviour in more than one way. First, there is persistence in activity with variation of method until a certain result is attained; secondly, the result once attained, the method which has produced it is subsequently preferred, the others being discarded. This form of conation has been verified among protozoa by Jennings' well-known observations of "Stentor." It is the true foundation of the method of trial and error, where either we want something but do not quite know what it is, but only that we are dissatisfied with everything else, or we know what we want but do not know the means to it. This is the position of Professor Thorndike's cats, who want to get out of the cage in which they are shut, but not knowing how to do it, "scrabble" about till they at last happen to pull or push the catch which sets them free. The value of these experiments was to show the seemingly ingenious things which might be done by this method. There is thirdly the adjustment and combination of responses to the indefinitely varying requirements of a situation. Here any single response might be taken as mechanistically predetermined by heredity or habit, but the combination is a unique product that can never be repeated. There must then be a factor dealing with the situation of the moment as required by the bearing on the result, otherwise the result is a success with no cause but "chance."

The question may be asked, why we should deny ideas in such cases. The answer is that ideas are founded upon experience and in particular an articulate experience which in many of these cases is available. This brings us to the problem of instinct.

Instinct.—A bird at mating time begins to build a nest, and even when brought up in captivity builds it true to type. The laying of eggs, brooding over them, feeding and attending to the young till they are fledged, follow in due course. There is a continuous sequence of actions till the result is reached and all is over. In the meantime every detail of behaviour is determined by relation to this result. Yet it is extremely difficult, and in the very comparable case of the solitary wasp quite impossible, to believe in any such elaboration of ideas as would be implied in saying that the bird fully understood what it was about. The whole proceeding then is steadily directed to an end which is not foreseen. This is the general definition of instinct. It cannot be identified with a compound reflex on account of the modifications and unique combinations of type activities that can be found in it. It is conative, but it is a mode of conation, a drive or a need which we must regard as part of the hereditary structure. But if there is no foresight, how are responses adapted to changes of the environment? The bird will in fact modify its behaviour to suit special cases, *e.g.* the location, materials or form of the nest. What modifies this behaviour if not foresight of the end? Sometimes possibly a foresight of shorter range, *e.g.* a dog having once been frustrated by a rabbit doubling at a particular point may anticipate it and cut the curve. Perhaps in less articulate fashion a bird finding a cat about moves its nest-building operations to a safer place. Even the solitary wasp, unable to get a spider into its hole by ordinary methods, has been seen to resort to one device after another till it has succeeded. To this proximate end her actions seem definitely directed. With such cases we may contrast instances of caterpillars persisting in details of cocoon spinning when they are superfluous; or that of the Sitaris beetle grub, which "ought" to attach itself to the hairy undergrowth of the bumble-bee, but will in fact respond to any similar surface in the same way and often perishes for that reason. If we contemplated such instances alone we should think of instinct as after all very like compound reflex; if we contemplated the others alone we should think of it as very like intelligence. The truth seems to be that it moves between an upper and a lower limit —Intelligence, which as it advances gradually takes its place by substituting foresight for hereditary determination of response, and Reflex in which no modification of detail is possible, and the mechanism must be perfect from birth in all particulars or useless. When either of these limits is touched the use of the term instinct seems inappropriate.

Limits of Animal Intelligence.—In instinct, however modified by inarticulate correlation, there is conation but no true purpose; but stages in the execution of an instinct may become purposive if there is articulate correlation, that is if the result is present in idea as something distinct from but connected with the act. This is impossible as long as the sensory life is limited to experience charged with Affect or feeling and thereby modifying reactions. But if we suppose an articulate perception, *e.g.* of visual objects as wholes of parts and of things related to and succeeding one another, whether charged with Affect or not, we have complexes of distinct but related elements. If again we suppose one element of such a complex capable of "reviving" the remainder the "revival" is easily shown to take the form of ideas of things related to the elements given. If, finally, action is directed to one of the elements so revived, it is directed by an ideal reference and is purpose. Thus purpose in an elementary form is an articulate correlation of perceptual and conative reactions. The evidence of such correlation in behaviour is broadly that the acquisition of co-ordinated modes of behaviour is not limited to habituation or trial and error. Much controversy has arisen on the question of whether any animal behaviour furnishes conclusive evidence of this kind for the operation of purpose. The most decisive evidence is that produced by Köhler's observations of chimpanzees. Below the anthropoids, which might be regarded as a transitional class, experimental work on monkeys, and in a less degree on dogs, cats, elephants and other mammalia reputed intelligent, tends, though less decisively, in the same direction.

Universals and Their Correlation.—What has told most strongly against the attribution of purpose to animals is probably the belief that ideas involve language and are of a general character, but (1) whether with or without language we form ideal references to particular things or occurrences which we remember or anticipate. Ideas are not as such general, though everything general is grasped in ideas. (2) In forming anticipatory ideas, we are moving in the direct line of conation, the idea merely giving necessary direction to the conative behaviour. In forming general ideas expressible in language, we go beyond the range of our immediate efforts (though of course we are constantly calling on ideas to help us in them), and compare one case with another. As the general ideas become formed, all objects to which they apply are in a sense grouped irrespectively of juxtaposition in a class, and what we learn by the idea we can apply to any member of the class. Here we get down to the "universal" underlying the less reflective use of observation in guiding anticipation, and at this deeper level an immense expansion of the field of correlation is opened. Further, in getting away from the immediate situation we have a similarly indefinite extension of range into the past and future. We grasp those combinations of inner and outer experiences which are ourselves and other persons and objects. We become aware of self in the true sense of a continuous unity, for which the immediate situation is only a detail. Thus in the result we arrive at a completely new principle of correlation and behaviour wherein any object or occasion may be dealt with in accordance with its affinities of character (its class) or its position in a structural whole, constituted by the life of the individual and of the groups, family and society to which he belongs.

Thought is more than language but it is by expression and communication that its achievements are consolidated and made the basis of further advance. Thus it is the social factor which makes its higher development possible.

Critical Thought.—In the animal world intelligence (the correlation effected by the individual) is confined to detail. The ground plan is laid by heredity in the shape of instinct. With the formation of general ideas it becomes possible to guide life by rules of behaviour which can be taught and eventually criticized, and by general aims, from self-advancement to religious devotion, which may govern all conduct. This does not abolish the underlying hereditary factor, but it does modify and even transform it. The simplest peoples have codes which put considerable restraint on raw impulse. Broadly, what all codes have to do is to accommodate the animality, selfishness and narrowness of the physical structure to the needs of social life and, as in response to the growth of knowledge social life expands, to adapt behaviour to the new requirements. Such codes do not originate in any systematic plan, but in action and reaction as between individuals and groups, which work towards an equilibrium of accepted custom, enduring until disturbed by some change in the social situation. But the order of life leaves men dissatisfied in many ways both intellectually and emotionally, and from a very early stage they begin to look for a compensation or solution, real or imaginary. They build up a wonder world of magic and an inner or after world of spirits, and find in one or both some shadow of the fuller harmony of feeling and experience which they need. All the time, through the cumulative action of tradition they are increasing their real power of dealing with nature and of organizing combined efforts and so learning the need of more definite conceptions and more trustworthy methods. Theories of nature and human life are originated, and though propagating themselves by suggestion and dogma they have eventually to sustain themselves against criticism. Their fortunes constitute the history of ethics, religion, philosophy and conscience, and cannot be outlined here. What must be said is that they force us to the attempt to bring the underlying conditions of life, ever in the background as the ultimate arbiters of success and failure, within the scope of intelligent appreciation, so that we may come to understand what has made us that which we are, and what are the ultimate conditions of that fuller harmony for which we seek. In this task of philosophy in its most comprehensive sense the principles underlying the purposes and methods of the mind become objects of the mind capable of critical exposition, and if such a task can ever be completed the extension of scope and increment of power would be comparable to that which came about through the rise of general ideas. It would be a step as great as that which separates human self-consciousness from animal instinct.

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COMPARETTI, DOMENICO (1835–1929), Italian scholar, was born at Rome on the 27th of June 1835. He studied at the university of Rome, took his degree in 1855 in natural science and mathematics, and entered his uncle's pharmacy as assistant. His scanty leisure was, however, given to study. He learned Greek by himself, and gained facility in the modern language by conversing with the Greek students at the university. In spite of all disadvantages, he not only mastered the language, but became one of the chief classical scholars of Italy. In 1857 he published, in the *Rheinisches Museum,* a translation of some recently discovered fragments of Hypereides, with a dissertation on that orator. This was followed by a notice of the annalist Granius Licinianus, and one on the oration of Hypereides on the Lamian War. In 1859 he was appointed professor of Greek at Pisa on the recommendation of the duke of Sermoneta. A few years later he was called to a similar post at Florence, remaining emeritus professor at Pisa also. He subsequently took up his residence in Rome as lecturer on Greek antiquities and greatly interested himself in the Forum excavations. He was a member of the governing bodies of the academies of Milan, Venice, Naples and Turin. The list of his writings is long and varied. Of his works in classical literature, the best known are an edition of the *Euxenippus* of Hypereides, and monographs on Pindar and Sappho. He also edited the great inscription which contains a collection of the municipal laws of Gortyn in Crete, discovered on the site of the ancient city. In the *Kalewala and the Traditional Poetry of the Finns* (English translation by I. M. Anderton, 1898) he discusses the national epic of Finland and its heroic songs, with a view to solving the problem whether an epic could be composed by the interweaving of such national songs. He comes to a negative conclusion, and applies this reasoning to the Homeric problem. He treats this question again in a treatise on the so-called Peisistratean edition of Homer (*La Commissione omerica di Pisistrato,* 1881). His *Researches concerning the Book of Sindibād* have been translated in the *Proceedings* of the Folk-Lore Society. His *Vergil in the Middle Ages* (translated into English by E. F. Benecke, 1895) traces the strange vicissitudes by which the great Augustan poet became successively grammatical fetich, Christian prophet and wizard. Together with Professor Alessandro d'Ancona, Comparetti edited a collection of Italian national songs and stories (9 vols., Turin, 1870–1891), many of which had been collected and written down by himself for the first time. Comparetti died in 1929.

COMPASS, a term of which the evolution of the various meanings is obscure; the general sense is "measure" or "measurement," and the word is used thus in various derived meanings—area, boundary, circuit. It is also more particularly applied to a mathematical instrument ("pair of compasses") for measuring or for describing a circle, and to the mariner's compass.

The common mathematical compasses or dividers are composed of two legs or rods, usually of steel, joined together by a pivot-joint at one end and pointed at the other. When used for drawing circles or arcs, the lower parts of the legs are removable or changeable for a new section carrying pen or pencil. *Beam compasses,* which consist of points sliding on a bar, to which they may be clamped at any desired point, are used for lengths greater than the pivot compasses can expand. The compasses used in engineering drawing are more fully described in the article DRAWING, ENGINEERING. It should be noted, however, that while the instruments used in this work are simple in design careful manipulation must be exercised to obtain good results.

Proportional dividers or compasses have a point at each end of the leg and the pivot between, thus forming a double pair of compasses opposite to each other. To adapt these two sets of compasses for variable proportions, the pivot is made a clamping screw and may be fixed at any point, or contains some similar device. In one type of proportional divider the whole length of the legs is divided into 200 equal parts, which are further subdivided into tenths by means of a vernier. By this means any desired ratio may be readily set off. Such an instrument is applicable to a variety of purposes in connections with lines, planes and solids. For example, the ratio between the diameter and the circumference of a circle is quickly obtained by one setting of the vernier, the circumference being reduced to lineal measure. *Triangular compasses* have three legs so that the vertices of a triangle may be all transformed simultaneously. *See* also TOOL: *Measurement.*

The compass has long been used in land surveying as an instrument for determining directions and, indirectly, angles. Almost all of the old surveys in America have been made with the compass as the angle-measuring instrument, and while this instrument to a great extent has been supplanted by the transit there are still many compasses in use. The compass is frequently used in preliminary mine surveys and for exploratory surveys, and the compass on the transit instrument is always used in all but city surveys as a check. A knowledge of the compass and compass surveying is essential to a clear understanding of old surveys, with which every surveyor is concerned when resurveying old lands measured by compass survey. For these reasons, the compass and compass surveying finds a place in every treatise of surveying and is discussed under the article SURVEYING. The solar compass is an instrument for determining the true meridian by an observation on the sun. It was formerly specified for important government surveys in the United States.

There are two distinct types of mariner's compasses in general use at the present time—the magnetic compass, which depends upon the Earth's magnetic field to obtain its directive force, and the gyro-compass (*q.v.*) which obtains its directive force from the Earth's rotation. (X.)

The Magnetic Compass, with which this article is concerned, is an instrument by means of which the directive force of that great magnet, the Earth, upon a freely-suspended needle, is utilized for a purpose essential to navigation. The needle is so mounted that it only moves freely in the horizontal plane, and therefore the horizontal component of the earth's force alone directs it. The direction assumed by the needle is not generally towards the geographical north but diverges towards the east or west of it, making a horizontal angle with the true meridian, called the magnetic variation or *declination;* amongst mariners this angle is known as the variation of the compass. In the usual navigable waters of the world the variation alters from 30° to the east to 45° to the west of the geographical meridian, being westerly in the Atlantic and Indian oceans, easterly in the Pacific. The vertical plane passing through the longitudinal axis of such a needle is known as the *magnetic meridian.* Following the first chart of lines of equal variation compiled by Edmund Halley in 1700, charts of similar type have been published from time to time embodying recent observations and corrected for the secular change, thus providing seamen with values of the variation accurate to about 30′ of arc. Possessing these data, it is easy to ascertain by observation the effects of the iron in a ship in disturbing the compass, and it will be found for the most part in every vessel that the needle is deflected from the magnetic meridian by a horizontal angle called the *deviation* of the compass; in some directions of the ship's head adding to the known variation of the place, in other directions subtracting from it. Local magnetic disturbance of the needle due to magnetic rocks is observed on land in all parts of the world, and in certain

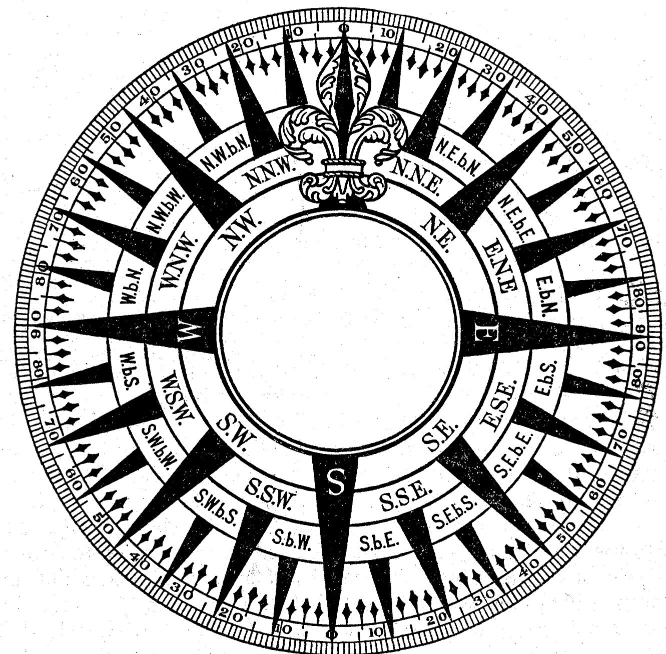

FIG. 1.—COMPASS CARD, SHOWING DIVISIONS INTO POINTS, QUARTER POINTS AND DEGREES. THE NORTH POINT IS EMBELLISHED WITH A "FLEUR DE LYS"

places extends to the land under the sea, affecting the compasses on board the ships passing over it. The general direction of these disturbances in the northern hemisphere is an attraction of the north-seeking end of the needle; in the southern hemisphere, it is repulsion. The approaches to Cossack, North Australia; Cape St. Francis, Labrador; the coasts of Madagascar and Iceland, are remarkable for such disturbance of the compass.

The compass as we know it is the result of the necessities of navigation which have increased from century to century. There are two main types of magnetic compass, the dry card and liquid compass; the former, known as the Thomson compass, invented by the late Lord Kelvin, is almost universally used in the mercantile marine but has been superseded in the British navy by the liquid type.

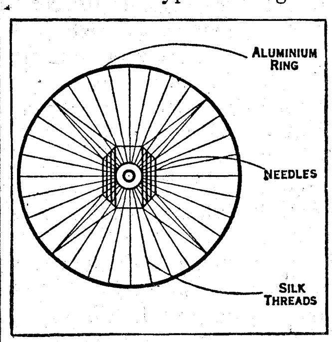

FIG. 2.—COMPASS FRAME TO WHICH CARD IS ATTACHED. THE NEEDLES, SUSPENDED FROM SILK THREADS, DIRECT THE CARD, AND THE WHOLE IS MOUNTED ON AN ALUMINIUM CAP AS SHOWN IN FIG. 3

The Compass Card.—The card consists of a paper ring marked with degrees and points similar to that shown in fig. 1. This is mounted on a frame, fig. 2, where an aluminium ring is connected by 32 radial silk threads to a central disc of aluminium; this is pierced in the centre to receive an aluminium cap with a highly polished sapphire centre worked to the form of an open cone. To direct the card eight short light needles are suspended by silk threads from the outer ring. The magnetic axis of any system of needles must exactly coincide with the axis passing through the north and south points of the card. Single needles are never used, two being the least number, and these are so arranged that the moment of inertia about every diameter of the card shall be the same. The combination of card, needles and cap is generally termed "the card"; on the continent of

Europe it is called the "rose." The section of a compass bowl in fig. 3 shows the mounting of a Thomson card on its pivot, which, in common with the pivots of most other compasses, is made of brass, tipped with osmium-iridium, which although very hard can be sharply pointed and does not corrode. Fig. 3 shows the general arrangement of mounting all compass cards in the bowl. In fig. 4 another form of compass called a liquid or spirit compass is shown partly in section. The card nearly floats in a bowl filled with distilled water, to which 35% of alcohol is added to prevent freezing; the bowl is hermetically sealed with pure india-rubber, and a corrugated expansion chamber is attached to the bottom to allow for the expansion and contraction of the liquid. The card is a mica disk, either painted as in fig. 1, or covered with linen upon which the degrees and points are printed, the needles being enclosed in brass.

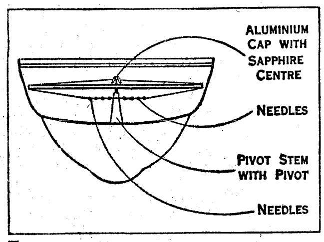

FIG. 3.—THOMSON'S COMPASS BOWL

The bowl is made of brass, a chamber filled with a viscous fluid being attached to the bottom to steady it when resting in the gimbal system of the binnacle

Mounting.—Great steadiness of card under severe shocks, combined with a minimum of friction in the cap and pivot, is obtained from this compass. All compasses are fitted with a gimbal ring to keep the bowl and card level under every circumstance of the ship's motion in a seaway, the ring being connected with the *binnacle* or pedestal by means of journals or knife edges. On the inside of every compass bowl a vertical black line is drawn, or pointer let in, called the "lubber's point," and it is imperative that when the compass is placed in the binnacle the line joining the pivot and the lubber's point be parallel to the keel of the vessel. Thus, when a degree on the card is observed opposite the lubber's point, the angle between the direction in which the ship is steering and the north point of the compass or course is at once seen, and if the magnetic variation and the disturbing effects of the ship's iron are known, the desired angle between the ship's course and the geographical meridian can be computed. In every ship a position is selected for the magnetic compass as free from neighbouring iron as possible. The compass is also provided with an *azimuth circle* or mirror, and a shadow pin or style is placed in the centre of the glass cover, by either of which the variable angle between the compass north and true north called the "total error," or variation and deviation combined can be observed. The binnacles or pedestals for compasses are generally constructed of wood about 4½in. high, and fitted to receive and alter at pleasure the several magnet and soft iron correctors. They are also fitted with different forms of suspension in which the compass is mounted to obviate the mechanical disturbance of the card caused by the vibration of the hull in ships driven by powerful engines.

Aircraft Compasses.—In Oct. 1909, a member of the Admiralty flew with Cody, taking an ordinary liquid compass resting in cotton waste in a box.

After the outbreak of the World War, as a result of the necessity of the situation, much pioneer work was done at the royal aircraft experimental station at Farnborough, and it was found that the main problems to be solved were (i.) to damp the vibrations of the engine to such an extent that they had no effect on the compass, (ii.) to so design the card that the effect on it of change of speed and course, or both, was as small as possible.

Definitely to accomplish (i.), it was necessary to produce a suspension so efficient that the vibrations were practically absorbed before they reached the bowl, and at the same time the compass had to be definitely located.

The bedding of cotton waste and that of horse-hair were later replaced by varying combinations of springs and felt pads, until finally a very efficient suspension was found in Sorbo rubber, which has since been generally employed.

In modern types, provision is made for securing Sorbo pads to the inside of the container in such a manner that they absorb vibrations in a lateral and vertical direction, special means are also provided for locating the compass inside the container so as to avoid any displacement of the lubber point.

Problem No. (ii.) arises owing to the fact that the true vertical is replaced by a false vertical when changes of speed and course, or both, are made. In the space at disposal, it is impossible to explain the effect on the compass under all conditions, but examples are given of the effect of change of speed only and of change of course only, in order to give a general idea of the complications that may arise.

Assume the magnet system to be replaced by a single needle suspended from a point above its centre of gravity and that the aeroplane is steering E. and begins to increase speed. The needle lags behind and is W. of the pivot; it will then swing to meet the line of dip through the pivot and settle there, producing easterly deviation. North and south accelerations have no effect because the line of the needle is not disturbed from the line of dip.

Supposing now a change of course from N. to E., the false vertical points down and W., the deviation is easterly as in the above case; if this deviation is less than the change of course, the compass underestimates the change; if the deviation is equal to the change of course, no turn is indicated at all; and if deviation exceeds the change, the sense of the turn as registered is opposite to the actual turn. The effect is the same turning from N. to W.

Turning from S. to either E. or W., the effect is to exaggerate the turn and is not therefore serious.

Turning from E. to W., there is no immediate effect, as the false vertical points down and N. or S.; but the angle of banking brings the false vertical nearer, or further, from the line of dip, thus diminishing or increasing the directive force.

From the above it will be seen that the most serious trouble arises when course is altered from N. and is commonly called "northerly turning error."

The above effects are the most important, but several others are introduced as well and may modify the former.

Development of the compasses was generally in the hands of the Admiralty compass department from the middle of 1917 onwards and proceeded fairly rapidly until finally, in 1918, the *aperiodic* compass was produced. Up to this time the card, consisting of card, float, and magnet system, was substantial, as, in ship compasses and when disturbed its oscillations were periodic.

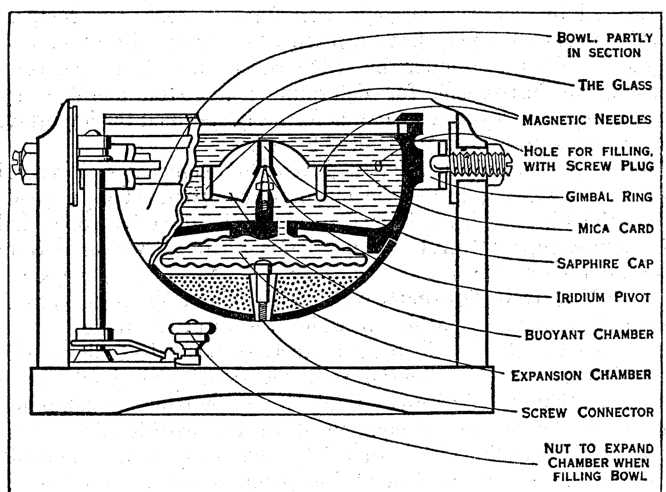

FIG. 4.—THE LIQUID COMPASS, USED IN THE BRITISH NAVY BECAUSE OF ITS COMPARATIVE STABILITY UNDER GUNFIRE

Compared with the dry card magnetic system, this compass is comparatively heavy and is therefore provided with a float. The cap is secured to the float which is so designed that when resting on the pivot the buoyancy is negative and there is a minimum of friction

The Aperiodic Compass.—The card and float were dispensed with, the magnets reduced in size, and wire or glass damping filaments radiating from the cap were introduced. When the system was disturbed, these filaments offered great resistance to passage through the liquid and the oscillations became aperiodic.

Without a card, however, it was difficult to use this instrument as a compass, and to overcome this, two very novel methods were

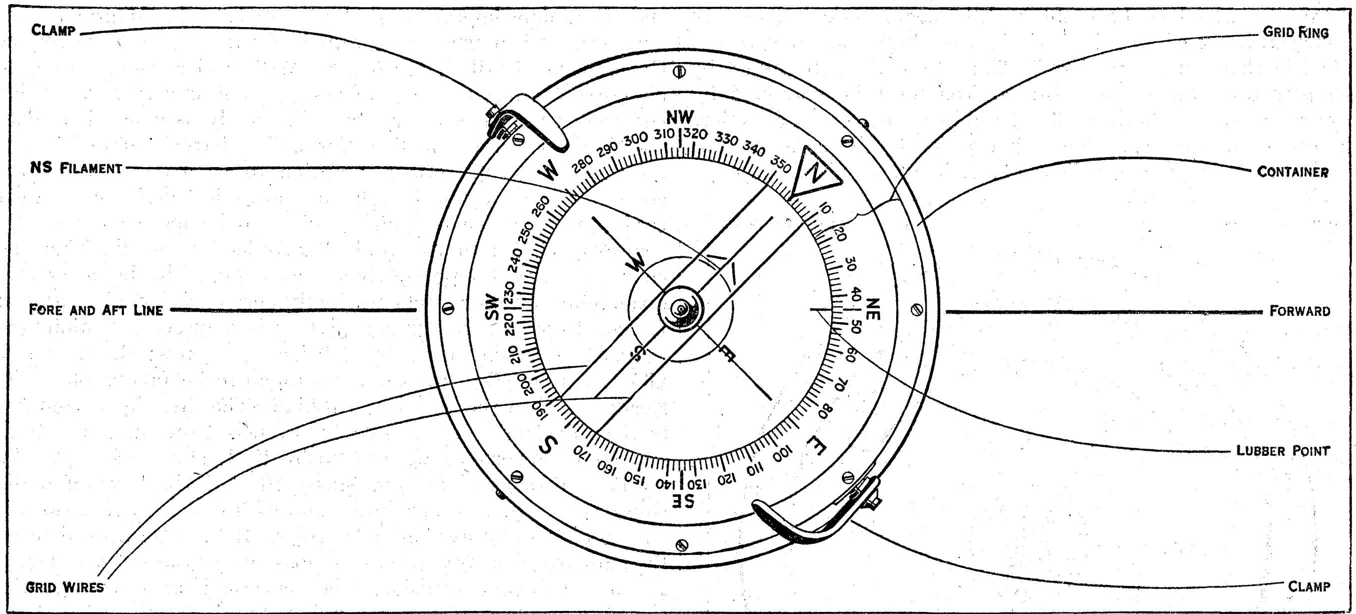

FIG. 5.—COMPASS TYPE P.4., SPECIALLY DESIGNED FOR USE IN AIRCRAFT

Engine vibrations are so successfully resisted that they become aperiodic and do not affect the magnetic system. To this end the card has been abandoned and the grid ring substituted. This is set to the course and the machine turned until the N.S. filament is parallel with the grid wires

introduced. In the first, a graduated ring was fitted to the top of the compass bowl, capable of being rotated and clamped in any position; grid wires were fitted across the inner diameter, running from 0° to 180°. To use this instrument as a compass, the ring is rotated until the course required is opposite the lubber point when it is clamped; the head of the machine is then brought round until the N. S. filament of the magnet system is parallel to the grid wires.

In the second method, a scale, graduated to 100°, is secured to the inner side of the bowl, the centre of the scale being in fore and aft line. The damping filaments are numbered 0, 1, 2, 3 clockwise looking down at the compass and spaced as follows:—100°, 100°, 100°, 60°, making 360° in all, and so secured to the cap that when the 0 filament coincides with the 0 on the scale the heading is North. Similarly with the No. 1 filament at 80° the heading would be South or 180°.

The fact that aeroplanes operate in extremes of temperature provides a further problem. Specifications for modern aeroplane compasses provide for a range of temperature from $-50°$ C to $+50°$. Pure alcohol is the most suitable liquid and will not freeze at the low temperatures. Unfortunately, it has been very difficult to find any paint or other coating which will stand it, the result being discoloration of the liquid and the formation of deposits.

Figures 5 and 6 show two aperiodic compasses, the former fitted with graduated rotatable ring, grid wires and clamp, the latter with the centesimal scale. The courses indicated are respectively N.E. or 45° and 83° or N. 83° E.

Deviation.—The effects of the iron and steel in ships upon the magnetic compass occupied the attention of the ablest physicists of the 19th century. The hull of an iron or steel ship is a magnet, and the distribution of its magnetism depends upon the direction of the ship's head when building, this result being produced by induction from the earth's magnetism, developed and impressed by the hammering of the plates and frames during the process of building. The disturbance of the compass by the magnetism of the hull is generally modified, sometimes favourably, more often unfavourably, by the magnetized fittings of the ship, such as masts, conning towers, deck houses, engines and boilers. Thus in every ship the compass needle is more or less subject to deviation differing in amount and direction for every azimuth of the ship's head. This was first demonstrated by Commander Matthew Flinders's experiments in H.M.S. "Investigator" in 1800–1803, and in 1810 led that officer to introduce the practice of placing the ship's head on each point of the compass and noting the amount of deviation whether to the east or west of the magnetic north, a process which is in full exercise at the present day and is called "swinging ship." When speaking of the magnetic properties of iron it is usual to adopt the terms "soft" and "hard." Soft iron is iron which becomes instantly magnetized by induction when exposed to any magnetic force, but has no power of retaining its magnetism. Hard iron is less susceptible of being magnetized, but when once magnetized it retains its magnetism permanently. The term "iron" used in these pages includes the "steel" now commonly employed in shipbuilding. If an iron ship be swung when upright for deviation, and the mean horizontal and vertical magnetic forces at the compass positions be also observed in different parts of the world, mathematical analysis shows that the deviations are caused partly by the permanent magnetism of hard iron, partly by the transient induced magnetism of soft iron both horizontal and vertical, and in a lesser degree by iron which is neither magnetically hard nor soft, but which becomes magnetized in the same manner as hard iron, though it gradually loses its magnetism on change of conditions, as, for example, in the case of a ship, repaired and hammered in dock, steaming in an opposite direction at sea. This latter cause of deviation is called sub-permanent magnetism. The horizontal directive force on the needle on board is nearly always less than on land, sometimes much less, whilst in armour-plated ships it ranges from ·8 to ·2 when the directive force on land=1·0. If the ship be inclined to starboard or to port additional deviation will be observed, reaching a maximum on N. and S. points, decreasing to zero on the E. and W. points. Each ship has its own magnetic character, but there are certain conditions which are common to vessels of the same type.

Instead of observing the deviation solely for the purposes of correcting the indications of the compass when disturbed by the iron of the ship, the practice is to subject all deviations to mathematical analysis with a view to their mechanical correction. The whole of the deviations when the ship is upright may be expressed nearly by five co-efficients, A, B, C, D, E. Of these A is a deviation constant in amount for every direction of the ship's head. B has reference to horizontal forces acting in a longitudinal direction in the ship, and caused partly by the permanent magnetism of hard iron, partly by vertical induction in vertical soft iron either before or abaft the compass. C has reference to forces acting in a transverse direction, and caused by hard iron. D is due to transient induction in horizontal soft iron, the direction of which passes continuously under or over the compass. E is due to transient induction in horizontal soft iron unsymmetrically placed with regard to the compass. When data of this character have been obtained the compass deviations may be mechanically corrected to within 1°—always adhering to the principle that "like cures like." Thus the part of B caused by the permanent magnetism of hard iron must be corrected by permanent magnets horizontally placed in a fore and aft direction, the other part caused by vertical soft iron by means of bars of vertical soft iron, called Flinders bars, before or abaft the com-

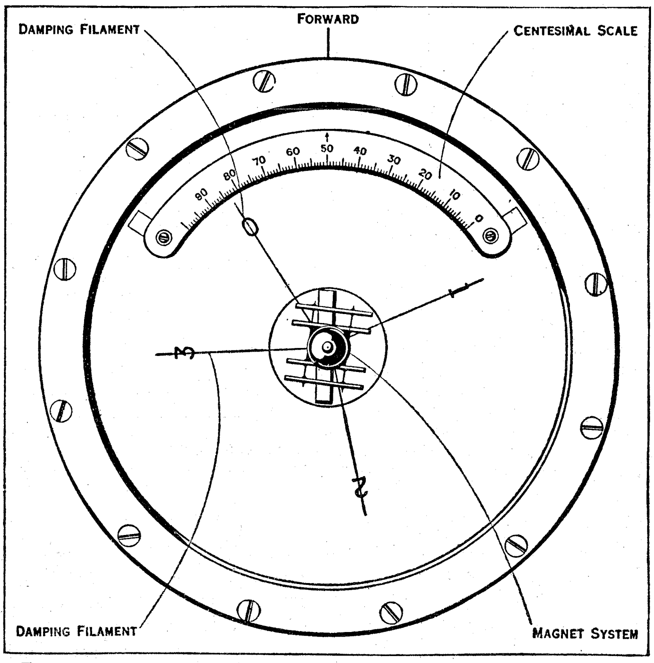

FIG. 6.—AIRCRAFT COMPASS TYPE 253, ANOTHER APERIODIC DESIGN
The absence of the card is here overcome in a different way. The course steered in degrees is the number indicated on the centesimal scale by the appropriate numbered filament, in this case 83°

pass. C is compensated by permanent magnets athwart-ships and horizontal; D by masses of soft iron on both sides of the compass, and generally in the form of cast-iron spheres, with their centres in the same horizontal plane as the needles; E is usually too small to require correction; A is fortunately rarely of any value, it is constant and can be adjusted by moving the lubber line in steering compasses. The deviation observed when the ship inclines to either side is due (1) to hard iron acting vertically upwards or downwards; (2) to vertical soft iron immediately below the compass; (3) to vertical induction in horizontal soft iron when inclined. To compensate (1), vertical magnets are used; (3) is partly corrected by the soft iron correctors of D; (2) and the remaining part of (3) cannot be conveniently corrected for more than one geographical position at a time. Although a compass may thus be made practically correct for a given time and place, the magnetism of the ship is liable to changes on changing her geographical position, and especially so when steaming at right angles or nearly so to the magnetic meridian, for then sub-permanent magnetism is developed in the hull. Some vessels are more liable to become sub-permanently magnetized than others, and as no corrector has been found for this source of deviation the navigator must determine its amount by observation.

Every compass and corrector supplied to ships of the British navy and machines belonging to the air ministry is examined and tested at the admiralty compass observatory.

The director is responsible for investigating the magnetic character of ships, selecting suitable positions for the compasses in the early stages of design and subsequently keeping records of their behaviour; similarly, in the case of machines for the Air ministry, he advises during the mock-up stage.

History.—The mariner's compass during the early part of the 19th century was still very imperfect, although numerous inventors had tried to improve it. In 1837 the admiralty compass committee was appointed to make a scientific investigation of the subject and propose a form of compass suitable alike for azimuth and steering purposes. The committee reported in July 1840, and after minor improvements by the makers the admiralty compass, the card of which is shown in fig. 1, was adopted by the Government. Until 1876, when Sir William Thomson introduced his patent compass, this compass was not only the regulation compass of the British navy, but was largely used in other countries in the same or a modified form. The introduction of powerful engines causing serious vibration to compass cards of the admiralty type, coupled with the prevailing desire for larger cards, the deviation of which could also be more conveniently compensated, led to the gradual introduction of the Thomson compass. Several important points were gained in the latter; the quadrantal deviation could be finally corrected for all latitudes; frictional error at the cap and pivot was reduced to a minimum, the average weight of the card being 200 grains; the long free vibrational period of the card was found to be favourable to its steadiness when the vessel was rolling. The first liquid compass used in England was invented by Francis Crow in 1813. Subsequent improvements were made by E. J. Dent, and especially by E. S. Ritchie, of Boston, Mass. In 1888 the form of liquid compass (fig. 4) was introduced, and with minor modifications is almost universally used in H.M. ships. It has also proved to be the most trustworthy magnetic compass under the shock of heavy gun fire at present available. The deflector is an instrument designed to enable an observer to reduce the deviations of the compass to an amount not exceeding 2° during fogs, or at any time when bearings of distant objects are not available. It is certain that if the directive forces on the N., E., S., and W. points of a compass are equal, there can be no deviation. With the deflector any inequality in the directive force can be detected, and hence the power of equalizing the forces by the usual soft iron and magnet correctors. Several kinds of deflector have been invented, that of Lord Kelvin (Sir William Thomson) being the simplest, but Dr. Waghorn's is also very effective.

The Magnetism of Ships.—In 1814 Flinders first showed (*see* Flinders's *Voyage,* vol. ii. appx. ii.) that the abnormal values of the variation observed in the wood-built ships of his day was due to deviation of the compass caused by the iron in the ship; that the deviation was zero when the ship's head was near the N. and S. points; that it attained its maximum on the E. and W. points, and varied as the sine of the azimuth of the ship's head reckoned from the zero points. He also described a method of correcting deviation by means of a bar of vertical iron so placed as to correct the deviation nearly in all latitudes. This bar, now known as a "Flinders bar," is still in general use. In 1820 Dr. T. Young (*see* Brande's *Quarterly Journal,* 1820) investigated mathematically the magnetism of ships. In 1824 Professor Peter Barlow (1776–1862) introduced his correcting plate of *soft* iron. Trials in certain ships showed that their magnetism consisted partly of hard iron, and the use of the plate was abandoned. In 1835 Captain E. J. Johnson, R.N., showed from experiments in the iron steamship "Garry Owen" that the vessel acted on an external compass as a magnet. In 1838 Sir G. B. Airy magnetically examined the iron steamship "Rainbow" at Deptford, and from his mathematical investigations (see *Phil. Trans.,* 1839) deduced his method of correcting the compass by permanent magnets and soft iron, giving practical rules for the same in 1840. Airy's and Flinders's correctors form the basis of all compass correctors to this day. In 1838 S. D. Poisson published his *Memoir on the Deviations of the Compass caused by the Iron in a Vessel.* In this he gave equations resulting from the hypothesis that the magnetism of a ship is partly due to the permanent magnetism of hard iron and partly to the transient induced magnetism of soft iron; that the latter is proportional to the intensity of the inducing force, and that the length of the needle is infinitesimally small compared to the distance of the surrounding iron. From Poisson's equations Archibald Smith deduced the formulae given in the *Admiralty Manual for Deviations of the Compass* (1st ed., 1862), a work which has formed the basis of numerous other manuals since published in Great Britain and other countries. In view of the serious difficulties connected with the inclining of every ship, Smith's formulae for ascertaining and providing for the correction of the heeling error with the ship upright continue to be of great value to safe navigation. In 1855 the Liverpool compass committee began its work of investigating the magnetism of ships of the mercantile marine, resulting in three reports to the Board of Trade, all of great value, the last being presented in 1861.

See also MAGNETISM and NAVIGATION; articles on Magnetism of Ships and Deviations of the Compass, *Phil. Trans.* (1839–83), *Journal United Service Inst.* (1859–89), *Trans. Inst. Nav. Archit.* (1860–62), *Report of Brit. Assoc.* (1862), *London Quarterly Rev.* (1865); also *Admiralty Manual* (1862–1920); Towson's *Practical Information on Deviations of the Compass* (1886). (E. W. C.; G. B. H.)

HISTORY OF THE MARINER'S COMPASS

The discovery that a lodestone, or a piece of iron which has been touched by a lodestone, will direct itself to point in a north and south position, and the application of that discovery to direct the navigation of ships, have been attributed to various origins. The Chinese, the Arabs, the Greeks, the Etruscans, the Finns and the Italians have all been claimed as originators of the compass. There is now little doubt that the claim formerly advanced in favour of the Chinese is ill-founded. In Chinese history we are told how, in the sixty-fourth year of the reign of Hwang-ti (2634 B.C.), the emperor Hiuan-yuan, or Hwang-ti, attacked one Tchi-yeou, on the plains of Tchou-lou, and finding his army embarrassed by a thick fog raised by the enemy, constructed a chariot (Tchi-nan) for indicating the south, so as to distinguish the four cardinal points, and was thus enabled to pursue Tchi-yeou, and take him prisoner. But, as other versions of the story show, this account is purely mythical. For the south-pointing chariots are recorded to have been first devised by the emperor Hian-tsoung (A.D. 806–820); and there is no evidence that they contained any magnet. There is no genuine record of a Chinese marine compass before A.D. 1297, as Klaproth admits. No sea-going ships were built in China before 139 B.C. The earliest allusion to the power of the lodestone in Chinese literature occurs in a Chinese dictionary, finished in A.D. 121, where the lodestone is defined as "a stone with which an attraction can be given to a needle," but this knowledge is no more than that existing in Europe at least five hundred years before. Nor is there any nautical significance in a passage which occurs in the Chinese encyclopaedia, *Poei-wen-yun-fou,* in which it is stated that under the Tsin dynasty, or between A.D. 265 and 419, "there were ships indicating the south."

The Chinese, Sir J. F. Davis informs us, once navigated as far as India, but their most distant voyages at present extend not farther than Java and the Malay Islands to the south (*The Chinese,* 1844). According to an Arabic manuscript, a translation of which was published by Eusebius Renaudot (Paris, 1718), they traded in ships to the Persian Gulf and Red Sea in the 9th century. Sir G. L. Staunton, in vol. i. of his *Embassy to China* (1797), after referring to the early acquaintance of the Chinese with the property of the magnet to point southwards, remarks (p. 445), "The nature and the cause of the qualities of the magnet have at all times been subjects of contemplation among the Chinese. The Chinese name for the compass is *ting-nan-ching,* or needle pointing to the south; and a distinguishing mark is fixed on the magnet's southern pole, as in European compasses upon the northern one." The number of points of the compass, according to the Chinese, is twenty-four, which are reckoned from the south pole; the form also of the instrument they employ is different from that familiar to Europeans. The needle is peculiarly poised, with its point of suspension a little below its centre of gravity, and is exceedingly sensitive; it is seldom more than an inch in length, and is less than a line in thickness. "It may be urged," writes Mr. T. S. Davies, "that the different manner of constructing the needle amongst the Chinese and European navigators shows the independence of the Chinese of us, as theirs is the *worse* method, and had they copied from us, they would have used the better one" (Thomson's *British Annual,* 1837, p. 291). On the other hand, it has been contended that a knowledge of the mariner's compass was communicated by them directly or indirectly to the early Arabs, and through the latter was introduced into Europe.

Sismondi has remarked (*Literature of Europe,* vol. i.) that it is peculiarly characteristic of all the pretended discoveries of the middle ages that when the historians mention them for the first time they treat them as things in general use. Gunpowder, the compass, the Arabic numerals and paper, are nowhere spoken of as discoveries, and yet they must have wrought a total change in war, in navigation, in science, and in education. G. Tiraboschi (*Storia della letteratura italiana,* IV. ii. p. 204, *et seq.,* ed. 2, 1788), in support of the conjecture that the compass was introduced into Europe by the Arabs, adduces their superiority in scientific learning and their early skill in navigation. He quotes a passage on the polarity of the lodestone from a treatise translated by Albertus Magnus, attributed by the latter to Aristotle, but apparently only an Arabic compilation from the works of various philosophers. As the terms *Zoron* and *Aphron,* used there to signify the south and north poles, are neither Latin nor Greek, Tiraboschi suggests that they may be of Arabian origin, and that the whole passage concerning the lodestone may have been added to the original treatise by the Arabian translators.

Dr. W. Robertson asserts (*Historical Disquisition concerning Ancient India,* p. 227) that the Arabs, Turks and Persians have no original name for the compass, it being called by them *Bossola,* the Italian name, which shows that the thing signified is foreign to them as well as the word. The Rev. G. P. Badger has, however, pointed out (*Travels of Ludovico di Varthema,* trans. J. W. Jones, ed. G. P. Badger, Hakluyt Soc., 1863, note, pp. 31 and 32) that the name of Bushla or Busba, from the Italian *Bussola,* though common among Arab sailors in the Mediterranean, is very seldom used in the Eastern seas,—*Daïrah* and *Beit el-Ibrah* (the Circle, or House of the Needle) being the ordinary appellatives in the Red Sea, whilst in the Persian Gulf *Kiblah-nāmeh* is in more general use. Robertson quotes Sir J. Chardin as boldly asserting that "the Asiatics are beholden to us for this wonderful instrument, which they had from Europe a long time before the Portuguese conquests," and proceeds to argue that the Arabs had neither instruments nor charts which were not copied from European ones. The observations of Chardin, who flourished between 1643 and 1713, cannot be said to receive support from the testimony of some earlier authorities. That the Arabs must have been acquainted with the compass, and with the construction and use of charts, at a period nearly two centuries previous to Chardin's first voyage to the East, may be gathered from the description given by Barros of a map of all the coast of India, shown to Vasco da Gama by a Moor of Guzerat (about the 15th of July 1498), in which the bearings were laid down "after the manner of the Moors," or "with meridians and parallels very small (or close together), without other bearings of the compass; because, as the squares of these meridians and parallels were very small, the coast was laid down by these two bearings of N. and S., and E. and W., with great certainty, without that multiplication of bearings of the points of the compass usual in our maps, which serves as the root of the others." Further, we learn from Osorio that the Arabs at the time of Gama "were instructed in so many of the arts of navigation, that they did not yield much to the Portuguese mariners in the science and practice of maritime matters." (See *The Three Voyages of Vasco da Gama,* Hakluyt Soc., 1869; note to chap. xv. by the Hon. H. E. J. Stanley, p. 138.) Also the Arabs that navigated the Red Sea at the same period are shown by Varthema to have used the mariner's chart and compass (*Travels,* p. 31).

Again, it seems that compasses of a primitive description, which can hardly be supposed to have been brought from Europe, were employed in the East Indies certainly as early as several years previous to the close of the 16th century, as appears from William Barlowe's *Navigator's Supply,* published in 1597. Bailak Kibdjaki, also, an Arabian writer, shows in his *Merchant's Treasure,* a work given to the world in 1282, that the magnetized needle, floated on water by means of a splinter of wood or a reed, was employed on the Syrian seas at the time of his voyage from Tripoli to Alexandria (1242), and adds:—"They say that the captains who navigate the Indian seas use, instead of the needle and splinter, a sort of fish made out of hollow iron, which, when thrown into the water, swims upon the surface, and points out the north and south with its head and tail" (Klaproth, *Lettre,* p. 57). Furthermore, although the sailors in the Indian vessels in which Niccola de' Conti traversed the Indian seas in 1420 are stated to have had no compass, still, on board the ship in which Varthema, less than a century later, sailed from Borneo to Java, both the mariner's chart and compass were used; it has been questioned, however, whether in this case the compass was of Eastern manufacture (*Travels of Varthema,* p. 249). We have already seen that the Chinese as late as the end of the 18th century made voyages with compasses on which but little reliance could be placed; and it may perhaps be assumed that the compasses early used in the East were mostly too imperfect to be of much assistance to navigators, and were therefore often dispensed with on customary routes. The Arab traders in the Levant certainly used a floating compass, as did the Italians before the introduction of the pivoted needle; the magnetized piece of iron being floated upon a small raft of cork or reeds in a bowl of water. The Italian name of *calamita,* which still persists, for the magnet, and which literally signifies a frog, is doubtless derived from this practice.

The Arabic geographer, Edrisi, who lived about 1100, is said by Boucher to give an account, though in a confused manner, of the polarity of the magnet (Hallam, *Mid. Ages,* iii. 9, part 2); but the earliest definite mention as yet known of the use of the mariner's compass in the middle ages occurs in a treatise entitled *De utensilibus,* written by Alexander Neckam in the 12th century. He speaks there of a needle carried on board ship which, being placed on a pivot, and allowed to take its own position of repose, shows mariners their course when the polar star is hidden. In another work (*De naturis rerum,* ii. 89) he writes,—"Mariners at sea, when, through cloudy weather in the day which hides the sun, or through the darkness of the night, they lose the knowledge of the quarter of the world to which they are sailing, touch a needle with the magnet, which will turn round till, on its motion ceasing, its point will be directed towards the north" (W. Chappell, *Nature,* 1876). The magnetical needle, and its suspension on a stick or straw in water, are clearly described in *La Bible Guiot,* a poem probably of the 13th century, by Guiot de Provins, wherein we are told that through the magnet (*la manette* or *l'amanière*), an ugly brown stone to which iron turns of its own accord, mariners possess an art that cannot fail them. A needle touched by it, and floated by a stick on water, turns its point towards the pole-star, and a light being placed near the needle on dark nights, the proper course is known (*Hist. littéraire de la France,* ix. p. 199; Barbazan, *Fabliaux,* ii. p. 328). Cardinal Jacques de Vitry, bishop of Acon in Palestine, in his *History* (cap. 89), written about the year 1218, speaks of the magnetic needle as "most necessary for such as sail the sea"; and another French crusader, his contemporary, Vincent de Beauvais, states that the adamant (lodestone) is found in Arabia, and mentions a method of using a needle magnetized by it which is similar to that described by Kibdjaki.

In 1248 Hugo de Bercy notes a change in the construction of compasses, which are now supported on two floats in a glass cup. From quotations given by Antonio Capmany (*Questiones Criticas*) from the *De contemplatione* of Raimon Lull, of the date 1272, it appears that the latter was well acquainted with the use of the magnet at sea, and before the middle of the 13th century the poets Gauthier d'Espinois and Guido Guinizzelli allude to the compass needle. Brunetto Latini also makes reference to the compass in his encyclopaedia *Livres dou trésor,* composed about 1260 (I. ii. 120). Dante (*Paradiso,* xii, 28–30) mentions the pointing of the magnetic needle toward the pole star. In Scandinavian records there is a reference to the nautical use of the magnet in the *Hauksbók,* the last edition of the *Landnámabók* (Book of the Colonization of Iceland):—"Floki, son of Vilgerd, instituted a great sacrifice, and consecrated three ravens which should show him the way (to Iceland); for at that time no men sailing the high seas had lodestones up in northern lands."

Haukr Erlendsson, who wrote this paragraph about 1300, died in 1334; his edition was founded on material in two earlier works, that of Styrmir Karason (who died 1245), which is lost, and that of Hurla Thordson (died 1284) which has no such paragraph. All that is certain is a knowledge of the nautical use of the magnet at the end of the 13th century. From T. Torfaeus we learn that the compass, fitted into a box, was already in use among the Norwegians about the middle of the 13th century (*Hist. rer. Norvegicarum,* iv. p. 345, Hafniae, 1711); and it is probable that the use of the magnet at sea was known in Scotland at or shortly subsequent to that time, though King Robert, in crossing from Arran to Carrick in 1306, as Barbour writing in 1375 informs us, "na nedill had na stane," but steered by a fire on the shore. Roger Bacon (*Opus majus* and *Opus minus,* 1266–1267) was acquainted with the properties of the lodestone, and wrote that if set so that it can turn freely (swimming on water) it points toward the poles; but he stated that this was not due to the pole-star, but to the influence of the northern region of the heavens.

The earliest unquestionable description of a pivoted compass is that contained in the remarkable *Epistola de magnete* of Petrus Peregrinus de Maricourt, written at Lucera in 1269 to Sigerus de Foncaucourt. Of this work twenty-eight mss. exist; seven of them being at Oxford. The first part of the epistle deals generally with magnetic attractions and repulsions, with the polarity of the stone, and with the supposed influence of the poles of the heavens upon the poles of the stone. In the second part Peregrinus describes first an improved floating compass with fiducial line, a circle graduated with 90 degrees to each quadrant, and provided with movable sights for taking bearings. He then describes a new compass with a needle thrust through a pivoted axis, placed in a box with transparent cover, cross index of brass or silver, divided circle, and an external "rule" or alhidade provided with a pair of sights. In the Leiden ms. of this work, which for long was erroneously ascribed to one Peter Adsiger, is a spurious passage, long believed to mention the variation of the compass.

Prior to this clear description of a pivoted compass by Peregrinus in 1269, the Italian sailors had used the floating magnet, probably introduced into this region of the Mediterranean by traders belonging to the port of Amalfi, as commemorated in the line of the poet Panormita: "Prima dedit nautis usum magnetis Amalphis." This opinion is supported by the historian Flavius Blondus in his *Italia illustrata,* written about 1450, who adds that its certain origin is unknown. In 1511 Baptista Pio in his *Commentary* repeats the opinion as to the invention of the use of the magnet at Amalfi as related by Flavius. Gyraldus, writing in 1540 (*Libellus de re nautica*), misunderstanding this reference, declared that this observation of the direction of the magnet to the poles had been handed down as discovered "by a certain Flavius." From this passage arose a legend, which took shape only in the 17th century, that the compass was invented in the year 1302 by a person to whom was given the fictitious name of Flavio Gioja, of Amalfi.

From the above it will have been evident that, as Barlowe remarks concerning the compass, "the lame tale of one Flavius at Amelphus, in the kingdome of Naples, for to have devised it, is of very slender probabilitie"; and as regards the assertion of Dr. Gilbert, of Colchester (*De magnete,* p. 4, 1600), that Marco Polo introduced the compass into Italy from the East in 1260, we need only quote the words of Sir H. Yule (*Book of Marco Polo*): "Respecting the mariner's compass and gunpowder, I shall say nothing, as no one now, I believe, imagines Marco to have had anything to do with their introduction."

When, and by whom, the compass card was added is a matter of conjecture. Certainly the *Rosa Ventorum,* or *Wind-rose,* is far older than the compass itself; and the naming of the eight principal "winds" goes back to the Temple of the Winds in Athens built by Andronicus Cyrrhestes. The earliest known wind-roses on the *portulani* or sailing charts of the Mediterranean pilots have almost invariably the eight principal points marked with the initials of the principal winds, Tramontano, Greco, Levante, Scirocco, Ostro, Africo (or Libeccio), Ponente and Maestro, or with a cross instead of L, to mark the east point. The north point, indicated in some of the oldest compass cards with a broad arrowhead or a spear, as well as with a T for Tramontano, gradually developed by a combination of these, about 1492, into a *fleur de lis,* still universal. The cross at the east continued even in British compasses till about 1700. Wind-roses with these characteristics are found in Venetian and Genoese charts of early 14th century, and are depicted similarly by the Spanish navigators. The naming of the intermediate subdivisions making up the thirty-two points or rhumbs of the compass card is probably due to Flemish navigators; but they were recognized even in the time of Chaucer, who in 1391 wrote, "Now is thin Orisonte departed in xxiiii. partiez by thi azymutz, in significacion of xxiiii. partiez of the world: al be it so that ship men rikne thilke partiez in xxxii." (*Treatise on the Astrolabe,* ed. Skeat, Early English Text Soc., 1872). The mounting of the card upon the needle or "flie," so as to turn with it, is probably of Amalphian origin. Da Buti, the Dante commentator, in 1380 says the sailors use a compass at the middle of which is pivoted a wheel of light paper to turn on its pivot, on which wheel the needle is fixed and the star (wind-rose) painted. The placing of the card at the bottom of the box, fixed, below the needle, was practised by the compass-makers of Nuremberg in the 16th century, and by Stevinus of Bruges about 1600. The gimbals or rings for suspension hinged at right-angles to one another, have been erroneously attributed to Cardan, the proper term being *cardine,* that is hinged or pivoted. The earliest description of them is about 1604. The term *binnacle,* originally *bittacle,* is a corruption of the Portuguese *abitacolo,* to denote the housing enclosing the compass, probably originating with the Portuguese navigators.

The improvement of the compass has been but a slow process. *The Libel of English Policie,* a poem of the first half of the 15th century, says with reference to Iceland (chap. x.)—

> Out of Bristowe, and costes many one,
> Men haue practised by nedle and by stone
> Thider wardes within a litle while.
> (Hakluyt, *Principal Navigations,* p. 201, 1599).

From this it would seem that the compasses used at that time by English mariners were of a very primitive description. Barlowe, in his treatise *Magnetical Advertisements,* printed in 1616 (p. 66), complains that "the Compasse needle, being the most admirable and useful instrument of the whole world, is both amongst ours and other nations for the most part, so bungerly and absurdly contrived, as nothing more." The form he recommends for the needle is that of "a true circle, having his Axis going out beyond the circle, at each end narrow and narrower, unto a reasonable sharpe point, and being pure steele as the circle it selfe is, having in the middest a convenient receptacle to place the capitell in." In 1750 Dr. Gowan Knight found that the needles of merchant-ships were made of two pieces of steel bent in the middle and united in the shape of a rhombus, and proposed to substitute straight steel bars of small breadth, suspended edge-wise and hardened throughout. He also showed that the Chinese mode of suspending the needle conduces most to sensibility. In 1820 Peter Barlow reported to the Admiralty that half the compasses in the British Navy were mere lumber and ought to be destroyed. He introduced a pattern having four or five parallel straight strips of magnetized steel fixed under a card, a form which remained the standard admiralty type until the introduction of the modern Thomson (Kelvin) compass in 1876. (*See* also NAVIGATION; TERRESTRIAL MAGNETISM.) (F. H. B.; S. P. T.)

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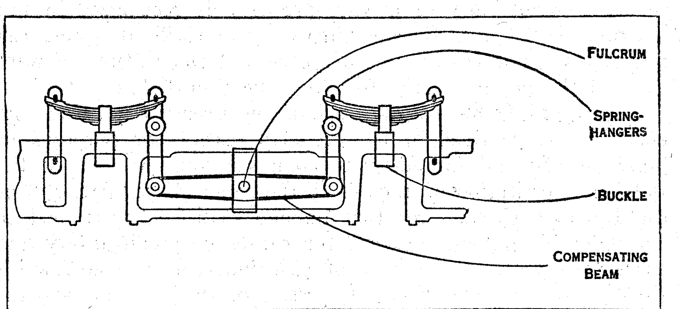
COMPASS PLANT, a native of the interior of North American prairies, which takes its name from the position assumed by the leaves. These turn their edges approximately to north and south, thus avoiding the excessive midday heat, while getting the full benefit of the morning and evening rays. The compass plant (*Silphium laciniatum*), called also pilot-weed and rosin-weed, belongs to the family Compositae. Another member of the same family, *Lactuca Scariola,* which has been regarded as the parent species of the cultivated lettuce (*L. sativa*), behaves in the same way when growing in dry exposed places; it is a native of Europe and northern Asia which has been widely introduced into North America.

COMPAYRÉ, JULES GABRIEL (1843–1913), French educationalist, was born at Albi on Jan. 2, 1843, and died on Feb. 24, 1913, in Paris. After holding various educational appointments he became in 1881 deputy for Lavaur in the chamber, and took an active part in the discussions on public education. Defeated at the elections of 1889, he was appointed rector of the Academy of Poitiers in 1890, and five years later to the Academy of Lyons. His principal publications are his *Histoire critique des doctrines de l'éducation en France* (1879); *Éléments d'éducation civique* (1881), a work placed on the index at Rome, but very widely read in the primary schools of France; *Cours de pédagogie théorique et pratique* (1885, 13th ed., 1897); *L'évolution intellectuelle et morale de l'enfant* (1893); and a series of monographs on *Les Grands Éducateurs.*

COMPENSATING BEAM. The name given to a lever which connects mechanical actions in such a manner as to provide an equalizing effect, or else causes synchronization of movements.



SKETCH OF A COMPENSATING BEAM IN AN AMERICAN LOCOMOTIVE
Applied to the axle box springs, and pivoted by pins through the fulcrum blocks, it equalizes the pressures, thus minimizing shocks due to running on uneven road beds

The principal example is that extensively applied to the axle-box springs of locomotives, particularly in countries where the roads are rather uneven. Injurious jerks and shocks are transmitted by the constantly varying loads on the respective axles. But if a lever is pivoted at the centre of its length, and the ends attached to the ends of the hangers of two springs, the result will be an equalization of the loads. These beams are variously fitted, in some locomotives between the driving-wheel springs, in others also between a rear driving-wheel set and those of a trailing axle, while compensation between the springs of leading driving-wheels and those of a pony truck is often made. The pivoting of the beam may be by holes and pins through the fulcrum blocks, or else the beam has half-circles cut out for the pivot or, rather, roller pins. The former arrangement is depicted in the drawing from an American locomotive. Some designs of central buffers embody a compensating beam to obviate uneven working.

COMPENSATION, a term applied in English law to a number of different forms of legal reparation; *e.g.,* under the Forfeiture Act 1870 (s.4), for loss of property caused by felony, or—under the Riot (Damages) Act 1886—to persons whose property has been stolen, destroyed, or injured by rioters (*see* RIOT). It is due, under the Agricultural Holdings Act 1883-1906, for agricultural improvements (*see* LANDLORD AND TENANT; *cf.* also ALLOTMENTS and SMALL HOLDINGS); under the Workmen's Compensation Act 1906 to workmen, in respect of accidents in the course of their employment (*see* WORKMEN'S COMPENSATION). Under the Licensing Act 1904, it is payable on the extinction of licences to sell intoxicants; under the Government Obligations Acts 1914 to 1916, for damage to property resulting from hostile action; under the Workmen's Compensation (Illegal Employment) Act 1918, for injuries which have been sustained by workmen in certain cases of illegal employment; under the Allotments Act 1922, to tenants for growing crops; and under the Landlord and Tenant Act 1927, for improvements and goodwill to tenants of business premises.

Compensation, in its most familiar sense, is a legal term for the reparation or satisfaction made to the owners of property which is taken by the State or by local authorities or by the promoters of public utilities under statutory authority.

The right of individual ownership had, up to quite recent times, one exception, viz., slavery. Men were free or unfree. The latter, in law, had no rights, but the former could dispose freely of their persons and of their property. This right of individual ownership has recently been challenged in Russia, which has abolished the right to private property, and has expropriated it for alleged public purposes without compensation. To a large extent, however, the U.S.S.R. has been compelled to reverse this policy and to recognize the right of individual ownership. Its example was followed by most of the Succession States which arose as a result of the World War. Influenced by the wave of communism which almost overwhelmed them, these States in the name of agrarian reform have expropriated private landowners either with inadequate compensation or with none at all. It is alleged that although individual ownership is one of the fundamental rights according to natural law or morality, it possesses no juridical basis. It may, however, be stated with confidence that the inviolability of private property is recognized in (1) the municipal law of the great majority of civilized states; (2) international law (*a*) in time of peace and (*b*) in time of war; and (3) the Peace Treaties following the World War.

Municipal Law—By Art. 545 of the French Civil Code, no one may be deprived of his property except for purposes of public utility and for adequate compensation. Art. 11 of the Belgian Constitution of 1893 is to the same effect. Art. 438 of the Italian Code declares that no one shall be constrained to surrender his property, except for causes of public utility and subject to *previous* payment of just indemnity. The Spanish Code is to the same effect. By Art. 3 of the Law of 1879 expropriation must be preceded by (1) declaration of public utility, (2) declaration that the whole or part of the land is indispensably required, (3) a just valuation, and (4) payment of the compensation. The provisions for the protection of private property in most of the South American republics are similar, with the addition borrowed from the United States that no one may be deprived thereof without due process of law. By Art. 153 of the Constitution of the German Federation property is guaranteed. Expropriation is admissible only in the public interest and so far as authorized by law. Adequate compensation must be given unless a federal law otherwise determines. Expropriation by the Federal Government as against States, local communities and associations serving public interests is permitted only if accompanied by compensation. By Art. 80 of the Danish Constitution; Art. 625 of the Netherlands Civil Code; Art. 104 and 105 of the Constitution of Norway, and others, the same principles of inviolability and compensation are also recognized.

In England it used to be said that the Crown is entitled by its prerogative to take the property of the subject without compensation; but this is not borne out either by the judicial decisions or by the practice of the executive. By Magna Carta, ch. 39, "no freeman shall be deprived of his freehold"; by the Petition of Right, "the ancient and undoubted right of every freeman is that he hath a full and absolute property in his goods and estate"; and by the Bill of Rights, "whereas by the common law and statutes every freeman hath a proprietie in his goods and estate." In the *Case of the King's Prerogative in Saltpetre* (1606), although it was held that the king might dig for saltpetre in land of a subject for the defence of the realm, nothing was said about compensation. In *X's Petition of Right* (1915) 3 K.B. 649, Avory J. held that the king by virtue of his prerogative was entitled to take possession of land for the defence of the realm without compensation. This decision was affirmed by the Court of Appeal, but in *De Keyser's Royal Hotel, Ltd.* v. *The King* (1920) A.C. 508, where the Crown claimed to take property for administrative purposes without compensation, the Court of Appeal ordered an examination of the records to be made, from which it appeared that from a very early period—1492—to modern times the Crown had never taken a subject's land without paying for it, and that there was no trace of any claim by the Crown to such a prerogative. It was further held that where a matter within the prerogative is provided for by statute the prerogative is merged in the Crown, and that by the Defence Act 1842 provision is made for payment of compensation "either for the absolute purchase thereof or for the possession of the use thereof during such time as the exigence of the public service shall require." This decision was affirmed by the House of Lords, which held, *inter alia,* that the Crown had no power to take possession of the premises in right of its prerogative *simpliciter,* and that the suppliants were entitled to compensation under the Act of 1842. In the later case of *France, Fenwick & Co., Ltd.* v. *The King* (1926) 43 T.L.R. 18, Wright J. said, "I shall assume that the Crown has no right at common law to take a subject's property for reasons of State without paying compensation." Thus it is a well established principle of English law that when the Crown takes the property of a subject the dispossessed owner is, as of right, entitled to full compensation. Where land is taken by the Crown, by local authorities, or by promoters of undertakings under statutory authority the amount of compensation is determined by agreement or by arbitration under the provisions of the Land Clauses Act 1845 and the Land Clauses Consolidation Act 1860. Similar Acts have been enacted in Scotland, India, and most of the Colonies. Compensation is also payable for land compulsorily acquired under numerous statutes, *e.g.,* Acquisition of Land (Assessment of Compensation) Acts 1919; Housing Act 1923; Public Health Act 1925; Town Planning Act 1925, and Housing Act 1925.

International Law.—The principle of the inviolability of private property has long been recognized by international jurists and publicists. It has been applied both in time of peace and in time of war, and has been embodied in numerous treaties.

It is a general rule of international law that private rights and private property to whomsoever belonging are not affected by the conquest, annexation, or cession of the territory in which they are situate. This fundamental right has been judicially affirmed in the United States in numerous cases, *e.g., U.S.* v. *Percheman,* 7 Peters 51 (1883). Apart from treaties it has long been recognized, first that a State is entitled to protect its subjects in another State from injury to their property resulting from measures in the application of which there is *discrimination* between them and the subjects of such other State; and secondly, that a State is entitled to protect its subjects in another State from *injustice* at the hands of such other State even though the measure complained of is applied equally to the subjects of such State. "A sovereign," said the American secretary of state, Frelinghuysen, in 1885, "who departs from the principles of public law cannot find excuse therefore in his own municipal code."

It is probably true to say that down to the end of the 16th century all enemy property, public or private, found by a belligerent within his territory at or after the outbreak of hostilities was liable to seizure and confiscation. Private property of immediate use in war is still liable to seizure, but is now subject to an obligation of restitution or, if it has been destroyed or consumed, of payment of its value. With regard to private property of other kinds there has in practice been gradual mitigation of confiscation, until all property, whether land or goods, and choses in action, such as debts and credits, enjoyed immunity from confiscation. Since the beginning of the 19th century we find only two instances of confiscation. One was the confiscation of property of British subjects found in Denmark in 1807—for which there had been no precedent for more than a century—and the other the decree issued in 1861 by the Southern Confederacy during the American Civil War confiscating all property of whatsoever kind except public stocks and securities held by alien enemies. According to the Continental theory immunity is obligatory, subject only to such qualifications as may be imposed by military necessity or public emergency; whilst the Anglo-American theory recognizes a right of confiscation, subject to a general policy of immunity. In their practical application each would permit confiscation in exceptional circumstances, such as public necessity or by way of reprisal, whilst, apart from such exceptions, each would recognize immunity. See *Brown* v. *United*

States, 8 Cranch, 110 (1814); *In re Ferdinand Ex-Tsar of Bulgaria* (1921), 1 Ch. 107. Upon the outbreak of the World War none of the belligerents attempted to confiscate enemy private property. On the contrary measures were adopted by all of them for its safe custody.

Treaties.—The principle of the inviolability of private property was embodied in the Peace Treaties concluded during and after the World War. Thus the Brest-Litovsk Peace Treaty of March 3, 1918, declared that it was not permissible to expropriate property rights without adequate compensation. This principle was expressly recognized in the Peace Treaties of Versailles, St. Germain-en-Laye, Trianon and Neuilly. It is true that liquidation of enemy private property within their own territories was granted to the Allied and Associated Powers. The property, however, was not confiscated, but its value credited to the reparation account of the conquered State. There was no intention to confiscate, although as a rule confiscation resulted, through the failure of the conquered States to compensate their own nationals in accordance with the terms of the Treaties. Further the property rights and interests of former enemy nationals in the Succession States are protected by express provisions in the treaties. If such rights and interests are expropriated or interfered with, the amount of compensation or damages is to be determined by the Mixed Arbitral Tribunals which have been established by the treaties (*see* the Vienna Report, International Law Association, 1927). (H. H. L. B.)

United States.—The fifth amendment to the U.S. Constitution provides that "no person shall be . . . deprived of life, liberty or property without due process of law; nor shall private property be taken for public use without just compensation." This amendment is construed as limiting the power of the Federal Government alone. The 14th amendment, however, applies to the States, and while it contains no clause specifically requiring just compensation when property is taken for a public use, such a requirement is none the less assumed to be implied in the clause that no State shall "deprive any person of life, liberty or property without due process of law." Property rights, however, are not "inviolable" in any absolute sense. The Supreme Court said, in sustaining the emergency rent laws of the District of Columbia in 1921—"The fact that tangible property is also visible tends to give rigidity to our conception of our rights in it that we do not attach to others less concretely clothed. But the notion that the former are exempt from the legislative modification required from time to time in civilized life is contradicted not only by the doctrine of eminent domain, under which what is taken is paid for, but by that of the police power in its proper sense, under which property rights may be cut down, and to that extent taken, without pay. Under the police power the right to erect buildings in a certain quarter of a city may be limited to from eighty to one hundred feet. *Welch* v. *Swasey,* 214 U.S. 91. Safe pillars may be required in coal mines. *Plymouth Coal Co.* v. *Pennsylvania,* 232 U.S. 531. Billboards in cities may be regulated. *St. Louis Poster Advertising Co.* v. *St. Louis,* 249 U.S. 269. Watersheds in the country may be kept clear. *Perley* v. *North Carolina,* 249 U.S. 511. These cases are enough to establish that a public exigency will justify the legislature in restricting property rights in land to a certain extent without compensation. . . . The only matter that seems to us open to debate is whether the statute goes too far. For just as there comes a point at which the police power ceases and leaves only that of eminent domain, it may be conceded that regulations of the present sort pressed to a certain height might amount to a taking without due process of law . . ." (*Block* v. *Hirsh,* 256 U.S. 135). Where eminent domain (*q.v.*) is the power used, money compensation must be given, equivalent in general to what the owner loses. The concept is at times ambiguous and is generally said to call for the market value of the property, although that, too, is at times ambiguous and it may sometimes fail to protect the expropriated owner from loss, as in *Banner Milling Co.* v. *State* (240 N.Y. 533, *certiorari* denied, 269 U.S. 582, 1925), where compensation did not include loss due to the cost of moving the business or interrupting its good will. (R. L. Ha.)

COMPENSATION INSURANCE: *see* WORKMEN'S COMPENSATION.

COMPETITION FESTIVALS: *see* FESTIVALS, MUSICAL.

COMPETITION IN INDUSTRY. According to doctrines evolved in the course of the eighteenth century and formulated by economists from Quesnay to Adam Smith, the well-being of a community is better served by leaving the individual free to manage his own affairs in his own way in the light of what he conceives to be his own interest than by subjecting him to interference by even the best intentioned government. Left to his own devices under conditions of economic freedom the individual will find his greatest gain in furnishing those goods or services for which there is most demand, and will, in the long run, find little profit in exacting a price much higher than his total expense of production. During the course of the Industrial Revolution these doctrines gained general acceptance, and, by the middle of the 19th century, the beneficially self-impelling and self-regulating nature of the economic order was widely held as an article of faith, to be reinforced a little later by the application to human affairs of what was popularly understood to be the Darwinian theory of progress, proceeding by a struggle for existence in which the least fit go under and the most fit survive.

The outlook of the 19th century upon the economic order came therefore to be increasingly dominated by the view that supplies, prices, profits, and wages were best left to look after themselves. Let the State give no privileges and set no impediments, let it be content to make the rules, let it leave the business world to its own devices, and competition would ensure that all would be for the best. The desire for gain would urge each to maximum effort; and competition would harmonize supplies and requirements, would ensure that the level of wages, prices, and profits were about what they ought to be, and would make for the elimination of the less fit economic unit and the survival of the more fit—the better placed, the more energetic, the more adaptable.

Law of Competition.—The "law of competition" under which, in conditions of economic freedom, these eminently desirable results achieve themselves may be set out crudely as follow:—(a) whenever demand grows in proportion to supply, competition between would-be buyers sends up the price; (b) a relatively high price spells a relatively large profit; (c) a relatively large profit attracts capital and enterprise to the industry; (d) supplies increase; (e) competition between sellers brings down the price until it barely covers production expense including a normal profit: whenever supply grows in proportion to demand, (a) prices fall; (b) profits shrink; (c) the weaker producers drop out of business leaving the stronger to carry on; (d) supplies contract; (e) profits rise to normal; and the cycle begins afresh.

Similarly, wages tend to find their own "natural" level in the competition of employers for workpeople and of workpeople for the best-paid employment.

What was not sufficiently realized by those who pinned their economic faith to the "law of competition" was that the law will operate completely and effectively only where a condition of perfect economic freedom prevails and where buyers and sellers have the widest knowledge of present and prospective demands, supplies, and prices. A condition of economic freedom demands something more than non-interference on the part of the State; it demands the free access of buyers to sellers and the absence of all action in restraint of free competition on the part of those engaged in industry. At no time has such a condition prevailed over the whole of industry and trade. It was probably most nearly reached in the first half of the 19th century when, following upon the great inventions, the improvement in transport, and the extension of joint-stocks financing, new enterprises sprang up and offered their wares with a minimum of collusion over extensive areas; but even then economic freedom was far from perfect. And it was to become steadily less so. By the 'seventies or 'eighties a new "law" began to force itself on the attention of the economic world; the law that "competition begets combination." However natural competition may be, it is not in human nature that several sellers should go on undercutting each other to the advantage of buyers when by agreement between themselves they can establish a higher price or control the common output and so keep prices above the competitive level. It is this second "law" that has already come to engage the attention of governments in many countries and is likely to constitute one of the major problems of government for many generations to come.

None the less, competition still prevails over wide areas of trade and industry, and in examining the nature and governance of demand, supply, and price, it is still convenient first to assume free competition and then to enquire into the extent to which the limitation of competition by external circumstance or by the deliberate action of interested parties nullifies the conclusions reached.

Kinds of Competition.—Competition is not necessarily to be identified with harshness or aggression. A common form of competition between producers or sellers is competition *in service*. The grocer "serves" his customers, and if he can "serve" them more acceptably than the rival grocer in the next street he will increasingly attract their custom. He cannot thereby be considered as displaying a ruthless attitude towards his rival. The grocer in the next street may be a very good fellow, and it may be pitiable that his business should decline, but the increasingly patronized grocer would find little moral justification for relaxing, on that account, his efforts to serve his customers well. His highest obligation is to do as well as he can that to which he has set his hand. If both were class-conscious members of a Grocers' Trade Union, the stronger might go easy with his service in order not to set a standard which would force the pace of the weaker; but to sacrifice service to loyalty is only to forsake one virtue for another—not necessarily higher. The more successful grocer may in human fellowship give his rival a hand in improving his service and so acquire double merit, but the fact that rivals do not universally do so reflects not upon competition but upon human nature.

The creative competition which centres upon the rendering of better service, even though it leaves the weakest to go to the wall and the hindmost to the devil, is in itself honourable and beneficial. In this respect it commonly differs from competition not of service but of injury. If the prospering grocer, not content with excelling by service, sets himself deliberately to injure his rival's business—by blocking his sources of supply, by selling goods below cost until the rival is driven from the field, or by false advertising,—the morality and social advantage of his proceeding become highly questionable. Such aggressive competition aimed at the injury of a rival may be defended with much plausibility on the ground that it merely speeds up the process of weeding out the inferior, and the argument might be acceptable if it were true that the power of aggression is always a measure of fitness to serve. To assume that such is the case is, however, just as dubious as to claim that the competitor in a footrace who gained first place by doping or bludgeoning his rivals was necessarily the best runner. One of the commonest types of competition pertains to quality and price. Each competitor endeavours either to sell the same article at a price lower than that quoted by his rival, or a better article at the same price. Such competition is commonly aided by informative advertising—a device which helps the average person to satisfy his wants more cheaply, more satisfactorily, and far more easily than if this method of broadcasting information did not exist. In this connection, the fact should be noted that, to justify the advertising of an article on a wide scale, it must be of such a quality as to satisfy the desires of those who purchase it.

Wastefulness of Competition.—In so far as advertising fails to increase knowledge concerning the quality and availability of goods, but merely induces buyers to shift their purchasing without gain to themselves, it represents a waste of materials and human effort. The degree to which such waste occurs is a matter of dispute.

Aggressive competition often expends effort in nugatory combat which might much more beneficially be given to improving and cheapening method, process, and product. Undercutting among rival manufacturers may lead to goods being sold at "cut-throat" prices; but the price may none the less be higher than it might be if the individual firms were in friendly communication or if the manufacture were concentrated in a few, instead of spread over many, establishments. Competitive production often means a wasteful duplication of activity and plant; it results in each firm working out its technical and commercial problems without help from the others; it allows each manufacturer to go in for many varieties and patterns and to specialize in none; it leaves each firm to buy in small quantities, to market in small parcels, and to carry separate stocks. It leads to needless multiplication of shops of all types, with the result that most shopkeepers make but a meagre livelihood, and far too many persons are diverted to the mercantile field when they would benefit society more by working in other industries. Thus, competition may stimulate the will to serve and yet deny the means. For these reasons goods produced under a régime of free competition may be dear even though the competing producers are making less than a living profit.

One of the most serious defects of the competitive system in an advanced industrial order arises out of the time lag between the decision to produce and actual production; coupled with lack of knowledge, intensified, may be, by deliberate secretiveness, as to what others may be planning to do. Even in primary agricultural production a season will elapse between seedtime and harvest; a decade may elapse between planting and fruit-bearing; and a temporary shortage may induce many, unknown to each other, to sow or plant for the production of what is momentarily scarce and dear; with the result that the eventual yield is inordinate, the glut leads to low prices and waste, each separate cultivator decides to plant anything rather than what he overplanted before, and shortage comes again.

In manufacture, the same process is to be observed. If the cotton trade is prosperous a score of enterprisers may decide to build new mills with the object of partaking in the current prosperity, none reckoning on the action of his fellow, but more than a season will elapse between the forming of a company and the production of the first bale of cloth, and, by then, circumstances that made the boom may have passed away, and into the very depths of the slump may be poured the products of a score of new mills. In this respect the case of manufacture is worse than the case of agriculture. The cotton factory remains, useless for anything but textile production, and in the effort of redundant factories merely to keep going, at whatever loss, a whole industry may be brought to a ruinous condition which may endure until some of the weaker factories have to close down, thereby reducing supplies and allowing prices to rise again. Fluctuation is inherent in all economic competition, and violent in "blind" competition, but, where business men are well informed as to the state and prospects of the market and the action and plans of their competitors, its extent may be lessened somewhat.

Informed and Uninformed Competition.—In the United States, where concerted action in restraint of competition is forbidden by law, the substitution of informed for uninformed competition has made marked progress. Not only is business information issued on a voluminous scale by the Government and by private agencies, but associations of firms in the same line of industry collect information as to enquiries, quotations, orders, stocks, etc., from members, and issue digests of the information to contributing members. The legality of such activities under the Anti-Trust laws, particularly when they relate to prices or output, is, however, doubtful. (*See* ASSOCIATIONS, INDUSTRIAL.)

Hindrances to Free Competition.—The chief obstacles which prevent competition from operating effectively may be classified under three heads, namely custom, monopoly, and governmental interference. Custom interferes in many ways with the free play of competitive forces. For example, farm rents in a whole community are often set at a definite share of the crop, regardless of the quality of the land. Merchants mark up the prices of their goods by customary percentages, ignoring the state of trade. Common labour commands a customary wage despite striking differences in the efficiencies of individual workers.

For centuries, monopoly, either complete or partial, has limited the realm of competition. Nothing is more natural than for competitors to get together and agree to fix prices, curtail production, divide up territory, and drive out competitors by fair means or foul. Improvement in means of communication and growth of large-scale enterprise has facilitated the extension of monopoly. The 19th century witnessed a widespread development of powerful monopolistic labour unions which, by raising wage rates unduly, have seriously curtailed opportunities for employment. Similarly, huge manufacturing concerns have adopted the policy of maintaining selling prices in the face of falling demand, and have thus necessarily brought about a decline in production and accentuated depression. Governments have long interfered with competition by fostering monopolies, levying tariff duties, fixing wage rates, and placing numerous restrictions upon the freedom of enterprise.

In most nations, the 20th century has seen a great increase in such interference.

Despite its wastefulness and weaknesses, most economists agree that no other economic system has as yet been able to turn out an average volume of product per man-hour even approaching that produced under a system of free competition.

The enormous quantity and variety of goods thrown upon the markets of the world during the period in which competition has been in the ascendant affords sufficient proof that individualism is a potent conjuror of worldly goods. Furthermore, competition is socially beneficial in another way as well, for it provides a zest that might otherwise be lacking in industrial endeavour. The presence of an avowed trade enemy, the sense of danger, the imperative need for keeping in fighting trim have produced in the past qualities of alertness, vigour, and self-reliance which the more amiable objective of service might not have fostered so keenly. The type of character produced by these influences may not be wholly admirable, but it is at any rate strong and forceful and it is a commonplace that very many of those who are eminent in the new sphere of service by combination acquired their ability and strength in an environment of competitive struggle. (J. H.; W. I. K.)

COMPIÈGNE, a town of northern France, capital of an arrondissement, department of Oise, 52 mi. N.N.E. of Paris, famous for its château, park and forest. Pop. (1936) 17,929. The town, which is a favourite summer resort, stands on the northwest border of the forest of Compiègne and on the left bank of the Oise, near its confluence with the Aisne. The river is crossed by a bridge built in the reign of Louis XV.

Compiègne (*Compendium*) seems originally to have been a hunting lodge of the early Frankish kings. It was enriched by Charles the Bald with two castles, and a Benedictine abbey dedicated to Saint Corneille, the monks of which retained down to the 18th century the privilege of acting for three days as lords of Compiègne, with full judicial privileges. It was in Compiègne that King Louis I the Debonair was deposed in 833; and at the siege of the town in 1430 Joan of Arc was taken prisoner by the English. A monument to her faces the hôtel de ville. The treaty of Compiègne, between Richelieu and the Dutch, was signed there in 1624. In 1814 Compiègne offered a stubborn resistance to the Prussian troops. Under Napoleon III it was the annual resort of the court during the hunting season. From 1870 to 1871 it was one of the headquarters of the German army. The town was again occupied by the Germans in 1914, and was bombarded in 1918, but most of the older buildings escaped serious injury.

The hôtel de ville, with a graceful façade surmounted by a lofty belfry, is late Gothic (early 16th century). Of the churches, St. Antoine (13th and 16th centuries) has some fine Renaissance stained glass, and St. Jacques dates from the 13th and 15th centuries. The remains of the ancient abbey of St. Corneille are used as a military storehouse. Compiègne, from a very early period until 1870, was the occasional residence of the French kings. Its magnificent palace (château), now an art museum, was erected chiefly by Louis XV and restored by Napoleon I. It has two façades, one overlooking the town, the other facing toward a fine park and the forest (55 sq.mi.), which is chiefly of oak and beech and was formerly considered one of the strategic defenses of Paris.

Compiègne is the seat of a subprefect, and has tribunals of first instance and of commerce. The industries comprise boatbuilding, ropemaking, cooperage and copper and iron founding. Asparagus is cultivated in the environs. There is river-borne trade in timber and coal.

COMPLEMENT, that which fills up or completes anything, *e.g.*, the number of men necessary to man a ship (Lat. *complere*, to fill up). In general the complement of an entity is that which with the given entity makes up a whole. In geometry the complement of an angle A is that angle which when added to A makes a right angle.

In the theory of aggregates the complement of an aggregate S is the aggregate which remains when S is taken away from the aggregate U which forms the domain of discourse. Two colours which produce white when mixed are called *complementary colours*.

(See COLOUR.) (L. M. G.)

COMPLEMENTARY COLOURS, any two *colours* which together produce white light are said to be complementary colours. (*See* COLOUR.)

COMPLEX NUMBERS. Since certain algebraic equations such as $x^2+1=0$ have no solutions in real numbers, early mathematicians were led to consider purely formal solutions involving square roots of negative numbers.

Thus Heron of Alexandria (*c.* A.D. 100) obtained the solution $\sqrt{-63}$, and Girolamo Cardan (1545) wrote $40=(5+\sqrt{-15})(5-\sqrt{-15})$. These numbers were considered to be quite meaningless, and the term *imaginary* was applied to them.

Geometric Representation.—If i is by definition a solution of the equation $x^2+1=0$, numbers of the form $a+bi$ where a and b are real are called *complex* (Karl Friedrich Gauss, 1832). The modern development of complex numbers began with the discovery of a geometric interpretation for them. This was indistinctly set forth by John Wallis (1685), and in completely satisfactory form by Caspar Wessel (1799).

Wessel's work received no attention, and the geometric interpretation was rediscovered by Jean Robert Argand (1806) and again by Gauss (1831). It is frequently called the *Argand diagram* (fig. 1).

Just as the real numbers represent points on a line, the complex numbers can be put into correspondence with the points on a plane. The multiples of i are called *purely imaginary* numbers and are plotted as points on the imaginary axis perpendicular to the axis of reals at the o-point. Then the number $a+bi$ corresponds to the point P where OP is the diagonal of the rectangle whose sides are a and bi. If $a+bi$ is multiplied by -1, its corresponding line or *vector* OP is rotated through 180°. Similarly if $a+bi$ is multiplied by i, its vector is rotated through 90°. Thus two successive multiplications by i produce the same effect as one multiplication by -1, so that in this sense $i^2=-1$.

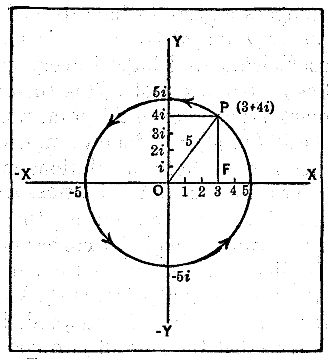


FIG. 1.—THE COMPLEX NUMBER

Logical Justification. The first satisfactory introduction of the complex numbers was given by Sir William Rowan Hamilton (*Trans. Royal Irish Acad.*) in 1835, although Gauss afterwards stated that the same idea had occurred to him in 1831.

Consider the set of all ordered couples $\alpha=(a_1, b_1)$, $\beta=(a_2, b_2)$, . . . of real numbers where $\alpha=\beta$ means that $a_1=a_2$ and $b_1=b_2$. Define the operations of addition and multiplication of couples by the equations

$$\alpha+\beta=(a_1+a_2,\ b_1+b_2),\ \alpha\beta=(a_1a_2-b_1b_2,\ a_1b_2+a_2b_1).$$

It can easily be shown that these couples combine according to the following rules:

$$\alpha+(\beta+\gamma)=(\alpha+\beta)+\gamma, \qquad \alpha(\beta\gamma)=(\alpha\beta)\gamma,$$
$$\alpha+\beta=\beta+\alpha, \qquad \alpha\beta=\beta\alpha,$$
$$\alpha(\beta+\gamma)=\alpha\beta+\alpha\gamma.$$

The couples of the form $(a,0)$ form a subset of the set of all couples which is abstractly identical with the set of real numbers. If $(a,0)$ corresponds to a, and $(b,0)$ corresponds to b, then $(a,0)+(b,0)$ corresponds to $a+b$, and $(a,0)\times(b,0)$ corresponds to ab. In this sense the real numbers are contained among these couples, and we may write $(a,0)=a$. In particular, $(0,0)=0$ and $(1,0)=1$. If k is real, $k(a,b)=(ka,kb)$. For every couple α, $\alpha+0=\alpha$ and $\alpha\times 1=\alpha$. For every $\alpha=(a,b)$ there is a couple $-\alpha=(-a,-b)$ such that $\alpha+(-\alpha)=0$; and for every $\alpha\neq 0$ there is a couple $1/\alpha=(a/(a^2+b^2),\ -b/(a^2+b^2))$ such that $\alpha\times(1/\alpha)=1$.

Thus the couples form a *number field.* All of the other rules of arithmetic which are valid for all fields are consequences of those enumerated. If one denotes the couple $(0,1)$ by the letter i, then $i^2=-1$ and

$$\alpha=(a,b)=a+bi.$$

These couples are precisely the complex numbers.

Another logical development of the complex field was given by Augustin Louis Cauchy (*Comptes Rendus,* Paris) in 1847. Consider the set of all polynomials

$$f(i)=c_0+c_1i+c_2i^2+\ .\ .\ .\ +c_ni^n$$

with real coefficients in the indeterminate i. Two polynomials are defined to be equal if they give the same remainder upon division by i^2+1. Thus every polynomial is equal to a polynomial c_0+c_1i of the first degree in i. Addition and multiplication are defined in the usual way. That is,

$$(a_1+b_1i)(a_2+b_2i)=a_1a_2+(a_1b_2+a_2b_1)i+b_1b_2i^2.$$

Upon dividing this product by i^2+1, the remainder $a_1a_2-b_1b_2+(a_1b_2+a_2b_1)i$ is obtained, which is therefore equal to the product. Since i^2+1 gives the remainder 0 upon division by i^2+1, it is true that i is a solution of the equation $x^2+1=0$. The laws of arithmetic are as readily provable as in Hamilton's approach.

It is significant that it is not possible to define *a* complex number separately from all other complex numbers. The complex field can be defined either by Hamilton's method or by Cauchy's method; a complex number is an element of the complex field.

Properties of the Complex Field.—Although the complex numbers appear to have been introduced to obtain a solution of the equation $x^2+1=0$, it is true that every equation with real coefficients, and indeed every equation with complex coefficients, has a complex root. This theorem, frequently called the Fundamental Theorem of Algebra, was proved by Gauss in his doctoral thesis (1799). It follows immediately that every equation of degree n has exactly n solutions, not necessarily distinct.

The Fundamental Operations.—Reference was made to the graphic representation of the complex numbers. The number $a+bi$ can be made to correspond to a point on the plane, or to the line segment or vector from the origin to this point. If the latter point of view is adopted, it is true that the sum of two complex numbers corresponds to the diagonal of the parallelogram whose edges are the summands. Since directed physical magnitudes such as forces and velocities add by the parallelogram rule, it is apparent that complex numbers are well suited for their computation.

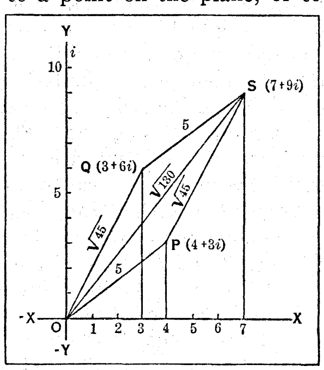


FIG. 2.—ADDITION OF COMPLEX NUMBERS

Multiplication of complex numbers is best treated through their polar representation (Roger Cotes, 1710; Abraham de Moivre, 1730; Leonhard Euler, 1743). If r represents the distance OP from the origin to the point $a+bi$, and if θ is the angle from the positive x-axis to OP, then

$$a+bi=r(\cos\theta+i\sin\theta)=r\ \mathrm{cis}\,\theta.$$

The number r is called the *absolute value* (Karl Weierstrass) or *modulus* (Cauchy) of $a+bi$, and θ is called the *argument* or *phase.*

By the usual definition of multiplication,

$$r_1\ \mathrm{cis}\,\theta_1\cdot r_2\ \mathrm{cis}\,\theta_2=r_1r_2\ \mathrm{cis}(\theta_1+\theta_2).$$

That is, the absolute value of a product is equal to the product of the absolute values of the factors, and the argument of the product is equal to the sum of the arguments of the factors. This leads to a simple graphic method of multiplying two complex numbers $a+bi$ and $c+di$. Construct a triangle upon the real unit segment with one of the vectors, say $a+bi$, as the other side. Construct a similar triangle upon the other vector $c+di$. The corresponding side to $a+bi$ of this second triangle will represent the product $(a+bi)(c+di)$.

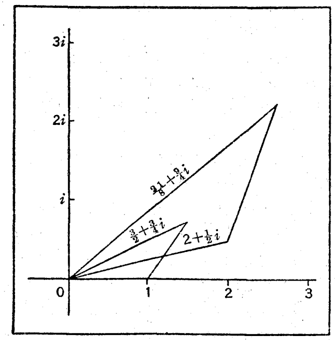


FIG. 3.—MULTIPLICATION

Since every equation such as $x^i-(a+bi)=0$ has n complex solutions, it follows that every complex number has n complex n-th roots. De Moivre's theorem states that

$$(r\ \mathrm{cis}\theta)^n=r^n\mathrm{cis}n\theta,\ r\ \mathrm{cis}\theta=(\sqrt[n]{r}\ \mathrm{cis}\frac{\theta+2k\pi}{n})^n,$$

$$k=0,1,2,\ \cdot\cdot\cdot\ ,n-1.$$

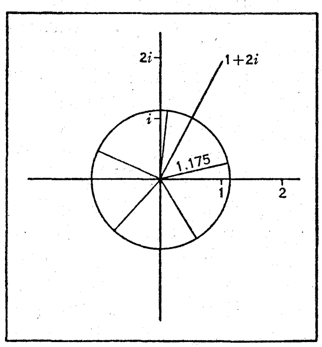


FIG. 4.—ROOTS OF A COMPLEX NUMBER

Thus to find the n-th roots of r cisθ, draw a circle of radius $\sqrt[n]{r}$ and draw a radius whose argument is θ/n. This is one root. Divide the circumference into n equal parts, and draw the n equally spaced radii of which the first root is one. These radii are the n n-th roots of r cisθ.

The power function in the complex field is, except in special cases, multiple-valued. That is,

$$(r\ \mathrm{cis}\theta)^{s\ \mathrm{cis}\varphi}=q\ \mathrm{cis}\xi$$

where q and ξ are defined by the equations

$$\xi=s\ \sin\varphi\cdot\log\ r+s(\theta+2n\pi)\cos\varphi,$$

$$\log\ q=s\ \cos\varphi\cdot\log\ r-s(\theta+2n\pi)\sin\varphi,\ n=0,\pm1,\pm2,\ \cdot\cdot\cdot\ .$$

Automorphisms.—Mathematicians have been bothered by their inability to draw any genuine distinction between the numbers i and $-i$. The number $a-bi$ is called the *conjugate* (Cauchy) of the number $a+bi$.

The conjugate of a sum is equal to the sum of the conjugates, and the conjugate of the product is equal to the product of the conjugates of the factors. In modern terminology, we say that the correspondence between $a+bi$ and $a-bi$ is an *automorphism* of the complex field. The complex solutions of an equation with real coefficients occur in conjugate pairs.

Number Theory.—The numbers of the form $a+bi$ where a and b are rational constitute the *Gaussian complex field.* The numbers of this type where a and b are rational integers form an *integral domain* or *ring* very like the ring of ordinary rational integers or whole numbers.

The *norm* (Gauss) of $a+bi$ is a^2+b^2, and the norm of a product is equal to the product of the norms of the factors. The numbers of norm 1 are the *units,* namely 1, -1, i and $-i$.

A number which is neither 0 nor a unit is called *composite* or *prime* according as it can or cannot be written as a product of two numbers neither of which is a unit. There exists a Euclid algorithm in this ring. That is, if $\beta\neq 0$ and α are two numbers of the ring, there exist two other numbers κ and ρ such that $\alpha=\beta\kappa+\rho$ where the norm of ρ is less than the norm of β. Then every two numbers have a greatest common divisor expressible linearly in terms of the numbers. Consequently the Fundamental Theorem of Arithmetic holds for this ring: Every number $\neq 0$ is factorable into a finite number of prime numbers and, save for unit factors and the order of the factors, this representation is unique. If p is a rational prime of the form $4k+1$, it is the product of two distinct conjugate complex primes; a rational prime of the form $4k+3$ is a complex prime; and $2=i(1-i)^2$ where $1-i$ is a complex prime. Much of ordinary number theory carries over to the complex integers.

Quaternions.—In 1843 Hamilton generalized the complex field to the algebra of *real quaternions* $a+bi+cj+dk$ where $i^2=j^2=k^2=-1$, $ijk=-1$. Most of the ordinary laws of arithmetic hold for such numbers except that the order of multiplication is not usually immaterial. This algebra is treated in detail elsewhere. (*See* QUATERNIONS.) In the hands of Josiah Willard Gibbs and Oliver Heaviside and others, the quaternion algebra has been developed into modern vector analysis, a method which is of great importance in mechanics, electricity and other branches of applied mathematics. (*See* VECTOR ANALYSIS.)

Hypercomplex Numbers.—This term is applied to numbers of the type $a_1e_1+a_2e_2+\ \ldots\ +a_ne_n$ where the a's are numbers of a field, the e's are linearly independent with respect to this field, and $e_ie_j=c_{ij1}e_1+c_{ij2}e_2+\ \ldots\ +c_{ijn}e_n$. Complex numbers and quaternions are special examples. The associative law of multiplication is usually assumed, but not the commutative law. (*See* LINEAR ALGEBRAS.)

Functions of a Complex Variable.—One of the most extensive and useful branches of mathematics is the theory of functions of a complex variable. Let $z=x+iy$ where x and y are real variables and $i^2=-1$. Then $w=u+iv$ is a function of z if u and v are functions of x and y. This function is *analytic* (or *regular*, or *holomorphic*, or *monogenic*) if u and v are differentiable and if the Cauchy-Riemann conditions hold, viz.

$$\partial u/\partial x=\partial v/\partial y, \qquad \partial u/\partial y=-\partial v/\partial x.$$

This theory is considered extensively elsewhere. (*See* FUNCTION.)

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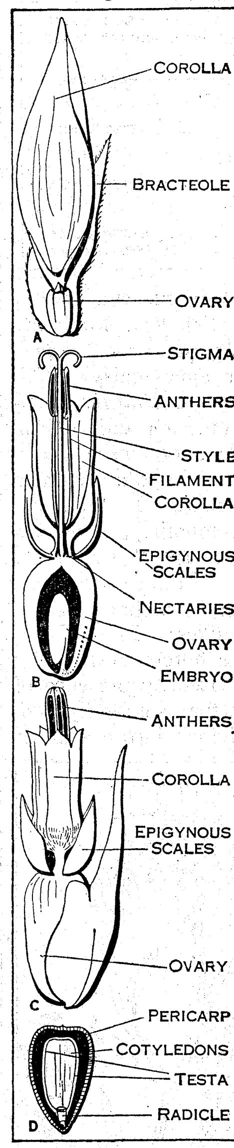
COMPLIANCE, a psychological term for one of the so-called "primary" emotions. When an animal or human being meets an opposing force which he recognizes as stronger than himself, he gives in to the opponent to avoid injury to himself, and takes whatever extra trouble is necessary to avoid a conflict inevitably disastrous to the weaker party. This feeling and reaction of compliance is the basic emotional mechanism which enables living organisms to escape destruction and suffering in the struggle for existence.

COMPLUVIUM, the open space left in the roof of the atrium of a Roman house for lighting (*see* CAVAEDIUM).

COMPOSITAE, the name given to the largest family of flowering plants. It includes approximately 900 genera and over 13,000 species comprising about one-fifteenth of the flowering plants. It is characterized by crowding of the flowers into heads. The family is cosmopolitan, and the plants show considerable variety in habit. The great majority, including most British representatives, are herbaceous, but in the warmer parts of the world shrubs and arborescent forms also occur; the latter are characteristic of the flora of oceanic islands. In herbaceous plants the leaves are often arranged in a rosette on a much shortened stem, as in dandelion, daisy and others; when the stem is elongated the leaves are generally alternate. The root is generally thickened, sometimes, as in dahlia, tuberous; root and stem contain oil passages, or, as in lettuce and dandelion, a milky white latex. The flowers are crowded in heads (*capitula*) which are surrounded by an involucre of green bracts,—these protect the head of flowers in the bud stage, performing the usual function of a calyx. The enlarged top of the axis, the receptacle, is flat, convex or conical, and the flowers open in centripetal succession. In many cases, as in the sunflower or daisy, the outer or ray-florets are larger and more conspicuous than the inner, or disc-florets; in other cases, as in dandelion, the florets are all alike. Ray-florets when present are usually pistillate, but neuter in some genera (as *Centaurea*); the disc-florets are hermaphrodite. The flower is epigynous; the calyx is sometimes absent, or is represented by a rim on the top of the ovary, or takes the form of hairs or bristles which enlarge in the fruiting stage to form the pappus, by means of which the seed is dispersed. The corolla, of five united petals, is regular and tubular in shape in the disc-florets, or irregular, when it is either strap-shaped (ligulate), as in the ray-florets of daisy, etc., or all the florets of dandelion, or more rarely two-lipped. The five stamens are attached to the interior of the corolla-tube; the filaments are free; the anthers are joined (syngenesious) to form a tube around the single style, ending in a pair of stigmas. The inferior ovary contains one ovule (attached to base of chamber), and ripens to form a dry one-seeded fruit, a typical achene; the seed is filled with the straight embryo.



FROM PERCY GROOM "ELEMENTARY BOTANY" (BELL & SONS)

SUNFLOWER, SHOWING DETAILS OF STRUCTURE

A. Ray flower, which has no stamens, style, or stigma

B. Vertical section through an inner floret

C. Inner floret; regular, with tubular five-toothed corolla, stamens and pistil

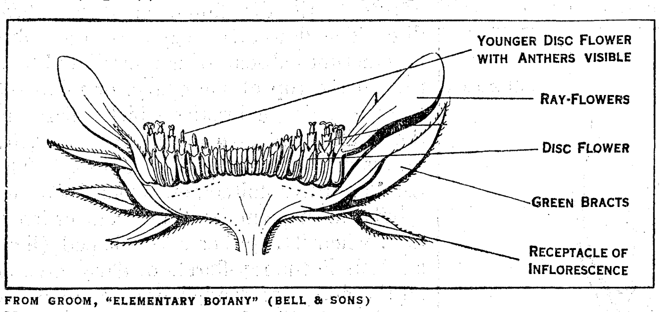
D. Vertical section of the one seeded fruit

The flower-heads are an admirable example of an adaptation for pollination by insects. The crowding of the flowers in heads ensures the pollination of a large number as the result of a single insect visit. Honey is secreted at the base of the style, and is protected from rain or dew and the visits of short-lipped insects by the corolla-tube, the length of which is correlated with the length of proboscis of the visiting insect. When the flower opens, the two stigmas are pressed together below the tube formed by the anthers, the latter split on the inside, and the pollen fills the tube; the style gradually lengthens and carries the pollen out of the anther tube, and finally the stigmas spread and expose their receptive surface which has hitherto been hidden, the two being pressed together. Thus the life history of the flower falls into two stages, an earlier or male and a later or female. This favours cross-pollination as compared with self-pollination. In many cases there is a third stage, as in dandelion, where the stigmas finally curl back so that they touch any pollen grains which have been left on the style below, thus ensuring self-pollination if cross-pollination has not been effected.

The devices for distribution of the fruit are very varied. Frequently there is a hairy or silky pappus forming a tuft of hairs, as in thistle or coltsfoot, or a parachute-like structure as in dandelion; these render the fruit sufficiently light to be carried by the wind. In *Bidens* the pappus consists of two or more stiff-barbed bristles which cause the fruit to cling to the coats of animals. Occasionally, as in sunflower or daisy, the fruits bear no special appendage and remain on the head until jerked off.

Compositae are generally considered to represent the most highly developed order of flowering plants. By the massing of the flowers in heads great economy is effected in the material required for one flower, as conspicuousness is ensured by the association; economy of time on the part of the pollinating insect is also effected, as a large number of flowers are visited at one time. The floral mechanism is both simple and effective, favouring cross-pollination, but ensuring self-pollination should that fail. The means of seed-distribution are also very effective.

A few members of the order are of economic value, *e.g., Lactuca* (lettuce; *q.v.*), *Cichorium* (chicory; *q.v.*), *Cynara* (artichoke



FROM GROOM, "ELEMENTARY BOTANY" (BELL & SONS)

VERTICAL SECTION THROUGH THE FLOWER HEAD OF THE SUNFLOWER

and cardoon; *q.v.*), *Helianthus* (Jerusalem artichoke). Many are cultivated as garden or greenhouse plants, such as *Solidago* (golden rod), *Ageratum, Aster* (*q.v.*) (Michaelmas daisy), *Helichrysum* ("everlasting"), *Zinnia, Rudbeckia, Helianthus* (sunflower), *Coreopsis, Dahlia* (*q.v.*), *Tagetes* (French and African marigold), *Gaillardia, Achillea* (yarrow), *Chrysanthemum, Tanacetum* (tansy), *Arnica, Doronicum, Cineraria, Calendula* (common marigold), *Echinops* (globe thistle), *Centaurea* (*q.v.*). Some are of medicinal value, such as *Anthemis* (chamomile), *Artemisia* (wormwood), *Tussilago* (coltsfoot), *Arnica.* Insect powder is prepared from species of *Pyrethrum* in the genus *Chrysanthemum.* A species of *Parthenium,* guayule, is a source of rubber.

The order is divided into two subfamilies:—*Tubuliflorae,* characterized by absence of latex, and the florets of the disc being not ligulate, and *Liguliflorae,* characterized by presence of latex and all the florets being ligulate. The first subfamily contains the majority of the genera, and is divided into a number of tribes. The family is well represented in Britain, in which 42 of the 900 genera are native. These include some of the commonest weeds, such as dandelion (*Taraxacum officinale*), daisy (*Bellis perennis*), groundsel (*Senecio vulgaris*) and ragwort (*S. Jacobaea*); coltsfoot (*Tussilago Farfara*) is one of the earliest plants to flower, and other genera are *Chrysanthemum* (ox-eye daisy and corn-marigold), *Arctium* (burdock), *Centaurea* (knapweed and cornflower), *Carduus* and *Cnicus* (thistles), *Hieracium* (hawkweed), *Sonchus* (sow-thistle), *Achillea* (yarrow, or milfoil, and sneezewort), *Eupatorium* (hemp-agrimony), *Gnaphalium* (cud-weed), *Erigeron* (fleabane), *Solidago* (golden-rod), *Anthemis* (may-weed and chamomile), *Cichorium* (chicory), *Lapsana* (nipplewort), *Crepis* (hawk's-beard), *Hypochaeris* (cat's-ear), and *Tragopogon* (goat's beard).

FROM GROOM'S "ELEMENTARY BOTANY" (G. BELL & SONS LTD.)

THE CORNFLOWER, OR BACHELOR'S BUTTON, A MEMBER OF THE FAMILY COMPOSITAE. THE SMALL FIGURE IS A VERTICAL SECTION OF AN INNER FLORET

In North America over 200 genera are represented by many species distributed over the whole country.

COMPOSITE ORDER, in architecture, the last developed and most complex of the classical orders (*see* ORDER), so called because its capital is a compound of the volutes (spirals) of the Ionic order and the acanthus leaves of the Corinthian. The earliest example known is found in the arch of Titus at Rome (A.D. 81). The form became common, however, only after the time of Hadrian (A.D. 117–138). The entablature was usually Corinthian, but in the Renaissance period Vignola and the other architects who arranged codifications of the orders developed a separate type based largely upon the temple of Venus at Rome (reign of Hadrian).

COMPOSITION, the action of putting together and the product of such action (Lat. *compositio,* from *componere,* to put together). In philology, the putting together of two words to form a single word; in grammar, the combination of words into sentences, and sentences into periods; the art of producing a work in prose or verse, or the work itself. In music "composition" is used both of the art of combining musical sounds in accordance with the rules of musical form, and of the whole art of creation or invention. In the other fine arts the word is used of the balanced arrangement of the parts of a picture, a piece of sculpture or a building, so that they form one harmonious whole.

The word also means an adjustment of differences between two or more parties. A more particular use is the legal one, for an agreement by which a creditor agrees to take a sum less than his debt in satisfaction of the whole. (*See* BANKRUPTCY.) In logic (*q.v.*) "composition" is the name given to a fallacy of equivocation, where what is true distributively of each member of a class is inferred to be true of the whole class collectively. Composition, often shortened to "compo," is the name given to materials compounded of more than one substance, and is used in various trades and manufactures for a mixture, such as stucco, cement and plaster.

COMPOSITOR. One who "composes," or sets up, printing-type. The compositor is a highly skilled craftsman, who can only do his work effectively if he is well educated and especially well read, for he has constantly to handle ms. bristling with difficult terms and of varying degrees of legibility.

The first step in the actual production of any class of printed matter is the composition of the written word from the manuscript. In the early days of printing, when type faces were large, and all type was set by hand, the compositor's work was of a simple straightforward character, consisting in the main of type-setting for books, pamphlets and small news-sheets.

The compositor's time, however, is not wholly taken up in mere type-setting. The matter having been composed, stickful by stickful, and deposited on a long narrow frame called a galley, is proved or printed in slip form, when it is carefully read for errors by the "corrector of the press" or printer's reader, and afterwards sent to the author for possible alterations. The matter is then made up into columns and pages, the latter being "imposed" on a stone or metal surface to be prepared for the actual printing on the press.

Imposition consists in laying the made-up pages on the imposing surface in such a way as to ensure that when the printed sheet of eight, sixteen or more pages is folded, the folios all fall in correct order and the margins around the pages are in agreement with instructions. A compositor engaged mainly on imposition is called a "stone hand." Various implements are used for this work, such as mallets, planers, shooters, chases and quoins. Modern methods have not eliminated the old-time tools, which are still necessary even in up-to-date printing offices. Metal quoins and furniture and mechanical lock-ups have, however, largely taken the place of the wooden prototypes which were invariably used up to fifty years ago.

In the office of a daily newspaper, the compositor is not called upon to impose the pages in sheets. Each page, owing to its size, is prepared singly for the stereotyper, who casts the plates, which in turn are imposed direct on the cylinders of the press.

The introduction of bar-line composing machines brought about a revolution in type-setting, but did not materially alter other branches of the compositor's work. It is the more rapid production on the machines that has made possible the huge development which has taken place in newspaper production in recent years. The bar-line machine, in which the complete line, or slug, is the unit, as distinct from the single letter or movable type, is most in use, especially in newspaper work, but a machine producing single-letter composition also has a wide vogue for book and magazine printing. The machine compositor, although as an apprentice fully trained in all classes of work, is rarely called away from the machine. In one other respect the compositor's work has undergone a great change. In addition to the setting of displayed advertisements for newspapers and magazines, the compositor is called upon to produce jobbing work of all descriptions, such as posters, programmes, brochures, catalogues, etc.—each of these providing its own special appeal, and demanding expert interpretation by the compositor, who is usually the designer of the "lay-out" as well. He has thus become much more of a craftsman than the old-time compositor, who knew little or nothing of the principles or opportunities of artistic display. It is probably due to these intensive changes in the work that the compositors have been able to maintain the old conditions of seven-year apprenticeship. (*See* PRINTING.)

COMPOUND, a combination of various elements to form a whole. A "chemical compound" is a substance which can be resolved by ordinary chemical methods into simple constituents, as opposed to an element which cannot be so resolved. (*See* CHEMISTRY.) A "compound engine" is one where the expansion of the steam is effected in two or more stages (*see* STEAM ENGINE); in zoology, the "compound eye" of insects and crustacea is made up of several *ocelli* or simple eyes (*see* EYE, ANATOMY OF); in botany, the "compound leaf" has two or more separate blades on a common leaf-stalk; in surgery, in a "compound fracture" the skin is broken as well as the bone. Compound interest is interest paid upon interest.

The verb "to compound" is used of the settlement of differences, and especially of an agreement made to pay part of a debt in discharge of the whole (*see* BANKRUPTCY); similarly of the substitution of one payment for periodic payments. In the system of "compounding" for rates the occupier of premises pays an increased rent, and the owner is responsible for the payment of the rates. In law, to compound a felony is to agree with the felon not to prosecute him, in return for valuable consideration, or, in the case of a theft, on return of the goods stolen. Such an agreement is a misdemeanour punishable by fine and imprisonment.

The name "compounders" was given during the reign of William III. of England to the members of a Jacobite faction who were prepared to restore James II. to the throne on certain conditions. Until 1853, in the University of Oxford, those possessing private incomes of a certain amount paid special dues for their degrees and were known as grand and petty compounders. The corruption "compound" (from the Malay *kampung,* a quarter of a village) is the name of the enclosed ground which surrounds an Anglo-Indian house.

COMPOUND ENGINE, a steam-engine (*q.v.*) in which the expansion is performed in two stages, the first in the "high-pressure cylinder" and the second in the "low-pressure cylinder." If three or four stages are employed the engine is called a *triple* or a *quadruple expansion engine* respectively.

COMPOUNDING: *see* LARCENY.

COMPOUND PIER, an architectural term for a pier (*q.v.*) or column (*q.v.*) consisting of a number of vertical members or mouldings clustered around or attached to a central mass. It developed in Roman architecture to allow a single pier to support several arches. In the Romanesque and Gothic periods the idea was worked out in a more complicated way in order to furnish support, or the appearance of support, not only for cross, diagonal and wall ribs, but often to carry the main elements of the arch mouldings. In some cases in the late Gothic work of France and Germany, the mouldings of a compound pier are the identical mouldings of the arch or ribs carried down to the ground without a capital. Compound piers are usually built of continuous layers of stone, but occasionally, in English work, the clustering shafts are independent and sometimes of a different material.

COMPRADOR, originally, a native servant in European households in the East, but now the name given to the native managers in European business houses in China, and also to native contractors supplying ships in the Philippines and elsewhere in the East. The word is Portuguese, from Lat. *comparare,* to procure.

COMPRESSED AIR. It would be possible to enumerate some 200 distinct applications of compressed air in the operation of machines and in manufacturing processes. No other power agent has such a varied range of uses, or is so conveniently stored and conveyed. Its applications may be broadly divided

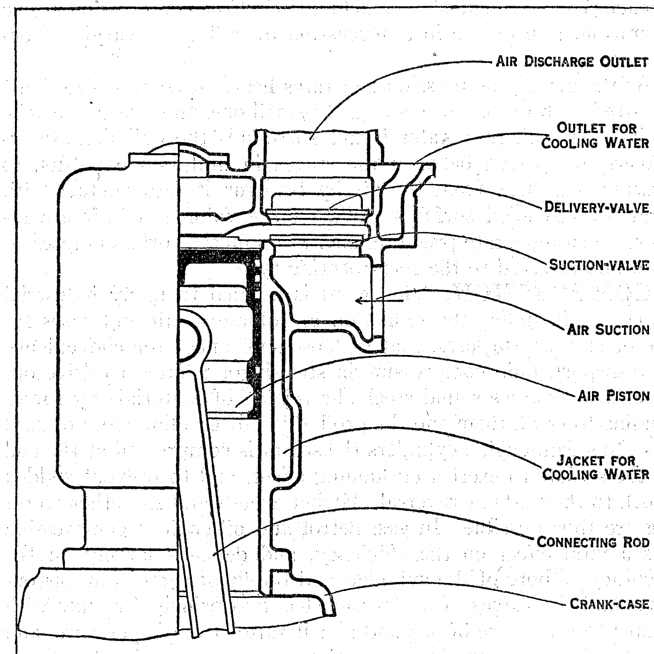


DIAGRAM SHOWING THE MECHANISM OF A SINGLE-ACTING AIR COMPRESSOR

Air, compressed to exert pressures varying from a few pounds to several thousand pounds per sq. inch, is a power agent of great utility, employed in some 200 different ways. Two of its most familiar uses are in instruments for breaking up roads, and in those for spraying paint on large surfaces

into free and enclosed action. In the former category are, for instance, the air-jets for cleaning machinery and fabrics, the nozzles for feeding air to gas and oil burners, the air-lifts for pumping, and operations such as the blowing out of tanks in submarines and oil ships, glass blowing, sand-blasting, and the spraying of whitewash, distemper, paint, varnish and enamel. These spraying processes are far more economic than the brush methods. In one case a ship required the services of six men for 136 hours to paint by hand, while with compressed-air spraying a similar ship was painted by two men in 40 hours.

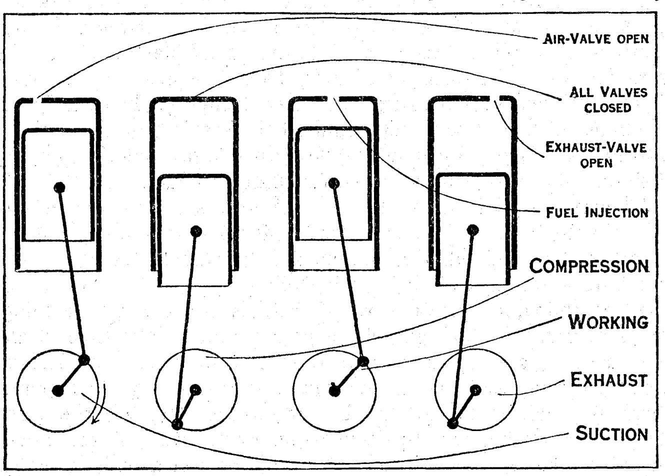
The category of enclosed action comprises scores of methods wherein the air acts in a cylinder to give a power movement, or is otherwise confined, *e.g.,* in portable pneumatic hammers for chipping, riveting, caulking, rock drilling, concrete breaking and sand ramming, and in the rotating tools for drilling, reaming, tapping, grinding, buffing, tube expanding and boiler-tube cleaning. Hoists, cranes, jacks and foundry moulding-machines, as well as forging and planishing hammers, resembling steam hammers in general type, are used in large numbers, and there are also chucks for machine-tools, to grip pieces of work on the movement of a hand or foot lever. Many actions on machines, which would otherwise be slowly and laboriously performed by hand, are effected in an instant by a pneumatic cylinder. Some kinds of engines, including those for torpedoes and coal-cutters, are air-driven, as are locomotives when fire or sparking is inadmissible. In railway service there are the air-brakes and the pneumatic signalling and switching apparatus. Large gas and oil engines are started up by a charge of compressed air, while caissons and tunnel shields are worked with its help. Other equipments for which it must be employed are those used in wreck raising and diving. In several industries testing is effected with air, besides inflation and the agitation of liquids.

Air pressures vary from a few to many thousand pounds per square inch. A hand compressor is used for small demands.

Power-driven machines include those actuated by belt pulley, steam cylinder, electric motor, gas, oil or petrol (gasolene) engine —the last especially for portable outfits for road-breaking. Single-acting compressors take in air through an inlet-valve at one stroke of the piston and force it through a discharge-valve to the storage receiver on the return stroke. This is sketched in the figure. Double-acting compressors have two sets of valves, and deliver air at each stroke. Single-stage machines effect the compression at one operation, multi-stage in a succession of cylinders, varying from two to five.

As the act of compression generates heat, all compressors must be fitted with means for cooling. In small ones fins are cast on the cylinder, in others a water-jacket surrounds the cylinder. Intercoolers are placed between the stages in multi-stage outfits, to abstract the heat from the air by bringing it into contact with large water-cooled surfaces. When large volumes of air are required at a moderate pressure, *e.g.*, in mining, a turbo-compressor is to be preferred to the reciprocating type.

COMPRESSION. This word is applied to many industrial processes, including the reduction in volume of air and gases for use or storage purposes, that of loose substances for convenience of transport, fluid compression in steel ingot making to drive out gases and produce sound steel, the testing of materials by forces tending to crush them and the production of gasoline from natural gas. In steam-engine cylinders the steam is compressed at the end of the stroke, to exert a cushioning effect, and to prevent sudden shock to the parts at reversal. Higher speeds and smoother working are thus possible. In gas, petrol and oil-engines compression has a vital effect on the efficiency, and depends largely on the accuracy of bore of the cylinder, and the fit of the piston, piston-rings and the valves. Compression has two principal results with regard to a mixture of gas and air; it raises the temperature, and also produces a more intimate mixture, through which the flame spreads more rapidly than it would do in an uncompressed mixture. *Compression ratio* is the ratio between the volume of gas in the cylinder with the piston at the outer end of its stroke, and the compressed volume when the piston is at the other end of its stroke. The degree of compression must be determined by the ignition temperature of the charge, which varies in different fuels. For instance, in the cylinder of a gas engine using the ordinary



THE CYCLE IN A 4-STROKE DIESEL ENGINE, SHOWING THE ACTION OF THE VALVES THROUGHOUT ONE REVOLUTION
The compression is very high in this engine, giving sufficient temperature to the air to ignite the charge of oil injected for the working stroke

town supply, the pressure ordinarily will not exceed 100 lb. per sq.in. Pre-ignition (*i.e.*, ignition during compression stroke) may be due to over-compression, and occurs when a certain supply of gas is changed for another kind, or when the gas comes in contact with overheated parts in the system, or when hot gases from the previous cycle are retained. The greatest pressures are used in the Diesel engine, in order to raise the temperature to a sufficient degree to ignite oil as it is sprayed into the cylinder gradually at the conclusion of the compressive stroke (*see* fig.). In practice, these range from about 450 to 480 lb. per square inch, the resultant temperature being about 1,000°. This is sufficient to cover the requirements for cold starting. A lower pressure can be used when a hot bulb, or similar heating device, is employed; lower compression allows a lighter construction of the engine parts.

COMPROMISE, a term, meaning strictly a joint agreement, which has come to signify such a settlement as involves a mutual adjustment, with a surrender of part of each party's claim. The equivalent word in Latin languages is *transactio* and its derivatives.

COMPROMISE MEASURES OF 1850, in American history, a series of measures the object of which was the settlement of five questions in dispute between the pro-slavery and anti-slavery factions in the United States. Three of these questions grew out of the annexation of Texas and the acquisition of western territory as a result of the Mexican War. The settlers who had flocked to California after the discovery of gold in 1848 adopted an anti-slavery State constitution on Oct. 13, 1849, and applied for admission into the Union. In the second place it was necessary to form a territorial Government for the remainder of the territory acquired from Mexico, including that now occupied by Nevada and Utah, and parts of Wyoming, Colorado, Arizona and New Mexico. The fundamental issue was in regard to the admission of slavery into, or the exclusion of slavery from, this region. Thirdly, there was a dispute over the western boundary of Texas. Should the Rio Grande be the line of division north of Mexico, or should an arbitrary boundary be established farther to the eastward; in other words, should a considerable part of the new territory be certainly opened to slavery as a part of Texas, or possibly closed to it as a part of the organized territorial section? Underlying all of these issues was, of course, the great moral and political problem as to whether slavery was to be confined to the south-eastern section of the country or be permitted to spread to the Pacific. The two questions not growing out of the Mexican War were in regard to the abolition of the slave trade in the District of Columbia, and the passage of a new fugitive slave law.

Congress met on Dec. 3, 1849. Neither faction was strong enough in both houses to carry out its own programme, and it seemed for a time that nothing would be done. On Jan. 29, 1850, Henry Clay presented the famous resolution which constituted the basis of the ultimate compromise. His idea was to combine the more conservative elements of both sections in favour of a settlement which would concede the Southern view on two questions, the Northern view on two, and the balance the fifth. Daniel Webster supported the plan in his great speech of March 7, although in doing so he alienated many of his former admirers. Opposed to the conservatives were the extremists of the North, led by William H. Seward and Salmon P. Chase, and those of the South, led by Jefferson Davis. Most of the measures were rejected and the whole plan seemed likely to fail, when the situation was changed by the death of President Taylor and the accession of Millard Fillmore on July 9, 1850. The influence of the administration was now thrown in favour of the compromise. Under a tacit understanding of the moderates to vote together, five separate bills were passed, and were signed by the president between Sept. 9 and 20, 1850. California was admitted as a free State, and the slave trade was abolished in the District of Columbia; these were concessions to the North. New Mexico (then including the present Arizona) and Utah were organized without any prohibition of slavery (each being left free to decide for or against, on admission to Statehood), and a rigid fugitive slave law was enacted; these were concessions to the South. Texas (*q.v.*) was compelled to give up much of the western land to which it had a good claim, and received in return $10,000,000.

This legislation had several important results. It helped to postpone secession and civil war for a decade, during which time the north-west was growing more wealthy and more populous, and was being brought into closer relations with the north-east. It divided the Whigs into "Cotton Whigs" and "Conscience Whigs," and in time led to the downfall of the party. In the third place, the rejection of the Wilmot Proviso and the acceptance (as regards New Mexico and Utah) of "Squatter Sovereignty" meant the adoption of a new principle in dealing with slavery in the territories, which, although it did not apply to the same territory, was antagonistic to the Missouri Compromise of 1820. The sequel was the repeal of the Missouri Compromise in the Kansas-Nebraska bill of 1854. Fourthly, the enforcement of the fugitive slave law aroused a feeling of bitterness in the North which helped eventually to bring on the war, and helped to make it, when it came, quite as much an anti-slavery crusade as a struggle for the integral preservation of the Union. The compromise measures are sometimes spoken of collectively as the Omnibus bill, owing to their having been grouped originally—when first reported (May 8) to the Senate—into one bill.

For the best account of the above Compromises *see* J. F. Rhodes, *History of the United States from the Compromise of 1850,* (1896). *See* also T. C. Smith, *Parties and Slavery* (1906). (W. R. Sm.)

COMPSA, ancient city of the Hirpini, Italy, near the sources of the Aufidus, on the boundary of Lucania and not far from that of Apulia, on a ridge 1,998 ft. above sea-level. It was betrayed to Hannibal in 216 B.C. after the defeat of Cannae, but recaptured two years later. It was probably occupied by Sulla in 89 B.C., and it was the scene of the death of T. Annius Milo in 48 B.C.

COMPTON, ARTHUR HOLLY (1892–), U.S. physicist, was born in Wooster, O., on Sept. 10, 1892. Graduating in 1913 at the College of Wooster, he pursued further studies at Princeton university, from which in 1916 he received the degree of doctor of philosophy. He was instructor in physics at the University of Minnesota in 1916–17, and research physicist for the Westinghouse Light company of East Pittsburgh, Pa., in 1917–19. After a year (1919–20) of research at Cambridge university, England, he became professor and head of the department of physics in Washington university at St. Louis, Mo. In 1923 he was made professor of physics in the University of Chicago. He returned to Washington university as chancellor in 1946. He made noteworthy investigations on the earth's rotation, on the specific heat of solids and especially on X-rays. He measured the wave length of the hard gamma rays and discovered the change in the wave length of X-rays when scattered and also the total reflection of X-rays. With C. H. Hagenow, he effected the complete polarization of X-rays and, with R. L. Doan, obtained X-ray spectra from ruled gratings. In recognition of his achievements in research he was awarded in 1927, jointly with C. T. R. Wilson, of England, the Nobel prize for physics. In addition to numerous scientific articles he published *Secondary Radiations Produced by X-rays* (1922) and *X-rays and Electrons* (1926).

COMPTON, HENRY (1632–1713), English divine, was educated at Queen's College, Oxford, then travelled in Europe, and was made bishop of Oxford in 1674, and in the following year was translated to the see of London. He was also appointed a member of the privy council, and was entrusted with the education of the two princesses—Mary and Anne. He showed unusual liberality to Protestant dissenters and held several conferences with the clergy of his diocese on the subject of reunion with them. On the accession of James II. he consequently lost his seat in the council and his deanery in the Chapel Royal; and for his firmness in refusing to suspend John Sharp, rector of St. Giles's-in-the-Fields, whose anti-papal writings had rendered him obnoxious to the king, he was himself suspended. At the Revolution Compton's old position was restored to him; and he was chosen as one of the commissioners for revising the liturgy. During the reign of Anne he remained a member of the privy council, and was one of the commissioners appointed to arrange the terms of the union of England and Scotland. He died at Fulham on July 7, 1713. He published, besides several theological works, *A Translation from the Italian of the Life of Donna Olympia Maladichini, who governed the Church during the time of Pope Innocent X., which was from the year 1644 to 1655* (1667), and *A Translation from the French of the Jesuits' Intrigues* (1669).

COMPTON, a city of Los Angeles county, California, U.S.A., midway between Los Angeles and Long Beach. It is served by the Southern Pacific and the Pacific Electric railways. In 1930 the population was 12,516; in 1940 it was 16,198 by the federal census. Compton is in a market-gardening region, and is surrounded by producing oil wells, oil-storage farms and refineries. The joint harbour of Los Angeles and Long Beach is but a few miles distant. On the southern border of the city is the new freight-classification yard of the Southern Pacific Company. The city is a residential suburb, and it also has substantial manufacturing industries of its own, whose products include rubber tyres, water bottles and fruit jars, ladders, tools and equipment for oil wells, and cooling towers for gasolene plants. Compton was founded about 1868, was incorporated as a city of the sixth class in 1888 and as a city of the fifth class in 1925. The new charter provides for a planning commission and for a city-manager form of government.

COMPTON EFFECT. The Compton Effect is the change in quality of a beam of X-rays when it is scattered. Imagine that a piece of paper when held between the eyes and a green light appears green, but that when the paper is moved to a position at right angles with the light its colour changes to yellow, and when turned to the opposite side from the light its colour becomes red. Such a change in colour would correspond to the increase in wave-length which X-rays undergo when they are scattered, a small change when scattered at a small angle, but a larger difference for the rays scattered at a large angle. This phenomenon owes its chief interest to the fact that it indicates a corpuscular structure for X-rays.

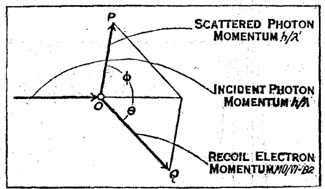


FIG. 1.—DIAGRAM OF PARALLELOGRAM OF MOMENTA IN COMPTON EFFECT

History.—The earliest experiments on secondary X-rays showed a difference in the penetrating power of the primary and the secondary rays. Barkla and his collaborators found (1908) that the secondary X-rays from heavy elements consist mostly of fluorescent radiations characteristic of the radiating element, and that it is the presence of these fluorescent rays which is chiefly responsible for the greater absorbability of the secondary rays. Later experiments, showed, however, a measurable difference in penetration even for the rays coming from light elements, such as carbon, from which no such fluorescent rays are emitted. It was established by J. A. Gray (1920) that in such cases the change in quality was an accompaniment of the process of scattering or diffuse reflection of the primary X-rays. A spectroscopic study of the scattered X-rays by A. H. Compton (1923) revealed the fact

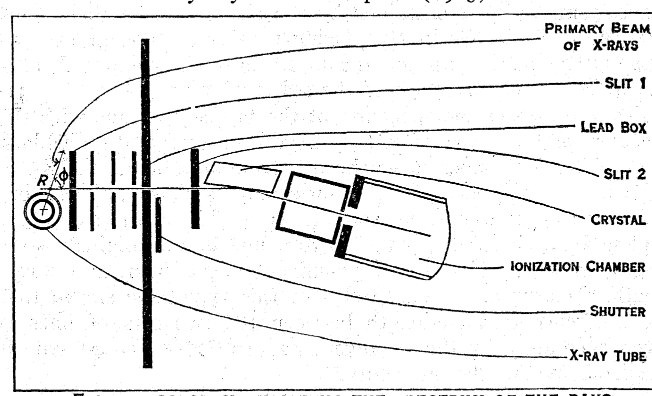


FIG. 2.—DIAGRAM ANALYZING THE SPECTRUM OF THE RAYS

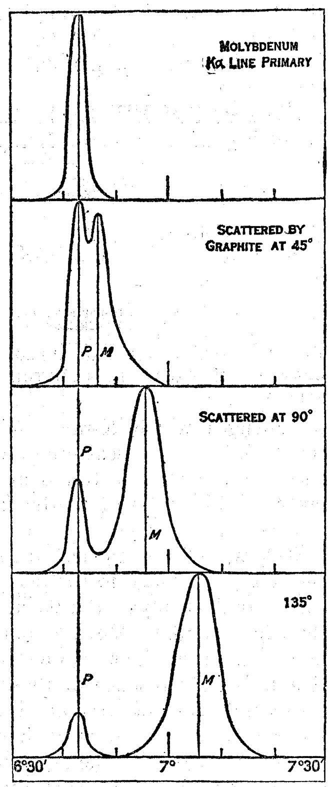
that different primary wave-lengths are increased in wave-length by the same amount when the rays are scattered, and he showed at the same time that this change could be explained if the X-rays are corpuscular in nature.

The Experiment and Its Explanation.—According to the theory that X-rays consist of electromagnetic waves, scattered X-rays are similar to an echo. When an X-ray wave passes through a piece of paper composed of electrons, each electron is set in vibration by the wave and, because of its forced vibrations, emits a new wave which goes in all directions as a scattered X-ray. The number of vibrations of these new waves per second is the same as the number of vibrations of the electron, which is in turn the same as the frequency of the original X-rays. Experiment, however, shows that the frequency of the scattered rays is less than that of the primary rays. This prediction of the wave theory of X-rays is thus incorrect.

The corpuscular theory of the scattering process supposes that each X-ray particle, or "photon" may collide with an electron of the scattering material and bounce off. In fig. 1 is shown a diagram of such a collision. The photon strikes the electron at O, and bounces off toward P, while the electron recoils from the impact in the direction OQ. The collision is supposed to be elastic; but a part of the energy of the photon is spent on the recoiling electron. It follows that the deflected or scattered photon must have less energy than it had before the collision. Such a decrease in the energy of the photon would be described in the language of the wave theory as a decrease in frequency or an increase in wave-length of the scattered X-ray. (*See* QUANTUM MECHANICS.)

As we shall show later, the photon theory can be put in a quantitative form, in which it predicts an increase in wave-length of the X-rays due to the scattering process of $2{\cdot}42 \times 10^{-10} \times (1 - \cos\phi)$ centimetre, where ϕ is the angle between the primary and the scattered rays.

A diagram of the apparatus used for testing this prediction is shown in fig. 2. X-rays pass through a radiator R, which may be for example a block of carbon or paraffin. Some of the rays are scattered through slits 1 and 2 into the X-ray spectrometer. In this instrument a crystal of calcite takes the place of the prism or the grating of an optical spectrometer and spreads the rays into a spectrum, which is examined by the ionization chamber. (*See* SPECTROSCOPY, X-RAY.) By placing the X-ray tube before the slits in place of the radiator, the spectrum of the primary X-rays can be compared with that of the scattered rays.



FROM "PHYSICAL REVIEW," 1923

FIG. 3.—SCATTERED X-RAY SPECTRUM

Line P is shown and one of increased wave-length, its position marked by M

Fig. 3 compares the spectrum of the primary X-rays with the spectrum of these rays after they have been scattered by a block of graphite. The upper curve shows a prominent line in the X-ray spectrum of molybdenum. The lower curves show the spectrum of these rays after being scattered from graphite at three different angles. In each case, in addition to a line of the original wave-length, there appears a more prominent line of increased wave-length. Measurements on spectra of this type have shown that the difference in wave-length between the two sets of lines is given accurately by the formula $2{\cdot}42 \times 10^{-10} \times (1 - \cos\phi)$ cm. as predicted by the photon theory.

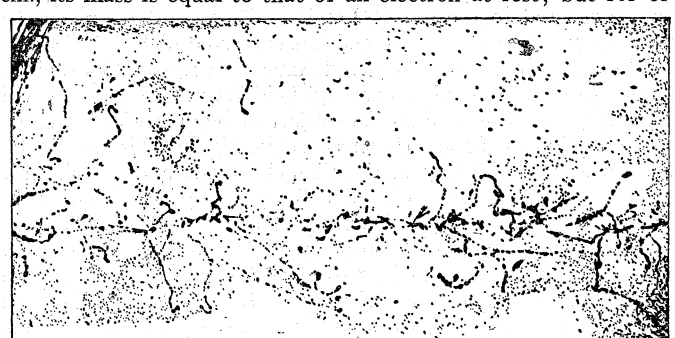
The line whose wave-length has not been changed is called the "unmodified" line. It may be accounted for as due to photons deflected by electrons that are too tightly held in the atom to recoil from the impact of the photon.

The Recoil Electrons.—We have seen that, according to the photon theory, when an X-ray particle collides with an electron, the electron recoils from the impact unless held too tightly by its atom. Electrons recoiling in this manner were discovered independently by C. T. R. Wilson and W. Bothe (1923) a few months after their prediction. Fig. 4 is a photograph of the trails of four such recoil electrons, taken by Ikeuti, using Wilson's method. It will be seen that the tracks of these electrons start nearly in the direction of the X-ray beam, as they should if they are recoiling from deflected X-ray photons. In fact a detailed study of such photographs shows that the number of these trails is about equal to the number of photons of scattered X-rays, and that their directions and ranges are in good accord with the predictions of the photon theory.

The corpuscular character of the scattered X-rays is shown most clearly by tracing the path of a photon after it has collided with an electron. This has been done (Compton and Simon, 1925) in the manner shown diagrammatically in fig. 5. A feeble beam of X-rays is admitted into a cloud expansion chamber of the type devised by Wilson to show the trails left by fast moving electrons. A photon is scattered by an electron at O, and the trail of the electron as it recoils is visible. If it starts along the line OQ, the X-ray particle must have proceeded in the direction OP, determined by the usual mechanical laws of elastic collisions. The deflected photon can make itself visible by exciting a second high-speed particle before it escapes through the wall of the chamber. The track at A represents such an occurrence. When such a second track appears it is possible to trace the path followed by the X-ray particle after its collision with the first electron. If the scattered X-rays did not consist of particles, but were propagated as waves spreading in all directions, when a second electron appears, there is no more reason why it should occur at A than at some other position such as B. The fact that in the experiments the scattered ray excited secondary electrons near the line OP, determined by the angle of recoil Θ, means that the X-rays go in definite directions.

Unless there is some improbably large error in the experiments, we may therefore infer that scattered X-rays go as discrete particles in definite directions. At the same time, experiments on the diffraction, interference and polarization of light and X-rays, and on electrical oscillations associated with electric waves, can leave no doubt but that electromagnetic radiation has the properties of waves. No satisfactory explanation has as yet been offered of how radiation may have at the same time the properties of waves and those of particles. Such a reconciliation does not, however, seem impossible.

The Photon.—The experiments associated with the Compton Effect thus seem to establish the existence of a particle of radiation. This particle, the photon, may be classified with the electron and the proton as one of the three fundamental units of matter. It does not possess an electric charge as do the electron and the proton, but it does have an electric "field," that is, it exerts a force on an electron in its neighbourhood. It also has mass, the essential characteristic of matter, its mass being $2{\cdot}19 \times 10^{-38}\ \lambda$ grams, where λ is the wave-length of the radiation expressed in centimeters. For a hard gamma ray, of wave-length $2{\cdot}4 \times 10^{-10}$ cm., its mass is equal to that of an electron at rest; but for ordinary light its mass is only about 0·000005 that of an electron. The photon seems to disappear when absorbed by an atom, and to be created again when the atom emits radiation. However, the suggestion has been made by G. N. Lewis (1926) that the photon is really retained by the atom and does not lose its identity. The motion of the photon is always with the speed of light, which in free space is about 3×10^{10} cm. per second.



FROM "PROCEEDINGS OF THE ROYAL SOCIETY," 1923, BY COURTESY OF THE COUNCIL, AND OF PROFESSOR C. T. R. WILSON

FIG. 4.—TRAILS OF ELECTRONS RECOILING FROM SCATTERED X-RAYS

Calculation of the Change of Wave-length of Scattered X-rays.—The photon theory can be put in quantitative form by making use of Einstein's postulate (1905) that the energy of the photon is proportional to the frequency of the corresponding wave. Einstein assumes that the energy of a light particle is $E=h\nu$, where ν is the number of vibrations per second of the corresponding wave and h is a universal constant which has the value $6{\cdot}55\times10^{-27}$ erg seconds. For a photon moving with the velocity of light, the theory of relativity demands that its momentum shall be E/c, where c is the velocity of light, *i.e.*, the momentum of a

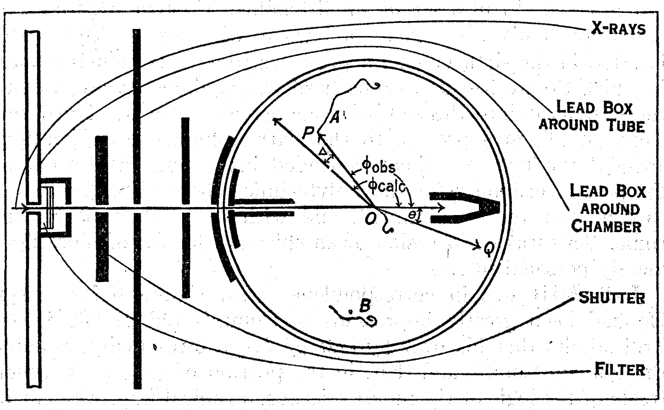


FIG. 5.—DIAGRAM SHOWING THAT A SECOND ELECTRON MAY BE EJECTED BY THE SCATTERED RAY AT A, BUT NOT AT B

photon is $h\nu/c$, or its equivalent h/λ, where λ is the wave-length of the corresponding wave.

The mathematical statement that the total energy after the collision between the photon and the electron is the same as before is,

$$h\nu = h\nu' + \tfrac{1}{2}mv^2, \qquad (1)$$

where ν' is the "frequency" of the photon after collision, and $\frac{1}{2}mv^2$ is the kinetic energy with which the electron recoils (neglecting higher powers of v^2/c^2, which become important only when the electron's speed v is comparable with that of light).

The statement that the total momentum of the photon and electron along the X axis remains equal to the $h\nu/c$ after the collision is, to the same degree of approximation,

$$\frac{h\nu}{c} = \frac{h\nu'}{c}\cos\phi + mv\cos\theta \qquad (2)$$

Similarly, along the Y axis the momentum is

$$O = \frac{h\nu'}{c}\sin\phi - mv\sin\theta \qquad (3)$$

In these three equations we have three unknown quantities, $=\nu'$, ν and θ (in the experiments ϕ is usually known), for which the equations may be solved. It is more convenient, however, to express the results of the solution thus:

$$\delta\lambda = \lambda' - \lambda = \frac{h}{mc}(1-\cos\phi) = 2{\cdot}42\times10^{-10}(1-\cos\phi) \qquad (4)$$

$$E_{kin} = \tfrac{1}{2}mv^2 = h\nu\times 2\alpha\cos^2\theta(\text{approx.}) \qquad (5)$$

$$\cot\theta = -(1+\alpha)\tan\tfrac{1}{2}\phi, \qquad (6)$$

where $\alpha = h/mc\,\lambda$. These equations represent the solutions of equations (1), (2) and (3) except for higher powers of v^2/c^2. Equations (4) and (6) are exact solutions if the relativity expressions for the kinetic energy and momentum of the electron are used.

Equation (4) expresses the difference in wave-length between the two sets of lines shown in fig. 3. It has been found to be as accurate as our knowledge of the constants, h, m, and c. Equation (5) describes the motion of the recoil electrons and has been found to agree with the experiments. The last equation (6) has been verified by experiments such as that pictured in fig. 5.

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(A. H. C.)

COMPTROLLER or **CONTROLLER,** the title of an official whose business primarily was to examine and take charge of accounts, hence to direct or control; *e.g.*, the English comptroller of the household, comptroller and auditor-general (head of the exchequer and audit department), comptroller-general of patents, etc., comptroller-general (head of the national debt office). The word is frequently spelt *controller,* as in controller of the navy, controller of the stationery office. The word is used in the same sense in the United States, as comptroller of the Treasury, an official who examines accounts and signs drafts, and comptroller of the currency, who administers the law relating to the national banks. In the United States a comptroller is also a principal business executive officer whose duty it is to translate information obtained in accounting and business records into instruments for administrative control. The general auditor is responsible to him, and his department deals with questions of insurance, compensation, taxation and costs.

COMPURGATION or **LAW WAGER,** a method of defence common to many of the tribes which overran the Roman empire and to the Welsh, and subsequently adopted by the Church. If the defendant could get a certain number of persons (compurgators) to support his denial on oath of the charge, he won his case.

COMPUTING MACHINES: *see* MATHEMATICAL INSTRUMENTS.

COMSTOCK, ANNA BOTSFORD (1854–1930), American naturalist and wood-engraver, was born at Otto, N.Y., on Sept. 1, 1854. She graduated at Chamberlain institute, Randolph, N.Y., in 1873, and at Cornell university in 1878, and studied art at Cooper Union, New York city. In 1878 she married J. H. Comstock (*q.v*). As a wood-engraver she attained success with nature subjects and exhibited engravings at the World's Columbian exposition at Chicago in 1893 and at other important expositions. She became an influential advocate of nature-study in education and, following a wide experience in university extension work in this field, was made in 1913 assistant professor and in 1920, professor of nature-study in Cornell university. Among her published works are: *Ways of the Six-Footed* (1903); *How to Know the Butterflies,* with J. H. Comstock (1904); *Handbook of Nature-Study* (Ithaca, N.Y., 1911, 16th ed., 1925); *The Pet Book* (1914); *Bird, Animal, Tree, and Plant Notebooks* (1914); and *Trees at Leisure* (1916).

COMSTOCK, ANTHONY (1844–1915), American anti-vice crusader, was born at New Canaan, Conn., on March 7, 1844. He received a high school education, and served (1863–65) with the 17th Connecticut Regiment in the Civil War. In 1872 he became an active worker with the Young Men's Christian Association in New York city and devoted himself chiefly to the suppression of salacious literature. He was instrumental in organizing the New York Society for the Suppression of Vice in 1873, and was appointed chief special agent of the society. In the same year he was able to secure the passage of the so-called Comstock Laws of 1873 through the Federal Congress, and was appointed special agent of the Post Office Department. For many years he carried on an energetic prosecution of such establishments, literature and practices as he deemed immoral and injurious to the public. He died in New York city on Sept. 21, 1915.

See H. Broun and M. Leech, *Anthony Comstock, Roundsman of the Lord* (1927).

COMSTOCK, JOHN HENRY (1849–1931), American entomologist, was born in Janesville, Wis., on Feb. 24, 1849. After his graduation at Cornell university in 1874, he pursued further study at Yale university in 1874–75 and at the University of Leipzig in 1888–89. He was instructor and assistant professor of entomology in 1875–78 at Cornell university, and, after serving as U.S. entomologist at Washington in 1879–81, was made professor of entomology at Cornell university and continued in that chair until 1914 when he became professor emeritus. By his influential work as a teacher and by his researches and writings, he contributed notably to the advancement of entomological science, and rose to foremost rank among American entomologists. Besides numerous articles in scientific journals his published writings include: *A Manual on the Study of Insects,* with Anna Botsford Comstock (Ithaca, N.Y., 1895, 1904, 1907); *Insect Life* (1897, 1891); *Introduction to Entomology* (Ithaca, 1888, 1920, 1924); *How to Know the Butterflies,* with Anna B. Comstock (1904); *The Spider Book* (1912); and *The Wings of Insects* (Ithaca, 1918).

COMTE, AUGUSTE (ISIDORE AUGUSTE MARIE FRANÇOIS XAVIER) (1798–1857), French Positive philosopher, was born on Jan. 19, 1798, at Montpellier, where his father was a receiver-general of taxes for the district. He went first to the local school, and in 1814 to the École Polytechnique, where he displayed, in addition to great intelligence, the strenuous application that marked him all his life. His tendency to rebellion against authority, however, was also strongly developed already, and before he had been there five years he was involved in a mutiny which resulted in the break-up of the school. In 1816 he returned to Paris to make his living by teaching mathematics.

Saint-Simon.—About 1818 Comte became associated with Saint-Simon, who was destined to exercise a very decisive influence upon the turn of his speculation. In after years he so far forgot himself as to write of Saint-Simon as a depraved quack, and to deplore his connection with him as purely mischievous. While the connection lasted he thought very differently. Saint-Simon is described as the most estimable and lovable of men, and the most delightful in his relations; he is one of the most worthy of philosophers. The most cursory glance into Saint-Simon's writings is enough to reveal the thread of connection between the ingenious visionary and the systematic thinker, though this is not to deny either Comte's originality of thought or his superiority to Saint-Simon. It was undoubtedly Saint-Simon who launched him, to take Comte's own word, by suggesting what became the two starting points of the Comtist system—first, that political phenomena are as capable of being grouped under laws as other phenomena; and second, that the true destination of philosophy must be social, and the true object of the thinker, the reorganization of the moral, religious and political systems. The occasion resulting in the breach between them (1824) was an attempt on Saint-Simon's part to print a production of Comte's as if it were in some sort connected with Saint-Simon's schemes of social reorganization. Not only was the breach not repaired, but long afterwards Comte, as we have said, with painful ungraciousness took to calling the encourager of his youth by very hard names.

In *Le Producteur* Comte began to expound the philosophic ideas that were now maturing in his mind. He announced a course of lectures (1826), which it was hoped would bring money as well as fame, and which were to be the first dogmatic exposition of the Positive philosophy. These attracted hearers so eminent as Humboldt the cosmologist, Poinsot the geometer, and Blainville the physiologist.

Unhappily, after the third lecture of the course, Comte suffered a severe attack of cerebral derangement. He did not recover his health for more than a year, and as soon as convalescence set in he was seized by so profound a melancholy at the disaster which had thus overtaken him, that he threw himself into the Seine. Fortunately he was rescued, and the shock did not stay his return to mental soundness.

The Course of Positive Philosophy began to be published in 1830; the lectures were renewed in 1828. In 1833 he was appointed examiner of the boys who in the various provincial schools aspired to enter the École Polytechnique at Paris. This and two other engagements as a teacher of mathematics secured him an income of some £400 a year. He made M. Guizot, then Louis Philippe's minister, the important proposal to establish a chair of general history of the sciences. If there are four chairs, he argued, devoted to the history of philosophy, that is to say, the minute study of all sorts of dreams and aberrations through the ages, surely there ought to be at least one to explain the formation and progress of our real knowledge. This wise suggestion, still unfulfilled, was at first welcomed, according to Comte's own account, by Guizot's philosophic instinct, and then repulsed by his "metaphysical rancour."

Every year from 1831 to 1848 he delivered a course of gratuitous lectures on astronomy, and this public spirit showed itself in other ways. He was imprisoned for refusing to serve in the National guard, his position being that, as a republican, though he would not take arms against the new monarchy, he would take no oath to defend it. His only relaxation was the opera, to which he was devoted.

In 1842, as already stated, the last volume of the *Positive Philosophy* was given to the public; but instead of the contentment which he had earned by 12 years' hard work, Comte found himself in the midst of a sea of small trouble. First in 1842 he separated from his wife. Next, a lawsuit with his publisher, who inserted in the sixth volume a protest against a certain footnote, in which Comte had used some hard words about Arago. Comte threw himself into the suit with energy and won it. Third and worst of all, in a preface to the sixth volume, he deliberately angered the men on whom depended his annual re-election to the post of examiner for the Polytechnic school. The result was that he lost the appointment, and with it, one-half of his income. This was the occasion of an episode which is of more than merely personal interest.

J. S. Mill was in correspondence with Comte before 1842. He had been greatly impressed by Comte's philosophic ideas; Mill admits that his own *System of Logic* owes many valuable thoughts to Comte, and that, in the portion of that work which treats of the logic of the moral sciences, a radical improvement in the conceptions of logical method was derived from the *Positive Philosophy*. Their correspondence turned principally upon the questions of the equality **between men** and women, and of the expediency and constitution of a sacerdotal or spiritual order. When Comte found himself straitened, he confided the entire circumstances to Mill. As might be supposed by those who know the affectionate anxiety with which Mill regarded the welfare of any one whom he believed to be doing good work in the world, he at once took pains to have Comte's loss of income made up to him, until Comte should have had time to repair that loss by his own endeavour. Mill persuaded Grote, Molesworth, and Raikes Currie to advance the sum of £240. At the end of the year (1845) Comte had taken no steps to enable himself to dispense with the aid of the three Englishmen. Mill applied to them again, but with the exception of Grote, who sent a small sum, they gave Comte to understand that they expected him to earn his own living. Mill had suggested to Comte that he should write articles for the English periodicals, and expressed his own willingness to translate any such articles from the French. Comte at first fell in with the plan, but he speedily surprised and disconcerted Mill by boldly taking up the position of "high moral magistrate," and accusing the three defaulting contributors of a scandalous falling away from righteousness and a high mind. Mill was chilled by these pretensions; and the correspondence came to an end. There is something to be said for both sides. Comte, regarding himself as the promoter of a great scheme for the benefit of humanity, might reasonably look for the support of his friends in the fulfilment of his designs, but his subsequent attitude of censorious condemnation put him entirely in the wrong.

From 1845 to 1848 Comte lived as best he could, as well as made his wife her allowance, on an income of £200 a year. His little account books of income and outlay, with every item entered down to a few hours before his death, are accurate and neat enough to have satisfied an ancient Roman householder. In 1848, through no fault of his own, his salary was reduced to £80. Littré and others, with Comte's approval, published an appeal for subscriptions, and on the money thus contributed Comte subsisted for the remaining nine years of his life. By 1852 the subsidy produced as much as £200 a year. It is worth noticing that Mill was one of the subscribers, and that Littré continued his assistance after he had been driven from Comte's society by his high pontifical airs. We are sorry not to be able to record any similar trait of magnanimity on Comte's part. His character, admirable as it is for firmness, for intensity, for inexorable will, for iron devotion to what he thought the service of mankind, yet offers few of those softening qualities that make us love good men and pity bad ones.

Comte's Literary Method.—It is best to think of him only as the intellectual worker, pursuing in uncomforted obscurity the laborious and absorbing task to which he had given up his whole life. His singularly conscientious fashion of elaborating his ideas made the mental strain more intense than even so exhausting a work as the abstract exposition of the principles of positive science need have been. He did not write down a word until he had first composed the whole matter in his mind. When he had thoroughly meditated every sentence, he sat down to write, and then, such was the grip of his memory, the exact order of his thoughts came back to him, and he wrote down what he had intended to write, without the aid of a note. It is hardly possible, however, to share the admiration expressed by some of Comte's disciples for his style. When compared with such philosophic writing as Hume's, Diderot's, Berkeley's, then Comte's manner is heavy, laboured, monotonous, without relief and without light. Only the interest of the matter prevents one from thinking of Rivarol's ill-natured remark upon Condorcet, that he wrote with opium on a page of lead. The general effect is impressive, not by any virtues of style, but by reason of the magnitude and importance of the undertaking and the visible conscientiousness and the grasp with which it is executed. It is by sheer strength of thought, by the vigorous perspicacity with which he strikes the lines of cleavage of his subject, that he makes his way into the mind of the reader; in the presence of gifts of this power we need not quarrel with an ungainly style.

Comte pursued one practice which ought to be mentioned in connection with his personal history, the practice of what he styled *hygiène cérébrale.* After he had acquired what he considered to be a sufficient stock of material, and this happened before he had completed the *Positive Philosophy,* he abstained from reading newspapers, reviews, scientific transactions and everything else, except two or three poets (notably Dante) and the *Imitatio Christi.* It is true that his friends kept him informed of what was going on in the scientific world. Still this partial divorce of himself from the record of the social and scientific activity of his time, though it may save a thinker from the deplorable evils of dispersion, moral and intellectual, accounts in no small measure for the exaggerated egoism, and the absence of all feeling for reality which marked Comte's later days.

In 1845 Comte made the acquaintance of Madame Clotilde de Vaux. Very little is known about her qualities. Her letters speak well for her good sense and good feeling, and it would have been better for Comte's later work if she had survived to exert a wholesome restraint on his exaltation. Their friendship had only lasted a year when she died (1846), but the period was long enough to give her memory a supreme ascendancy in Comte's mind. After her death Comte was inconsolable, he visited her tomb every week and invoked her memory three times every day.

Comte lost no time, after the completion of his *Course of Positive Philosophy,* in proceeding with the *System of Positive Polity,* for which the earlier work was designed to be a foundation. The first volume was published in 1851, and the fourth and last in 1854. In 1848 when the political air was charged with stimulating elements, he founded the Positive society, with the expectation that it might grow into a reunion as powerful over the new revolution as the Jacobin club had been in the revolution of 1789. The hope was not fulfilled, but a certain number of philosophic disciples gathered round Comte, and eventually formed themselves, under the guidance of the new ideas of the latter half of his life, into a kind of church, for whose use was drawn up the *Positivist Calendar* (1849), in which the names of those who had advanced civilization replaced the titles of the saints. Gutenberg and Shakespeare were among the patrons of the thirteen months in this calendar. In the years 1849, 1850 and 1851, Comte gave three courses of lectures at the Palais Royal. They were gratuitous and popular, and in them he boldly advanced the whole of his doctrine, as well as the direct and immediate pretensions of himself and his system. The third course ended in the following uncompromising terms "In the name of the past and of the future, the servants of humanity—both its philosophical and its practical servants—come forward to claim as their due the general direction of this world. Their object is to constitute at length a real Providence in all departments—moral, intellectual and material. Consequently they exclude once for all from political supremacy all the different servants of God—Catholic, Protestant or Deist—as being at once behindhand and a cause of disturbance." A few weeks after this invitation, a very different person stepped forward to constitute himself a real Providence.

The Catechism of Positivism was published in 1852. In the preface Comte took occasion to express his approval of Louis Napoleon's *coup d' état* of the 2nd of December—"a fortunate crisis which has set aside the parliamentary system and instituted a dictatorial republic." Whatever we may think of the political sagacity of such a judgment it is due to Comte to say that he did not expect to see his dictatorial republic transformed into a dynastic empire, and next, that he did expect from the Man of December freedom of the press and of public meeting. His later hero was the emperor Nicholas, "the only statesman in Christendom"—as unlucky a judgment as that which placed Dr. Franca in the Comtist Calendar. Comte died of cancer on Sept. 5, 1857. By his will he appointed 13 executors who were to preserve his rooms at 10 rue Monsieur-le-Prince as the headquarters of the new religion of Humanity.

Early Writings.—In proceeding to give an outline of Comte's system, we shall consider the *Positive Polity* as the more or less legitimate sequel of the *Positive Philosophy,* notwithstanding the deep gulf which so eminent a critic as J. S. Mill insisted upon fixing between the earlier and the later work. His letters when he was a young man of one-and-twenty, and before he had published a word, show how strongly present the social motive was in his mind, and in what little account he should hold his scientific works, if he did not perpetually think of their utility for the species. "I feel," he wrote, "that such scientific reputation as I might acquire would give more value, more weight, more useful influence to my political sermons." In 1822 he published a *Plan of the Scientific Works necessary to reorganize Society.* In this he points out that modern society is passing through a great crisis, due to the conflict of two opposing movements; the first, a disorganizing movement owing to the break-up of old institutions and beliefs; the second, a movement towards a definite social state, in which all means of human prosperity will receive their most complete development and most direct application. How is this crisis to be dealt with? What are the undertakings necessary in order to pass successfully through it towards an organic state? The answer to this is that there are two series of works. The first is theoretic or spiritual, aiming at the development of a new principle of co-ordinating social relations, and the formation of the system of general ideas which are destined to guide society. The second work is practical or temporal; it settles the distribution of power, and the institutions that are most conformable to the spirit of the system which has previously been thought out in the course of the theoretic work. As the practical work depends on the conclusions of the theoretical, the latter must obviously come first in order of execution.

In 1826 this was pushed farther in a most remarkable piece called *Considerations on the Spiritual Power*—the main object of which is to demonstrate the necessity of instituting a spiritual power, distinct from the temporal power and independent of it. In examining the conditions of a spiritual power proper for modern times, he indicates in so many terms the presence in his mind of a direct analogy between his proposed spiritual power and the functions of the catholic clergy at the time of its greatest vigour and most complete independence—that is to say from about the middle of the 11th century, until towards the end of the 13th. He refers to De Maistre's memorable book, *Du Pape,* as the most profound, accurate and methodical account of the old spiritual organization, and starts from that as the model to be adapted to the changed intellectual and social conditions of the modern time. In the *Positive Philosophy,* again (vol. v.p.344), he distinctly says that catholicism, reconstituted as a system on new intellectual foundations, would finally preside over the spiritual reorganization of modern society. Much else could be quoted to the same effect. If unity of career, then, means that Comte from the beginning designed the institution of a spiritual power, and the systematic reorganization of life, it is difficult to deny him whatever credit that unity may be worth, and the credit is perhaps not particularly great. Even the readaptation of the catholic system to a scientific doctrine was plainly in his mind 30 years before the final execution of *Positive Polity,* though it is difficult to believe that he foresaw the religious mysticism in which the task was to land him. A great analysis was to precede a great synthesis, but it was the synthesis on which Comte's vision was centred from the first. Let us first sketch the nature of the analysis. Society is to be reorganized on the base of knowledge. What is the sum and significance of knowledge? That is the question which Comte's first master-work professes to answer.

The Law of the Three States.—The *Positive Philosophy* opens with the statement of a certain law of which Comte was the discoverer, and which has always been treated both by disciples and dissidents as the key to his system. This is the Law of the Three States. It is as follows: Each of our leading conceptions, each branch of our knowledge, passes successively through three different phases; there are three different ways in which the human mind explains phenomena, each way following the other in order. These three stages are the theological, the metaphysical and the positive. Knowledge, or a branch of knowledge is, in the theological state, when it supposes the phenomena under consideration to be due to immediate volition, either in the object or in some supernatural being. In the metaphysical state, for volition is substituted abstract force residing in the object, yet existing independently of the object; the phenomena are viewed as if apart from the bodies manifesting them; and the properties of each substance have attributed to them an existence distinct from that substance. In the positive state inherent volition or external volition and inherent force or abstraction personified have both disappeared from men's minds, and the explanation of a phenomenon means a reference of it, by way of succession or resemblance, to some other phenomenon—means the establishment of a relation between the given fact and some more general fact. In the theological and metaphysical state men seek a cause or an essence; in the positive they are content with a law. To borrow an illustration from an able English disciple of Comte:—"Take the phenomenon of the sleep produced by opium. The Arabs are content to attribute it to the 'will of God.' Moliere's medical student accounts for it by a *soporific principle* contained in the opium. The modern physiologist knows that he cannot account for it at all. He can simply observe, analyse and experiment upon the phenomena attending the action of the drug and classify it with other agents analogous in character."—(*Dr. Bridges*).

The first and greatest aim of the positive philosophy is to advance the study of society into the third of the three stages—to remove social phenomena from the sphere of theological and metaphysical conceptions, and to introduce among them the same scientific observation of their laws which has given us physics, chemistry, physiology. Social physics will consist of the conditions and relations of the facts of society, and will have two departments—one, statical, containing the laws of order; the other dynamical, containing the laws of progress. While men's minds were in the theological state, political events, for example, were explained by the will of the gods, and political authority based on divine right. In the metaphysical state of mind, then, to retain our instance, political authority was based on the sovereignty of the people, and social facts were explained by the figment of a falling away from a state of nature. When the positive method has been finally extended to society, as it has been to chemistry and physiology, these social facts will be resolved, as their ultimate analyses, into relations with one another, and instead of seeking causes in the old sense of the word, men will only examine the conditions of social existence. When that stage has been reached, not merely the greater part, but the whole of our knowledge, will be impressed with one character, the character, namely, of positivity or scientificalness: and all our conceptions in every part of knowledge will be thoroughly homogeneous. The gains of such a change are enormous. The new philosophical unity will now in its turn regenerate all the elements that went to its own formation. The mind will pursue knowledge without the wasteful jar and friction of conflicting methods and mutually hostile conceptions; education will be regenerated; and society will reorganize itself on the only possible solid base—a homogeneous philosophy.

Classification of Sciences.—The *Positive Philosophy* has another object besides the demonstration of the necessity and propriety of a science of society. This object is to show the sciences as branches from a single trunk—is to give to science the ensemble or spirit or generality hitherto confined to philosophy, and to give to philosophy the rigour and solidity of science. Comte's special object is a study of social physics, a science that before his advent was still to be formed; his second object is a review of the methods and leading generalities of all the positive sciences already formed, so that we may know both what system of inquiry to follow in our new science, and also where the new science will stand in relation to other knowledge.

The first step in this direction is to arrange scientific method and positive knowledge in order, and this brings us to another cardinal element in the Comtist system, the classification of the sciences. In the front of the inquiry lies one main division, that, namely, between speculative and practical knowledge. With the latter we have no concern. Speculative or theoretic knowledge is divided into abstract and concrete. The former is concerned with the laws that regulate phenomena in all conceivable cases: the latter is concerned with the application of these laws. Concrete science relates to objects or beings; abstract science to events. The former is particular or descriptive; the latter is general. Thus, physiology is an abstract science; but zoology is concrete. Chemistry is abstract; mineralogy is concrete. It is the method and knowledge of the abstract sciences that the positive philosophy has to reorganize in a great whole.

Comte's principle of classification is that the dependence and order of scientific study follows the dependence of the phenomena. Thus, as has been said, it represents both the objective dependence of the phenomena and the subjective dependence of our means of knowing them. The more particular and complex phenomena depend upon the simpler and more general. The latter are the more easy to study. Therefore science will begin with those attributes of objects which are most general, and pass on gradually to other attributes that are combined in greater complexity. Thus, too, each science rests on the truths of the sciences that precede it, while it adds to them the truths by which it is itself constituted. Comte's series or hierarchy is arranged as follows:— (1) Mathematics (that is, number, geometry, and mechanics), (2) Astronomy, (3) Physics, (4) Chemistry, (5) Biology, (6) Sociology. Each of the members of this series is one degree more special than the member before it, and depends upon the facts of all the members preceding it, and cannot be fully understood without them. It follows that the crowning science of the hierarchy dealing with the phenomena of human society will remain longest under the influence of theological dogmas and abstract figments, and will be the last to pass into the positive stage. You cannot discover the relations of the facts of human society without reference to the conditions of animal life; you cannot understand the conditions of animal life without the laws of chemistry; and so with the rest.

This arrangement of the sciences, and the Law of the Three States, are together explanatory of the course of human thought and knowledge. They are thus the double key of Comte's systematization of the philosophy of all the sciences from mathematics to physiology, and his analysis of social evolution, which is the base of sociology. Each science contributes its philosophy. The co-ordination of all these partial philosophies produces the general positive philosophy. Thousands had cultivated science, and with splendid success; not one had conceived the philosophy which the sciences when organized would naturally evolve. A few had seen the necessity of extending the scientific method to all enquiries, but no one had seen how this was to be effected. . . . The positive philosophy is novel as a philosophy, not as a collection of truths never before suspected. Its novelty is the organization of existing elements. Its very principle implies the absorption of all that great thinkers had achieved; while incorporating their results it extended their methods. . . . What tradition brought was the results; what Comte brought was the organization of these results. He always claimed to be the founder of the positive philosophy. That he had every right to such a title is demonstrable to all who distinguish between the positive sciences and the philosophy which co-ordinated the truths and methods of these sciences into a doctrine—(*G. H. Lewes*).

Comte's classification of the sciences has been subjected to a vigorous criticism by Herbert Spencer. Spencer's two chief points are these:—(1) He denies that the principle of the development of the sciences is the principle of decreasing generality; he asserts that there are as many examples of the advent of a science being determined by increasing generality as by increasing speciality. (2) He holds that any grouping of the sciences in a succession gives a radically wrong idea of their genesis and their interdependence; no true filiation exists; no science develops itself in isolation; no one is independent, either logically or historically. Littré, by far the most eminent of the scientific followers of Comte, concedes a certain force to Spencer's objections, and makes certain secondary modifications in the hierarchy in consequence, while still cherishing his faith in the Comtist theory of the sciences. J. S. Mill, while admitting the objections as good, if Comte's arrangement pretended to be the only one possible, still holds the arrangement as tenable for the purpose with which it was devised. G. H. Lewes asserts against Spencer that the arrangement in a series is necessary, on grounds similar to those which require that the various truths constituting a science should be systematically co-ordinated, although in nature the phenomena are intermingled.

The first three volumes of the *Positive Philosophy* contain an exposition of the partial philosophies of the five sciences that precede sociology in the hierarchy. Their value has usually been placed very low by the special followers of the sciences concerned; they say that the knowledge is second-hand, is not coherent, and is too confidently taken for final. The Comtist replies that the task is philosophic, and is not to be judged by the minute accuracies of science. In these three volumes Comte took the sciences roughly as he found them. His eminence as a man of science must be measured by his only original work in that department—the construction, namely, of the new science of society. This work is accomplished in the last three volumes of the *Positive Philosophy*, and the second and third volumes of the *Positive Polity*. The Comtist maintains that even if these five volumes together fail in laying down correctly and finally the lines of the new science, still they are the first solution of a great problem hitherto unattempted. "Modern biology has got beyond Aristotle's conception; but in the construction of the biological science, not even the most unphilosophical biologist would fail to recognize the value of Aristotle's attempt. So for sociology. Subsequent sociologists may have conceivably to remodel the whole science, yet not the less will they recognize the merit of the first work which has facilitated their labours."—(*Congreve*).

Sociological Conceptions.—We shall now briefly describe Comte's principal conceptions in sociology, his position in respect to which is held by himself, and by others, to raise him to the level of Descartes or Leibnitz. Of course the first step was to approach the phenomena of human character and social existence with the expectation of finding them as reducible to general laws as the other phenomena of the universe, and with the hope of exploring these laws by the same instruments of observation and verification as had done such triumphant work in the case of the latter. Comte separates the collective facts of society and history from the individual phenomena of biology; then he withdraws these collective facts from the region of external volition, and places them in the region of law. The facts of history must be explained, not by providential interventions, but by referring them to conditions inherent in the successive stages of social existence. This conception makes a science of society possible. What is the method? It comprises, besides observation and experiment (which is, in fact, only the observation of abnormal social states), a certain peculiarity of verification. We begin by deducing every well-known historical situation from the series of its antecedents. Thus we acquire a body of empirical generalizations as to social phenomena, and then we connect the generalizations with the positive theory of human nature. A sociological demonstration lies in the establishment of an accordance between the conclusions of historical analysis and the preparatory conceptions of biological theory. As Mill puts it:—"If a sociological theory, collected from historical evidence, contradicts the established general laws of human nature; if (to use M. Comte's instances) it implies, in the mass of mankind, any very decided and natural bent, either in a good or in a bad direction; if it supposes that the reason in average human beings predominates over the desires, or the disinterested desires over the personal—we may know that history has been misinterpreted, and that the theory is false. On the other hand, if laws of social phenomena, empirically generalized from history, can, when once suggested, be affiliated to the known laws of human nature; if the direction actually taken by the developments and changes of human society can be seen to be such as the properties of man and of his dwelling-place made antecedently probable, the empirical generalizations are raised into positive laws, and sociology becomes a science." The result of this method is an exhibition of the events of human experience in co-ordinated series that manifest their own graduated connection.

Next, as all investigation proceeds from that which is known best to that which is unknown or less well known, and as, in social states, it is the collective phenomenon that is more easy of access to the observer than its parts, therefore we must consider and pursue all the elements of a given social state together and in common. The social organization must be viewed and explored as a whole. There is a nexus between each leading group of social phenomena and other leading groups; if there is a change in one of them, that change is accompanied by a corresponding modification of all the rest. "Not only must political institutions and social manners on the one hand, and manners and ideas on the other, be always mutually connected; but further, this consolidated whole must be always connected by its nature with the corresponding state of the integral development of humanity considered in all aspects of intellectual, moral and physical activity."—(*Comte*).

Is there any one element which communicates the decisive impulse to all the rest—any predominating agency in the course of social evolution? The answer is that all the other parts of social existence are associated with, and drawn along by, the contemporary condition of intellectual development. The reason is the superior and preponderant element which settles the direction in which all the other faculties shall expand. "It is only through the more and more marked influence of the reason over the general conduct of man and of society, that the gradual march of our race has attained that regularity and persevering continuity which distinguish it so radically from the desultory and barren expansion of even the highest animal orders, which share, and with enhanced strength the appetites, the passions, and even the primary sentiments of man." The history of intellectual development, therefore, is the key to social evolution, and the key to the history of intellectual development is the law of the Three States.

Among other central thoughts in Comte's explanation of history are these:—The displacement of theological by positive conceptions has been accompanied by a gradual rise of an industrial régime out of the military régime; the great permanent contribution of catholicism was the separation which it set up between the temporal and the spiritual powers; the progress of the race consists in the increasing preponderance of the distinctively human elements over the animal elements; the absolute tendency of ordinary social theories will be replaced by an unfailing adherence to the relative point of view, and from this it follows that the social state, regarded as a whole, has been as perfect in each period as the co-existing condition of humanity and its environment would allow.

The elaboration of these ideas in relation to the history of the civilization of the most advanced portion of the human race occupies two of the volumes of the *Positive Philosophy*, and has been accepted by very different schools as a masterpiece of rich, luminous, and far-reaching suggestion. Whatever additions it may receive, and whatever corrections it may require, this analysis of social evolution will continue to be regarded as one of the great achievements of human intellect.

The third volume of the *Positive Polity* treats of social dynamics, and takes us again over the ground of historic evolution. It abounds with remarks of extraordinary fertility and comprehensiveness, but it is often arbitrary; and its views of the past are strained into coherence with the statical views of the preceding volume. As it was composed in rather less than six months, and as the author honestly warns us that he has given all his attention to a more profound co-ordination, instead of working out the special explanations more fully, as he had promised, we need not be surprised if the result is disappointing to those who had mastered the corresponding portion of the *Positive Philosophy.* Comte explains the difference between his two works. In the first his "chief object was to discover and demonstrate the laws of progress, and to exhibit in one unbroken sequence the collective destinies of mankind, till then invariably regarded as a series of events wholly beyond the reach of explanation, and almost depending on arbitrary will. The present work, on the contrary, is addressed to those who are already sufficiently convinced of the certain existence of social laws, and desire only to have them reduced to a true and conclusive system."

The Positivist System.—The main principles of the Comtian system are derived from the *Positive Polity* and from two other works,—the *Positivist Catechism; a Summary Exposition of the Universal Religion, in twelve Dialogues between a Woman and a Priest of Humanity;* and second, *The Subjective Synthesis* (1856), which is the first and only volume of a work upon mathematics announced at the end of the *Positive Philosophy.* The system for which the *Positive Philosophy* is alleged to have been the scientific preparation contains a polity and a religion; a complete arrangement of life in all its aspects giving a wider sphere to intellect, energy and feeling than could be found in any of the previous organic types—Greek, Roman, or Catholic-feudal. Comte's immense superiority over such pre-revolutionary utopians as the Abbe Saint Pierre, no less than over the group of post-revolutionary utopians, is especially visible in this firm grasp of the cardinal truth that the improvement of the social organism can only be effected by a moral development, and never by any changes in mere political mechanism, or any violences in the way of an artificial redistribution of wealth. A moral transformation must precede any real advance. The aim, both in public and private life, is to secure to the utmost possible extent the victory of the social feeling over self-love, or altruism over egoism.[1] This is the key to the regeneration of social existence, as it is the key to that unity of individual life which makes all our energies converge freely and without wasteful friction towards a common end. What are the instruments for securing the preponderance of altruism? Clearly they must work from the strongest element in human nature, and this element is feeling or the heart. Under the catholic system the supremacy of feeling was abused, and the intellect was made its slave. Then followed a revolt of intellect against sentiment. The business of the new system will be to bring back the intellect into a condition, not of slavery, but of willing ministry to the feelings. The subordination never was, and never will be, effected except by means of a religion, and a religion to be final, must include a harmonious synthesis of all our conceptions of the external order of the universe. The characteristic basis of a religion is the existence of a power without us, so superior to ourselves as to command the complete submission of our whole life. This basis is to be found in the positive stage in humanity, past, present and to come, conceived as the Great Being.

"A deeper study of the great universal order reveals to us at length the ruling power within it of the true Great Being, whose destiny it is to bring that order continually to perfection by constantly conforming to its laws, and which thus best represents to us that system as a whole. This undeniable Providence, the supreme dispenser of our destinies, becomes in the natural course the common centre of our affections, our thoughts and our actions. Although this Great Being evidently exceeds the utmost strength of any, even of any collective, human force, its necessary constitution and its peculiar function endow it with the truest sympathy towards all its servants. The least amongst us can and ought constantly to aspire to maintain and even to improve this Being. This natural object of all our activity, both public and private, determines the true general character of the rest of our existence, whether in feeling or in thought; which must be devoted to love, and to know, in order rightly to serve our Providence, by a wise use of all the means which it furnishes to us. Reciprocally this continued service, whilst strengthening our true unity, renders us at once both happier and better."

The exaltation of humanity into the throne occupied by the Supreme Being under monotheistic systems made all the rest of Comte's construction easy enough. Utility remains the test of every institution, impulse, act; his fabric becomes substantially an arch of utilitarian propositions, with an artificial Great Being inserted at the top to keep them in their place. The Comtist system is utilitarianism crowned by a fantastic decoration. Translated into the plainest English, the position is as follows: "Society can only be regenerated by the greater subordination of politics to morals, by the moralization of capital, by the renovation of the family, by a higher conception of marriage, and so on. These ends can only be reached by a heartier development of the sympathetic instincts. The sympathetic instincts can only be developed by the religion of humanity." Looking at this problem in this way, even a moralist who does not expect theology to be the instrument of social revival, might still ask whether the sympathetic instincts will not necessarily be already developed to their highest point, before people will be persuaded to accept the religion, which is at the bottom hardly more than sympathy under a more imposing name. However that may be, the whole battle—into which we shall not enter—as to the legitimateness of Comtism as a religion turns upon this erection of humanity into a Being. The various hypotheses, dogmas, proposals, as to the family, to capital, etc., are merely propositions measurable by considerations of utility and a balance of expediencies. Many of these proposals are of the highest interest, and many of them are actually available; but there does not seem to be one of them of an available kind, which could not equally well be approached from other sides, and even incorporated in some radically antagonistic system. Adoption, for example, as a practice for improving the happiness of families and the welfare of society, is capable of being weighed, and can in truth only be weighed, by utilitarian considerations, and has been commended by men to whom the Comtist religion is naught. The singularity of Comte's construction, and the test by which it must be tried, is the transfer of the worship and discipline of catholicism to a system in which "the conception of God is superseded" by the abstract idea of humanity, conceived as a kind of personality.

And when all is said, the invention does not help us. We have still to settle what *is* for the good of humanity, and we can only do that in the old-fashioned way. There is no guidance in the conception. No effective unity can follow from it, because you can only find out the right and wrong of a given course by summing up the advantages and disadvantages, and striking a balance, and there is nothing in the religion of humanity to force two men to find the balance on the same side. The Comtists are no better off than other utilitarians in judging policy, events, conduct.

The particularities of the worship, its minute and truly ingenious re-adaptations of sacraments, prayers, reverent signs, down even to the invocation of a New Trinity, need not detain us. They are said, though it is not easy to believe, to have been elaborated by way of Utopia. If so, no Utopia has ever yet been presented in a style so little calculated to stir the imagination, to warm the feelings, to soothe the insurgency of the reason. It is a mistake to present a great body of hypotheses—if Comte meant them for hypotheses—in the most dogmatic and peremptory form to which language can lend itself. And there is no more extraordinary thing in the history of opinion than the perversity with

[1]For Comte's place in the history of ethical theory *see* ETHICS.

which Comte has succeeded in clothing a philosophic doctrine, so intrinsically conciliatory as his, in a shape that excites so little sympathy and gives so much provocation. An enemy defined Comtism as catholicism *minus* Christianity, to which an able champion retorted by calling it catholicism *plus* science. Comte's Utopia has pleased the followers of the catholic, just as little as those of the scientific spirit.

The elaborate and minute systematization of life, proper to the religion of humanity, is to be directed by a priesthood. The priests are to possess neither wealth nor material power; they are not to command but to counsel; their authority is to rest on persuasion, not on force. When religion has become positive and society industrial, then the influence of the Church upon the State becomes really free and independent, which was not the case in the middle ages. The power of the priesthood rests upon the special knowledge of man and nature; but to this intellectual eminence must also be added moral power and a certain greatness of character, without which force of intellect and completeness of attainment will not receive the confidence they ought to inspire. The functions of the priesthood are of this kind:—To exercise a systematic direction over education; to hold a consultative influence over all the important acts of actual life, public and private; to arbitrate in cases of practical conflict; to preach sermons recalling those principles of generality and universal harmony which our special activities dispose us to ignore; to order the due classification of society; to perform the various ceremonies appointed by the founder of the religion. The authority of the priesthood is to rest wholly on voluntary adhesion, and there is to be perfect freedom of speech and discussion. This provision hardly consists with Comte's congratulations to the tsar Nicholas on the "wise vigilance" with which he kept watch over the importation of western books.

The Condition of Women had always powerfully impressed Comte; to him it seemed absolutely essential to elevate it. (*See* a remarkable passage in his letters to M. Valat, pp. 84–87.) His friendship with Madame de Vaux had deepened the impression, and in the reconstructed society women are to play a highly important part. They are to be carefully excluded from public action, but they are to do many more important things than things political. To fit them for their functions they are to be raised above material cares, and they are to be thoroughly educated. The family, which is so important an element of the Comtist scheme of things, exists to carry the influence of woman over man to the highest point of cultivation. Through affection she purifies the activity of man. "Superior in power of affection, more able to keep both the intellectual and the active powers in continual subordination to feeling, women are formed as the natural intermediaries between humanity and man. The Great Being confides specially to them its moral providence, maintaining through them the direct and constant cultivation of universal affection, in the midst of all the distractions of thought or action, which are for ever withdrawing men from its influence. . . . Besides the uniform influence of every woman on every man, to attach him to humanity, such is the importance and the difficulty of this ministry that each of us should be placed under the special guidance of one of these angels, to answer for him, as it were, to the Great Being. This moral guardianship may assume three types—the mother, the wife and the daughter; each having several modifications, as shown in the concluding volume. Together they form the three simple modes of solidarity, or unity with contemporaries, obedience, union and protection—as well as the three degrees of continuity between ages by uniting us with the past, the present and the future. In accordance with my theory of the brain, each corresponds with one of our three altruistic instincts —veneration, attachment and benevolence."

How the positive method of observation and verification of real facts has landed us in this, and much else of the same kind, is extremely hard to guess. Seriously to examine an encyclopaedic system, that touches life, society and knowledge at every point, is evidently beyond the compass of such an article as this. There is in every chapter a whole group of speculative suggestions, each of which would need a long chapter to itself to elaborate or to discuss. There is at least one biological speculation of astounding audacity, that could be examined in nothing less than a treatise. Perhaps we have said enough to show that after performing a great and real service to thought Comte almost sacrificed his claims to gratitude by the invention of a system that, as such, and independently of detached suggestions, is markedly retrograde. But the world will take what is available in Comte, while forgetting that in this work which is as irrational in one way as Hegel is in another. (J. Mo.; X.)

See also the article POSITIVISM.

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COMUS, the spirit of revelry (Gr. κῶμος, band of revellers); in art, occasionally shown as attendant on Dionysus (q.v.); described by Philostratus in *Imagines* i. 2. From this source, presumably, Ben Jonson got the name (*Pleasure reconciled to Virtue,* 1619). Milton's *Comus* is his own creation, only the name being classical.

See Roscher's *Lexikon,* art. "Komos," and *cf.* JONSON; MILTON.

COMYN, JOHN (d. *c.* 1300), Scottish baron, was a son of John Comyn (d. 1274), justiciar of Galloway, who was a nephew of the constable of Scotland, Alexander Comyn, earl of Buchan (d. 1289), and of the powerful and wealthy Walter Comyn, earl of Mentieth (d. 1258). The elder Comyn took a prominent part in the affairs of Scotland with his uncle the earl of Buchan and had interests in England as well as in his native land; he fought for Henry III. at Northampton and at Lewes, and was imprisoned for a short time in London. The younger Comyn, who had inherited the lordship of Badenoch from his great-uncle the earl of Mentieth, was appointed one of the guardians of Scotland in 1286, and shared in the negotiations between Edward I. and the Scots in 1289–90. When Margaret, the Maid of Norway, died in 1290, Comyn was one of the claimants for the Scottish throne, but he urged the claim of his brother-in-law, John Baliol. After supporting Baliol in his rising against Edward I., Comyn submitted to Edward in 1296.

JOHN COMYN (d. 1306), called the "red Comyn," was a grandson of the justiciar. Like Badenoch, his father, he assisted Baliol against Edward I., and was for some time a hostage in England. Having been made guardian of Scotland after the battle of Falkirk (1298) he led the resistance to the English king for about five years, and then early in 1304 surrendered. He is remembered for his quarrel with Robert the Bruce. The pair met at Dumfries in Jan. 1306; during a heated altercation charges of treachery were made, and Comyn was stabbed to death either by Bruce or by his followers.

Another member of the Comyn family active in Scottish affairs during these troubled times is JOHN COMYN, earl of Buchan (d. *c.* 1313). This earl, a son of Earl Alexander, was constable of Scotland, and was first an ally and then an enemy of Robert the Bruce.

CONACRE, in Ireland, a system of letting land, mostly in small patches, and usually for the growth of potatoes as a kind of return instead of wages. It is now practically obsolete.

CONANT, JAMES BRYANT (1893–), American educator, was born in Boston, Mass. March 26, 1893. He received both his A.B. and Ph.D (1916) degrees from Harvard University, and, after spending a year in the research division of the Chemical Warfare Service, returned to Harvard University as an instructor in chemistry. He was advanced in rank until he became professor of organic chemistry in 1929 and chairman of the department in 1931. On May 8, 1933 he was elected president of Harvard University to succeed A. Lawrence Lowell. He was recognized as one of the more brilliant of the younger organic chemists of the country by the award to him in 1932 of the Chandler Medal. Later in the same year he received the Nichols Medal of the American Chemical Society, in recognition of his researches into the chemical structure of chlorophyll. His research has also included work in reduction and oxidation processes, free radicals, and the quantitative study of organic reactions. His publications include papers in scientific journals, and textbooks.

CONATION, a psychological term, originally chosen by Sir William Hamilton (*Lectures on Metaphysics,* pp. 127 foll.), used generally of an attitude of mind involving a tendency to take *action* (Lat. *conari,* attempt), *e.g.,* when one decides to remove an object which is causing a painful sensation, or to try to interrupt an unpleasant train of thought. This use of the word tends to lay emphasis on the mind as self-determined in relation to external objects. Another less common use of the word is to describe the pleasant or painful sensations which accompany muscular activity; the *conative* phenomena, thus regarded, are psychic changes brought about by external causes. More usually the term conation is employed now as synonymous with willing, and denotes one of the ultimate kinds of mental process. It includes all that is known as impulse, desire and act of volition.

The chief difficulty in connection with conation is that of distinguishing it from "feeling," a term of very vague significance both in technical and in common usage. Thus the German psychologist F. Brentano holds that no real distinction can be made. He argues that the mental process from sorrow or dissatisfaction, through hope for a change and courage to act, up to the voluntary determination which issues in action, is a single homogeneous whole (*Psychologie,* pp. 308–309). The mere fact, however, that the series is continuous is no ground for not distinguishing its parts; if it were so, it would be impossible to distinguish by separate names the various colours in the solar spectrum, or indeed perception from conception. A more material objection, moreover, is that, in point of fact, the feeling of pleasure or pain roused by a given stimulus is specifically different from, and indeed may not be followed by, the determination to modify or remove it. Pleasure and pain, *i.e.,* hedonic experiences *per se,* are essentially distinct from appetition and aversion; the pleasures of hearing music or enjoying sunshine are not in general accompanied by any volitional activity. It is true that painful sensations are generally accompanied by definite aversion or a tendency to take action, but the cases of positive pleasure are amply sufficient to support a distinction. Therefore, though in ordinary language such phrases as "feeling aversion" are quite legitimate, accurate psychology compels us to confine "feeling" to states of consciousness in which no conative activity is present, *i.e.,* to psychic phenomena of pleasure or pain considered by themselves.

CON BRIO (It.), "with fire" (lit. "noise"), a familiar direction in musical scores, *e.g., Allegro con brio.*

CONCA, SEBASTIANO (1679–1764), Italian painter of the Florentine school, was born at Gaeta, and studied at Naples under Francesco Solimena. In 1706, along with his brother Giovanni, who acted as his assistant, he settled at Rome, where for several years he worked in chalk only, to improve his drawing. He was patronized by the Cardinal Ottoboni, who introduced him to Clement XI.; and a "Jeremiah" painted in the church of St. John Lateran was rewarded by the pope with knighthood and by the cardinal with a diamond cross. Of his many pictures the "Probatica," or "Pool of Siloam," in the hospital of Santa Maria della Scala, at Siena, is considered the finest.

CONCARNEAU, a fishing port of western France in the south of the department of Finistère, 14 mi. S.E. of Quimper. Pop. (1936), 5,878. The town is picturesquely placed on the Baie de la Forêt. The old portion stands on an island, and is surrounded by ramparts, parts of which are believed to date from the 14th century, while a fashionable little watering-place is growing up on the adjacent Sables-Blancs. Sardine-tinning is carried on. Of recent years the lace industry has revived among the women.

CONCENTRATION CAMPS are camps in which the civilian population of a conquered country or territory in a state of rebellion are gathered to end guerilla warfare waged by civilians wearing civilian clothes and therefore indistinguishable from the peaceful citizens. They were used by the Spaniards in Cuba and the British in South Africa. The Nazi regime used them in peace and war. In peace time recalcitrant citizens are put in such camps. (*See* SOUTH AFRICAN WAR, 1899–1902.)

CONCEPCIÓN, a province in the southernmost part of central Chile, lying between the province of Ñuble on the north and east, and Bío-Bío and Cautín on the south. Bounded by the Pacific on the west, Concepción is one of the few provinces of Chile whose eastern border is not adjacent to Argentina. Area 2,201 sq.mi.; population (1940 census) 308,241, one of the three most densely inhabited provinces of Chile. Concepción is the most important province in south central Chile because of its advantageous commercial position, fertility, mining and industries. The climate is mild and the rainfall abundant. The coast is indented by the large and sheltered bay of Concepción and the northern part of the gulf of Arauco. Talcahuano, on Concepción bay, is 8 mi. N. of the provincial capital (Concepción) and is its port. Other ports and industrial towns on the bay are Penco and Tomé. The province produces large quantities of grain, vegetables, wine, livestock and timber. Near the coast are extensive deposits of coal, which is shipped principally from Lota and Coronel on the gulf of Arauco. The coal mines at these places are the largest in the country, and the most productive in South America. The State central railway from Santiago to Puerto Montt crosses the eastern part of the province, and branch lines serve the important towns and industrial centres along the coast.

CONCEPCIÓN, a city of south central Chile, capital of a province and department of same name, on the right bank of the Bío-Bío river, 7 mi. above its mouth, and 355 mi. S.S.W. of Santiago by rail. Pop. (1940) 85,938. It is the commercial centre of a rich agricultural region, its trade passing in great part through the port of Talcahuano, 8m. distant by rail. The small port of Penco, situated on the same bay and 10m. distant by rail, also receives a part of the trade. Concepción is one of the southern termini of the Chilean central railway, by which it is connected with Santiago to the north, with Valdivia and Puerto Montt to the south, and with the port of Talcahuano. Another line extends southward through the Chilean coal-producing districts to Curanilhue, and a short line of 10m. runs northward to Penco. The districts tributary to Concepción produce wheat, wine, wool, cattle, coal and timber, and among the industrial establishments of the city are flour mills, furniture and carriage factories, distilleries and breweries. The city is built on a level plain but little above sea-level, and is laid out in regular squares with broad streets. It is an episcopal see with a cathedral and several fine churches, and is the seat of a university. The city was founded by Pedro de Valdivia in 1550. It was situated on the bay of Talcahuano where the town of Penco now stands but was destroyed by earthquakes in 1570, 1730 and 1751, and was then (1755) removed to the margin of the Bío-Bío. In 1835 it was laid in ruins, a graphic description of which is given by Charles Darwin in *The Voyage of H.M.S. Beagle,* and severe damage was suffered in the earthquake of 1939. The city was twice burned by the Araucanians during their long struggle against the Spanish colonists.

CONCEPCIÓN or **VILLA CONCEPCIÓN,** the principal town and a river port of northern Paraguay, on the Paraguay river, 138 mi. (234 mi. by river) N. of Asunción, and about 345 ft. above sea-level. Pop. (1940) 14,793, largely Indians and mestizos. It is a distributing centre for the towns on both sides of the Paraguay-Brazil border and is a port of call for the river steamers trading with the Brazilian town of Corumbá, Mato Grosso. The principal products of the sparsely inhabited country which surrounds Concepción are Paraguay tea, or "yerba maté," cattle and quebracho.

CONCEPT AND CONCEPTION, in philosophy, a term applied to a general idea derived from and considered apart from the particulars observed by the senses. The mental process by which this idea is obtained is called abstraction (*q.v.*). By the comparison, for instance, of a number of boats, the mind abstracts a certain common quality or qualities in virtue of which the mind forms the general idea of "boat." Thus the connotation of the term "boat," being the sum of essential qualities in respect of which all boats are regarded as alike, whatever their individual peculiarities may be, is described as a "concept." The mental process by which a concept is affirmed is called "conception," a term which is often loosely used in a concrete sense for "concept" itself. It is also used even more loosely as synonymous in the widest sense with "idea," "notion." Strictly, however, it is contrasted with "perception," and implies the mental reconstruction and combination of sense-given data. Thus when one carries one's thoughts back to a series of events, one constructs mentally a whole made up of parts which take definite shape and character by their mutual inter-relations. This process is called *conceptual synthesis,* the possibility of which is a *sine qua non* for the exchange of information by speech and writing. It should be noticed that this (very common) psychological interpretation of "conception" differs from the metaphysical or general philosophical definition given above, in so far as it includes mental presentations in which the universal is not specifically distinguished from the particulars. Some psychologists prefer to restrict the term to the narrower use which excludes all mental states in which particulars are cognized, even though the universal be present also.

In biology conception is the coalescence of the male and female generative elements, producing pregnancy.

CONCEPTUALISM (from "Concept"), in philosophy, a term applied by modern writers to a scholastic theory of the nature of universals, to distinguish it from the two extremes of nominalism and realism. The scholastic philosophers took up the old Greek problem as to the nature of true reality, whether the general idea or the particular object is more truly real. Between realism which asserts that the *genus* is more real than the *species,* and that particulars have no reality, and nominalism according to which *genus* and *species* are merely names (*nomina, flatus vocis*), conceptualism takes a mean position. The conceptualist holds that universals have a real existence, but only in the mind, as the concepts which unite the individual things; *e.g.,* there is in the mind a general notion or idea of boats, by reference to which the mind can decide whether a given object is, or is not, a boat. On the one hand "boat" is something more than a mere sound with a purely arbitrary conventional significance; on the other it has, apart from particular things to which it applies, no reality; its reality is purely abstract or conceptual. This was enunciated by Abélard in opposition to Roscellinus (nominalist) and William of Champeaux (realist). Abélard held that it is only by becoming a predicate that the class-notion or general term acquires reality. Thus similarity (*conformitas*) is observed to exist between a number of objects in respect of a particular quality or qualities. This quality becomes real as a mental concept when it is predicated of all the objects possessing it ("quod de pluribus natum est praedicari"). Hence Abelard's theory is alternatively known as sermonism (*sermo,* "predicate"). His statement of this position oscillates markedly, inclining sometimes towards the nominalist, sometimes towards the realist statement, using the arguments of the one against the other. Hence he is described by some as a realist, by others as a nominalist. When he comes to explain that objective similarity in things which is represented by the class-concept or general term, he adopts the theological Platonic view that the ideas which are the archetypes of the qualities exist in the mind of God. They are, therefore, *ante rem, in re* and *post rem,* or, as Avicenna stated it, *universalia ante multiplicitatem, in multiplicitate, post multiplicitatem* (universals exist before, in, and after the multiplicity of their particulars). The whole controversy suffers from a tendency to confuse "idea" in the sense of a concept or notion in the mind with "idea" in the Platonic sense of an ultimate archetype of phenomenal objects. (A. Wo.)

CONCERT, a term meaning, in general, co-operation, agreement or union; the more specific usages being in music and in diplomacy. The term "Concert of Europe" has been commonly applied, since the Congress of Vienna (1814–15), to the six great European Powers consulting or acting together in questions of common interest. This ceased to exist on the formation, before the World War, of the Triple Alliance and the Triple Entente.

A complete history of concerts, in the sense of musical entertainments, has yet to be written, but it appears that some of the earliest entertainments of this kind were given in England. This was as long ago as 1672 when on Dec. 30, John Banister, a well-known violinist of the day and leader of the King's Band, who was also a composer, announced the first of them as follows in the *London Gazette:*

"These are to give notice that at Mr. John Banister's house, now called the Musick School, over against the George Tavern, in White Friars, this present Monday, will be musick performed by excellent masters, beginning precisely at four of the clock in the afternoon, and every afternoon for the future, precisely at the same hour."

The charge of admission to these "musick" makings was one shilling and from the fact that they were continued by Banister till the year of his death (1679) they were evidently successful.

Another and better known pioneer in the same field was Thomas Britton (1643–1714) who lives in history as the "Musical Small-Coal Man." (He was an itinerant vendor of "small-coal" who was at the same time a man of wide general knowledge and intelligence and an enthusiastic music-lover.) His concerts given weekly in a room over his shop in Clerkenwell, were established in 1678 and enjoyed great popularity. The most eminent performers, including even Handel, appeared at them and they were attended by all the best people of the day, who paid the modest subscription of ten shillings a year for the privilege.

The first of London's regular concert rooms was formerly supposed to have been that known as "Hickford's," situated in the first instance in Panton street, Haymarket, but recent researches have shown that there were two earlier rooms. Of these the first and most important was one situated in Villiers street, Strand, known usually as the York Buildings Room, where concerts were being given at least as early as 1685, and the other, a smaller room in Covent Garden, known as "La Vendu," where concerts were also being regularly given about the same time.

It was not until some years later that Hickford's was opened, the first mention of it which is to be found in the newspapers of the period being contained in an advertisement in the *Post Boy* for 1697. But once established, Hickford's speedily eclipsed in popularity and importance both of its predecessors and remained for some three-quarters of a century the centre of London's musical life.

In 1739 Hickford shifted his quarters to Brewer street, Golden Square, where the "*new* Great Room" which he referred to in his advertisements remained in excellent preservation until 1934 when, with deplorable disregard of its unique interest and historical associations—Mozart had actually appeared here as a prodigy of eight—it was pulled down to make room for a neighbouring hotel.

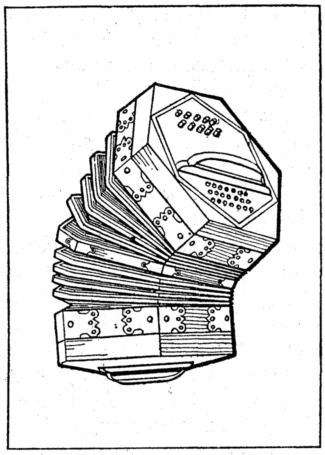
Hickford's Room, where concerts continued to be given till 1779, was succeeded as London's chief musical resort by the Hanover Square Rooms, where from 1774 onwards for the best part of a century many of the more important concerts took place. Much frequented also during this period were the Argyll Rooms (from about 1800 to 1830), while later (1858) came St. James's hall which, in turn, was for many years the centre of London's musical life.

Here were given the famous Monday and Saturday Popular concerts, the Richter concerts, those of the Philharmonic Society, and others, important and unimportant, in ever-increasing numbers as year by year the concert-giving industry steadily developed. Yet St. James's hall was never a satisfactory undertaking financially and it was pulled down in 1905 to make way for the Piccadilly hotel which occupies its site today.

In the meantime the somewhat larger Queen's hall had already been erected in Langham place, and this constitutes London's most important concert room to-day, though not the largest, this distinction belonging to the Royal Albert hall with its accommodation for 10,000 hearers.

On the Continent and in America concert-giving has followed much the same course as that sketched above, developing everywhere from the smallest beginnings into a veritable industry of prodigious dimensions. In Germany and Austria, under the patronage system, private performances in the residences of the sovereigns and great nobles at first checked the development of ordinary public concerts but by the beginning of the 18th century these were coming to be known, and by Beethoven's time they were well established; the like applying in the case of Paris, where the famous "Concerts spirituels" were founded by Philidor in 1725. (H. A. Sc.)

CONCERTINA, a wind instrument of the seraphine family with free reeds, forming a link in the evolution of the harmonium from the mouth organ, intermediate links being the cheng and the accordion. The concertina consists of two hexagonal or rectangular keyboards connected by a long expansible bellows of many folds similar to that of the accordion. The keyboards are furnished with rows of knobs, which, on being pressed down by the fingers, open valves admitting the air compressed by the bellows to the free reeds, which are thus set in vibration. The English concertina, or melodion, invented by Sir Charles Wheatstone in 1829, the year of the reputed invention of the accordion (*q.v.*), is constructed with a double action, the same note being produced on compressing and expanding the bellows, whereas in the German concertina or accordion two different notes are given out. Concertinas are made in complete families—treble, tenor, bass, and double bass, having a combined total range of nearly seven octaves.



THE CONCERTINA, A LINK BETWEEN THE MOUTH ORGAN AND THE HARMONIUM. THE SOUND IS PRODUCED BY THE PRESSURE OF AIR FROM THE BELLOWS ON FREE METALLIC REEDS

The timbre of the concertina is penetrating but soft, and the instrument is capable of the most delicate gradations of tone. It is possible to play on it diatonic and chromatic passages, or arpeggios in legato or staccato style, with rapidity, shakes single and double in thirds, and also to play in parts as on the pianoforte or organ, and to produce very rich chords. Concertos were written for concertina with orchestra by Molique and Regondi, a sonata with piano by Molique, while Chaikovski scored in his second orchestral suite for four accordions.

The aeola, constructed by the representatives of the original firm of Wheatstone, is a still more artistically developed concertina.

See also ACCORDION; CHENG; HARMONIUM; FREE-REED VIBRATOR.

CONCERTO, in music, a term which appears as early as the beginning of the 17th century, at first with vague meanings, but soon acquiring a sense justified by its etymology (Lat. *concertus*, from *certare*, to strive; also confused with *concentus*), being applied chiefly to compositions in which unequal instrumental or vocal forces are brought into opposition.

Although by Bach's time the concerto as a purely instrumental form was thoroughly established, the term frequently appears in the autograph title-pages of his church cantatas, even when the cantata contains no instrumental prelude. Indeed, so entirely does the actual concerto form, as Bach understands it, depend upon the opposition of masses of tone unequal in volume, with a compensating inequality in power of commanding attention, that Bach is able to rewrite an instrumental movement as a chorus without the least incongruity of style. The very title of his secular cantata, *Vereinigte Zwietracht der wechselnden Saiten* ("united contest of turn-about strings"), is a perfect definition of the earlier form of *concerto grosso,* in which the chief mass of the orchestra was opposed, not to a mere solo instrument, but to a small group called the *concertino;* unless, indeed, the whole work was for a large orchestral mass in which tutti passages alternate with passages in which the whole orchestra is dispersed in every possible kind of grouping.

But the special significance of this cantata is that its first chorus is arranged from the second movement of the first Brandenburg concerto and that, while the orchestral material is merely transposed and arranged for larger forces, the whole four part chorus has been evolved from the solo part for a kit-violin (*violino piccolo*). This shows that the true relation between the opposed factors in a concerto depends not on volume of sound, but on power to command attention.

A conveniently isolated individual will command more attention than the crowd, whether in real life, drama, or instrumental music. But in music the human voice, with human words, will thrust any orchestral force into the background, whether the voice be individual or choral. The full chorus is the equivalent of the kit-violin and the kit-violin is the equivalent of the full chorus because both assert personality against the orchestra.

Hence the polyphonic concerto is fundamentally identical with the vocal aria, as matured by Alessandro Scarlatti. The orchestra is entrusted with a short pregnant summary or ritornello of the main contents of the movement, and the solo, or the groups corresponding thereto, will either take up this material or first introduce new themes to be combined with it, and, in short, enter into relations with the orchestra very like those between the actor and the chorus in Greek drama. The polyphonic concerto, the vocal aria, and the forms of many of Bach's choruses, even including some that contain fugues, ought to be classed under the head of ritornello forms. (*See* ARIA.) Many of Bach's larger movements for solo instruments without orchestra will at once reveal the proper lines of their interpretation in the light of ritornello form. The harpsichord, no less than the organ, can obviously imitate contrasts between solos and tuttis with excellent effect.

In slow movements of concertos Bach uses the *ground bass* (*see* VARIATIONS), diversified by changes of key (klavier concerto in D minor), the more melodic types of binary form, sometimes with the repeats ornamentally varied or inverted (concerto for 3 klaviers in D minor, concerto for klavier, flute, and violin in A minor), are found besides aria-form on the aria scale. In finales the *rondo* form (violin concerto in E major, klavier concerto in F minor) and the binary form (3rd Brandenburg concerto) may be found.

When musical forms changed to those of the dramatic sonata style the problems of the concerto proved ridiculously easy to ordinary musicians and the tasks of the highest interest to the greatest composers. Bach's sons took important new steps. Philipp Emanuel Bach developed a romantic rhetoric. Johann Christian, the "London" Bach, initiated the all-important method of emphasizing a change of key so that it became a dramatic event irreversible except by other dramatic developments. Mozart, as a boy, modelled himself closely on Johann Christian Bach, and by the time he was 20 was able to write concerto ritornellos that gave the orchestra admirable opportunity for asserting itself by the statement, in charmingly epigrammatic style, of some five or six sharply contrasted themes, afterwards to be worked out with additions by the solo, with the orchestra's co-operation and intervention.

The problem changes rapidly as the scale of the composition grows. On a large scale a too-facile alternation between solo and tutti produces forms too sectional for the high organization required in first movements; yet frequent alternation is evidently necessary, as the solo is audible only above a very subdued orchestral accompaniment, and it would be inartistic to confine the orchestra to that function. Hence in the classical concerto the ritornello is never abandoned, in spite of the enormous dimensions to which the sonata style expanded it. Mendelssohn and most later composers evidently see in it only a conventional impediment easily abandoned. Yet its absence reduces the whole style to a more theatrical and lighter art-form. Hence it is restored to its place not only by Brahms in his four magnificent examples, but by Joachim in his Hungarian concerto and by Elgar in his violin concerto. The danger in so long an orchestral prelude is that the work may for some minutes be indistinguishable from a symphony and thus the entry of the solo may be unexpected without being inevitable. This will happen if the composer treats his tutti so like the exposition of a sonata movement as to make a deliberate transition from his first group of themes to a second group in a complementary key, even if the transition be only temporary—as in Beethoven's C minor concerto. But Beethoven's C minor concerto is the one which Spohr and Hummel and even Joachim took as their model, and thus the true solution of the problem remained for Brahms to rediscover.

Mozart keeps his whole tutti in the tonic, relieved only by his mastery of sudden subsidiary modulation. Beethoven, in turn, after the C minor concerto, grasped the true function of the opening tutti and enlarged it to his new purposes. With an interesting experiment of Mozart's before him, he, in his G major concerto, Op. 58, allowed the solo player to state the opening theme, making the orchestra enter *pianissimo* in a foreign key. In this concerto he also gave variety of key to the opening tutti by means of an important theme which modulates widely, an entirely different thing from a deliberate modulation from material in one key to material in another. His fifth and last pianoforte concerto in E flat begins with a rhapsodical introduction for the solo player, followed by a long tutti confined to the tonic major and minor with a strictness explained by the gorgeous modulations with which the solo subsequently treats the second subject. In this concerto Beethoven also organizes the only undigested convention of the form, namely, the *cadenza,* a custom elaborated from the operatic aria, in which the singer was allowed to extemporize a flourish on a pause near the end. A similar pause was made in the final ritornello of a concerto, and the soloist was supposed to extemporize what should be equivalent to a symphonic coda. Cadenzas are, to this day, a form of musical appendicitis, since the player (or cadenza-writer) cannot be the composer himself and is rarely so capable of entering into his intentions as Joachim, whose written cadenzas for classical violin concertos are unsurpassable.

Brahms's first concerto in D minor, Op. 15, was the outcome of many changes and, though on a mass of material originally intended for a symphony, was nevertheless so perfectly assimilated into concerto form that in his next essay, the violin concerto, Op. 77, he had no more to learn and was free to continue making true innovations. He found out how to include wide key contrasts in the opening tutti, thus giving the form a wider range in definitely functional key than any other instrumental music. Further, it may be noted that in this work Brahms develops a counterplot in the opposition between solo and orchestra; giving not only the development by the solo of material stated by the orchestra, but also a counter-development by the orchestra of material stated by the solo. This concerto is, on the other hand, remarkable as being the last in which a blank space is left for a cadenza; a testimony of confidence in Joachim. In the pianoforte concerto in B flat, and in the double concerto, Op. 102, the idea of an introductory statement in which the solo takes part before the opening tutti is carried out on a large scale, and in the double concerto both first and second subjects are thus suggested.

The forms of slow movements and finales in classical concertos, though often treated in special ways, present no general principles peculiar to the concerto; for a sectional opposition between solo and tutti is not of great disadvantage to slow movements and finales. The scherzo, on the other hand, is normally too sectional for successful adaptation to classical concerto style, and the solitary great example of its use is the second movement of Brahms' B flat pianoforte concerto, a movement in a very special form.

The post-classical concertos, in which the first movement dispenses with the opening tutti, began with Mendelssohn, whose violin concerto dominates the whole subsequent history of the form. The happy idea of putting a cadenza at the dramatic crisis of the return after development instead of in the coda has almost become a convention. The other movements of concertos have not been affected by Mendelssohn's changes, nor does the linking of all three movements uninterruptedly together make any essential difference to the scheme. But there is no limit to the expansion or reduction of the first movement. Spohr reduces it to an accompanied recitative in his *Gesangs-scene,* a work in which he discovered that a concerto could be an aria, which astonished him as the swimming of ducklings astonishes the fostering hen. Bruch's famous G minor concerto (not his only interesting experiment in new concerto-forms) also reduced the first movement to dramatic gestures without dramatic action. On the other hand, the huge first movement of Schumann's pianoforte concerto was originally intended to stand alone under the title of Fantasia. This example would cover the case of most first movements of this size in modern concertos, whether like Schumann's they have "second subjects" and recapitulations or not.

The case where the concerto as a whole is a fantasia (as with Liszt) needs no discussion. Another line has been struck out by Saint-Saëns, most neatly in his first violoncello concerto; namely, that the whole work is one movement, but that after an exposition comprising a "first" and "second" subject the development drifts into a slow movement (or scherzo), and this is followed by a finale of which the matter is partly independent and partly a recapitulation completing the first movement. In his C minor pianoforte concerto Saint-Saëns begins with a theme with variations and proceeds with a slow second theme, followed by a scherzo and finale which transform their own and the previous materials in various effective ways. But really the term Fantasia would adequately cover all post-classical forms of concerto. The only modern meaning of the word is "composition for one or more solo players with orchestra"; and no special aesthetic or formal questions remain to be considered within the limits of this article.

(D. F. T.)

CONCERT PROGRAMMES have been subject to many changes during recent times, not least in the matter of their length. More and more it has come to be recognized that, in the case at all events of serious music, the amount which can be properly assimilated and enjoyed at one sitting is strictly limited, and modern concert-goers read with amazement of the Gargantuan musical feasts which their robuster predecessors were apparently able to digest. Thus of a concert given by Beethoven in 1807 one reads that the programme consisted of no fewer than four of his symphonies (the first four); while that of another concert which he gave in the following year was even more astonishing, including the C minor and Pastoral symphonies, the Choral Fantasia, the G major piano concerto, two extracts from the Eisenstadt Mass, a vocal item ("Ah! perfido") and an improvisation on the piano. Modern concert programmes are not only more reasonable in length but also, in the best instances, far more thoughtfully and artistically arranged.

In this connection reference may be made to the analytical programme or concert programme with explanatory notes and comments. This is usually regarded as a recent invention, but it goes back considerably farther than is generally supposed. As early as 1783, according to Grove, something of the kind was tried in Berlin, while in Great Britain Thomson, the first Reid Professor of Music at Edinburgh university, in 1841 incorporated historical and analytical notes on the pieces to be performed in the programmes of the concerts of the Professional Society of Edinburgh. Later Ella, in connection with the concerts of the Musical Union, which began in 1845; Wylde in the programme books of the New Philharmonic Society, whose first concert was given in 1852; John Hullah, and others, adopted the same procedure, which has since become practically the rule in England and America in the case of concerts of a suitable type. Elsewhere the analytical programme has never established itself to anything like the same extent as in England and America.

CONCESSIONS. The term concession covers a wide range in time, space and variety of forms and uses. Many of the types of grant, franchise, contract, charter and license embraced within its meaning have been known for centuries in widely separated parts of the globe. It is, however, only since about 1900 that the word has come to have an interest for the general reader. In the discussions preceding, during and subsequent to the World War, the subject of concessions came to more general public notice. They were revealed as the legal means, the forms of contract and agreement, under which the industrial development of large parts of the world, especially those parts known as backward countries, has recently been accelerated. Hostile critics have described them as instruments for "economic penetration," devices for control of markets and raw materials, disguises for aggression, means for undermining the sovereignty of weak States, and even—instancing the Baghdad railway concession—as the ultimate cause of the World War. So grandiose and sinister a conception serves only to illustrate the Protean and fascinating character of concessions.

Origin and History.—Though concessions have a long history, their origin is obscure. A concession meant at first a grant from prince or king; the older form of grant usually reading, in royal phrase, "concessimus" or "damus et concedimus." They may be said to have existed in one form or another from time immemorial; but they seem to have appeared first in Europe during the middle ages and since that time their history can be traced in nearly all parts of the civilized world. That history breaks into three divisions: The first or feudal period was confined largely to grants of land and runs from the early middle ages apparently down to the time of the discovery of America. In this period those concessions were granted upon which the great landed estates of western Europe and of England were founded. Some authorities maintain that the greater part of the landed estates in France under the *ancien régime* were based upon concessions from the Crown, and the English law writer Coke, referring in the year 1660 to the great English estates, remarked, "and so . . . their estates, which were nothing but concessions from the Crown." The second period is that of the early chartered companies such as the East India company, the London company, the Massachusetts company, the Hudson Bay company, and of various individual adventurers who received grants of land and a greater or less measure of sovereign power over the territories they were to develop and their inhabitants. The third period in the history of concessions runs parallel with the modern industrial era. In this period concessions have taken increasingly the form of franchises with which during most of the period they have gone step by step and side by side on a similar course. Both alike have undergone an evolution, proceeding from an agreement, permission, license, or title, more or less secret, in which favour, privilege, grant, grace or gift was the predominant element, to a form of contract in which the chief element is bargain, exchange and open competition, and from which the elements of privilege, favour and secrecy have practically disappeared.

Nature of Concessions.—Concessions partake of the character of franchises, permits, charters, licenses and contracts, and vary with the industries and conditions which call them into being. In Latin American countries concession covers a very wide latitude. A writer summing up the situation says, "a contract to lay sewers, to lay a pipe line, to sell mules, to build a factory, or a hospital, or a school, to buy timber tracts on the public domain, to explore a given section for mineral or water, to supply beef or coal or oil to any public institution, is called a concession."

During a period of more than three years' duration the bulletin of the Pan American union recorded an average of 300 concessions per year and the list was not exhaustive. Some of these concessions are mere permits—police or administrative formalities; such are water permits. Some have a traditional quality as if they were survivals or inheritances from an early period; such are certain land grants for colonization. Some are licenses existing for the preservation of governmental authority over certain spheres of business; such are banking concessions. Some are arrangements for economy; such are concessions of a portion of a tract of land in return for the surveying of the whole tract. Some are reciprocal contracts for the development of resources, for improvement of communications and for increased control of territory; such are concessions for building railroads. Some are business contracts in which the Government offers inducements to capital, usually foreign, for the development of industries or natural resources; such are the oil concessions. It is this last type of concessions which most of those who have written or spoken upon the subject have in mind; it is concessions of this type which constitute concessions *par excellence.* Such concessions are issued under general provisions of laws and are in a broad sense open on similar terms to all applicants. It is in this type that we find the predominant motive for concessions both in Latin America and elsewhere. That motive on the part of the grantor is the desire on the part of undeveloped or partially developed countries to bring in outside capital and industrial skill for the establishment or extension of industries and for the exploitation of natural resources. On the part of the concessionaire the motive is twofold—to secure favourable conditions for the adventure of capital, and to secure protection from injury by new or unfair impositions after the capital has been adventured and a prospect appears of a return. The chief specific benefit sought through concessions is exemption from taxation—first from local or import taxes, secondly from export taxes. Such exemptions are not unusual in the United States: municipalities seeking the establishment of new industries, or the erection of new plants within their limits, frequently offer exemption from local taxation for a given period; export taxes, on the other hand, are expressly prohibited under the Constitution, which states that "no tax or duty shall be laid on articles exported from any State."

The geographical range of concessions is as wide as its range in time. Not only are they numerous in Latin America but also in Europe, Africa and Asia. They are frequent in France, Spain, Italy, Bulgaria, Turkey, Russia, Persia, the Dutch East Indies, the Philippine islands and China. They occur in British colonial possessions and are not unknown in the United States. Numbers of concessions were issued in the former South African republic and on the annexation of that country were the subject of an inquiry instituted under a commission, appointed by the British Government. The report of this commission is among the most authoritative and illuminating sources available to the student of the subject.

Political Concessions.—The various types of concessions already referred to are chiefly if not wholly of the industrial or commercial type. There is another type of concession—the political—which has the essential character of a treaty, both parties being Governments and the documents constituting international agreements. Examples of this type of concession are found as early as 1557 when China granted to Portugal the concession of Macao, which has remained in the control of Portugal ever since. They include the famous Chinese concessions: to Russia for the

Chinese Eastern railway (1896); to Germany for the Shantung railway (1897); to Germany the city, port and environs of Kiauchau (1898); to Great Britain Weihaiwei (1898); to Belgium, part of the port of Tientsin (1902). Of the same general type are the concessions of Guantanamo bay made by Cuba to the United States in 1899, that of Fonseca bay granted by Nicaragua to the United States in 1916, and that for the Baghdad railway granted to Germany by Turkey in 1911.

Similar to these in one respect—that the grantor surrenders certain prerogatives of sovereignty to the concessionaire—is the famous concession granted by the sultan of Borneo to Sir James (Rajah) Brooke in 1842 under which the principality of Sarawak has been governed by the Brooke family ever since. Other concessions of the kind are those made by the sultan of Zanzibar to the British East Africa company and the German East Africa Association and those granted by the sultans of Brunei and Sulu in 1877 to Alfred Dent and Baron de Overbeck. As a rule concessions of this type are conditional upon payment of a nominal annual rent.

To this type of concessions is due a development of some interest—that of "concessions within concessions." These are found in the chartered companies which sprang up about the end of the 19th century, such as the Royal Niger company, the Imperial British East Africa company, the British South Africa company, and the British North Borneo company. Some if not all of these companies were originally based upon concessions made by chiefs or tribes of the various regions described, and they in turn granted concessions for the development of industries and of the natural resources within their boundaries.

Mining Concessions.—Concessions have provided the customary basis for development in the mining industry through many centuries and over the greater part of the world. Since the year 1256, mining has been conducted under concessions in Spain; it has been so conducted in France since feudal times, and in portions of Germany from the earliest records. Concessions have afforded and still afford the customary basis of mining operations not only in those countries, but also in Latin America, in Turkey, and the Balkan States, in the East Indies, in portions of China, and in considerable portions of Africa. Under the law of 1791 in France mining operations can be conducted only by virtue of an act of concession from the State, and the law of France has established legal forms for such concessions—the most recent adopted in 1882—which are models for such regulations in all French colonies and possessions, and have been much used in drawing similar forms and regulations in other portions of the globe.

Oil Concessions.—One of the most ancient, most numerous and most widely distributed types of concession and one that has been prolific of controversy is the concession for oil. A concession for the collection of petroleum, which was then used, it appears, chiefly for medicinal purposes, was granted in the district of Miano de Medisano by the ducal chamber of Parma, Italy, in the year 1400. Since that time petroleum concessions have increased in number and have spread over nearly all of the known world. There are few countries however remote where they have not appeared and their number is beyond computation. The rapid industrial development of the first quarter of the 20th century, however, with its new applications of petroleum for power and fuel, particularly to automotive engines, has given the oil concession a fresh and fateful importance. Statesmen and engineers have declared that oil is the chief factor in progress and that the nation which controls the oil supply will control the future of the world. Great Governments have striven to secure a share in oil fields and oil concessions. The Government of the United States has interposed to prevent concessions in the Caribbean region being granted to transatlantic companies and to secure to her citizens a share in the oil-fields of Mesopotamia. The British Government has meantime become an actual partner in one great oil corporation and has a voice in the management of at least two others. The situation recalls that of the 16th and 17th centuries when bullionism was the prevalent economic doctrine and the possession of the precious metals and the mines thereof was regarded as the chief end of individual and governmental effort.

Though oil concessions are operated in different lands and couched in different languages, they are surprisingly alike in character. If one examines the texts of a hundred or more, ranging from China to Peru, he will find them essentially similar. They are true, bilateral contracts with obligations upon the concessionaire always substantial and often onerous. The concessionaire is usually obliged to make an investment or do a prescribed amount of drilling within a certain time and, in the event of finding oil, to pay a royalty upon each ton or barrel obtained. A typical example is afforded by the Tabasco contract—one of the Pearson concessions of Mexico. The terms required S. Pearson and Son to deposit in advance the sum of $20,000, to invest within seven years the sum of $350,000 and to pay a royalty to 10% of the profits. Though it was at one time denounced by politicians and others as an iniquitous contract, draining the natural wealth of Mexico for the benefit of foreigners, the fact is that after considerable expenditure no production was obtained. The terms of many concessions are less onerous than these, yet as a rule concessions are burdensome to all but very wealthy holders.

The terms of concessions may be illustrated by the royalties required in typical cases in different parts of the world:—Burma, Yomah Oil Co. Ltd., 16c per barrel; Egypt, Anglo-Egyption Oil Co. Ltd., 36c per ton; Germany, the Allgemeine Erdoelgesellschaft, 5% of gross production; Italy, Anglo-Italian Petroleum Co. Ltd., 5% of the net product; Mexico, Sres. Flores and Loaeza, 10% of the net profit; Panama, Lincoln G. Valentine, 5% of gross production; Persia, Anglo-Persian Oil Co. Ltd., 16% of the net profits plus £3,000 per annum; United States, Edwin B. Foster (Osage Indian Lease), 10% of the gross production; Venezuela, General Asphalt Co., 5% of gross production; Caribbean Petroleum Co., 40c per ton, also rent of 8c per acre; West Indies, United British West Indies Petroleum Syndicate, Ltd., 48c per ton.

The payment of royalty is often the least onerous obligation to be met by the holder of an oil concession. More burdensome are the requirements of investment and of performance of drilling, etc., within a given period. For example, the Valentine concession in Panama required an investment of $5,000,000, and the Pearson concessions in Mexico required an investment of $2,975,000. The difficulties of conducting engineering operations in remote and tropical countries such as Colombia, Panama, Persia, China, where natural conditions are adverse and means of transportation are lacking, are very great.

Because of the enormous economic and financial interests involved and because of the ease with which the popular imagination can be inflamed over international competition, oil concessions contain many possibilities of friction. Recent events in Iraq, in Colombia, in Persia, in Venezuela, in Mexico, show what explosive political material they conceal. In the course of time, as the present furore for possession of oil reserves dies down, to be replaced by other prizes of international competition, oil concessions will lose their present prominence. Meanwhile it may be hoped that that competition, which has often been pursued with a zeal worthy of a better cause, may be tempered with moderation and so guided as to prevent it from imperilling the peace of the world.

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CONCH. In architecture, the term is sometimes given to the half dome over the semicircular apse of the basilica (*q.v.*). In late Roman and in Renaissance buildings shells are frequently carved in the heads of circular niches. A low class of the negro or other inhabitants of the Bahamas and the Florida Keys are sometimes called "Conches" or "Conks" from the shell-fish which form their staple food.

CONCHOID: *see* CURVES, SPECIAL.

CONCHOLOGY, the study of shells, especially those of the Mollusca (*q.v.*); it formerly included the study of lamp shells, barnacles, and even of certain worm tubes.

CONCIERGE, in modern usage, a hall-porter or janitor, but originally the important guardian of a house or castle; in the middle ages a court official who was the custodian of a royal palace.

In Paris, when the *Palais de la Cité* ceased about 1360 to be a royal residence and became the seat of the courts of justice, the *Conciergerie* was turned into a prison. The word is of unknown origin; the Latinized form was *Concergius* or *Concergerius.*

CONCILIATION IN INDUSTRIAL RELATIONS: *see* INDUSTRIAL RELATIONS.

CONCINI, CONCINO (d. 1617), COUNT DELLA PENNA, MARSHAL D'ANCRE, Italian adventurer, minister of Louis XIII. of France, was a native of Florence. He came to France in the train of Marie de' Medici, and married the queen's lady-in-waiting, Leonora Dori, known as Galigai. In 1610 he had purchased the marquisate of Ancre and the position of first gentleman-in-waiting. Then he obtained successively the governments of Amiens and of Normandy, and in 1614 the bâton of marshal. As first minister of the crown from that date, he abandoned the policy of Henry IV., allowed the treasury to be pillaged, and drew upon himself the hatred of all classes. The nobles were bitterly hostile to him, particularly Condé, with whom he negotiated the treaty of Loudun in 1616, and whom he had arrested, on the advice of Richelieu, in September, 1616. But Louis XIII. was tired of Concini's tutelage. Concini was killed by the guards on April 24, 1617. Leonora was accused of sorcery and sent to the stake in the same year.

See E. Lavisse, *Histoire de France,* vol. vi.

CONCLAVE, strictly a room or set of rooms, locked with a key (from Lat. *conclave,* from *cum,* together, and *clavis,* a key); in this sense the English word is obsolete. Its present loose application to any private or close assembly, especially ecclesiastical, is derived from its technical application to the assembly of cardinals met for the election of the pope, with which this article is concerned, and in which connection it is applied to that system of strict seclusion to which the electors of the pope have been and are submitted, formerly as a matter of necessity, and subsequently as the result of a legislative enactment; hence the word has come to be used of the electoral assembly of the cardinals. The system was instituted by Gregory X in 1274.

Episcopal appointment by election can be traced back to an early date. The method of election at Rome was the same as in other towns; the Roman clergy and people and the neighbouring bishops each took part in it in their several capacities. The people would signify their approbation or disapprobation of the candidates more or less tumultuously, while the clergy were, strictly speaking, the electoral body, met to elect for themselves a new head, and the bishops acted as presidents of the assembly and judges of the election. We can well imagine that in an assembly of such size, in which the candidates were acclaimed rather than elected by counting votes, the various functions were not very distinct, and that persons of importance, whether clerical or lay, were bound to influence the elections, and sometimes decisively. Moreover, this form of election lent itself to cabals; and these frequently gave rise to quarrels, sometimes involving bloodshed and schisms, *i.e.,* the election of antipopes, as they were later called. The remedy for this abuse was found in having recourse, more or less freely, to the support of the civil power. The emperor Honorius, for example, upheld Boniface (418) against his competitor Eulalius, at the same time laying down that cases of contested election should henceforth be decided by a fresh election; but this would have been a dangerous method and was consequently never applied. Theodoric upheld Symmachus (498) against Laurentius because he had been elected first and by a greater majority.

The accepted fact soon became law, that the candidate should not receive the episcopal consecration until he had obtained the confirmation of the emperor. Hence arose long vacancies of the See, indiscreet interference in the elections by the imperial officials, and sometimes cases of simony and venality. This deplorable state of affairs lasted almost without interruption till the middle of the 11th century. When the emperors were at Rome, they presided over the elections; when they were away, the rival factions of the barons struggled for the spiritual power as they did for the temporal. During this period were seen cases of popes imposed by a faction rather than elected, and then, at the mercy of sedition, deposed, poisoned, or thrown into prison, sometimes to be restored by force of arms. After the death of Clement II. the delegates of the Roman clergy actually went to Polden to ask Henry III. to give them a pope, and similar steps were taken after the death of Damascus II., who reigned only 20 days. Fortunately on this occasion Henry III. appointed, just before his death, a man of high character, his cousin Bruno, bishop of Toul, who presented himself in Rome in company with Hildebrand. From this time began the reform. Hildebrand had the election of Victor II. (1055), Stephen IX. (1057), and Nicholas II. (1058) carried out according to the canonical form, including the imperial ratification. The celebrated bull *In nomine Domini* of April 13, 1059 determined the electoral procedure. Out of respect for tradition, it preserved all the former factors in the election though their scope was modified. The election was reserved to the members of the higher clergy, to the cardinals, among whom the cardinal bishops have the preponderating position. The consent of the rest of the clergy and the people was now only a formality. The same was the case of the imperial intervention; the emperor had no rights save those he had received as a concession from the Holy See. Further, by this bull, the emperors would have to deal with the *fait accompli;* for it provided that, in the event of disturbances aroused by mischievous persons at Rome preventing the election from being carried out there freely and without bias, the cardinal bishops, together with a small number of the clergy and of the laity, should be empowered to hold the election where they should think fit; that should difficulties of any sort prevent the enthronement of the new pope, the pope elect would be empowered immediately to act as if he were actually pope. This legislation was definitely accepted by the emperor by the concordate of Worms (1119). Two other points of great importance were established by Alexander III. at the Lateran Council of 1179. The constitution *Licet de vitanda discordia* makes all the cardinals equally electors, and no longer mentions the lower clergy or the people; it also requires a majority of two-thirds of the votes to decide an election. This latter provision, which still holds good, made imperial antipopes henceforth impossible.

Abuses nevertheless arose. An electoral college too small in numbers, which no higher power has the right of forcing to haste, can prolong disagreements and draw out the course of the election for a long time. It is this period during which we actually find the Holy See left vacant most frequently for long spaces of time. Thus, after the death of Clement IV. in 1268, the cardinals, of whom 17 were gathered together at Viterbo, allowed two years to pass without coming to an agreement; the magistrates of Viterbo had recourse to the method of seclusion: they shut up the electors in the episcopal palace, blocking up all outlets; and since the election still delayed, the people removed the roof of the palace and allowed nothing but bread and water to be sent in. Under the pressure of famine and of this strict confinement, the cardinals finally agreed, on Sept. 1, 1271, to elect Gregory X., after an interregnum of two years, nine months and two days.

Taught by experience, the new pope considered what steps could be taken to prevent the recurrence of such abuses; in 1274, at the council of Lyons, he promulgated the constitution *Ubi periculum,* the substance of which was as follows: At the death of the pope, the cardinals who were present are to await their absent colleagues for ten days; they are then to meet in one of the papal palaces in a closed conclave; none of them is to have to wait on him more than one servant, or two at most if he were ill; in the conclave they are to lead a life in common, not even having separate cells; they are to have no communication with the outer world, under pain of excommunication for any who should attempt to communicate with them; food is to be supplied to the cardinals through a window which would be under watch. Finally, the election is to be the sole business of the conclave, and the magistrates of the town where it was held are called upon to see that these provisions be observed. Adrian V. and John XX. were weak enough to suspend the constitution *Ubi periculum,* and the abuses at once reappeared. This further proof was therefore decisive, and Celestine V., who was elected after a vacancy of more than two years, took care, before abdicating the pontificate, to revive the constitution of Gregory X., which was inserted in the Decretals (lib. i. tit. vi., *de election. cap.* 3).

Electoral Reform.—Pius IV. undertook the task of reforming and completing the legislation of the conclave. The bull *In eligendis* (of Oct. 1, 1562), signed by all the cardinals, is a model of precision and wisdom. In addition to the points already stated, we may add the following: that every day there was to be a scrutiny, *i.e.,* a solemn voting by specially prepared voting papers (concealing the name of the voter, and to be opened only in case of an election being made at that scrutiny), and that this was to be followed by the "accessit," *i.e.,* a second voting, in which the cardinals might transfer their suffrages to those who had obtained the greatest number of votes in the first. Except in case of urgent matters, the election was to form the whole business of the conclave. The cells were to be assigned by lot. The functionaries of the conclave were to be elected by the secret vote of the Sacred College, and the most stringent measures were to be taken to ensure seclusion.

All previous legislation concerning the conclave was codified and renewed by Pius X.'s bull, *Vacante Sede Apostolico* (Dec. 25, 1904), which abrogates the earlier texts, except Leo XIII.'s constitution *Praedecessores Nostri* (May 24, 1882), authorizing occasional derogations in circumstances of difficulty, *e.g.,* the death of a pope away from Rome or an attempt to interfere with the liberty of the Sacred College. The bull of Pius X. is rather a codification than a reform, the principal change being the abolition of the scrutiny of accession and the substitution of a second ordinary scrutiny during the same session.

Until after the Great Schism the conclaves were held in various towns outside of Rome; but since then they have all been held in Rome, with the single exception of the conclave of Venice (1800), and in most cases in the Vatican. There was no place permanently established for the purpose, but removable wooden cells were installed in the various apartments of the palace, grouped around the Sistine chapel, in which the scrutinies took place. The arrangements prepared in the Quirinal in 1823 did duty only three times, and for the most recent conclaves it was necessary to arrange an inner enclosure within the vast but irregular palace of the Vatican. Each cardinal is accompanied by a clerk or secretary, known for this reason as a conclavist, and by one servant only. With the officials of the conclave, this makes about two hundred and fifty persons who enter the conclave and have no further communication with the outer world save by means of turning-boxes. Since 1870 the solemn ceremonies of earlier times have not been seen; for instance the procession which used to celebrate the entry into conclave; or the daily arrival in procession of the clergy and the brotherhoods to enquire at the "rota" (turning-box) of the auditors of the Rota: "Habemusne Pontificem?" and their return accompanied by the chanting of the *"Veni Creator";* or the "Marshal of the Holy Roman Church and perpetual guardian of the conclave" visiting the churches in state. But a crowd still collects morning and evening in the great square of St Peter's, towards the time of the completion of the vote, to look for the smoke which rises from the burning of the voting-papers after each session; when the election has not been effected, a little straw is burnt with the papers, and the column of smoke then apprises the spectators that they have still no pope. Within the conclave, the cardinals, alone in the common hall, usually the Sistine chapel, proceed morning and evening to their double vote, the direct vote and the "accessit." Sometimes these sessions have been very numerous; for example, in 1740, Benedict XIV. was only elected after 255 scrutinies; on other occasions, however, and notably in the case of the last few popes, a well-defined majority has soon been evident, and there have been but few scrutinies. Each vote is immediately counted by three scrutators, appointed in rotation, the most minute precautions being taken to ensure that the voting shall be secret and sincere. When one cardinal has at last obtained two-thirds of the votes, the dean of the cardinals formally asks him whether he accepts his election, and what name he wishes to assume. As soon as he has accepted, the first cardinal deacon goes to the *Loggia* of St. Peter's and announces the news to the assembled people. The conclave is dissolved; on the following day the election is officially announced to the various governments. A few days after his election, takes place the coronation, from which the pontificate is officially dated, and the pope receives the tiara with the triple crown, the sign of his supreme spiritual authority (*see* TIARA).

Right of Veto.—In conclusion, a few words should be said with regard to the right of *veto.* During the 16th and 17th centuries, the various Catholic Courts instructed the Cardinals of their own nation to secure, as far as lay in their power, the removal of candidates distasteful to their party; and the governments could even make public their desire to exclude certain candidates. But they soon claimed an actual right of formal and direct exclusion, which should be notified in the conclave in their name by a cardinal charged with this mission, and should have a decisive effect; that is what has been called the right of veto. We cannot say precisely at what time during the 16th century this transformation of the practice into a right, tacitly accepted by the Sacred College, took place. The fact remains, however, that it was a right based on custom, and was not supported by any text or written concession; but the diplomatic right was straightforward and definite, and was better than the intrigues of former days. During the 19th century Austria exercised, or tried to exercise, the right of veto at all the conclaves, except that which elected Leo XIII. (1878); it did so again at the conclave of 1903. On Aug. 2 Cardinal Rampolla had received 29 votes, when Cardinal Kolzielsko Puzina, bishop of Cracow, declared that the Austrian government opposed his election; the Sacred College considered that it ought to yield, and on Aug. 4 elected Cardinal Sarto, who took the name of Pius X. By the bull *Commissum Nobis* (Jan. 20, 1904), Pius X. suppressed all right of "veto" or "exclusion" on the part of the secular governments, and forbade, under pain of excommunication reserved to the future pope, any cardinal or conclavist to accept from his government the charge of proposing a "veto," or to exhibit it to the conclave under any form.

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CONCORD, a town of Middlesex county, Massachusetts, U.S.A., 20m. N.W. of Boston, served by the Boston and Maine Railroad. It has an area of 25 sq.mi., and a population in 1940 (federal census) of 7,972. The state reformatory for men is situated here.

The village of Concord, where the confluence of the Sudbury and the Assabet forms the beautiful little Concord river celebrated by Thoreau, has a wealth of historic and literary associations. A county convention held here in Aug. 1774 recommended the calling of the first provincial congress of Massachusetts, which met here on Oct. 11, 1774, and in March and April 1775. After that the colonists began storing military supplies in the village, and it became the objective of the British expedition which at Lexington on April 19, 1775, engaged in the first battle of the Revolution. In a brief engagement at Lexington early in the morning, blood was shed on both sides, but no British were killed. At Concord

500 minute-men confronted the British troops and drove them back on Lexington. A granite obelisk, erected in 1837, when Emerson wrote his ode on the battle, marks the spot where the first British soldiers fell. Across the stream, "where once the embattled farmers stood, and fired the shot heard round the world," is a fine bronze "minute-man" by D. C. French. Many notable orations have been delivered here on the anniversary of the battle, among them one by Edward Everett in 1825 and one by George William Curtis in 1875.

The town was settled and incorporated in 1635. It was the home of Ralph Waldo Emerson, Henry D. Thoreau, Nathaniel Hawthorne, A. Bronson Alcott and his daughter Louisa, and other distinguished writers and philosophers. From the "Old Manse," built in 1765 for William Emerson, his grandson wrote *Nature*, and Hawthorne wrote his *Mosses from an Old Manse*. "Orchard house" still stands—the home of the Alcotts during the years when the "Concord Summer School of Philosophy and Literature" (1879–88) was held in a rude building adjoining. The "Concord" grape was first grown here by Ephraim Bull in 1853, marking the beginning of the cultivation of table grapes in America on a commercial scale.

CONCORD, a city in the southern part of North Carolina, U.S.A., on the Rocky river, 21 mi. N.E. of Charlotte; the county seat of Cabarrus county. It is on federal highway 29, and is served by the Southern railway. The population in 1920 was 9,903, of whom 1,746 were Negroes, and was 11,820 in 1930 and 15,572 in 1940 by the federal census. It is in a cotton-growing district, and has textile mills. Concord was laid out in 1793 and incorporated in 1851.

CONCORD, the capital of New Hampshire, U.S.A., and the county seat of Merrimack county, on the Merrimack river, near the centre of the southern part of the state. It is on federal highways 3, 4 and 202; is served by the Boston and Maine railroad; and has a municipal airport. The area is 64 sq.mi. The population was 25,228 in 1930 and 27,171 in 1940 (85% native born) by the federal census.

Concord has broad, well shaded streets, several parks, and many fine public buildings. The state capitol is an impressive structure of fine-grained white granite from the neighbouring quarries. The state hospital for the insane and the state prison are situated here, and there are several homes and hospitals founded by private philanthropy. St. Paul's school for boys (Protestant Episcopal, 1853) is 2 mi. W. of the city. There is abundant water power. The factory product (with leather belting and printing and publishing leading) was valued in 1939 at $10,729,380. Large quantities of granite are shipped from Concord.

A trading-post was established here about 1660. In 1725 Massachusetts granted the land to some of her citizens, who established a settlement called Pennycook (the name of the Indians who had formerly occupied it), but New Hampshire in 1727 issued an overlapping grant, and the conflicting claims gave rise to a celebrated land case. The settlement was incorporated by the Massachusetts general court in 1734 as Rumford, and the settlers finally (1755) were confirmed in their possession, but under the jurisdiction of New Hampshire. In 1765 the name was changed to "the parish of Concord," and in 1784 the town of Concord was incorporated. A city charter granted in 1849 was accepted in 1853. In 1778 and again in 1781–82 a State Constitutional Convention met in Concord; in 1782, the first State legislature; and in 1788, the convention which ratified the Federal Constitution. The State capital was definitely established there in 1808. The *New Hampshire Patriot*, founded (1808) and for 20 years edited by Isaac Hill, was a leading exponent of Jacksonian democracy in New England. Concord was the home of the picturesque and versatile Benjamin Thompson (Count Rumford) and of Mary Baker Eddy, founder of the Christian Science movement. The site of Mrs. Eddy's home is occupied by a home for aged Christian Scientists.

CONCORD, BOOK OF, the collective documents of the Lutheran confession, consisting of the *Confessio Augustana*, the *Apologia Confessionis Augustanae*, the *Articula Smalcaldici*, the *Catechismi Major et Minor* and the *Formula Concordiae*. This last was a formula issued on the 25th of June 1580 (the jubilee of the Augsburg Confession) by the Lutheran Church in an attempt to heal the breach which, since the death of Luther, had been widening between the extreme Lutherans and the Crypto-Calvinists. Previous attempts at concord had been made at the request of different rulers, especially by Jacob Andreä with his Swabian Concordia in 1573, and Abel Scherdinger with the Maulbronn Formula in 1575. In 1576 the elector of Saxony called a conference of theologians at Torgau to discuss these two efforts and from them produce a third. The *Book of Torgau* was evolved, circulated and criticized; a new committee, prominent on which was Martin Chemnitz, sitting at Bergen near Madgeburg, considered the criticisms and finally drew up the *Formula Concordiae*. It consists of (*a*) the "Epitome," (*b*) the "Solid Repetition and Declaration," each part comprising twelve articles; and was accepted by Saxony, Württemberg, Baden among other states, but rejected by Hesse, Nassau and Holstein. Even the free cities were divided, Hamburg and Lübeck for, Bremen and Frankfort against. Hungary and Sweden accepted it, and so finally did Denmark, where at first it was rejected, and its publication made a crime punishable by death. In spite of this very limited reception the *Formula Concordiae* has always been reckoned with the five other documents as of confessional authority.

See P. Schaff, *History of Creeds* ch. vi., and *Creeds of the Evangelical Protestant Churches;* W. A. Curtis, art. "Confessions" in Hasting's, *Encyclopaedia of Religion and Ethics* (§ 13, "Confessions in the Lutheran Churches") with references.

CONCORDANCE, literally agreement, harmony; hence derivatively a citation of parallel passages, and specifically an alphabetical arrangement of the words contained in a book with citations of the passages in which they occur. Concordances in this last sense were first made for the Bible. Originally the word was only used in this connection in the plural *concordantiae*, each group of parallel passages being properly a *concordantia*.

The original impetus to the making of concordances was due to the conviction that the several parts of the Bible are consistent with each other, as parts of a divine revelation. To Anthony of Padua (1195–1231) tradition ascribes the first concordance, the anonymous *Concordantiae Morales*, of which the basis was the Vulgate. The first authentic work was due to Cardinal Hugh of St. Cher, a Dominican monk (d. 1263), who, in preparing for a commentary on the Scriptures, found the need of a concordance. It became the basis of one by Conrad of Halberstadt (*c.* 1290) and of another by John of Segovia in the next century. The first Hebrew concordance was compiled in 1437–45 by Rabbi Isaac Nathan b. Kalonymus of Arles (printed at Venice in 1523 by Daniel Bomberg, in Basel in 1556, 1559 and 1581). It was published under the title *Meir Natib*, "The Light of the Way," and in 1556 was translated into Latin by Johann Reuchlin. Its errors were corrected by Mario di Calasio, a Franciscan friar, who published a four-volume folio *Concordantiae Sacr. Bibl. Hebr. et Latin*, at Rome, 1621, much enlarged, with proper names included. Another concordance based on Nathan's was Johann Buxtorf the elder's *Concordantiae Bibl. Ebraicae nova et artificiosa methodo dispositae*, Basel, 1632. Calasio's concordance was republished in London under the direction of William Romaine in 1747–49, in four volumes, folio. In 1754 Dr. John Taylor, a Presbyterian divine in Norwich, published in two volumes the *Hebrew Concordance adapted to the English Bible*. In the middle of the 19th century Dr. Julius Fürst issued a thoroughly revised edition of Buxtorf's concordance. The *Hebräischen und chaldäischen Concordanz zu den Heiligen Schriften Alten Testaments* (Leipzig, 1840) carried forward the development of the concordance in several directions. It gave (1) a corrected text founded on Hahn's Vanderhoogt's Bible; (2) the Rabbinical meanings; (3) explanations in Latin, and illustrations from the three Greek versions, the Aramaic paraphrase, and the Vulgate; (4) the Greek words employed by the Septuagint as renderings of the Hebrew; (5) notes on philology and archaeology, so that the concordance contained a Hebrew lexicon. An English translation by Dr. Samuel Davidson was published in 1867. A revised edition of Buxtorf's work with additions from Fürst's was published by B. Bär (Stettin, 1862). A new concordance embodying the matter of all previous works with lists of proper names and particles was published by Solomon Mandelkern in Leipzig (1896; smaller edition, 1900). There are also concordances of biblical proper names by G. Brecher (Frankfort-on-Main, 1876) and Schusslovicz (Wilna, 1878).

A Concordance to the Septuagint, published at Frankfort in 1602 by Conrad Kircher of Augsburg, gave the Hebrew words in alphabetical order and the Greek words by which they are translated under them. A Septuagint concordance, giving the Greek words in alphabetical order, was published in 1718 in two volumes by Abraham Tromm, a learned minister at Groningen, then in the eighty-fourth year of his age. It gives the Greek words in alphabetical order; a Latin translation; the Hebrew word or words for which the Greek term is used by the Septuagint; then the places where the words occur in the order of the books and chapters; at the end of the quotations from the Septuagint places are given where the word occurs in Aquila, Symmachus and Theodotion, the other Greek translations of the Old Testament; and the words of the Apocrypha follow in each case. Besides an index to the Hebrew and Chaldaic words there is another index which contains a lexicon to the *Hexapla* of Origen. In 1887 (London) appeared the *Handy Concordance of the Septuagint giving various readings from Codices Vaticanus, Alexandrinus, Sinaiticus and Ephraemi, with an appendix of words from Origen's Hexapla, not found in the above manuscripts,* by G.M., without quotations. A work of the best modern scholarship was brought out in 1897 by the Clarendon Press, Oxford, entitled *A Concordance to the Septuagint and the other Greek versions of the Old Testament including the Apocryphal Books,* by Edwin Hatch and H. A. Redpath, assisted by other scholars; this was completed in 1900 by a list of proper names.

The first Greek concordance to the New Testament was published at Basel in 1546 by the Lutheran Sixt Birck or Xystus Betuleius (1500–54). This was followed by Stephen's concordance (1594) planned by Robert Stephens and published by Henry, his son. Then in 1638 came the ταμιεῖον of Erasmus Schmied or Schmid, which has been the basis of subsequent concordances to the New Testament. Revised editions of it were published at Gotha in 1717, and at Glasgow in 1819. In the middle of the 19th century Bruder brought out a beautiful edition (Tauchnitz) collating the readings of Erasmus, R. Stephens' third edition, the Elzevirs, and others, and presenting a selection from ancient patristic mss. and various interpreters. Bruder was edited, with readings of S. P. Tregelles, in 1888, by Westcott and Hort. The *Englishman's Greek Concordance of the New Testament,* and the *Englishman's Hebrew and Chaldee Concordance* are intended to put the results of the above-mentioned works at the service of those who know little Hebrew or Greek. They are the work of George V. Wigram assisted by W. Burgh and superintended by Tregelles, B. Davidson and W. Chalk (1843; 2nd ed. 1860). Mention should also be made of *A Concordance to the Greek Testament with the English version to each word; the principal Hebrew roots corresponding to the Greek words of the Septuagint, with short critical notes and an index,* by John Williams, LL.D., London (1767).

In 1884 Robert Young brought out a *Concordance to the Greek New Testament with a dictionary of Bible Words and Synonyms:* this contains a concise concordance to eight thousand changes made in the Revised Testament. Another important work of modern scholarship is the *Concordance to the Greek Testament,* edited by the Rev. W. F. Moulton and A. E. Geden, according to the texts adopted by Westcott and Hort, Tischendorf, and the English revisers.

The first concordance to the English version of the New Testament was published in London, 1535, by Thomas Gybson. It is a black-letter volume entitled *The Concordance of the New Testament most necessary to be had in the hands of all soche as delyte in the communication of any place contayned in ye New Testament.* The first English concordance of the entire Bible was John Marbeck's, *A Concordance, that is to saie, a worke wherein by the order of the letters of the A.B.C. ye maie redely find any worde conteigned in the whole Bible, so often as it is there expressed or mentioned,* Lond. 1550. Although Robert Stephens had divided the Bible into verses in 1545, Marbeck does not seem to have known this and refers to the chapters only. In 1550 also appeared Walter Lynne's translation of the concordance issued by Bullinger, Jude, Pellican and others of the Reformers. Other English concordances were published by Cotton, Newman, and in abbreviated forms by John Downham or Downame (ed. 1652), Vavasor Powell (1617–70), Jackson and Samuel Clarke (1626–1701). In 1737 Alexander Cruden (*q.v.*) published his *Complete Concordance to the Holy Scriptures of the Old and New Testament, to which is added a concordance to the books called Apocrypha,* superseding all its predecessors. Three editions were published during Cruden's life, and many since his death. Later concordances only supersede his notably accurate work by combining an English with a Greek and Hebrew concordance (*a*) the *Critical Greek and English Concordance,* by C. F. Hudson, H. A. Hastings and Ezra Abbot, Boston (Mass.), and (*b*) the *Critical Lexicon and Concordance to the English and Greek New Testament,* by E. L. Bullinger, 1892. James Gall's *Interpreting Concordance to the New Testament,* shows the Greek original of every word, with a glossary explaining the Greek words of the New Testament with their varied renderings in the Authorized Version. The most convenient is (*c*) *Young's Analytical Concordance* (Edinburgh, 1879), giving (1) the original Hebrew or Greek of any word in the English Bible; (2) the literal and primitive meaning of every such original word; (3) thoroughly reliable parallel passages. There is a *Students' Concordance to the Revised Version of the New Testament* showing the changes embodied in the revision, published under licence of the universities; and a concordance to the Revised Version by J. A. Thoms for the Christian Knowledge Society. Biblical concordances having familiarized students with the value and use of such books for the systematic study of an author, the practice of making concordances has now become common. There are concordances to the works of Shakespeare, Browning, and many other writers. (D. M.)

CONCORDAT, a term originally denoting an agreement between ecclesiastical persons or secular persons, but later applied to a pact concluded between the ecclesiastical authority and the secular authority on ecclesiastical matters which concern both, and, more specially, to a pact concluded between the pope, as head of the Catholic Church, and a temporal sovereign for the regulation of ecclesiastical affairs in the territory of such sovereign (*pactum concordatum* or *solemnis conventio*). It is to concordats in this later sense that this article refers.

For the purposes of a concordat the state recognizes the official *status* of the church and of its ministers and tribunals; guarantees it certain privileges; and sometimes binds itself to secure for it subsidies representing compensation for past spoliations. The pope on his side grants the temporal sovereign certain rights, such as that of making or controlling the appointment of dignitaries; engages to proceed in harmony with the government in the creation of dioceses or parishes; and regularizes the situation produced by the usurpation of church property, etc. The great advantage of concordats—indeed their principal utility—consists in transforming necessarily unequal unilateral claims into contractual obligations analogous to those which result from an international convention. Whatever the obligations of the state towards the ecclesiastical society may be in pure theory, in practice they become more precise and stable when they assume the nature of a bilateral convention by which the state engages itself with regard to a third party. And reciprocally, whatever may be the absolute rights of the ecclesiastical society over the appointment of its dignitaries, the administration of its property and the government of its adherents, the exercise of these rights is limited and restricted by the stable engagements and concessions of the concordatory pact, which bind the head of the church with regard to the nations.

Concordats have therefore the perpetuity of conventions which contain no time limitation; but, like every human convention, they can be denounced, in the form in use for international treaties, and for good reasons, which are summed up in the exigencies of the general good of the country. Nevertheless, there is no example of a concordat having been denounced or broken by the popes, whereas several have been denounced or broken by the civil powers, sometimes in the least diplomatic manner, as in the case of the French concordat in 1905. The rupture of the concordat at once terminates the obligations which resulted from it on both sides; but it does not break off all relation between the church and the state, since the two societies continue to coexist on the same territory. To the situation defined by concordat, however, succeeds another situation, more or less uncertain and more or less strained, in which the two powers legislate separately on mixed matters, sometimes not without provoking conflicts.

Objects of Concordatory Conventions.—These cannot be described in detail; they bear upon very varied matters and we must confine ourselves here to a brief *résumé*. In the first place there is the official recognition by the state of the Catholic religion and its ministers. Sometimes the Catholic religion is declared to be the state religion, and at least the free and public exercise of its worship is guaranteed. As regards candidates for ecclesiastical offices, the concordats concluded with Catholic nations regularly give the sovereign the right to nominate or present to bishoprics, often also to other inferior benefices, such as canonries, important parishes and abbeys; or at least the choice of the ecclesiastical authority is submitted to the approval of the civil power. In all cases canonical institution (which confers ecclesiastical jurisdiction) is reserved to the pope or the bishops. In countries where the head of the state is not a Catholic, the bishops are regularly elected by the chapters, but the civil power has the right to strike out objectionable names from the list of candidates which is previously submitted to it. Certain concordats deal with the orders and congregations of monks and nuns with a view to subjecting them to a certain control while securing to them the legal exercise of their activities. Ecclesiastical immunities, such as reservation of the criminal cases of the clergy, exemption from military service and other privileges, are expressly maintained in a certain number of pacts. One of the most important subjects is that of church property. An agreement is come to as to the conditions on which pious foundations are able to be made; the measure in which church property shall contribute to the public expenses is indicated; and, in the 19th century, the position of those who have acquired confiscated church property is regularized. In exchange for this surrender by the church of its ancient property the state engages to contribute to the subsistence of the ministers of public worship, or at least of certain of them.

Concordats in History.—Scholars agree in associating the earliest concordats with the celebrated contest about Investitures (*q.v.*), which so profoundly agitated Christian Europe in the 11th and 12th centuries. The first in date is that which was concluded for England with Henry I. in 1107 by the efforts of St. Anselm. The convention of Sutri of 1111 between Pope Paschal II. and the emperor Henry V. having been rejected, negotiations were resumed by Pope Calixtus II. and ended in the concordat of Worms (1122), which was confirmed in 1177 by the convention between Alexander III. and the emperor Frederick I. In this concordat a distinction was made between spiritual investiture, by the ring and pastoral staff, and lay or feudal investiture, by the sceptre. The emperor renounced investiture by ring and staff, and permitted canonical elections; the pope on his part recognized the king's right to perform lay investiture and to assist at elections. Analogous to this convention was the concordat concluded between Nicholas IV. and the king of Portugal in 1289.

The lengthy discussions on ecclesiastical benefices in Germany ended finally in the concordat of Vienna, promulgated by Nicholas V. in 1448. Already at the council of Constance attempts had been made to reduce the excessive papal reservations and taxes in the matter of benefices, privileges which had been established under the Avignon popes and during the Great Schism; for example, Martin V. had had to make with the different nations special arrangements which were valid for five years only, and by which he renounced the revenues of vacant benefices. The council of Basel went further: it suppressed annates and all the benefice reservations which did not appear in the *Corpus Juris*. Eugenius IV. repudiated the Basel decrees, and the negotiations terminated in what was called the "concordat of the princes," which was accepted by Eugenius IV. on his death-bed (bulls of Feb. 5 and 7, 1447). In Feb. 1448 Nicholas V. concluded the arrangement, which took the name of the concordat of Vienna. This concordat, however, was not received as law of the Empire. In Germany the concessions made to the pope and the reservations maintained by him in the matter of taxes and benefices were deemed excessive, and the prolonged discontent which resulted was one of the causes of the success of the Lutheran Reformation.

In France the opposition to the papal exactions had been still more marked. In 1438 the Pragmatic Sanction of Bourges adopted and put into practice the Basel decrees, and in spite of the incessant protests of the Holy See the Pragmatic was observed throughout the 15th century, even after its nominal abolition by Louis XI. in 1461. The situation was modified by the concordat of Bologna, which was personally negotiated by Leo X. and Francis I. of France at Bologna in Dec. 1515, inserted in the bull *Primitiva* (Aug. 18, 1516), and promulgated as law of the realm in 1517, but not without rousing keen opposition. All bishoprics, abbeys and priories were in the royal nomination, the canonical institution belonging to the pope. The pope preserved the right to nominate to vacant benefices *in curia* and to certain benefices of the chapters, but all the others were in the nomination of the bishops or other inferior collators. However, the exercise of the pope's right of provision still left considerable scope for papal intervention, and the pope retained the annates.

The concordats drawn up during the 17th and 18th centuries either fell to the ground or had to be recast. In the 19th century we find a long series of concordats, of which a good number are still in force. The first in date and importance is that of 1801, concluded for France between Napoleon and Pius VII. after laborious negotiations. The first consul was given the right to nominate bishops, the bishoprics and parishes were redistributed and the erection of seminaries allowed. The pope condoned those who had acquired church property; and by way of compensation the government engaged to give the bishops and curés suitable salaries. The concordat was solemnly promulgated on Easter Day 1802, but the government had added to it unilateral provisions of Gallican tendencies, which were known as the Organic Articles. After having been the law of the Church of France for a century, it was denounced by the French Government in 1905.

A concordat with England was proposed by Castlereagh in 1814, but the negotiations broke down over the question of episcopal nominations. In addition to the case of France, important concordats were concluded during the 19th century with Germany, Bavaria (1817), Prussia (1821), Hanover (1824); Austria (1855, denounced by the Austrian Government on the proclamation of papal infallibility in 1870); Spain (1851, 1855, 1904); Switzerland (1828, 1845, 1888) and Portugal (1857, 1886). In the case of Russia, a formal concordat was found inapplicable even as far back as 1847. In the case of Holland and Belgium, concordats were replaced by an amicable *modus vivendi*. After the World War of 1914–1918 many new concordats were made. The most important were with Poland (1925), Lithuania and Rumania (1927), Italy (1929) and Germany (1933).

See J. Turmel's article on "Concordat" in Hastings *Encyclopaedia of Religion and Ethics; Catholic Encyclopaedia*, art. "Concordat"; Mirbt, art. "Konkordate" in Herzog-Hauck, *Realencyklopädie*, 3rd ed. (with reff.); A. Mercati, *Raccolta di Concordati* (1919); F. M. Cappello, *De natura concordatorum* (1928); M. Bierbaum, *Das Konkordat in Kultur, Politik, und Recht* (1928); On the Italian Concordat *see* W. Parsons, *The Pope and Italy* (1929); on the French concordats: Thomas, *Le concordat de 1516* (1910).

CONCORDIA, a Roman goddess, the personification of civic concord. Several temples in her honour were erected at Rome, the most ancient being one on the Capitol, dedicated to her by Camillus (367 B.C.), subsequently restored by Livia, the wife of Augustus, and consecrated by Tiberius (A.D. 10). Concordia was represented as a matron holding in her right hand either a *patera* or an olive branch, and in her left either a *cornu copiae* or a sceptre.

CONCORDIA (mod. CONCORDIA SAGITTARIA), an ancient town of Venetia, in Italy, 16ft. above sea-level, 31m. W. of Aquileia, at the junction of roads to Altinum and Patavium, to Opitergium (and thence either to Vicetia and Verona, or Feltria and Tridentum), to Noricum by the valley of the Tilaventus (Tagliamento), and to Aquileia. Previously a mere village, Augustus made it a colony. Under the later empire it was one of the most important towns of Italy; it had a strong garrison and a factory of missiles for the army. In the garrison cemetery many important inscriptions have been discovered. It was taken and destroyed by Attila in A.D. 452. Parts of the ancient city walls, the sites of the forum and the theatre, and probably that of the arms factory have been found. The ancient see of Concordia was transferred in 1339 to Portogruaro, where it still remains. The old Romanesque cathedral and baptistery are preserved.

CONCORDIA, a city of northern Kansas, U.S.A., on the Republican river, 155m. W. of Atchison; the county seat of Cloud county. It is on the Meridian national highway, and is served by the Burlington, the Missouri Pacific, the Santa Fe and the Union Pacific railways. The population in 1930 federal census was 5,792 and in 1940, 6,255. It has a large wholesale trade, and manufactures flour, brick, brooms, butter and cheese, and ice. Coal, building stone and clay are found near by. Concordia was settled about 1871, and was incorporated in 1872.

CONCRETE, a term used in various technical senses, with the general significance of combination, conjunction, solidity. Thus the building material made up of separate substances combined into one is known as concrete (*see* below). In mathematics and music, the adjective has been used as synonymous with "continuous" as opposed to "discrete," *i.e.*, "separate," "discontinuous." This antithesis is no doubt influenced by the idea that the two words derive from a common origin, whereas "discrete" is derived from the Latin *discernere* (to discriminate), as "concrete" is derived from *concrescere* (to grow together). In logic and also in common language concrete terms are those which signify persons or things as opposed to abstract terms which signify qualities, relations, attributes (so J. S. Mill). Thus the term "man" is concrete, while "manhood" and "humanity" are abstract, the names of the qualities implied. Confusions between abstract and concrete terms are frequent; thus the word "relation," which is strictly an abstract term implying connection between two things or persons, is often used instead of the correct term "relative" for people related to one another. Concrete terms are further subdivided as singular, the names of things regarded as individuals, and general or common, the names which a number of things bear in common in virtue of their possession of common characteristics. These latter terms, though concrete in so far as they denote the persons or things which are known by them (*see* DENOTATION), have also an abstract sense when viewed connotatively, *i.e.*, as implying the quality or qualities in isolation from the individuals. The ascription of adjectives to the class of concrete terms, upheld by J. S. Mill, has been disputed on the ground that adjectives are applied both to concrete and to abstract terms. Hence some logicians make a separate class for adjectives, as being the names neither of things nor of qualities, and describe them as attributive terms.

See J. S. Mill, *System of Logic,* 1874; J. N. Keynes, *Formal Logic,* 1906; H. W. B. Joseph, *Introduction to Logic,* 1916; A. Wolf, *Essentials of Logic,* 1926.

CONCRETE is a building material made by mixing stone, sand, water and a cementing material. The ingredients are mixed together with the addition of clean water into a plastic mass which gradually hardens into a rock-like substance of the nature of conglomerate. As a building material it is distinguished by the facility with which it can be deposited and moulded while plastic into almost any shape. Materials suitable for its manufacture are almost universally available and the mixing and placing do not require expert labour. It is adapted to an infinite variety of uses in engineering and architecture, including massive structures such as heavy foundations, retaining walls, dock walls, breakwaters, bridges and dams, and more intricate construction in ferro-concrete for floors, columns, buildings, arches, domes, towers, water tanks, pontoons, foundation cylinders, piles, open-work jetties and many other purposes. It has been used in masses of over 30 million cu.ft. in a single dam.

Concrete made with lime as the cementing material was largely used by the Romans in the construction of aqueducts, bridges and other massive work, generally with a facing of brickwork or masonry on the exposed surfaces, and some specimens of the ancient works have exhibited extraordinary durability. Lime in some form was almost the only binding material available until the introduction in the 19th century of Portland cement. The latter material is so superior in strength and reliability that it has almost superseded lime, except for unimportant work. Limited use is also made of other cements having qualities similar to Portland cement, such as natural cement and cement made from blast furnace slag (*see* CEMENT). When water is added to cement a slow chemical action takes place with liberation of some heat, and the cement in a few hours begins to harden into a stone-like substance. When it is mixed with sand a mortar is formed which sets hard, but with less ultimate strength than neat cement, and if broken stones are mixed with the mortar, concrete is obtained. In practice the materials are mixed together at one time and sound dense concrete is obtained when the mortar is in such volume and so mixed as to fill all the interstices among the broken stones. The sand used should be clean and sharp, entirely free from clay, loam, silt or vegetable matter, and it will give best results when it is a good blend of grains of all sizes from $\frac{1}{4}$in. down to $\frac{1}{1000}$inch. It may be obtained in a natural state from pit, river or seashore, or may be produced by crushing natural rock such as granite, trap or hard sandstone.

The stone may be pebbles or flints from gravel beds, or crushed hard rock, or broken artificial material such as slag, bricks, clinker or even concrete. Cinders and coke are sometimes used to form a light concrete, but should be excluded from important work. Hard limestone is generally suitable but has been found unsatisfactory in concrete conduits for conveyance of soft water, and is not the best material for producing fire-resisting concrete. Granite, gneiss, trap and hard sandstone rock produce good aggregate for concrete. Generally the angular stones produced by crushing rock are less easily formed into dense concrete without voids than the rounded stones of natural gravel which slip past each other readily and are thus more easily compacted together. Smoothness of surface of the stones is no disadvantage from the point of view of adhesion of the materials when the stones are small. The water used for mixing should be clean and free from acid alkali, oil or vegetable contamination. Sea water can be used without adverse effect other than the production of some surface efflorescence. Water from peat moors should not be used.

Concrete Mixtures.—Concrete may be mixed in very different proportions according to the strength required, and the size of stone used may be varied in accordance with the massiveness of the rock. The general principle to be followed in proportioning the mixture is that the volume of mortar produced by the mixing together of the cement and sand should be rather more than sufficient to fill the interstices of the broken stone so that no unfilled voids remain. The voids in broken stone are usually under 50% so that a quantity of sand equal to half the broken stone will normally suffice for complete filling. Relative proportions of cement, sand and stone, are frequently stated thus 1 : 3 : 6, which indicates a mixture in the proportions of one part of cement to three parts of sand and six parts of stone. Such a mixture with stone of a maximum size of 3in. is suitable for foundations of mass concrete and similar work where great strength is not required. A 1 : 2 : 4 mixture is generally appropriate for reinforced concrete building construction with stone not exceeding $\frac{3}{4}$in. so that the concrete may be readily filled between and around the reinforcing bars. Mixtures still richer in cement are required for concrete piles to obtain adequate strength and for tanks and hydraulic structures to obtain watertightness. The richest mixture in common use is 1 : 1 : 2 which is suitable for reinforced concrete in marine works, and for reinforced conduits to convey water under pressure. The proportions given are in round numbers, but the best proportions to use for particular materials should be determined by ascertaining by experiment the nature of the grading and the percentage of voids. The densest mixture of stones and sand, *i.e.,* the one which weighs most per unit volume, will be capable of furnishing the strongest concrete. The tests for grading are used to indicate whether a part of the constituent materials should be augmented or diminished. Addition of fine sand to promote water-tightness is often useful in concrete for hydraulic and marine works. The proportion of water to be used is almost as important as that of the other constituents. Enough water should be added to produce, after thorough mixing a plastic mass which can be rammed and tamped into position, so as to fill completely all corners and enclose solidly all reinforcement where such occurs. Too dry a mixture will give rise to inevitable voids and surface defects, while excess of water causes marked diminution of strength. Small quantities of concrete may be mixed by hand on a wooden platform, the dry materials being turned over by shovel two or three times before water is added, and the mixture again turned over twice while wet or until a uniform consistency is obtained. Most concrete mixing is now done by machines, in quantities of from 6 cu.ft. to 60 cu.ft. at a time. In one type the mixing is done in a power-operated drum having internal vanes which cause rapid and thorough mixture of the materials as the drum rotates. The machine includes power-operated loading and discharging apparatus and a measuring tank for water.

The question of the endurance of concrete under exposure to chemicals is important. Sea water contains salts which sometimes penetrate and affect pervious concrete and any steel reinforcement contained therein. It is considered that magnesium sulphate is the most injurious of such salts. The fundamental precaution to be taken in the case of concrete for marine structures is to make the concrete so dense that penetration by water is prevented. A mixture in the proportions 1 : 1 : 2 formed with well graded small aggregate and an adequate proportion of very fine material in the sand will give good endurance under most circumstances. Concrete is readily attacked by strong acids, but where thoroughly hardened and of dense quality it offers considerable resistance to weak acid solutions. In certain arid regions soluble alkaline salts contained in the ground are injurious to concrete. Such salts include the sulphates and chlorides of magnesium sodium and calcium. The remedy, as in the case of sea water appears to be the use of dense impervious concrete. Mineral oils such as petroleum, engine and transformer oils have little effect on good concrete. Vegetable oils, such as palm oil, have on the other hand a very injurious effect, as they unite with the lime of the cement and cause softening and disintegration.

Properties of Concrete.—The most important quality of concrete is the facility with which it can be formed into large and strong monolithic structures. Its usefulness depends on high compressive strength in conjunction with great durability and adequate tensile strength to ensure cohesion. The strength of concrete naturally depends on the quality and proportions of the constituents as well as the methods of mixing and placing, and obviously the proportion of cement used will have a large effect on the result. In England compressive strength is commonly determined by the force required to crush 6in. cubes of concrete. In the United States 6in. by 12in. cylinders are usually specified. When cement is used complying with the British Standard Specification 1925, the crushing stress for cubes 28 days old should be not less than 2,000lb. per sq.in. for a 1 : 2 : 4 mixture, rising to 3,000lb. per sq.in. for a 1 : 1 : 2 mixture. Much higher results are commonly obtained. The tensile strength is only a fraction of the compressive strength, usually about one-tenth. Concrete expands and contracts with rise and fall of temperature and it is a curious and important fact that the rate of expansion is almost the same as that of steel, a condition which enables the two materials to act together in the structural combination known as ferro-concrete, where primarily the concrete sustains the forces of compression and the steel resists the forces of tension. The question of the elasticity of concrete is important in relation to the stresses in ferro-concrete construction. Concrete yields much more than steel under the same stress, so that relatively the concrete is more elastic to an extent which for convenience is expressed by a ratio termed the modulus ratio. The actual ratio for matured concrete is commonly from 7 to 10, whereas for purposes of calculation a ratio of 15 is often assumed. While undergoing the chemical changes that transform it from a plastic to a hard material, concrete is subject to shrinkage, which, while introducing some secondary stresses in the materials of ferro-concrete, causes it to close around and hold the reinforcing bars with firm grip. Watertightness is of special importance in hydraulic and marine structures and is promoted by having a mixture in which the mortar is rather more than sufficient to fill the interstices in the aggregate and is watertight in itself. As a rule watertightness cannot be relied on where the mortar is a 1 : 2 mixture, whereas a 1 : 1 mixture will usually be satisfactory. Proper grading of the sand and a sufficiency of fine sand are necessary for the attainment of the best results.

Concrete is largely used as a casing around structural steelwork for protection against fire. It is well known that bare steelwork, owing to its excellent heat conducting properties, soon attains a dangerous temperature in a fire with consequent failure from softening. Concrete in comparison with steel is a poor conductor of heat and furnishes protection by delaying the passage of heat to the steelwork. As the temperature of the concrete rises on the surface to a high level dehydration takes place, accompanied by increase in the heat insulating properties, so that although the surface layers of the concrete are damaged the penetration of heat is thereby further hindered. A thickness of 2in. of concrete well bound to the steelwork with wire or metal mesh reinforcement meets the requirements of certain building authorities and fire associations. Concrete is frequently used as the wearing surface on floors subject to foot traffic and occasionally also to floors to sustain wheeled traffic. The wearing surface is usually a coating of fine concrete or mortar from 1 to 2in. thick applied on top of the concrete floor. The requirements of such a coating are strength and resistance to abrasion, as well as good adhesion to the concrete below, and they are in the main to be attained by the use of fine hard aggregate such as quartz, granite or flint, in a well graded mixture from ¼in. down to fine sand. Two parts of such aggregate mixed with one part of cement, applied before the floor concrete has completely set, and well trowelled to produce a smooth surface, should produce a satisfactory result. Carborundum offers very high resistance to abrasion and in a finely divided form like fine sand is sometimes mixed with the surface floor layer. Small proportions of powdered cast-iron or steel are also sometimes used to improve the density and wearing qualities of floors, but it is doubtful whether they add anything to the wearing properties of good concrete made with quartz or granite. Silicate of soda is an acid-resisting liquid chemical "hardener" which may be added to the mixing water or applied on the surface of finished concrete, with the object of hardening the surface and improving the resistance to abrasion.

Uses of Plain Concrete.—Plain or mass concrete though not so adaptable to architectural treatment can be used for almost all building purposes for which massive masonry or brickwork is suitable. It is particularly suitable for the construction of monolithic foundation slabs to distribute the load from buildings, walls, piers and all classes of heavy erections, from the fact that it is deposited in a plastic condition and thereby takes perfect and uniform bearing even on irregular ground. The spreading of the load so as to keep the pressure on the ground within its safe bearing power is effected by making the foundation slab wider than the wall or other part which is sustained. The use of concrete as a foundation for important roads is a reversion after many centuries to the excellent practice of the Romans. A substantial foundation of concrete is almost indispensable where a large volume of heavy traffic has to be borne. Plain concrete is well adapted to the construction of gravity retaining walls for the holding up of a vertical face of earth. The foundation slab for such a wall usually has considerable projection beyond its face and is deposited in a trench without the use of shutters or forms. The wall itself requires to be built within shutters or forms back and front which are held against a series of standing timbers stayed from the ground by raking or horizontal struts as the circumstances may require. The shutters may be of timber or sheet steel and are usually arranged in horizontal courses of a few feet in height. The concrete is deposited and well rammed in layers between the shutters and after a course has set firm the shutters are removed and raised into position for the next course. A sound smooth surface is obtained on the concrete by working a spade or other suitable tool repeatedly up and down on the inside of the shutters whereby the coarse stones are kept back, finer material is brought to the face and air is expelled. High retaining walls may be very massive and are suitable for the use of a variety of concrete known as rubble or cyclopean concrete in which large blocks of stone are embedded. Such concrete is made with ordinary concrete as a matrix and with the large stone as an exceedingly coarse aggregate. Good results are obtained when the large stones, which according to circumstances may be as large as a man or a crane can lift, are placed and embedded in a soft layer of plain concrete, and then covered over by the succeeding layer of plain concrete which must be rammed and worked so as to surround every stone. The large stones must be kept sufficiently far from the shutters and from each other to ensure that the plain concrete will flow into and completely fill all interstices.

Dams, dock walls and graving docks are classes of structure in which concrete is used in enormous masses and where cyclopean concrete may often be used to advantage. In the case of a dam, various classes of concrete are used to suit the conditions in different parts of the work. In the heart of the dam, mass and weight are required, and proportions varying from 1 : 2 : 4 to 1 : 3 : 6 are commonly used. Watertightness is obtained by providing a richer and denser layer next to the water face with a mixture varying from 1 : 1 : 2 to 1 : 2 : 4. In the case of a high dam large compressive stresses will be developed in the concrete near the inner and outer surfaces at the bottom under varying conditions of water level, so that richer and stronger concrete may be necessary in these regions. Where climatic conditions are severe rich concrete may be necessary on all exposed surfaces and sometimes it is advisable to have the surfaces protected with a facing of granite or other durable masonry. Somewhat similar conditions obtain in the case of concrete for dock walls and graving docks. The construction should be watertight and surfaces exposed to wear and abrasion should be protected either by rich concrete or by a separate facing of granite or similar material. A number of dock walls have been provided with foundations in an interesting manner by sinking large cellular structures of concrete through the ground until a firm foundation is reached. Such constructions are known variously as caissons or monoliths and are usually built up on a metal shoe formed with cutting edges. The sinking is effected by excavating the earth from the cellular interior spaces by hand excavation or by mechanical means, using a grab. As excavation proceeds the structure sinks and at the same time building upwards with mass concrete or concrete blocks takes place so that the top is kept above ground level. When a firm foundation has been reached the interior spaces may be filled with concrete or the bottom may simply be plugged with concrete and the rest of the spaces filled with sand or broken stone. Such a foundation structure is generally used as a base on which to build a wall of mass concrete. In the case of breakwaters (*q.v.*) very large use has been made of concrete in the form of huge pre-cast blocks. Where the depth of water is not great the whole structure may be formed of such blocks, but more frequently their use is confined to the upper part of the construction resting on top of a broad bank of rubble deposited in the water. The blocks are made and cured in a large construction yard ashore and are handled and lowered into position by heavy travelling cranes and set into correct position by the aid of divers. At the port of Dublin, blocks of 350 tons weight were used which were handled and deposited by heavy floating sheers.

Deposition Under Water.—It is sometimes necessary to deposit concrete in water and as concrete sets as well in water as in air excellent concrete can be obtained provided it is not disturbed during the setting period. The danger to be feared is that motion of the water will carry away some of the cement and so weaken the concrete. One method is to fill the concrete into large canvas bags which are lowered into position through the water. Such a "bag block" is plastic and flexible and adapts and fits itself when deposited to the sea bed or to adjacent blocks. Where the under water space in which the concrete is to be deposited is confined, so that disturbance from currents or motion of the water is eliminated, the plastic concrete may be deposited through a large tube reaching almost to the bottom of the space. This method is appropriate where under water shutters have been erected, or where the concrete is confined within the walls of cylinders, caissons, monoliths and similar constructions. Concrete deposited through the tube is conveyed directly to the bottom of the space to be filled and as further concrete is sent down the space is gradually filled with quiet displacement of the water as the surface of the concrete rises. There is no need to raise the tube as filling proceeds and indeed best results are obtained when the lower end of the tube is kept near the bottom of the space. The filling should proceed without intermission until the whole quantity is deposited. Some "laitance" or scum formed of material washed out of the cement will always be found on the upper surface of concrete. Such scum should be carefully removed before any further concrete is placed on top.

Ferro-concrete.—The introduction of ferro-concrete is generally attributed to Joseph Monier, a French gardener, who about the year 1868 developed the idea of strengthening concrete by incorporating in it a network of small iron rods for the purpose of constructing water basins. Many other inventors, some even before Monier, have contributed to the scientific development of the combination which is now almost indispensable in civil engineering work. In almost any engineering structure certain members or parts have to sustain forces of compression tending to crush them while other parts have to sustain tensile stresses which exert a tearing effect and other parts again are subject to transverse stresses tending to shear them through. The fundamental basis of the ferro-concrete combination is that concrete is provided to sustain the compressive stresses and to act as the universal binding material of the system, while steel is provided to withstand the tensile stresses and to assist in resisting shearing stresses. From broad theoretical considerations controlled by the results of many experiments and much practical experience, laws have been formulated which enable ferro-concrete members and parts to be accurately and economically proportioned for the duty they have to perform. The fundamental properties that enable the two elements to act in combination are the equality of the coefficients of expansion and the adhesion and grip with which even plain round steel rods are held so that stresses are transmitted to them without giving rise to slipping. Other properties which conduce to the economy and usefulness of the system of construction are the facility with which it can be formed within moulds to any desired shape, the excellent protection against corrosion afforded to the steelwork by its coating with cement, and the permanence and fire resisting quality of the construction.

Floor Slabs.—Fire resisting floors are frequently formed with a series of small rolled steel joists filled in with plain concrete, the joists being arranged to carry the load, but this type of construction is not classed as reinforced concrete. In a reinforced concrete floor slab steel rods are used in the bottom of the slab to take the tensile stresses and the concrete itself resists the compressive stresses and shearing stresses which in the other case are taken by the top flanges and the webs of the steel joists. A simple reinforced floor slab of this kind is shown in cross-section in fig. 1. Main steel rods to provide the cross-section ascertained by calculation are disposed regularly across the span in the bottom of the slab which is subject to tension, and a smaller quantity of distribution rods are arranged at right angles to bind the slab in the other direction. Fig. 2 illustrates the difference introduced by continuity of a slab over more than one span whereby tension occurs in the upper part of the slab over intermediate supports so that there the

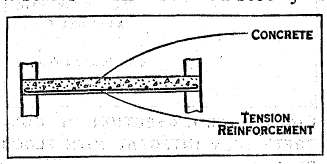


FIG. 1.—CROSS-SECTION OF SIMPLE REINFORCED FLOOR SLAB

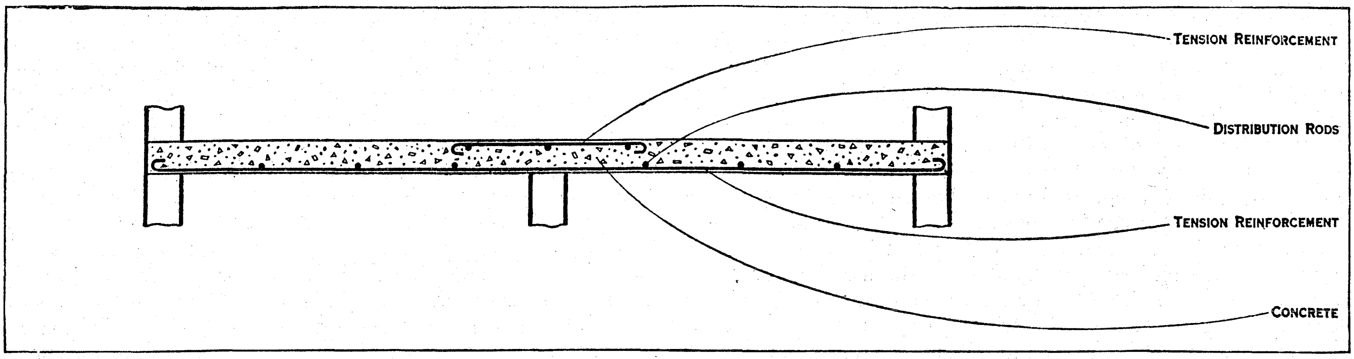


FIG. 2.—CROSS-SECTION OF FLOOR SLAB, SHOWING THE ARRANGEMENT OF REINFORCEMENT RODS IN THE CENTRE, WHERE TENSION OCCURS

reinforcing rods must be arranged near the upper surface.

Beams.—Beams of plain rectangular form are frequently used as lintels bridging over openings in walls, and are usually formed of the same thickness as the wall and with a depth arranged to suit the load. The tensile flange is constituted by a number of rods in the bottom of the beam while an area of concrete in the top of the beam constitutes the compression flange as shown in fig. 4. Reinforcement of vertical "stirrups" or other form may be provided to aid the concrete in resisting shearing stresses. Beams in reinforced construction are most frequently required to carry reinforced concrete floor slabs which when cast integrally with the beams can be utilized to augment their cross section and strength. Such a beam is indicated in fig. 5. In this case the concrete in the vertical stem or web is called upon to sustain proportionately larger stresses so that web reinforcement may become essential, and this is provided either by vertical links or "stirrups" as shown, or by bending up in a diagonal direction certain of the main tension rods in the end portions of the beam, or by a combination of the two methods. Suitable arrangements for continuity may be provided, as shown in fig. 2, which represents a beam continuous over two spans. It is noteworthy that by bending up certain of the main rods and overlapping them in the top of the beam over a support not only is provision made for resisting shearing stresses but also for withstanding the reverse bending which occurs. Continuous beams are usually more heavily stressed at intermediate supports than in the central portions of spans so that it is often appropriate to increase the depth by forming the bottom with a downward slope for a short distance next to each support.

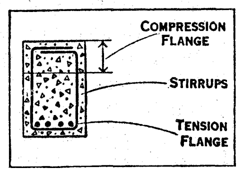


FIG. 3.—CROSS-SECTION OF RECTANGULAR CONCRETE BEAM

Columns.—A ferro-concrete column for the support of vertical loads, when properly designed and constructed, is at once economical, durable and fire resisting. It consists of a shaft of concrete containing a number of vertical steel bars bound together at close intervals by smaller steel bars either in the form of a continuous spiral or of separate links. The shaft may have any shape appropriate to the conditions and site. Sections of circular or octagonal shape are commonly adopted when spiral hooping is used, while square and rectangular cross sections are more commonly used with a binding of separate links. Typical cross sections of a square and an octagonal column are shown in fig. 6. The square column has four main vertical rods with a binding of separate links while the octagonal column has eight main rods with a continuous spiral binding. The thickness of concrete covering the main rods should in no case be less than 1½in. The load is borne partly by the concrete and partly by the steel, the greater portion being usually allocated to the concrete. The distribution of the load takes place in accordance with the elastic properties of the materials, so that if the modular ratio (referred to above) is 15, each square inch of cross section of main steel rod will bear 15 times as much load as a square inch of concrete. Thus if the cross section of a particular column had 300 sq.in. of concrete and 10 sq.in. of steel, the steel would carry as much as 10 x 15 = 150 sq.in. of concrete and would therefore carry half as much as the actual concrete or one-third of the total load. If the average working stress on such a column were fixed at 500lb. per sq.in. the capacity of the column for sustaining load would be ascertained thus:—

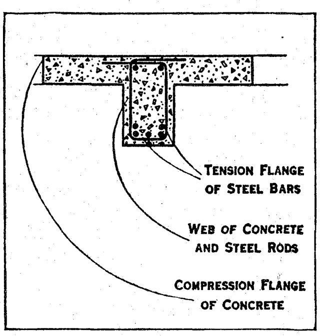
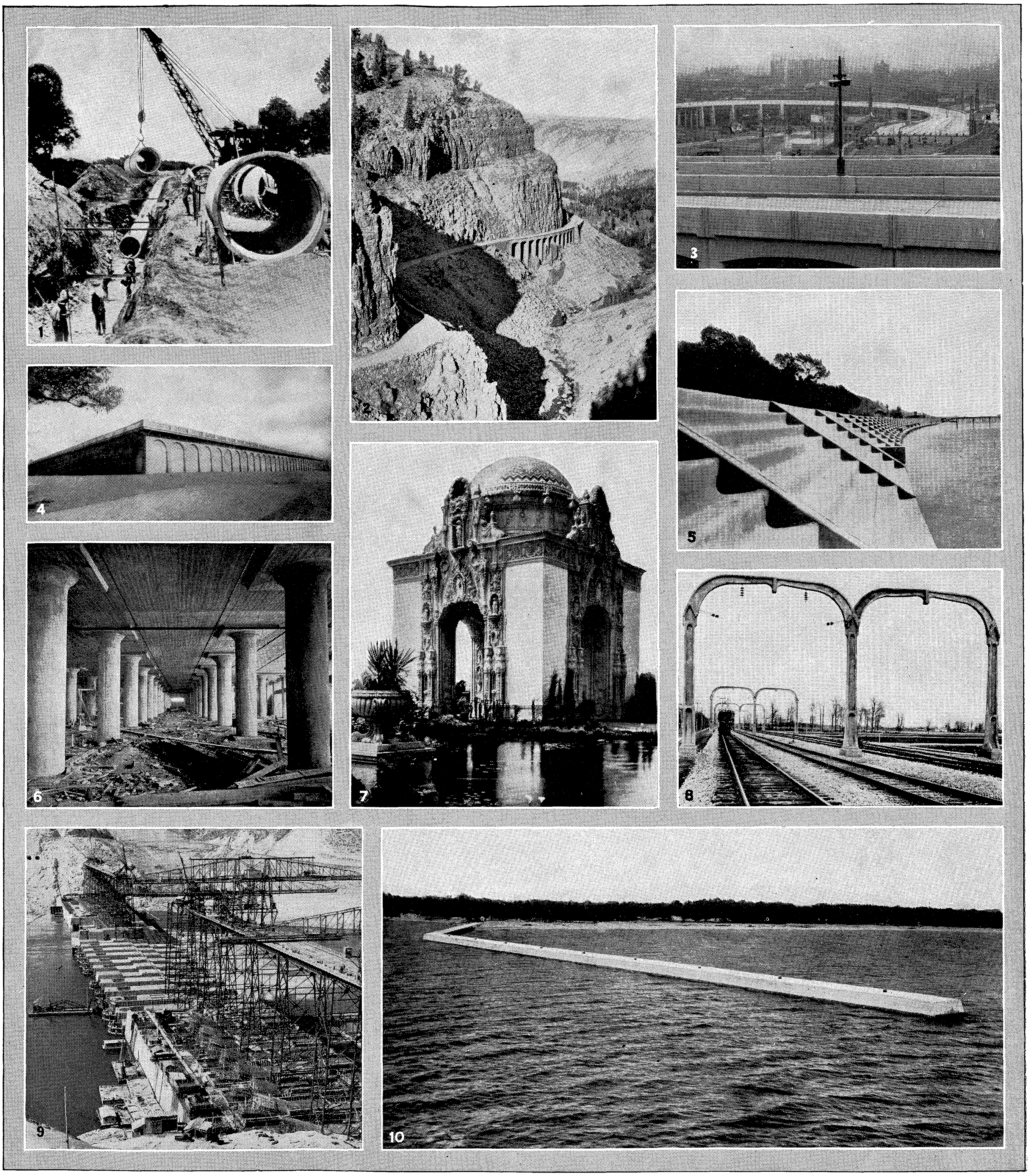


FIG. 4.—CROSS-SECTION OF CONCRETE BEAM INTEGRAL WITH FLOOR SLAB

Concrete	300×500	=150,000lb.
Steel	10×50×500=	75,000lb.
	Total	225,000lb.
		or 100 tons.

It is seldom possible to arrange that columns shall be loaded uniformly over their cross section in the manner assumed in the foregoing simple calculation. In actual building construction they are usually employed to support ferro-concrete floors in a monolithic construction whereby the bending of the floor beams induces bending effects also in the columns, which must be taken into consideration along with the loads in determining the cross sections required. Fig. 7 is a perspective section showing a typical construction in a building where the columns support main beams which in turn carry a series of subsidiary beams over which a slab floor is formed. It is readily understood that considerable labour is involved in fabricating and supporting the moulds for the beams in a construction of this type, and efforts at simplification have resulted in patented floors of the flat slab type in which all beams projecting below the floor slab are dispensed with and a thicker floor slab is supported directly on the columns through large circular or square capitals. Such a floor is usually reinforced by several systems of rods radiating from the columns and disposed near the under surface of the slab in the central portions of floor panels and near the top where they pass over the capitals. The design of floors of this type is based on approximate theory controlled by the results of stress measurements in tests of actual floors. The method has hitherto found little application in Britain, where much more use has been made of light flat-ceilinged floors having in their lower part rows of hollow tile blocks set so as to leave intermediate spaces for the formation of narrow reinforced beams, the floor being completed by a continuous concrete layer placed over the tiles and beams. Floors of this type are well adapted for filling in the panels between the main floor beams of structural steel-framed buildings, and have the advantages of lightness and good insulating qualities, while a plaster ceiling can be applied to the grooved soffits of the tiles.

Foundations.—Reinforced concrete construction is adapted to varied uses in foundation work. Thus, retaining walls of ample strength can be readily constructed in places where there is no room for a wall of mass concrete. Heavy columns can be supported in a relatively thin but wide-spread foundation of reinforced concrete with great saving in weight, volume and depth of construction, as compared with mass concrete. On weak ground, a complete layer of light reinforced concrete in the shape of a plain or ribbed slab may be provided to distribute the entire load over



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STRUCTURAL CONCRETE APPLIED TO LARGE-SCALE OPERATIONS

1. Section of large concrete pipe being placed in line from the Ozark mountains to Tulsa, Oklahoma
2. Concrete viaduct along cliff on mountain road through Golden Gate canyon, Yellowstone National park, Wyoming
3. Six-lane concrete express highway leading to New Jersey entrance of Lincoln tunnel connecting New Jersey with New York
4. Concrete reservoir, Eastern Hills, Cincinnati, Ohio, holding a reserve of 35,000,000 gallons
5. Sea wall built of concrete sections along gulf coast of State of Mississippi. The step formation permits its use as a landing for small boats, or observation gallery during aquatic sports
6. Rail and Harbour Terminals building, Toronto, Canada, showing columns and floors of reinforced concrete. View of the superstructure during construction
7. Concrete monument, entrance to Valhalla Memorial park, Burbank, California. Structure is concrete throughout, the intricate outer decoration being made of pre-cast architectural concrete
8. Concrete trolley wire supports, Detroit, Toledo & Ironton railroad
9. A concrete-pouring record: approximately 10,500,000 cu.yd. of concrete in the Grand Coulee dam on the Columbia river, U.S.A. View shows the steel trestle erected prior to the pouring above the base
10. Concrete breakwater, Port Maitland, near Yarmouth, Nova Scotia

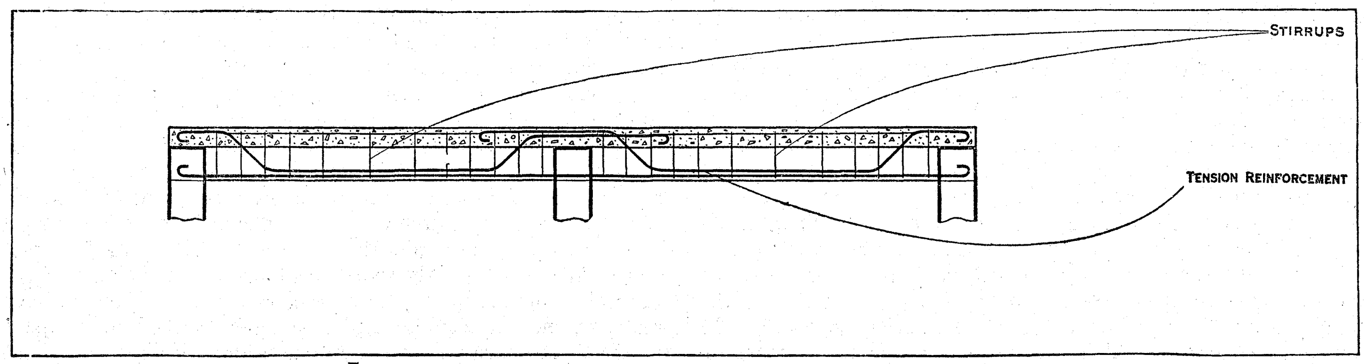

FIG. 5.—DIAGRAM SHOWING LONGITUDINAL ELEVATION OF CONCRETE BEAM

the whole basement area of a structure in an economical and efficient manner unattainable with other methods of construction.

Ferro-concrete piles have largely superseded timber piles as a means of transmitting heavy loads down through layers of weak material to a firm stratum of ground, without the necessity for deep excavation. They are usually made of one or other of the types of column section shown in fig. 6, and are manufactured in a horizontal position in moulds laid out on a prepared floor. A fine concrete mixture of the order of $1 : 1\frac{1}{2} : 3$ is desirable for piles, to enable them to withstand the severe stresses produced in handling and driving with a heavy hammer, and a still richer mixture is of advantage for marine work. When ordinary Portland cement is used piles will normally be fit for driving in 30 days; if first quality rapid hardening Portland cement is used the piles may be driven at seven days, and with the use of "ciment fondu" they may be driven when 24 hours old. Concrete piles require to be driven with a heavy hammer which for satisfactory results should weigh at least half as much as the pile. A steel helmet or collar fitted over the head of the pile receives the strokes of the hammer and transmits them to the pile head through a cushioning layer of canvas or rope. Fig. 8 shows the method of pile driving in progress for the foundations of a large power station where 6,000 concrete piles from 25ft. to 46ft. long were used. A close wall of piling driven from the surface can be readily provided in soft or wet ground in many cases where the construction of an ordinary wall within a deep timbered trench would be prohibitive owing to excessive difficulty and cost. The special piles used for such work are known as "sheet piles" and are formed with bevelled points and grooved ends so that they drive close together in a regular line. A satisfactory form has semi-circular grooves at each end and a short projecting tongue on the cast-iron

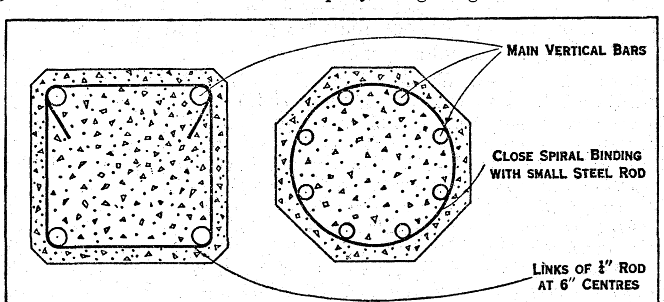

FIG. 6.—TYPICAL SECTIONS OF CONCRETE COLUMN
Left, a square column with four main vertical rods and a binding of separate links. Right, an octagonal column with eight main vertical rods and a continuous spiral binding

point which engages with the groove on the last driven pile, while the upper end may be held to line between timber walings during the driving. The circular hole formed by the grooves of the meeting piles is filled with cement mortar after being cleaned out with a water jet. This type of pile is shown in fig. 8 which also indicates the restricted driving head which is provided to enable the driving helmet to pass the last driven pile.

Caissons and Floating Craft.—An important development in subaqueous foundation work, such as dock walls, jetties, breakwaters and bridge piers, consists in the employment of reinforced concrete caissons of rectangular, cylindrical or other form which may be constructed in dry dock or on a staging on dry land, then launched or floated out, towed to the site, and deposited in position on a bed prepared by dredging or by divers. Such caissons form a permanent part of the construction and are generally used as a working base for further operations of sinking downwards and building upwards, the top being kept always above water. Sinking

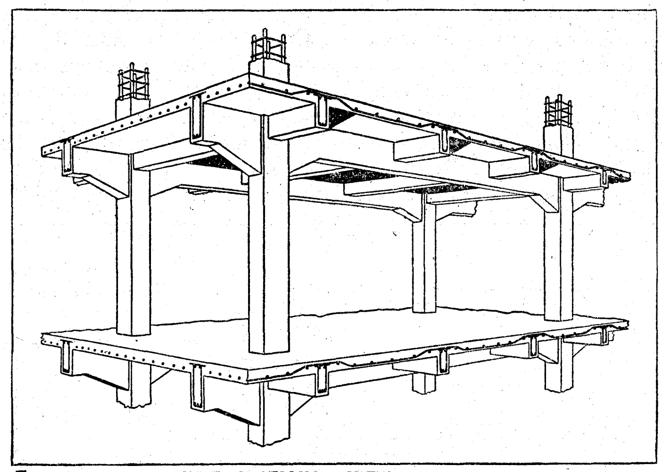

FIG. 7.—PERSPECTIVE SECTIONAL VIEW OF REINFORCED CONCRETE STRUCTURE, SHOWING COLUMNS, BEAMS AND FLOOR SLABS

downwards through suitable materials may be effected by grabbing through open wells in the interior of the caisson, while for difficult cases the excavation may be carried on by men working under compressed air. Large concrete caissons have been applied in the construction of the upper portions of breakwaters as at Valparaiso and elsewhere. In the Oswald street bridge at Glasgow cylindrical caissons 20ft. in diameter were used for the foundations of the piers. These caissons were constructed on a staging ashore, fitted with a false bottom, lowered into the water, floated out to position, deposited on the prepared bed, and after removal of the temporary bottom, sunk to the necessary depth by grabbing and excavation inside, the pier on top of a group of caissons being built up as the sinking proceeded.

Concrete Ships.—The results of the construction of reinforced concrete cargo vessels at the close of the World War were satisfactory and indeed surprising as regards watertightness, main longitudinal and transverse strength and lightness of construction. The hull weight in careful design was less than that of a wooden vessel, though somewhat greater than that of a steel hull. The principal disadvantage lay in the relative tenderness of the thin skin construction under the bumping and rubbing to which a vessel is often subject when in port and when touching ground. The results were instructive as regards the possibilities of carrying out light watertight concrete constructions with rich concrete of small aggregate without the addition of any special waterproofing material and with very fine limits of cover of concrete and spacing of bars. In Great Britain, in addition to numerous barges and steam tugs, a few self-propelled cargo vessels were constructed, the principal being the "Armistice" of about 1,100 tons dead weight which at the beginning of 1928 had been in continuous service for eight years.

Roads.—Concrete, either plain or containing a mesh of reinforcement, has been used for many years as a foundation layer for roads subject to heavy traffic, particularly in cities. A more recent development, to some extent still in the experimental stage, is its use to form the finished road surface. Such use has been rendered practicable by great improvement in the quality of cement and increased knowledge of the methods of attaining dense wear-resisting concrete. The principal requirements are: (*a*) Adequate strength to sustain the heaviest loads imposed by the traffic and distribute them on to the ground. This is a matter of the design of a plain or reinforced slab of sufficient strength. (*b*) Resistance to abrasion. This is dependent on quality of concrete, and satisfactory results can be obtained when aggregate and sand of the hardest and most wear-resisting nature, such as quartz, granite or flint, are used in properly graded proportions with a somewhat rich mixture of the best cement and no avoidable excess of mixing water. Particular care is also required to see that the surface is not exposed to the sun or dry winds during the first week or two after laying, as otherwise perfect setting and hardening will be prevented by evaporation of water. A coating of sand two or three inches thick, kept damp by frequent spraying, forms a useful protection during the period of curing. (*c*) Adequate precautions to prevent cracking. Cracking due to shrinkage in large flat areas of concrete is unavoidable, and large, unsightly cracks are most readily avoided by laying the concrete in bays with construction joints arranged on definite lines. In one method alternate transverse strips are laid and allowed to set, and the intermediate bays are then filled in. In another method the concrete is laid in two or more longitudinal strips of a maximum width

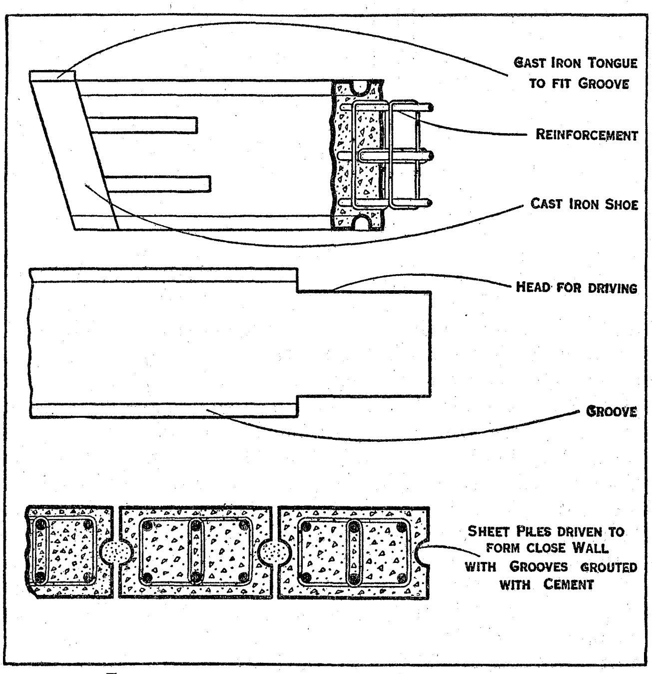

FIG. 8.—REINFORCED CONCRETE SHEET PILING
Upper, point of pile fitted with sloping iron shoe; centre, head of pile restricted in width to receive the driving helmet; lower, cross-section through row of piles driven vertically to form a close wall of concrete in the ground

of about 15ft. The length of a strip may be about 25 to 50ft. according as the concrete is plain or reinforced.

Bridges and Arches.—Bridges of moderate span may be formed of simple beams and slabs, but the field for this class of construction is limited by the rapidly increasing deadweight of the structure itself. The particular form of bridgework for which ferro-concrete is pre-eminently suited is arch construction which compels consideration wherever abutment and headroom conditions are suitable and the span is not small. The particular advantage of the arch is that a single main member serves to carry the load as compared with two main members and a web system in the case of a beam or truss. Further, the arch has the economical advantage that the thrust is principally taken by concrete, which is cheaper for this purpose than steel, and in large arches only a relatively small proportion of reinforcement is required to withstand such tensile stresses as may develop in consequence of irregular distribution of live load and the effects of shrinkage, temperature and rib-shortening in the concrete. The arch form, in addition, lends itself to the attainment of good appearance. The largest arch bridge completed in 1928 is the road bridge of 432ft. span across the Seine at St. Pierre du Vauvray, France. Whereas formerly 400ft. was looked on as being near the practicable limit for a concrete arch, recent developments have greatly extended the limits, and completely worked-out projects are now in existence for more than one bridge with spans of about 600ft., while spans of 1,000ft. do not appear to be unattainable.

Hydraulic Works.—There has been rapid extension in the use of ferro-concrete in all classes of hydraulic construction (*see* AQUEDUCTS and DAMS). It is employed for all classes of tank construction, including underground covered tanks, tanks erected on the ground and tanks supported on high towers. For the latter class a circular form is usually most appropriate with circumferential hoop reinforcement to resist the bursting effect of the water pressure on the sides. Where water pressure has to be resisted a rich concrete mixture not leaner than $1 : 1\frac{1}{2} : 3$ is called for, and an internal rendering of cement mortar will give added security against percolation. It is also of great importance that the risk of formation of cracks should be eliminated as far as practicable, and consideration of the elastic co-operation of the materials and the desirability of keeping the actual tensile stress on the concrete below its rupture value lead to the employment of low tensile stresses on the steel. Satisfactory results may be expected when the sections of concrete and steel are suitably proportioned and the stress on the steel, when the latter is considered as taking the whole of the tension, is limited to about 10,000lb. per sq.in. The reinforcement must be consistently proportioned throughout and be without sudden breaks in the quantity or arrangement. Surfaces of concrete do not lend themselves very readily to satisfactory architectural treatment, so that in many fine buildings the supporting framework of reinforced concrete is entirely hidden behind facework of masonry or other material. Good effects in buildings can be attained when the visible concrete is well finished and confined to well-proportioned and suitably lined vertical and horizontal bands of the framework, the rest of the elevation being formed of panelling and face-work of other materials. In bridges principal reliance must be placed on satisfactory form and proportions combined with very careful work in constructing and setting the moulds which form the exposed surfaces. Parapets and pillars of good finish and appearance may be pre-cast in small pieces in carefully finished moulds, preferably of metal.

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CONCRETION, in petrology, a name applied to nodular or irregularly shaped masses of various size occurring in a great variety of sedimentary rocks, differing in composition from the main mass of the rock, and in most cases obviously formed by some process which ensued after the rock was deposited. As these bodies present so many variations in composition and structure, it will conduce to clearness if some of the commonest be briefly described. In sandstones there are often hard rounded lumps, which separate out when the rock is broken or weathered. They are mostly siliceous, but sometimes calcareous, and may differ very little in general appearance from the bulk of the sandstone. Through them the bedding passes uninterrupted, thus showing that they are not pebbles; often in their centres shells or fragments of plants are found. Argillaceous sandstones and flagstones very frequently contain "clay galls" or concretionary lumps richer in clay than the remainder of the rock. Nodules of pyrite and marcasite are common in many clays, sandstones and marls. Their outer surfaces are tuberculate; internally they commonly have a radiate fibrous structure. Usually they are covered with a dark brown crust of limonite produced by weathering; occasionally imperfect crystalline faces may bound them. Not infrequently (*e.g.,* in the Gault) these pyritous nodules contain altered fossils.

Another type of concretion, very abundant in many clays and shales, is the "septarian nodule." These are usually flattened, disk-shaped or ovoid, often lobulate externally like the surface of a kidney. When split open they prove to be traversed by a network of cracks, which are usually filled with calcite and other minerals. These white infillings of the fissures resemble partitions; hence the name from the Latin *septum,* a partition. Sometimes the cracks are partly empty. They vary up to ½in. in breadth, and are best seen when the nodule is cut through with a saw. These concretions may be calcareous or may consist of carbonate of iron. The former are common in some beds of the London Clay, and were formerly used for making cement. The clay-ironstone nodules or sphaerosiderites are very abundant in some Carboniferous shales, and have served as iron ores; some of the largest are 3ft. in diameter, and in the centre fossils are often found, *e.g.,* coprolites, pieces of plants, fish teeth and scales. Phosphatic concretions are often present in certain limestones, clays, shelly sands, and marls.

Another very important series of concretionary structures are the flint nodules which occur in chalk, and the patches and bands of chert which are found in limestones. Flints consist of dark-coloured cryptocrystalline silica. They weather grey or white by the removal of their more soluble portions by percolating water. Their shapes are exceedingly varied, and often they are studded with tubercules and nodosities. They sometimes have internal cavities and very frequently contain shells of echinoderms, molluscs, etc., partly or entirely replaced by silica, but preserving their original forms. Chert occurs in bands and tabular masses rather than in nodules; it often replaces considerable portions of a bed of limestone (as in the Carboniferous limestone). Corals and other fossils frequently occur in chert, and when sliced and microscopically examined both flint and chert often show silicified foraminifera, polyzoa, etc., and sponge spicules.

These examples will indicate the great variety of substances which may give rise to concretions, which seem to arise from the tendency of chemical compounds to be slowly dissolved by interstitial water, either while the deposit is unconsolidated or at a later period; it is highly probable that such solutions are usually in the colloidal state. Certain nuclei, present in the rock, then determine reprecipitation of these solutions, and the deposit once begun goes on till either the supply of material for growth is exhausted, or the physical character of the bed is changed by pressure and consolidation till it is no longer favourable to further accretion. The process resembles the growth of a crystal in a solution by slowly attracting to itself molecules of suitable nature from the surrounding medium; but in the majority of cases it is not the crystalline forces, or not these alone, which attract the particles. The structure of a flint, for example, shows that the material had so little tendency to crystallize that it remained permanently in cryptocrystalline or subcrystalline state. That the concretions grew in the solid sediment is proved by the manner in which lines of bedding pass through them and not round them. (J. S. F.)

CONCUBINAGE. The state of a man and woman cohabiting as married persons without the full sanctions of legal marriage. (Lat. *concubina,* a concubine; from *con-,* with, and *cubare,* to lie.)

In early historical times, when marriage laws had scarcely advanced beyond the purely customary stage, the concubine was definitely recognized as a sort of inferior wife, differing from those of the first rank mainly by the absence of permanent guarantees. The history of Abraham's family shows us clearly that the concubine might be dismissed at any time, and her children were liable to be cast off equally summarily with gifts, in order to leave the inheritance free for the wife's sons (Genesis xxi. 9 ff., xxv. 5 ff.).

Roman Law.—The Roman law recognized two classes of legal marriage: (1) with the definite public ceremonies of *confarreatio* or *coemptio,* and (2) without any public form whatever and resting merely on the *affectio maritalis, i.e.* the fixed intention of taking a particular woman as a permanent spouse. The difference between English and Scottish law, which once made "Gretna Green marriages" so frequent, is due to the fact that Scotland adopted the Roman law which on this particular point was followed by the whole mediaeval Church.

Next to these strictly lawful marriages came concubinage as a recognized legal status, so long as the two parties were not married and had no other concubines. It differed from the formless marriage in the absence (1) of *affectio maritalis,* and therefore (2) of full conjugal rights. For instance, the concubine was not raised, like the wife, to her husband's rank, nor were her children legitimate, though they enjoyed legal rights forbidden to mere bastards, *e.g.,* the father was bound to maintain them and to leave them (in the absence of legitimate children) one-sixth of his property; moreover, they might be fully legitimated by the subsequent marriage of their parents. In the East, the Emperor Leo the Philosopher (d. 911) insisted on formal marriage as the only legal status; but in the Western Empire concubinage was still recognized even by the Christian emperors. The early Christians had naturally preferred the formless marriage of the Roman law as being free from all taint of pagan idolatry; and the ecclesiastical authorities recognized concubinage also. The first Council of Toledo (398) bids the faithful restrict himself "to a single wife or concubine, as it shall please him"; and there is a similar canon of the Roman synod held by Pope Eugenius II. in 826. Gratian, in the 12th century, tried to explain this away by assuming that the concubinage here referred to meant a formless marriage; but in 398 a church council can scarcely so have misused the technical terms of the then current civil law.

Even as late as the Roman councils of 1052 and 1063, the suspension from communion of a layman who had a wife and a concubine *at the same time* implies that mere concubinage was tolerated. It was also recognized by many early civil codes. In Germany "left-handed" or "morganatic" marriages were allowed by the Salic law between nobles and women of lower rank. In different States of Spain the laws of the later middle ages recognized concubinage under the name of *barragania,* the contract being lifelong, the woman obtaining by it a right to maintenance during life, and sometimes also to part of the succession, and the sons ranking as nobles if their father was a noble. In Iceland, the concubine was recognized in addition to the lawful wife, though it was forbidden that they should dwell in the same house. The Norwegian law of the later middle ages provided definitely that in default of legitimate sons, the kingdom should descend to illegitimates.

Handfasting.—In the Danish code of Valdemar II., which was in force from 1280 to 1683, it was provided that a concubine kept openly for three years shall thereby become a legal wife; this was the custom of *hand vesten,* the "handfasting" of the English and Scottish borders, which appears in Scott's *Monastery.* In Scotland, the laws of William the Lion (d. 1214) speak of concubinage as a recognized institution; and, in the same century, the great English legist Bracton treats the "concubina *legitima*" as entitled to certain rights. There seems to have been at times a pardonable confusion between some quasi-legitimate unions and those marriages by mere word of mouth, without ecclesiastical or other ceremonies, which the Church, after some natural hesitation, pronounced to be valid. Thus, in the case of Richard d'Anesty, decided by papal rescript in 1143, "a marriage solemnly celebrated in church, a marriage of which a child had been born, was set aside as null in favour of an earlier marriage constituted by a mere exchange of consenting words." The great mediaeval canon lawyer Lyndwood illustrates the difficulty of distinguishing, even as late as the middle of the 15th century, between concubinage and a clandestine, though legal, marriage. He falls back on the definition of an earlier canonist that if the woman eats out of the same dish as the man, and if he takes her to church, she may be presumed to be his wife; if, however, he sends her to draw water and dresses her in vile clothing, she is probably a concubine.

Clerical Celibacy and Concubinage.—Another and more serious confusion between concubinage and marriage was caused by the gradual enforcement of clerical celibacy (*see* CELIBACY). During the bitter conflict between laws which forbade sacerdotal marriages and long custom which had permitted them, it was natural that the legislators and the ascetic party generally should studiously speak of the priests' wives as concubines, and do all in their power to reduce them to this position. This very naturally resulted in a too frequent substitution of clerical concubinage for marriage; and the resultant evils form one of the commonest themes of complaint in church councils of the later middle ages. It may be gathered from the Dominican C. L. Richard's *Analysis Conciliorum* (vol. ii., 1778) that there were more than 110 such complaints in councils and synods between the years 1009 and 1528. Dr. Rashdall (*Universities of Europe in the Middle Ages*) points out that a master of the University of Prague, in 1499, complained openly to the authorities against a bachelor for assaulting his concubine.

Concubinage in general was struck at by the concordat between the Pope Leo X., and Francis I. of France in 1516; and the Council of Trent, while insisting on far more stringent conditions for lawful marriage than those which had prevailed, imposed heavy penalties on concubinage and appealed to the secular arm for help against contumacious offenders (Sessio xxiv. cap. 8).

See also J. A. and Aug. Theiner, *Einfuhrung d. erzwungenen Ehelosigkeit* (1828, re-issued in 1845); Du Cange's *Glossarium, s.v. Concubina*, the article "Concubinat" in Wetzer and Welte's *Kirchenlexikon* (2nd ed., Freiburg i/B., 1884), and Dr. H. C. Lea's *History of Sacerdotal Celibacy* (3rd ed., 1907). (G. G. C.)

CONDÉ, PRINCES OF. The French title of prince of Condé, assumed from the ancient town of Condé-sur-l'Escaut, was borne by a branch of the house of Bourbon. The first who assumed it was the famous Huguenot leader, Louis de Bourbon (*see* below), the fifth son of Charles de Bourbon, duke of Vendôme. His son, HENRY, prince of Condé (1552–1588), also belonged to the Huguenot party. Fleeing to Germany he raised a small army with which in 1575 he joined Alençon. He became leader of the Huguenots, but after several years' fighting was taken prisoner of war. Not long after he died of poison, administered, according to the belief of his contemporaries, by his wife, Catherine de la Trémouille. This event, among others, awoke strong suspicions as to the legitimacy of his heir and namesake, HENRY, prince of Condé (1588–1646). In 1609 King Henry IV. arranged for him a marriage with Charlotte de Montmorency, whom shortly after Condé was obliged to save from the king's persistent gallantry by a hasty flight, first to Spain and then to Italy. On the death of Henry, Condé returned to France, and intrigued against the regent, Marie de' Medici; but he was seized, and imprisoned for three years (1616–19). His wife elected to share his captivity. On his release Condé strove to blot out the memory of the Huguenot connections of his house by affecting the greatest zeal against Protestants. His son Louis, the great Condé, is separately noticed.

The next in succession was HENRY JULES, prince of Condé (1643–1709), son of the great Condé and of Claire Clémence de Maillé-Brézé, niece of Richelieu. His grandson, Louis Henry, duke of Bourbon (1692–1740), Louis XV.'s minister, did not assume the title of prince of Condé which properly belonged to him.

The son of the duke of Bourbon, LOUIS JOSEPH, prince of Condé (1736–1818), distinguished himself in the Seven Years War, and most of all by his victory at Johannesburg. As governor of Burgundy he improved the industries and means of communication of that province. At the Revolution he took up arms in behalf of the king, became commander of the "army of Condé," and fought in conjunction with the Austrians till the peace of Campo Formio in 1797, being during the last year in the pay of England. He then served the emperor of Russia in Poland, and after that (1800) returned into the pay of England, and fought in Bavaria. In 1800 Condé arrived in England, where he resided for several years. On the restoration of Louis XVIII. he returned to France. He died in Paris in 1818. He wrote *Essai sur la vie du grand Condé* (1798).

LOUIS HENRY JOSEPH, duke of Bourbon (1756–1830), son of the last named, was the last prince of Condé. At the Revolution he fought with the army of the *emigrés* in Liège. Between the return of Napoleon from Elba and the battle of Waterloo, he headed an abortive royalist rising in La Vendée (*see* VENDÉE, WARS OF THE). On Aug. 27, 1830, he was found hanged.

See Muret, *L'Histoire de l'armée de Condé;* Chamballand, *Vie de Louis Joseph, prince de Condé;* Crétineau-Joly, *Histoire des trois derniers princes de la maison de Condé;* and *Histoire des princes de Condé*, by the duc d'Aumale (translated by R. B. Borthwick, 1872).

CONDE, JOSÉ ANTONIO (1766–1820), Spanish Orientalist, was born at Peraleja (Cuenca), and educated at the University of Alcalá. His *Historia de la Dominación de los Árabes en España* was published in 1820–21. Only the first volume was corrected by the author, the other two being compiled from his manuscript by Juan Tineo. This work was translated into German (1824–25), French (1825) and English (1854). Conde's pretensions to scholarship have been severely criticized by Dozy, and his history is now discredited.

CONDÉ, LOUIS DE BOURBON, PRINCE OF (1530–1569), fifth son of Charles de Bourbon, duke of Vendôme, younger brother of Antoine, king of Navarre (1518–62), was the first of the famous house of Condé. After his father's death in 1537 Louis was educated in the principles of the reformed religion. Brave though deformed, gay but extremely poor for his rank, Condé was led by his ambition to a military career. He fought with distinction in Piedmont under Marshal de Brissac; in 1552 he forced his way with reinforcements into Metz, then besieged by Charles V.; he led several brilliant sorties from that town; and in 1554 commanded the light cavalry on the Meuse against Charles. In 1557 he was present at the battle of St. Quentin. But descendants of the constable de Bourbon were still looked upon with suspicion in the French court, and Condé's services were ignored. The court designed to reduce his narrow means still further by despatching him upon a costly mission to Philip II. of Spain. His personal griefs thus combined with his religious views to force upon him a rôle of political opposition. He was concerned in the conspiracy of Amboise, which aimed at forcing from the king the recognition of the reformed religion. He was consequently condemned to death, and was only saved by the decease of Francis II. At the accession of the boy-king Charles IX., the policy of the court was changed, and Condé received from Catherine de Medici the government of Picardy. But the struggle between the Catholics and the Huguenots soon began once more, and henceforward the career of Condé is the story of the wars of religion (*see* FRANCE: *History*). He was the military as well as the political chief of the Huguenot party, and displayed the highest generalship on many occasions, and notably at the battle of St. Denis. At the battle of Jarnac, with only 400 horsemen, Condé rashly charged the whole Catholic army. Worn out with fighting, he at last gave up his sword, and a Catholic officer named Montesquiou treacherously shot him through the head on March 13, 1569.

CONDÉ, LOUIS II. DE BOURBON, PRINCE OF (1621–1686), called the great Condé, son of Henry, prince of Condé, and Charlotte de Montmorency, was born in Paris on Sept. 8, 1621, and educated by the Jesuits at Bourges. The duc d'Enghien, as he was styled during his father's lifetime, served in the campaigns of 1640 and 1641 in northern France, and at twenty-two, was compelled, for political reasons, to marry Richelieu's niece, Claire Clémence de Maillé-Brézé, a child of thirteen. He was passionately attached to Marthe du Vigean, and resented his forced marriage. He was present with Richelieu during the dangerous plot of Cinq-Mars, and afterwards fought in the siege of Perpignan (1642).

In 1643 Enghien was appointed to command against the Spaniards in northern France and at the battle of Rocroy (May 18) at the age of 22 won his place amongst the great captains of modern times. Enghien returned to Paris in triumph, and in gallantry and intrigues strove to forget his hated marriage. In 1644 he was sent to Germany with reinforcements for Turenne, who was hard pressed, and took command of the whole army. The battle of Freiburg (Aug.) was desperately contested, but in the end the French army won a great victory over the Bavarians and Imperialists under Count Mercy. The summer campaign of 1645 opened with the defeat of Turenne by Mercy, but this was retrieved in the brilliant victory of Nördlingen, in which Mercy was killed, and Enghien himself received several serious wounds. The capture of Philipsburg was the most important of his other achievements during this campaign. In 1646 Enghien served under the duke of Orleans in Flanders, and when, after the capture of Mardyck, Orleans returned to Paris, Enghien, left in command, captured Dunkirk (Oct. 11th). (*See* THIRTY YEARS' WAR.)

It was in this year that the old prince of Condé died. The enormous power that fell into the hands of his successor, together with his own military renown, alarmed the court. Condé himself held Burgundy, Berry, the marches of Lorraine, and other important territories; his brother Conti held Champagne, his brother-in-law, Longueville, Normandy. The government, therefore, determined to permit no increase of his already overgrown authority, and Mazarin determined at once to find him employment and to tarnish his fame as a general. He was sent to lead the revolted Catalans. Ill-supported, he was forced to raise the siege of Lerida, and returned home in bitter indignation. In 1648, however, he received the command in the Low Countries; and at Lens (Aug. 19) a battle took place, which ended in a victory that fully restored his prestige.

In September of the same year Condé was recalled to court, for the regent Anne of Austria required his support. Influenced by the fact of his royal birth and by his arrogant scorn for the bourgeois, Condé lent himself to the court party, and finally, after much hesitation, he consented to lead the army which was to reduce Paris (Jan. 1649).

On his side, insufficient as were his forces, the war was carried on with vigour, but the political situation inclined both parties to peace, which was made at Rueil on March 20 (*see* FRONDE, THE). But Condé soon became estranged from the court. His own pride and ambition, and the personal resentment of Anne caused the sudden arrest of Condé, Conti and Longueville on Jan. 18, 1650. Others, including Turenne and his brother the duke of Bouillon, made their escape. Vigorous efforts for the release of the princes were made. The women of the family were now its heroes. The young princess of Condé, having collected an army, obtained entrance into Bordeaux. But the delivery of the princes was brought about in the end by the junction of the old Fronde (the party of the parlement and of Cardinal de Retz) and the new Fronde (the party of the Condés); and Anne was at last, in February 1651, forced to liberate them from their prison at Havre. A later shifting of parties left Condé and the new Fronde isolated. With the court and the old Fronde in alliance against him, Condé made common cause with the Spaniards, who were at war with France. At the battle of the Faubourg St. Antoine (Sept. 1651) Condé and Turenne, two of the foremost captains of the age, measured their strength (July 2, 1652), and the army of the prince was only saved when La Grande Mademoiselle, daughter of the duke of Orleans, persuaded the Parisians to admit him within their gates and to turn the cannon of the Bastille on Turenne's army. Paris underwent a new investment, which ended in the flight of Condé to the Spanish army (Sept. 1652), and thenceforward, up to the peace, he was in open arms against France, and held high command in the army of Spain. But his genius found little scope in the cumbrous and antiquated system of war practised by the Spaniards, and his disastrous defeat at the Dunes near Dunkirk (June 14, 1658), in which an English contingent of Cromwell's veterans took part on the side of Turenne, led Spain to open negotiations for peace. After the peace of the Pyrenees in 1659, Condé obtained his pardon (January 1660) from Louis XIV., who thought him less dangerous as a subject than as possessor of the independent sovereignty of Luxemburg, which had been offered him by Spain as a reward for his services.

Condé now accepted, and loyally maintained henceforth, the position of a chief subordinate, even subservient, to a masterful sovereign. At Chantilly he gathered round him a brilliant company, which included many men of genius—Molière, Racine, Boileau, La Fontaine, Nicole, Bourdaloue and Bossuet. Proposals for the election, at first of Condé's son Enghien, and afterwards of Condé himself, to the throne of Poland, were eventually vetoed (1674) by Louis XIV., and John Sobieski was elected. In 1668 Condé proposed to Louvois, the minister of war, a plan for seizing Franche-Comté, the execution of which was entrusted to him, and successfully carried out. With Turenne he was the principal French commander in the campaign of 1672 against the Dutch. At the forcing of the Rhine passage at Tollhuis (June 12) he received a severe wound, after which he commanded in Alsace against the Imperialists. In 1673 he was again engaged in the Low Countries, and in 1674 he fought his last great battle at Seneff against the prince of Orange (Aug. 11). His last campaign was that of 1675 on the Rhine, where the army had been deprived of its general by the death of Turenne; and where by his careful and methodical strategy he repelled the invasion of the Imperial army of Montecucculi. He spent the last eleven years of his life in retirement at Chantilly, where he specially sought the companionship of Bourdaloue, Nicole and Bossuet, and devoted himself to religious exercises. He died on Nov. 11, 1686.

His fame rests on his military genius. Unlike his great rival Turenne, Condé was equally brilliant in his first battle and in his last. The one failure of his generalship was in the Spanish Fronde, and in this everything united to thwart his genius. In private life he was harsh and unamiable, seeking only the gratification of his own pleasures and desires. Condé's unhappy wife had some years before her husband's death been banished to Châteauroux on a trumped-up charge of infidelity. Condé placed her in confinement, and in his last letter to the king requested him never to allow her to be released.

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CONDÉ, the name of some 20 villages in France. The important ones are: Condé-en-Brie (Lat. *Condetum*) a seat of a principality in the middle ages; Condé-sur-Aisne (*Condatus*) given in 870 by Charles the Bold to the abbey of St. Oven at Rouen, and which also gave its name to a seigniory during the middle ages; Condé-sur-Marne (*Condate*) has a fine church with Romanesque tower, and was once a place of some importance. Condé-sur-l'Escaut in the department of Nord at the junction of the canals of the Scheldt and the Condé-Mons (pop. [1936] 6,288), lies 7 mi. north by east of Valenciennes and 2 mi. from the Belgian frontier. Condé (*Condate*) dates from the late Roman period. It passed into French possession by the Treaty of Nijmwegen (1678). It was taken by the Austrians (1793) and in 1815 it again fell to the allies. It was from this place that the princes of Condé (*q.v.*) took their title (*see* P. L. Perron-Gélineau, *Condé ancien et moderne* [Nantes, 1886]). There is also a town in the department of Calvados, 33 m. south-south-west of Caen, called Condé-sur-Noireau (*q.v.*), important for cotton-spinning and weaving.

CONDENSATION: *see* METALLURGY.

CONDENSATION OF GASES: *see* LIQUEFACTION OF GASES.

CONDENSATION TRAILS are artificial clouds, usually of small ice crystals, formed in the wakes of aircraft. Such trails are most often formed at heights of 25,000 ft. and above, but occasionally at much lower levels. Condensation trails are more readily visible than the aeroplane and therefore favour the defense and reduce surprise in military missions.

Although condensation trails occasionally result from the mechanical mixing of two adjacent moist air strata of different temperatures, they are usually due to the water vapour contained in the exhaust gases. The engine discharges somewhat more water vapour than the weight of gasoline consumed. At low temperatures this provides sufficient water vapour to supersaturate the air and form a cloud. The exhaust gases also supply a copious number of nuclei of condensation.

The cloud will persist only if the relative humidity is initially high, so that moist air and low temperatures are the favourable conditions. As the aeroplane approaches its ceiling, the power output and hence the vapour output decrease and condensation trails become less likely. (*See* METEOROLOGY; CLOUDS.)

(H. G. HN.)

CONDENSED MILK: *see* FOOD PRESERVATION.

CONDENSER, an instrument for compressing air, gas, steam, or a device for concentrating electricity (*see* p. 216). Condenser also is used in textile work to denote an apparatus which doffs the web from the carding machines and separates it into slivers of soft yarn. It is also used in photography as a lens to produce powerful illumination of a slide or other object which is being viewed. A lantern condenser causes light rays to converge after passing through the slide, so that they may also pass through the remaining lenses, which focus the picture on the screen.

Perhaps the best known type of condenser is that used in connection with steam. James Watt in 1769 first patented a device for the condensation of steam in a vessel separate from the steam-cylinder. In the early atmospheric engine a vertical cylinder was open at the top, and the piston was connected by a chain to a pivoted beam, the other end of which worked a pump rod. On admission of steam the piston was pushed up to the top, then steam was turned off, and a spray of cold water thrown on to the piston. The steam in the cylinder condensed, creating a partial vacuum, with the consequence that the piston was forced down by atmospheric pressure, and became ready for another cycle. The great waste of power due to this alternate heating and cooling of the cylinder led Watt to invent the separate condenser, in which he closed the cylinder at each end, and jacketed

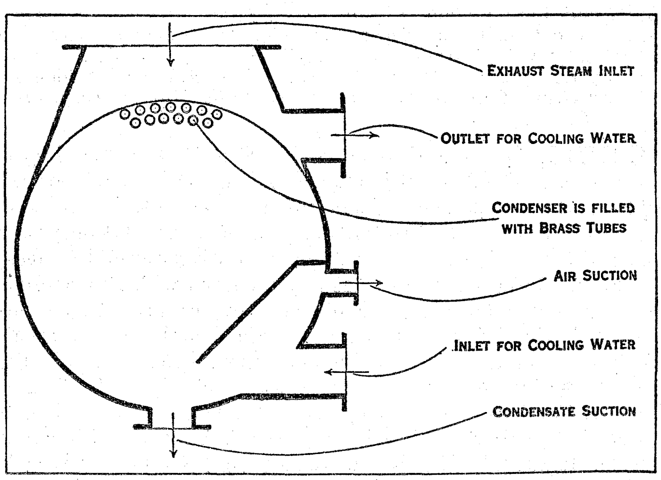


FIG. 1.—CROSS-SECTION OF A SURFACE CONDENSER, SHOWING THE MOVEMENT THROUGHOUT THE SYSTEM

The cooling water circulates through the tubes, and the exhaust steam from the engine or turbine, becoming condensed by contact with these cold surfaces, falls to the bottom

it, to conserve the heat. It will be apparent from this that the purpose of a condenser is to create a partial vacuum at the exhaust branch of a prime mover. The air pump improves this condition by removing air which has leaked into the system. The expansive properties of the steam in the cylinder or turbine are utilized to the best advantage. The vacuum is measured in inches of mercury, and the effect of increase in vacuum is very marked in the case of turbines; thus, an increase of from 27 in. to 29 in. has resulted in some cases in a saving of over 13% in steam consumption. For reciprocating steam engines it is not quite so important to attain a high vacuum, because of the limited volume of cylinder space for expansion. Steam condensers are divided into the two main classes of surface and jet condenser.

A surface condenser is a vessel filled with brass tubes, passing through plates near the ends; cooling water circulates through these tubes, and the exhaust steam being admitted becomes condensed by contact with the great number of cold surfaces, and falls to the bottom, being then the condensate, which goes from there into a reservoir termed a hot well, or is pumped direct to the boiler. The cooling water is dealt with in the manner explained under COOLING SYSTEMS. Improvements in the ordinary condenser (fig. 1) are made in several cases, the object being to expose a large area of tubes to the incoming steam. Regenerative condensers are designed so that the temperature of the condensate does not fall so much as usual; this reduces heat losses caused by the lower boiler-feed temperature.

In a jet condenser the steam and water mingle for the purpose of cooling. The jet condenser may be of three types; the barometric, siphon or ejector. The ejector condenser (fig. 2) is the simplest in design. A stream of cooling water is discharged down through a nozzle, and the steam enters a passage at right angles and is directed on to the water by the set of guides—direct condensation being thus effected. An evaporative condenser comprises a mass of tubes arranged upon a platform or roof; the steam passes through the numerous tubes, and the cooling water, trickling over their outsides, produces rapid evaporation of the water film and condensation of the steam. Condensers in gas-making practice cool the gas and remove all substances which are not permanent gases at normal temperatures. These include atmospheric condensers, which have the exteriors of the tubes through which the gas passes cooled by the air, and water condensers. The latter are supplied with a flow of water surrounding the gas tubes while in another class the water goes through tubes, and the gas around them. Water-cooling by flow or by submergence in a tank is also done in the case of ammonia and CO_2, in refrigerating plants. Condensers used in ammonia plants are classified as atmospheric, double-pipe and submerged. Other manufactures requiring the use of condensing apparatus are those of petroleum and perfumes.

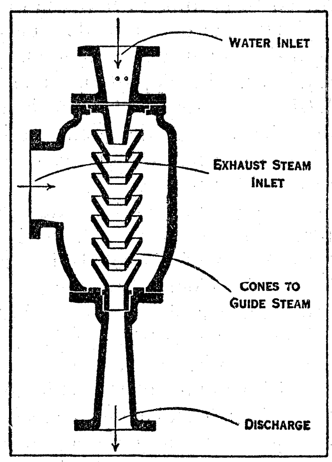


FIG. 2.—SECTION OF AN EJECTOR CONDENSER

The stream of cooling water rushes down through the cones and the exhaust steam entering at the side is directed on to the water, so becoming condensed

(F. H.)

CONDENSER (ELECTRICAL), a piece of electrical apparatus used originally solely for storing an electric charge, but now having many forms and diverse industrial and scientific applications. Until comparatively recent years the term condenser had been associated almost exclusively with the leyden jar, although the name was not used until some time after the discovery of the jar. It was first bestowed by Alessandro Volta (1745–1827) upon a different apparatus used by him in the course of his investigations upon atmospheric electricity. Volta's apparatus more resembled an electrophorus (*q.v.*), and was used as a condenser of variable capacity. At that time electricity was regarded as a fluid which could be condensed if the proper procedure were adopted, but it is now known that the action of a condenser is to store electricity by an accumulation of charges on the plates, electrodes or armatures of the condenser.

The electrical condenser is distinct in its properties from other electrical apparatus in that energy is stored in it in electrical form, and the energy which is passed into it during the charging process by connecting the condenser to a source of electromotive force is entirely or almost entirely returned again, when the condenser is discharged by connecting its plates or coatings by a wire. In the early days of electrical experiment in the 17th and 18th centuries many attempts were made to store up the "electric fire."

Leyden Jar.—The first real success in this direction was achieved by the discovery of the device subsequently called the leyden jar. This discovery was first made in October 1745 by Dean E. G. von Kleist of the cathedral of Kamin, who used a small apothecary's vial with a nail or piece of wire to make connection inside, the vial being held in the hand. By presenting the nail to the conductor of an electrical machine he found that the electricity passed into the vial as he showed by taking it into another room where it was possible to set fire to spirits of wine with the discharge spark, and to receive a shock by touching the nail. Some three months later, in Jan. 1746, Pieter van Musschenbroek, a professor in the University of Leyden, independently discovered the same phenomenon using a glass bottle filled with water and having an iron wire dipping into the water and projecting out through the cork so that it could be hung from a musket barrel suspended horizontally by silk threads. After electrifying the bottle, a violent shock could be obtained if the musket barrel and the jar were simultaneously grasped.

The leyden jar was in the succeeding years developed into various forms and put to many uses, both for purposes of science and amusement; and it is still used in laboratories, though the interest in it is largely historical. For many electrical experimental applications it forms a useful condenser which is not costly, but for most industrial applications it has been superseded by other forms of condenser having greater efficiency and other desirable electrical properties. The leyden jar of today consists of a wide-mouthed jar or bottle of good quality glass, as free as possible from bubbles or other irregularities and coated inside and outside with a layer of tinfoil extending over the bottom of the jar and for a distance up the side of one-half to two-thirds of the height of the jar. The exposed upper surface is generally coated with shellac or similar varnish to reduce surface leakage. The top of the jar is usually closed with a wooden stopper through which a brass rod is passed to make connection with the tinfoil. Various sizes of jars are in use, these giving different electrical capacity values—the electrical capacity of a condenser being the measure of its electrical size or, in other words, the measure of the charge it can store under the application of a given charging voltage.

Fundamental Units.—The fundamental unit of electrical capacity in the electrostatic system of measurement is the centimetre or abstatfarad (*see* ELECTRICITY), and this unit is employed to some extent in Europe, while an old unit of capacity, called after the leyden jar and equal to 1,000 cm., still has some adherents. The practical unit of capacity in terms of the workaday electrical units of the volt and the coulomb (one ampere is one coulomb per second) is called the farad, after Michael Faraday (*q.v.*), whose researches were so intimately associated with electrical discovery and who also carried out fundamental work on the dielectric of the condenser. This unit is rather large, so that for most purposes the microfarad (equal to one-millionth of a farad, *i.e.*, 10^{-6}F) is employed as the unit of measurement. For still smaller condensers, such for example as many of those employed in radio communication there is employed the still smaller unit, the micromicrofarad (equal to one billionth of a farad, *i.e.*, 10^{-12}F), convenient in order to avoid the use of very small fractions in expressing the capacity.

Construction and Properties.—The essential components of any form of condenser are: first, the metal plates, foils, or armatures forming the conducting connections or parts where the electric charges accumulate; and, second, the insulating dielectric (so designated by Faraday) which separates the plates. In the leyden jar the dielectric is the glass which separates the two tinfoil coatings, and the main differences between the jar and the more modern forms of condenser lie in the use of different dielectric materials, some being more suited for certain conditions than others. The most important dielectrics now in use in condensers are air, mica, paper impregnated with various other insulating materials, glass, ebonite, oil and certain cellulose compounds, such as celluloid and cellulose acetate. These are but a very few of the insulating materials which could possibly be used as condenser dielectrics, but they possess special properties fitting them for some particular application of the condensers. The dielectric properties of most importance in condenser construction are specific inductive capacity, or dielectric constant; dielectric strength; resistivity; and phase difference. The relative importance attachable to each of these depends upon the use to which the condenser is to be applied.

The first mentioned of these properties, specific inductive capacity, determines the capacity of a condenser of given physical dimensions. It is expressed as the ratio of the capacity of a condenser having the particular material as dielectric to the capacity of the same condenser, or of a condenser of exactly similar physical dimensions but having the plates separated by air only. The higher the value of this constant, therefore, the greater is the capacity of a condenser of given dimensions. The materials giving high values for the dielectric constant have, however, in many cases other harmful properties which prohibit their practical use in condensers. Most useful condenser dielectrics have a dielectric constant below 8, while insulating oil, and oil- or wax-impregnated paper dielectrics have values usually between 2 and 4.

The second property—dielectric strength—expresses the ability of a condenser to withstand the application to it of high voltages. When the voltage applied between the plates of a condenser is gradually increased the electric stress in the dielectric is increased also, until ultimately a value is reached at which the dielectric gives way—or breakdown occurs—and a discharge, generally in the form of a spark, passes through the material. The breakdown voltage per unit thickness of the material depends to some extent upon the thickness itself and upon the nature of the conducting electrodes that are applied to its surfaces. In general the breakdown voltage is relatively greater for the thinner sheets of the material, with the result that it is generally economical to subdivide high voltage condensers into a number of smaller elements, connected electrically in series, each element having a thinner dielectric adapted to withstand the appropriate fraction of the total voltage applied to the whole composite condenser.

The resistivity of the dielectric expresses a measure of the leakage or passage of electricity from one terminal to the other when voltage is applied. The property is of most interest for condensers which are subjected to steady or direct voltages. It is a quantity which is most commonly measured in connection with condenser dielectrics as a means of estimating the quality of the dielectric, not only from the point of view of the quality of the material itself but chiefly as a guide to the efficiency with which it has been freed from moisture. Minute traces of water, whether in the form of moisture condensed on the surfaces of the dielectric or actually absorbed into the pores of the material, bring about a very marked reduction of the resistivity, and such reduction is generally accompanied also by a marked decrease in the breakdown voltage, or dielectric strength of the substance.

The dielectric phase difference is a property which is encountered only when a condenser is subjected to alternating voltages, and it then expresses the departure of the condenser from the ideal. When a condenser is subjected to an alternating voltage there is a charging current flowing into it during all the time that the voltage across its terminals is increasing. This charging current falls to zero when the voltage reaches its maximum value, and during all the time that the voltage is decreasing a discharge current will flow out of the condenser, this falling to zero again when the voltage reaches its minimum value and is about to commence increasing again. Thus, if the applied voltage waveform is sinusoidal, the waveform of the current flowing in the circuit—made up of the successive charging and discharging currents—will likewise be sinusoidal, but there will be a phase displacement between the two, the current wave being 90° in advance of the voltage wave. In a condenser with an ideal or perfect dielectric—if such could be constructed—this phase displacement would be exactly 90° and no energy would be expended in the dielectric; but in all practical dielectrics a phenomenon known as electric absorption is observed, the effect of which is that the charging current does not cease at the instant that the voltage reaches a steady value, but persists for some time after in the form of a gradually decreasing absorption current. Likewise the discharge from most dielectrics does not cease immediately the applied voltage has been removed or has decreased to its steady minimum value, but it persists in the form of a gradually decreasing absorption discharge. Thus the zero points of the current waveform of the condenser subjected to an alternating voltage do not coincide in time with the instants of maximum and minimum value of the voltage waveform, but are delayed by a small fraction of a period. The phase displacement between current and voltage is thus very slightly less than 90°. The departure from exactly 90° is the phase difference. The amount of energy expended in the dielectric is directly proportional to the sine of this phase difference angle—or, since in almost all cases this difference is small, the losses become directly proportional to the phase difference itself. This quantity is sometimes also expressed as the power factor of the dielectric (numerically equal to the sine of the phase difference, or the cosine of the phase angle).

For many condenser dielectrics the phase difference increases with frequency, with the result that condensers employing these substances are unsuited for use in high frequency circuits. With some other materials, however, the increase is either small or negligible while in some a maximum value is reached in the ordinary range of practical frequencies so that there is relatively a reduction of losses at the higher or radio frequencies. This property is one which has a very considerable bearing upon the choice of condenser dielectric for any given use, since in practice so many condensers are required for use in alternating current circuits either of high or low frequency.

Types, Uses and Materials.—There are today many varieties of condensers, although the number of different dielectrics is limited. The wide variety of applications for which they are used, however, has involved the development of a correspondingly wide variety in designs produced primarily to fit the condenser for its particular application. In the field of radio communication alone many types of condensers have been produced from time to time, and are in common use for the different purposes for which condensers are needed both in transmitting and in receiving apparatus, the design of the condenser depending to a considerable extent upon the nature of the voltage to which it is to be subjected.

The chief practical uses to which the early Leyden jars were applied was in conjunction with wireless telegraphy apparatus, and a modification of the original jars is still occasionally used for such purposes. An improvement was introduced about 1904 by Moscicki in the form of elongated glass tubes with silvered coatings for the conductors, and a thickening of the glass adjacent to the edges of the metal coatings so as to reduce the intensity of the electric stress in the material at these points, and so to reduce the liability to breakdown. For ships' wireless transmitting sets another modification has been much used. This consists of interleaved glass and metal sheets mounted in an oil-filled container. The glass dielectric of these condensers has not inconsiderable dielectric losses, when subjected to high voltages. The general growth in the power of wireless stations of recent years, accompanied by the replacement in many cases of the spark or damped-wave transmitters by continuous-wave ones, has rendered it imperative to make use of condenser dielectrics having the lowest possible electrical losses. In some cases air dielectric condensers have certain advantages for radio uses, particularly for the short wave-length stations. They are, however, also used sometimes in the longer wave stations, where bulk is of no particular importance.

Mica as a dielectric for condensers for radio transmitters has been particularly developed during the last decade, apart from the use of smaller condensers for ship spark transmitters. With it it has become possible to construct condensers for use in high frequency circuits wherein they often have to pass very large high frequency currents produced by valve oscillators, the condensers causing an energy loss of not more than 0.02% of the reactive kilovoltamperes flowing in the circuit. The electrical efficiency of such condensers can thus be said to exceed 99.98%.

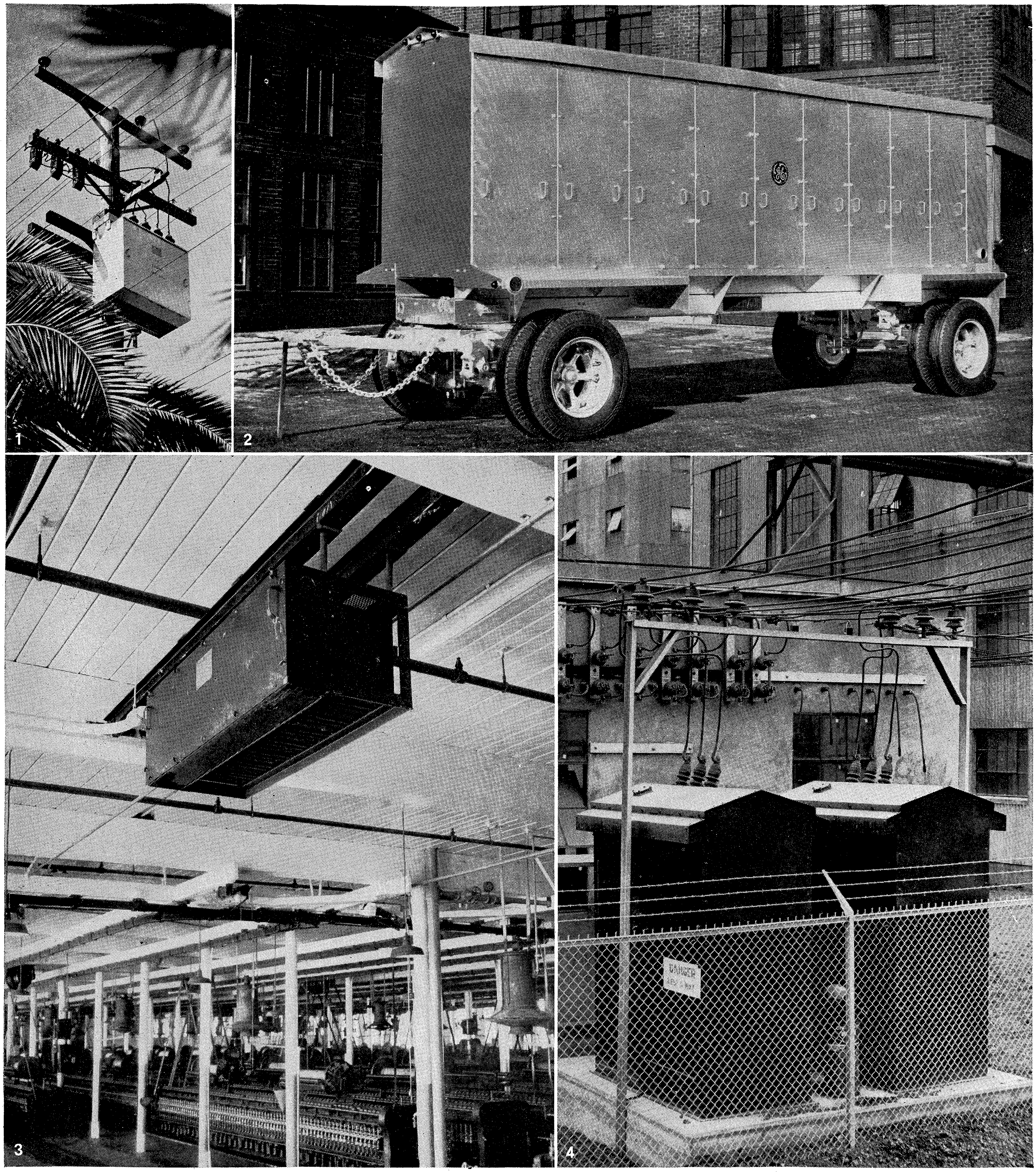
For radio transmitters using frequencies in excess of about 2,000 kilocycles quite small condensers with mica dielectric suffice. At the other end of the scale are the huge condensers used in high-power radio stations, where very large currents and high voltages are involved.

These condensers are all constructed of a very large number of small condenser elements arranged in groups connected together in series and parallel to provide sufficient bulk of dielectric for the electrical loading. Each of these elements consists of interleaved thin sheets of mica and metallic foil—usually copper or tin—securely held together to prevent relative movement. Each of these elements, therefore, has to support only a fraction of the total voltage applied to the condenser, depending upon the number of such elements connected in series; while likewise it has to carry only a fraction of the total current flowing into the condenser, depending upon the number of such elements connected in parallel.

In the application of condensers to radio apparatus operating upon the very high frequencies necessary for "short wave" and "beam" transmissions, further difficulties have been encountered owing to the energy losses in the dielectric forming the terminal insulators for the condenser. The proper subdivision of the current in the interior of the condenser to ensure that no part of the condenser is overloaded also presents some difficulty unless great care is taken to ensure that all the current paths through the condenser have as nearly as possible the same inductance. In condensers for long wave-length radio circuits this factor is of little importance, but with frequencies in excess of a few million per second excessive heating of parts of the condenser may occur if it is not considered in the design of the condenser. A recent form of condenser, with a mica dielectric, specially produced for use in these very high frequency circuits, consists of several small condensers mounted upon one another, so that they are all joined in series. Each is enclosed in an insulating tube, which provides the insulation between the top and bottom metal parts which form the terminals of the condenser. The electrical stress in this insulator is by this means reduced to a reasonably small figure, while inside each of the condenser parts the current flow is subdivided into several channels, each consisting of a number of condenser elements connected in series, as requisite for the operating voltage and frequency.

So in radio transmitters and in receiving sets as now commonly used for the reception of broadcast transmissions, a variety of condenser arrangements is commonly employed including both fixed and variable condensers. Of the fixed condensers those of smallest capacity—below about 0.01 microfarad—are customarily made with a mica dielectric, while for the larger capacities paper dielectric condensers are generally used. Still larger capacity condensers of similar type, up to about 20 microfarads, are used in the filter circuits of the so-called battery eliminators which are often used to enable a radio receiver to obtain its current supplies from electric lighting mains, in which application they perform the functions of providing a low impedance bypass path for unwanted currents of audio frequency.

Variable condensers used in radio receiving sets are constructed in as simple a manner as possible in order to avoid unnecessary expense in their manufacture. They are now almost always of the rotary vane type in which a number of fixed metal vanes are mounted on a supporting framework and a similar set of slightly smaller vanes are mounted upon a spindle carried in the same framework, so that by turning the spindle the one set of vanes can be moved so as to interleave with the other set to a greater or less extent. In these condensers the dielectric is the air between the two sets of plates; and some form of insulation is provided, so that although both sets of vanes are supported by the same framework they are electrically insulated from one another. The capacity of these condensers is almost directly proportional to the amount by which the two sets of vanes overlap one another, so that if the rotary set of vanes is semicircular the capacity of the condenser will be very closely proportional to the angular rotation



BY COURTESY OF GENERAL ELECTRIC COMPANY

LARGER CAPACITORS AND THEIR USES

1. Pole-mounted Pyranol capacitor installed to increase the current-carrying capacity of distribution feeders by improving the power factor
2. Large mobile capacitor for substation service which can be moved readily from one location to another to increase the current-carrying capacity of central-station or industrial circuits
3. Dust-tight capacitor installed in an industrial plant to improve the power factor of the distribution circuit
4. Large Pyranol capacitors for substation service. (The word "Pyranol," registered, U.S. patent office, is the name of the liquid dielectric with which the capacitors are treated)

CONDENSER (ELECTRICAL)

BY COURTESY OF GENERAL ELECTRIC COMPANY

VARIOUS TYPES OF CAPACITORS

1. Small Pyranol capacitor for increasing the current-carrying capacity of fluorescent-lamp circuits by improving the over-all power factor
2. Electrolytic capacitor for motor-starting service
3. Small Pyranol capacitors for suppression of radio interference
4. Pyranol capacitors for radio transmitters
5. Subway-type Pyranol capacitor for use on underground distribution systems

The word "Pyranol" is registered, U.S. patent office of the spindle from its initial or "zero" position. Until recently all variable condensers were constructed of this form, the differences in design consisting mainly in the means adopted to support the various parts and to insulate the two sets of vanes; in recent years, however, other variations have been introduced primarily in order to facilitate the tuning of the circuits of the radio receiver in which the condensers are used. By appropriate shaping of the vanes of the condenser the capacity can be made proportional to the square of the angular rotation of the spindle, or to the reciprocal of the square of the angle, or to the logarithm of it, or to almost any other desired mathematical function. The object of such modifications is to facilitate the use of the apparatus by making the scale-reading of the dial attached to the condenser spindle proportional, for example, to the resonance wave-length of the circuit in which the condenser is used, or proportional to its frequency, etc.

Such condensers for accurate experimental work need to be constructed in a much more robust manner and on a larger scale than are those used in radio receivers.

The most mechanically robust patterns can also be used as capacity standards for testing and measurement purposes, when they have been accurately calibrated. In some cases the space between the plates is filled with insulating oil to increase the capacity of the condenser.

Paper as a dielectric for electrical condensers has been used for many years, condensers using large sheets of this material, soaked in paraffin wax and interleaved with tinfoil sheets, having been employed since the early days of both telegraphic and telephonic communication. With the increasing use of telephones—every instrument usually requires at least one condenser, and the exchanges large numbers—the methods of manufacturing these condensers have been very much simplified. Today they are made by rolling long strips of paper and foil together on a machine until the required capacity is obtained, the condenser "plate" thus obtained being pressed flat and impregnated with some form of insulating wax. Various grades of paper are employed, depending to some extent upon the uses for which the condensers are intended, while for the conducting "plates" of the condenser either very thin tinfoil or aluminium foil is used, or a foiled paper, viz., a thin paper into the substance of which a deposit of tin is pressed to form a conducting coating. This latter conductor was introduced in 1900 by G. F. Mansbridge at a time when the manufacture of long strips of tinfoil of sufficient thinness for use in paper condensers presented almost insuperable difficulties. The condenser plates, after the impregnation, are sealed into a metal or insulating casing which must also prevent the access of moist air to the condenser paper, since this would cause rapid deterioration of the insulation.

Condensers of this type, constructed with a type of paper that allows only of low electrical losses, are used on alternating current electric power circuits for improvement of the power factor of the circuit. Particularly for voltages of about 500 and upwards similar condensers are often treated with an oil impregnation in place of wax, and are sealed in a metal tank or container filled with a high flash-point insulating oil. The oil being fluid permits of the flow of convection currents if any appreciable heat is liberated in the condenser, and so aids in the cooling of the condenser and tends to prevent failure of the dielectric. These condensers have also found application in conjunction with electric railway signalling equipment where they provide a means of resonating the circuits of the signalling relays. For the electric induction furnace, too, these condensers are also used to form a resonant circuit tuned to the frequency of the generator supplying the electrical energy to the furnace, the winding of the furnace coil providing the inductance of the circuit, so that the requisite large current can flow through the circuit of the coil and condenser while the generator has only to provide the energy required to melt the metal in the furnace, the electrical losses in the condenser being negligible. These furnaces are commonly worked with alternator supply, at frequencies of between 500 and 5,000 cycles. Under these conditions the electrical losses in the condensers, if of paper dielectric, become of importance unless adequate cooling of the dielectric is provided by the oil. For still higher frequencies, valve oscillators are often used, usually with mica dielectric condensers immersed in oil.

The readiness of a condenser to allow the passage of high frequency currents has furnished two other important applications of condensers in conjunction with high voltage electric power lines. When these lines are carried overhead they are liable to disturbances due to lightning and similar atmospheric electrical effects, which often cause damage to the transformers and other apparatus connected to the lines. With condensers connected between the lines and earth the high frequency disturbances and surges can be drained away to earth and their harmful energy dissipated. Similar condensers joined to the lines and connected to a special type of radiotelephone apparatus provide a means of guiding speech communication along the power lines, and thus furnish a valuable and very reliable means of communication between the power stations and substations connected with the power line network. This communication is not so liable to interruption and other disturbances as are separate telephone lines of the ordinary type.

In all these and many other applications of condensers the real heart of the condenser is the dielectric, and a proper use of the materials and knowledge of their properties has been the only means of building up the present known types of condensers. Many insulating materials besides those mentioned here are known, and may yet be applied in condenser construction as appropriate uses for them develop.

See P. R. Coursey, *Electrical Condensers, their Construction, Design and Industrial Uses* (1927), for extensive bibliography. (P. R. C.)

CONDER, CHARLES (1868–1909), English artist, son of a civil engineer, was born in London, and spent his early years in India. After an English education he went into the government service in Australia, but in 1890 determined to devote himself to art, and studied for several years in Paris, where in 1893 he became an associate of the Société Nationale des Beaux-Arts. About 1895 his reputation as an original painter, particularly of Watteau-like designs for fans, spread among a limited circle of artists in London, mainly connected first with the New English Art Club, and later the International Society; and his unique and charming decorative style, in dainty pastoral scenes, gradually gave him a certain vogue.

Conder died on Feb. 9, 1909.

CONDÉ-SUR-NOIREAU, a town in the department of Calvados, France, at the union of the Noireau and Drouance, 33 mi. S.S.W. of Caen by rail. Pop. (1936), 4,479. Throughout the middle ages Condé (*Condatum, Condetum*) was the seat of an important castellany, which was held by a long succession of powerful nobles and kings. The place was held by the English from 1417 to 1449. Of the castle some ruins of the keep survive. The church of St. Martin has a choir of the 12th and 15th centuries, and a stained-glass window (15th century) representing the Crucifixion.

The town is the seat of a tribunal of commerce, a board of trade-arbitrators and a chamber of arts and manufactures. It is important for its cotton-spinning and weaving, and for its fairs. It should not be confused with Condé sur l'Escaut, from which the princes of Condé (*q.v.*) took their title.

CONDILLAC, ÉTIENNE BONNOT DE (1715–1780), French philosopher, was born at Grenoble of a legal family and, like his elder brother, the well-known political writer, abbé de Mably, took orders and became abbé de Mureau.[1] His works are *Essai sur l'origine des connaissances humaines* (1746), *Traité des systèmes* (1749), *Traité des sensations* (1754), *Traité des animaux* (1755), a comprehensive *Cours d'études* (1767–73), written for the young Duke Ferdinand of Parma, a grandson of Louis XV, *Le Commerce et le gouvernement, considérés relativement l'un à l'autre* (1776), and two posthumous works, *Logique* (1781) and the unfinished *Langue des calculs* (1798). In his earlier days in Paris he came much into contact with the circle of Diderot. A friendship with Rousseau, which lasted in

[1] *i.e.,* abbot *in commendam* of the Premonstratensian abbey of Mureau in the Vosges.—(Ed.)

some measure to the end, may have been due in the first instance to the fact that Rousseau had been domestic tutor in the family of Condillac's uncle, M. de Mably, at Lyons.

Though Condillac's genius was not of the highest order, he is important both as a psychologist and as having established systematically in France the principles of Locke, whom Voltaire had lately made fashionable. In setting forth his empirical sensationism, Condillac shows many of the best qualities of his age and nation, lucidity, brevity, moderation and an earnest striving after logical method. Nevertheless, in the analysis of the human mind on which his fame chiefly rests, he has missed out the active and spiritual side of human experience. His first book, the *Essai sur l'origine des connaissances humaines,* keeps close to his English master. He accepts with some indecision Locke's deduction of our knowledge from two sources, sensation and reflection, and uses as his main principle of explanation the association of ideas. His next book, the *Traité des systèmes,* is a vigorous criticism of those modern systems which are based upon abstract principles or upon unsound hypotheses. His polemic, which is inspired throughout with the spirit of Locke, is directed against the innate ideas of the Cartesians, Malebranche's faculty-psychology, Leibnitz's monadism and pre-established harmony, and, above all, against the conception of substance set forth in the first part of the *Ethics* of Spinoza. By far the most important of his works is the *Traité des sensations,* in which he questions Locke's doctrine that the senses give us intuitive knowledge of objects, that the eye, for example, judges naturally of shapes, sizes, positions and distances. To clear up such questions we must study our senses separately, to distinguish precisely what ideas we owe to each sense, to observe how the senses are trained, and how one sense aids another. The result, he is confident, will show that all human faculty and knowledge are transformed sensation only, to the exclusion of any other principle, such as reflection. The plan of the book is that the author imagines a statue organized inwardly like a man, animated by a soul which has never received an idea, into which no sense-impression has ever penetrated. He then unlocks its senses one by one, beginning with smell, as the sense that contributes least to human knowledge. At its first experience of smell the consciousness of the statue is entirely occupied by it; and this occupancy of consciousness is attention. The statue's smell-experience will produce pleasure or pain; and pleasure and pain will thenceforward be the master-principle which, determining all the operations of its mind, will raise it by degrees to all the knowledge of which it is capable. The next stage is memory, which is the lingering impression of the smell-experience upon the attention: "memory is nothing more than a mode of feeling." From memory springs comparison: the statue experiences the smell, say, of a rose while remembering that of a carnation; and "comparison is nothing more than giving one's attention to two things simultaneously." And "as soon as the statue has comparison it has judgment." Comparisons and judgments become habitual, are stored in the mind and formed into series, and thus arises the powerful principle of the association of ideas. From comparison of past and present experiences in respect of their pleasure-giving quality arises desire; it is desire that determines the operation of our faculties, stimulates the memory and imagination, and gives rise to the passions. The passions, also, are nothing but sensation transformed. So runs the argument in the first section of the treatise. In the second section Condillac invests his statue with the sense of touch, which first informs it of the existence of external objects. In a very careful and elaborate analysis, he distinguishes the various elements in our tactile experiences—the touching of one's own body, the touching of objects other than one's own body, the experience of movement, the exploration of surfaces by the hands; he traces the growth of the statue's perceptions of extension, distance and shape. The third section deals with the combination of touch with the other senses. The fourth section deals with the desires, activities and ideas of an isolated man who enjoys possession of all the senses; and ends with observations on a "wild boy" who was found living among bears in the forests of Lithuania. The conclusion of the whole work is that in the natural order of things everything has its source in sensation, and yet that this source is not equally abundant in all men; and, finally, that man is nothing but what he has acquired; all innate faculties and ideas are to be swept away.

Condillac's work on politics and history, contained, for the most part, in his *Cours d'études,* offers few features of interest, except so far as it illustrates his close affinity to English thought: he had not the warmth and imagination to make a good historian. In logic, on which he wrote extensively, he is far less successful than in psychology. He enlarges with much iteration, but with few concrete examples, upon the supremacy of the analytic method; argues that reasoning consists in the substitution of one proposition for another which is identical with it, and further he rejects the mediaeval apparatus of the syllogism. It is obvious enough that Condillac's anti-spiritual psychology, with its explanation of personality as an aggregate of sensations, leads straight to atheism and determinism. There is, however, no reason to question the sincerity with which he repudiates both these consequences. What he says upon religion is always in harmony with his profession; and he vindicated the freedom of the will in a dissertation that has very little in common with the *Traité des sensations* to which it is appended. The common reproach of materialism should certainly not be made against him. He always asserts the substantive reality of the soul; and in the opening words of his *Essai,* "Whether we rise to heaven, or descend to the abyss, we never get outside ourselves—it is always our own thoughts that we perceive," we have the subjectivist principle that forms the starting-point of Berkeley.

As was fitting to a disciple of Locke, Condillac's ideas have had most importance in their effect upon English thought. In matters connected with the association of ideas, the supremacy of pleasure and pain, and the general explanation of all mental contents as sensations or transformed sensations, his influence can be traced upon the Mills and upon Bain and Herbert Spencer. And, apart from any definite propositions, Condillac did a notable work in the direction of making psychology a science. His method, however, of imaginative reconstruction was by no means suited to English ways of thinking. In spite of his protests against abstraction, hypothesis and synthesis, his allegory of the statue is in the highest degree abstract, hypothetical and synthetic. In France, however, Condillac's doctrine, so congenial to the tone of 18th century philosophism, reigned in the schools for over 50 years, challenged only by a few who, like Maine de Biran, saw that it gave no sufficient account of volitional experience. Early in the 19th century the romantic awakening of Germany had spread to France, and sensationism was displaced by the eclectic spiritualism of Victor Cousin.

Bibliography.—Condillac's collected works were published in 1798 and two or three times subsequently; the last edition (1822) has an introductory dissertation by A. F. Théry. The *Encyclopédie méthodique* has a very long article on Condillac (Naigeon). Biographical details and criticism of the *Traité des systèmes* in J. P. Damiron's *Mémoires pour servir à l'histoire de la philosophie au dix-huitième siècle,* tome iii.; a full criticism in V. Cousin's *Cours de l'histoire de la philosophie moderne,* ser. i. tome iii.

See also F. Rethoré, *Condillac ou l'empirisme et le rationalisme* (1864); L. Dewaule, *Condillac et la psychologie anglaise contemporaine* (1891); V. Saltnikova, *Die Philosophie Condillac* (1901); G. De Baguenault de Puchesse, *Condillac: sa vie, sa philosophie, son influence* (1910); H. Bédaude, *Condillac à Parme, Lettres inédites* (Grenoble, 1924); Z. Q. Schaupp, *The Naturalism of Condillac* (1926).

(H. St.)

CONDITION, a stipulation, agreement. (Lat. *condicio,* from *condicere,* to agree upon, arrange; not connected with *conditio* from *condere, conditum,* to put together.) The term is applied technically to any circumstance, action or event which is regarded as the indispensable requisite of some other circumstance, action, or event. It is also applied generally to the sum of the circumstances in which a person is situated, and more specifically to favourable or prosperous circumstances; thus a person of wealth or birth is described as a "person of condition," or an athlete as being "in condition," *i.e.,* physically fit, having gone through the necessary course of preliminary training. In all these senses there is implicit the idea of limitation or restraint imposed with a view to the attainment of a particular end.

(1.) *In Logic* the term "condition" is closely related to "cause" in so far as it is applied to prior events, etc., in the absence of which another event, called the effect, would not take place. It is, however, different from "cause," inasmuch as a cause usually consists of a multiplicity of conditions each of which is indispensable, but only the totality of which is adequate to the production of the effect. It is customary to distinguish between positive and negative conditions. Positive conditions are those which actually contribute something to the result; negative conditions consist in the absence of whatever may frustrate or modify the effect in question. Thus light, warmth, and moisture are each a positive condition of the healthy growth of a plant; the absence of wire-worms and other pests, on the other hand, would be called a negative condition.

Assertions concerning the relation between conditions and results are called *conditional* assertions (judgments or propositions). They are of two main types known as *hypothetical* and *disjunctive* respectively. In the hypothetical assertion this condition is usually contained explicitly in the antecedent, and the result in the consequent. Thus, *e.g., if the temperature of a metal is raised, its volume is increased,* (or generally *if A, then C, i.e.,* if a certain antecedent is true, a certain consequent is true). In the disjunctive assertion the condition is implicit rather than explicit, but still it is there. Thus, *e.g., either the volume of a metal remains the same or its temperature has changed* (or generally *either A1 or A2, i.e.,* alternative A1 or alternative A2 is true). But this means *if the temperature of a metal has not changed, its volume remains the same* (or generally *if not A2, then A1,* or vice versa).

(2.) *In Philosophy* the above uses of the term condition have led to the contrast between "conditioned" and "absolute" being (or "dependent" versus "independent" being). Thus all finite things exist in certain relations not only to all other things, but possibly also to thought; in other words, all finite existence is "conditioned." Hence Sir Wm. Hamilton speaks of the "philosophy of the unconditioned," *i.e.,* of thought in distinction to things which are determined by thought in relation to other things (*see* ABSOLUTE). An analogous distinction is made (*cf.* H. W. B. Joseph, *Introduction to Logic,* pp. 380, foll.) between the so-called universal laws of nature and conditional principles which, though they are regarded as having the force of law, are yet dependent or derivative, *i.e.,* cannot be treated as universal truths. Such principles hold good under present conditions, but other conditions might be imagined under which they would be invalid; they hold good only as corollaries from the laws of nature under existing conditions.

(3.) *In Law,* condition in its general sense is a restraint annexed to a thing, so that by the non-performance the party to it shall receive prejudice and loss, and by the performance commodity or advantage. Conditions may be either (1) condition in a deed or *express* condition, *i.e.,* the condition being expressed in actual words; or (2) condition in law or *implied* condition, *i.e.,* where, although no condition is actually expressed, the law implies a condition. The word is also used indifferently to mean either the event upon the happening of which some estate or obligation is to begin or end, or the provision or stipulation that the estate or obligation will depend upon the happening of the event. A condition may be of several kinds: (1) a condition *precedent,* where, for example, an estate is granted to one for life upon condition that, if the grantee pay the grantor a certain sum on such a day he shall have the fee simple; (2) a condition *subsequent,* where, for example, an estate is granted in fee upon condition that the grantee shall pay a certain sum on a certain day, or that his estate shall cease. Thus a condition precedent gets or gains, while a condition subsequent keeps and continues. A condition may also be *affirmative,* that is, the doing of an act; *negative,* the not doing of an act; *restrictive, compulsory,* etc. The word is also used adjectivally in the sense set out above, as in the phrases "conditional legacy," "conditional limitation," "conditional promise," etc., that is, the legacy, the limitation, the promise is to take effect only upon the happening of a certain event.

CONDITIONAL FEE, in common law, an estate or property granted to a man and to the heirs of his body, or to the heirs male of his body. As developed in English law, it was called a conditional fee by reason of the condition expressed or implied in the donation of it, that if the donee died without such particular heirs, the land should revert to the donor. In other words it was a fee simple on condition that the donee had issue, and as soon as such issue was born, the estate was supposed to become absolute by the performance of the condition. A conditional fee was converted by the statute *De Donis Conditionalibus* into an estate tail (*see* ENTAIL; LAWS RELATING TO REAL PROPERTY).

CONDITIONAL LIMITATION, in law, a phrase used in two senses. (1) The qualification annexed to the grant of an estate or interest in land, providing for the determination of that grant or interest upon a particular contingency happening. An estate with such a limitation can endure only until the particular contingency happens; it is a present interest, to be divested on a future contingency. The grant of an estate to a man so long as he is parson of Dale or while he continues unmarried are instances of conditional limitations of estates for life (resolutive condition). (2) A future use or interest in land limited to take effect upon a given contingency. For instance, a grant to X. and his heirs to the use of A., provided that when C. returns from Rome the land shall go to the use of B. in fee simple. B. is said to take under a conditional limitation, operating by executory devise or springing or shifting use (investitive condition). (*See* REMAINDER, REVERSION.)

CONDITIONED REFLEX, (1) the neural mechanism by which, under certain definite conditions, (*a*) a new stimulus is substituted for the one originally effective in bringing about a specific reaction or (*b*) a new response takes the place of the originally adequate reaction to a specific stimulus. Thus, with a horse, the snap of the whip is a substitute stimulus for the smart of the lash. The exclamation of an adult who stubs his toe is a substitute response for the child's howl of pain. (2) Modification of reflex behaviour as a result of alteration of the conditions under which the behaviour in question occurs, without assumption as to the neural mechanisms involved.

The first conditioned reflex experiments were conducted by Pavlov, a Russian physiologist. He discovered that certain signal stimuli, like sight and smell of food, are just as effective as the taste of food for evoking the salivary flow. This raised the question: Can *any* neural stimulus, such as the ringing of an electric bell, be substituted for the natural stimulus in arousing reflex reaction? In putting this problem to test, Pavlov used dogs as subjects, and worked chiefly with the alimentary and reject reflexes. The dog was fastened in position before a partition which could be opened for the presentation of food. An electric bell was sounded and kept ringing until after the food was presented. After about 30 trials, it was found that the sounding of the bell alone was sufficient to evoke the salivary flow. Thus, a new reflex had been built up. The dog responded to the sounding of the bell in the same way that he did to the taste of food. This new reaction was named by Pavlov the conditioned reflex.

Control of Subject and Stimulus.—The subject of a conditioned reflex experiment, whether animal, child or adult, must be in a physical condition which permits the functioning of the natural or unconditioned reflex. That is, if the salivary reflex is being conditioned to a new stimulus, the dog must be hungry. The environment must be controlled so that all stimuli more potent biologically than the ones under test are eliminated.

Presentation of Stimulus.—There are three possible ways of combining the neutral stimulus with the adequate stimulus. The bell may be sounded before presentation of food; simultaneously with presentation of food; or after food is given. Only the first two methods result in a conditioned reflex. 427 successive presentations of the odour of vanillin 5 to 10 sec. after acid was introduced into the mouth failed to develop a conditioned rejection reflex. On the other hand, a single trial with the vanillin presented before the acid sufficed to build up a conditioned response. For the most efficient conditioning the new stimulus must not only precede the natural stimulus, but it must also overlap the other in point of time. It is possible, however, to build up a conditioned reflex, even though an appreciable interval occurs between the cessation of the new stimulus and the beginning of the natural stimulus. After a considerable number of trials, the response will occur upon presentation of the conditioned stimulus, but only after an interval of time equal to the period of separation occurring in the original trials. This is called a trace reflex because the proximate cause of the response is not supposed to be the neural stimulus, but rather its trace left on the central nervous system. The longest latent period reported is about 30 minutes.

Conditions for Modifying the Response.—The natural response to an electric shock is withdrawal. The natural response to food may be smacking the lips together with increased salivary flow. By suitable presentation of these two stimuli it has been found that the electric shock will combine with the food as stimulus to the extent of inhibiting the defence reflex and establishing salivary flow as the new response to the shock stimulus. If, however, the electric current is applied to skin over bone, it will not become conditioned to the food response. In a situation of this sort the result will depend in each instance on the relative strength of the two unconditioned responses. The one which is physically weaker and biologically less important is lost while the more fundamental reflex wins out. This principle is particularly vital in the reconditioning of children.

Use and Adaptability of the Conditioned Reflex.—In animal psychology the conditioned reflex has been particularly useful in investigating sensory discrimination. A conditioned reflex is first built up to a specific sensory stimulus, let us say, auditory. Then a different stimulus of the same category is substituted. If the animal does not respond to the new sound it is inferred that he discriminates between the two. By this method of differential conditioning it has been found that a dog's hearing is more sensitive than a man's. In experiments with children, Mateer suggests using the speed with which a conditioned reflex can be developed as an index of intelligence. Extension of Pavlov's technique to human subjects was made possible by apparatus designed by Lashley for catching and measuring salivary secretion. Cason in combining the eye wink with a substitute stimulus proved that the conditioned response occurs more quickly than the voluntary eye wink. He also succeeded, after 400 repetitions, in bringing about contraction of the pupil in response to the ringing of the bell, although the normal response to the bell is a slight dilation. Watson and Jones have proved that emotional responses of children can be reconditioned. Although a child is not naturally afraid of a furry animal, he becomes afraid if a naturally frightening sound accompanies presentation of the animal. In this way many unnatural emotional responses are built up. Jones has demonstrated the possibility of removing undesirable fears by what is known as a reconditioning technique. If the animal the child fears is brought into the room when the child is eating, the eating, being a stronger biological response, controls and the withdrawal response is eliminated. (*See* BEHAVIOURISM.)

Evaluation of the Conditioned Reflex.—With regard to the supposed underlying neural mechanism, the question has been raised as to whether or not the conditioned reflex is a true reflex. An experiment by Lang and Olmsted may indicate that it is not. A true reflex is a predetermined necessary response of the organism to a given stimulus. If an experimentally created, conditioned reflex wherein saliva flows at the beat of a metronome is a true reflex, it should still function even though the salivary receptor tract is destroyed. Lang and Olmsted found that the removal of afferent connections from the salivary gland abolishes the conditioned reaction. This demonstrates a dependence upon a second neural mechanism which is not present in a true reflex. Nevertheless the conditioned reflex is an accepted method for changing behaviour. As such it is firmly established in the animal laboratories and widely recognized as a basic method of child training all over the world.

See I. P. Pavlov, *Conditioned Reflexes* (Eng. trans. by G. V. Anrep, 1927) and W. H. Burnham, *The Normal Mind* (1924); W. Kohler, *The Mentality of Apes* (Eng. trans. 1925). (E. H. MA.)

CONDOM, a town of south-western France, capital of an arrondissement in the department of Gers, 27 mi. N.N.W. of Auch, on the right bank of the Baïse, a tributary of the Gironde. Pop. (1936), 4,064. Condom (Condomus) was founded in the 8th century, but in 840 was sacked and burnt by the Normans. A monastery, built here *c.* 900 by the wife of Sancho of Gascony, destroyed by fire, was rebuilt in 1011 by Hugh, bishop of Agen. Round this abbey the town grew up, and in 1317 was made into an episcopal see by Pope John XXII. The line of bishops, which included Bossuet (1668–1671), came to an end in 1790 when the see was suppressed. Condom was, during the middle ages, a fortress of considerable strength. During the Hundred Years' War, after several unsuccessful attempts, it was captured and held by the English. In 1569 it was sacked by the Huguenots under Gabriel, count of Montgomery. The Gothic church of St. Pierre (1506 to 1521), till 1790 a cathedral, is without aisles or transept. On the south is a beautifully sculptured portal. An adjoining cloister of the 16th century is occupied by the *hôtel de ville.* The former episcopal palace with its graceful Gothic chapel is used as a law-court. There are a subprefecture, a tribunal of first instance, and a communal college. The town is the chief centre of the brandy trade of Armagnac.

CONDOR, a South American vulture (*Vultur gryphus*), almost the largest of existing birds of flight. It usually measures about 4 ft. in length and 9 ft. between the tips of its wings, but large specimens span 10 ft. or more. The head and neck are destitute of feathers, and the head, which is much flattened above, is in the male crowned with a caruncle or comb, while the skin of the neck in the same sex forms a wattle. The adult plumage is of a uniform black, with the exception of a frill of white feathers nearly surrounding the base of the neck, and certain wing feathers which have large patches of white. The middle toe is greatly elongated, and the hinder one but slightly developed, while the talons are comparatively straight and blunt. The female, contrary to the usual rule among birds of prey, is smaller than the male.

The condor is a native of the South American Andes, from the Straits of Magellan to 4° north latitude. It is often seen on the shores of the Pacific, especially during the rainy season, but its favourite haunts are at elevations of 10,000 to 16,000 ft. There, during February and March, on inaccessible ledges of rock, it deposits two white eggs, from 3 to 4 in. in length, its nest consisting merely of a few sticks. Incubation lasts for seven weeks, and the young are covered with a whitish down until almost as large as their parents. They are unable to fly till a year old. By preference condors feed on carrion, but do not hesitate to attack sheep, goats and deer. They are exceedingly voracious. When gorged with food, they are sluggish and may then be readily caught. They sleep during the greater part of the day, searching for food in the morning and evening. They are heavy sleepers, and hunters climb the trees on which they roost, noosing them before they wake. They can exist, it is said, without food for more than 40 days. On wing the movements of the condor are remarkably graceful. The birds flap their wings on rising from the ground, but after attaining a moderate elevation they seem to sail on the air. Thus Darwin watched one for half an hour without once observing a flap of its wings. Humboldt observed them over Chimborazo at a height of more than 23,000 ft.

THE CALIFORNIA CONDOR

The California condor (*Gymnogyps californianus*) is found in the Coast ranges of southern California from Monterey bay south to Lower California. It has white under-wing coverts, with a wing spread of 10 ft. It is sometimes larger than the condor of South America, though not of as heavy build. (*See* VULTURE.)

CONDORCET, MARIE JEAN ANTOINE NICOLAS CARITAT, MARQUIS DE (1743–1794), French mathematician, philosopher and revolutionary, was born at Ribemont, in Picardy, on Sept. 17, 1743. He descended from the ancient family of

Caritat, who took their title from Condorcet, in Dauphiné. He was educated at the Jesuit college in Rheims and at the College of Navarre in Paris, where he showed his first promise as a mathematician. In 1769 he became a member of the Academy of Sciences, to which he contributed papers on mathematical and other subjects.

He was the friend of almost all the distinguished men of his time, and a zealous propagator of the religious and political views then current among the *literati* of France. He was induced by D'Alembert to take an active part in the preparation of the *Encyclopédie*. He was elected to the perpetual secretaryship of the Academy of Sciences in 1777, and to the French Academy in 1782, and was a member of other European academies. In 1785 he published his *Essai sur l'application de l'analyse aux probabilités des décisions prises à la pluralité des voix,* a remarkable work which has a distinguished place in the history of the doctrine of probability; a second edition, greatly enlarged and completely recast, appeared in 1804, under the title of *Éléments du calcul des probabilités et son application aux jeux de hazard, à la loterie, et aux jugements des hommes, etc.* In 1786 he married Sophie de Grouchy, a sister of Marshal Grouchy, said to have been one of the most beautiful women of her time. Her *salon* at the Hôtel des Monnaies, where Condorcet lived in his capacity as inspector-general of the mint, was one of the most famous of the time. In 1786 Condorcet published his *Vie de Turgot,* and in 1787 his *Vie de Voltaire*. Both works were widely and eagerly read, and are perhaps, from a purely literary point of view, the best of Condorcet's writings.

The outbreak of the Revolution, which he greeted with enthusiasm, involved him in a great deal of political activity. He was elected to represent Paris in the Legislative Assembly, and became its secretary. He was chief author of the address to the European Powers. On April 21 and 22, 1792, he presented to the Assembly a scheme for a system of State education, which was the basis of that ultimately adopted. Condorcet was one of the first to declare for a republic, and drew up the memorandum which led to the suspension of the king and the summoning of the national convention (Sept. 4, 1792). In the convention he represented the department of Aisne, and was a member of the committee on the Constitution. His draft, however (presented Feb. 15, 1793), was rejected in favour of that of H. de Séchelles. In the trial of Louis XVI. he voted against the death penalty. But his independent attitude was becoming dangerous and his opposition to the arrest of the Girondists led to his condemnation and outlawry. He found a refuge at the house of Mme. Vernet, widow of the sculptor.

To occupy his mind, some of his friends prevailed on him to engage on the work by which he is best known, the *"Esquisse d'un tableau historique des progrès de l'esprit humain."* Other works were written at the same time, including the *"Avis d'un proscrit à sa fille."* Some of them were published by friends at the time and others were issued after his death. Still interested in public affairs and believing that the house of Mme. Vernet was watched, he escaped, and after hiding in thickets and quarries for three days, entered the village of Clamart on the evening of April 7, 1794. His appearance betrayed him, and he was taken to Bourg-la-Reine and imprisoned. Next morning he was found dead, whether from exhaustion or by poison is unknown.

His philosophical fame rests chiefly on the *Esquisse* mentioned above. Its fundamental idea is that of the continuous progress of the human race to an ultimate perfection. The disorders and violence of the revolution he attributed to bad institutions, from which humanity would ultimately free itself. He conceived the history of humanity as divided into nine epochs, advancing from the primitive life of hunting and fishing, through the pastoral to the agricultural age; with the invention of the alphabet at this stage the third period closes and authenticated history begins. The subsequent stages are the epochs of Greece and Rome and the middle ages, in two divisions, one closing with the crusades and the other with the invention of printing. The eighth epoch extends to the philosophical revolution effected by Descartes, and the ninth to the revolution of 1789, including the discoveries of Loke, Newton and Rousseau. In the tenth epoch, that of the future, he pictures man advancing to the destruction of all inequalities of opportunity and the perfection of individual human nature. The basis of all progress, he thought, was popular education. The book is notable for its intense aversion to all religion, especially Christianity, and to monarchy. It had considerable influence on Comte.

Madame de Condorcet (b. 1764), who was some 20 years younger than her husband, was rendered penniless by his proscription and compelled to support not only herself and her four-year-old daughter but her younger sister, Charlotte de Grouchy. After the end of the Jacobin Terror she published an excellent translation of Adam Smith's *Theory of Moral Sentiments;* in 1798 a work of her own, *Lettres sur la sympathie;* and in 1799 her husband's *Éloges des académiciens*. Later she co-operated with Cabanis, who had married her sister, and with Garat in publishing the complete works of Condorcet (1801–04). She adhered to the last to the political views of her husband, and under the Consulate and Empire her *salon* became a meeting-place of those opposed to the autocratic régime. She died at Paris on Sept. 8, 1822.

A *Biographie de Condorcet,* by M. F. Arago, is prefixed to A. Condorcet-O'Connor's edition of Condorcet's works, in 12 volumes (1847–49). There is an able essay on Condorcet in Lord Morley of Blackburn's *Critical Miscellanies*. On Condorcet as a historical philosopher *see* Comte's *Cours de philosophie positive,* iv. 252–253, and *Système de politique positive,* iv. Appendice Général, 109–111; F. Laurent, *Études,* xii. 121–126, 89–110; and R. Flint, *Philosophy of History in France and Germany,* i. 125–138. The *Mémoires de Condorcet sur la Révolution française, extraits de sa correspondance et de celles de ses amis* (2 vols., Ponthieu, 1824), which were in fact edited by F. G. de la Rochefoucauld-Liancourt, are spurious. *See* also J. F. E. Robinet, *Condorcet, sa vie et son oeuvre,* and more especially L. Cahen, *Condorcet et la Révolution française* (1904). On Madame de Condorcet *see* Antoine Guillois, *La Marquise de Condorcet, sa famille, son salon et ses oeuvres* (1897); S. Krynska, "Entwicklung und Fortschritt nach Condorcet und A. Comte," in vol. 67 of *Berner Studien z. Phil. u. ihrer Gesch.* (1908).

CONDOTTIERE (plural, *condottieri*), an Italian term, derived ultimately from Latin *conducere,* meaning either "to conduct" or "to hire," for the leader of the mercenary military companies, often several thousand strong, which used to be hired out to carry on the wars of the Italian states. The word is often extended so as to include the soldiers as well as the leader of a company. The condottieri played a very important part in Italian history from the middle of the 13th to the middle of the 15th century. The special political and military circumstances of mediaeval Italy, and in particular the wars of the Guelphs and Ghibellines, brought it about that the condottieri and their leaders played a more conspicuous and important part in history than the "free companies" elsewhere. Amongst these circumstances the absence of a numerous feudal cavalry, the relative luxury of city life and the incapacity of city militia for wars of aggression were the most prominent. From this it resulted that war was not merely the trade of the condottiere, but also his monopoly, and he was thus able to obtain whatever terms he asked, whether money payments or political concessions. These companies were recruited from wandering mercenary bands and individuals of all nations, and from the ranks of the many armies of middle Europe which from time to time overran Italy.

Montreal d'Albarno, a gentleman of Provence, was the first to give them a definite form. A severe discipline and an elaborate organization were introduced within the company itself, while in their relations to the people the most barbaric licence was permitted. Montreal himself was put to death at Rome by Rienzi, and Conrad Lando succeeded to the command. The grand company, as it was called, soon numbered about 7,000 cavalry and 1,500 select infantry, and was for some years the terror of Italy. They seem to have been Germans chiefly. On the conclusion (1360) of the peace of Bretigny between England and France, Sir John Hawkwood (*q.v.*) led an army of English mercenaries, called the white company, into Italy, which took a prominent part in the confused wars of the next thirty years. Towards the end of the century the Italians began to organize armies of the same description. This ended the reign of the purely mercenary company, and began that of the semi-national mercenary army which endured in Europe till replaced by the national standing army system. The first company of importance raised on the new basis was that of St. George, originated by Alberigo, count of Barbiano, many of whose subordinates and pupils conquered principalities for themselves. Shortly after, the organization of these mercenary armies was carried to the highest perfection by Muzio Attendolo Sforza, condottiere in the service of Naples, who had been a peasant of the Romagna, and by his rival Brancaccio di Montone in the service of Florence. The army and the renown of Sforza were inherited by his son Francesco Sforza, who became duke of Milan (1450). Less fortunate was another great condottiere, Carmagnola, who first served one of the Visconti, and then conducted the wars of Venice against his former masters, but at last awoke the suspicion of the Venetian oligarchy, and was put to death before the palace of St. Mark (1432). Towards the end of the 15th century, when the large cities had gradually swallowed up the small states and Italy itself was drawn into the general current of European politics, and became the battlefield of powerful armies—French, Spanish and German—the condottieri, who proved unequal to the gendarmerie of France and the improved Italian troops disappeared.

The soldiers of the condottieri were almost entirely heavy armoured cavalry (men-at-arms). They had, at any rate before 1400, nothing in common with the people among whom they fought, and their disorderly conduct and rapacity seem often to have exceeded that of other mediaeval armies. They were always ready to change sides at the prospect of higher pay. They were connected with each other by the interest of a common profession, and by the possibility that the enemy of to-day might be the friend and fellow-soldier of to-morrow. Further, a prisoner was always more valuable than a dead enemy. In consequence of all this their battles were often as bloodless as they were theatrical and skilful. Splendidly equipped armies were known to fight for hours with hardly the loss of a man (Zagonara, 1423; Molinella, 1467).

CONDOURIOTES, PAUL (1855–1935), Greek admiral and statesman, was born April 14 (new style), 1855, in the island of Hydra. He adopted a naval career and served in the Greco-Turkish War of 1897. He commanded the fleet in the Balkan War of 1912–13, and twice defeated the Turkish navy in the Dardanelles. In the Zaïmes and Skouloudes cabinets of 1915 he was Minister of Marine, but followed M. Venizelos to Salonika in 1916 and formed with him and Gen. Danglès the Provisional Government, opposed to that of King Constantine. After the king's first deposition in 1917, he again became Minister of Marine in the third Venizelos cabinet, resigning in 1919, when parliament bestowed on him the title of "admiral" for life. In 1920, on the death of King Alexander, he was for a short time regent. Soon after the defeat of M. Venizelos he resigned and went abroad, but returned, and on Dec. 20, 1923, the day after George II. left Greece, was again appointed regent. On March 25, 1924, the National Assembly, after deposing the dynasty, confirmed his mandate until after the plebiscite of April 13, and his title was then changed to that of president of the republic. On March 19, 1925, he resigned but resumed the Presidency on Aug. 24, after the fall of Pangalos, and remained in office until Dec. 1929.

CONDUCTION: *see* HEAT: *Conduction of Heat in Solids* and *in Gases and Liquids;* ELECTRICITY, CONDUCTION OF.

CONDUCTIVITY, in heat, is the quantity of heat (*q.v.*) passing per second through a slab of unit cross-sectional area when the temperature gradient between the two faces is unity. Electrical conductivity is the current, or the quantity of electricity (*q.v.*) passing per second, through a similar slab when the potential gradient is unity, and it is the reciprocal of the resistivity. In sound (*q.v.*) the conductivity of the orifice or neck of a resonator is the ratio of the area to the length of the orifice.

CONDUIT, a channel for the conveyance of liquids. The word is chiefly applied to artificial channels or pipes through which water is conveyed (*see* AQUEDUCTS).

CONE, in its earliest geometric use, denoted the solid space swept over by a right triangle rotating about one side (altitude or *axis, a*) the other side (*base, r*) tracing out the circle *base* of the cone, and the hypotenuse (*slant height, s*) its *curved surface,* the *vertex* V of triangle, and cone being the same (fig. 1).

Cones and Conics.—At first the size of the vertical angle of such a *right circular* cone (twice that of the triangle) appeared important, and hence such cones were divided into three classes, according to its size, and hence were named "acute-, right-, obtuse-angled." The natural position of a plane cutting through a cone seemed to be perpendicular to the slant height (*i.e.,* the hypotenuse or *generatrix* in any position, called also an *element, e,* of the surface). It is said that Menaechmus (*c.* 350 B.C.), in striving to construct the so-called double mean proportional, $a:x=x:y=y:b$, discriminated three corresponding types of conic sections, afterwards named, respectively, ellipse, parabola and hyperbola. It was the "great geometer," Apollonius, born at Perga in Pamphylia (*fl. c.* 225 B.C.), student in the Euclid school of Alexandria, who perceived and showed that the type of cone was indifferent, any plane section of any circular cone, parallel to an element, yielding a parabola, and other sections yielding either an ellipse or hyperbola.

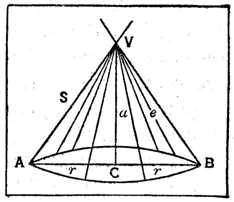


FIG. 1.—A CONE AND ITS ELEMENTS

Volume and Area.—The conception of a cone as solid called for the measurement of its content, a fact enunciated first by the travelling philosopher Democritus (*c.* 460–*c.* 370 B.C.), proved by Eudoxus of Cnidos (*c.* 408–*c.* 355 B.C.), and later completed by the great reckoner, Archimedes (287–212 B.C.), who showed that a cone, hemisphere and cylinder, all of the same base and height (fig. 2) have volumes respectively as 1, 2, 3,—a relation holding for any type of the extremes—the cone and cylinder. If they had equal bases and heights, the volume of the one is one third that of the other, which is the product of base and height. Plainly the curved surface of a right circular cone may be thought as slit all along any element and then flattened out on a plane (tangent along the opposite element) into a circular sector; hence the curved surface equals in area the sector area, *i.e.,* the half-product of base-circumference as arc and slant height as radius.

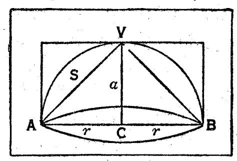


FIG. 2.—RELATION OF CONE, CYLINDER AND HEMISPHERE

Oblique Cone.—The circular cone is defined by Apollonius more generally as the surface (or its enclosed volume) traced by a right line passing through a fixed point (vertex) and gliding along a fixed circle. The right line through this vertex and the centre of this circle is the *axis;* if this be at right angles to the *base* (the plane of the circle), the cone is *right;* otherwise, it is *oblique,* in which case the vertical angle is not of constant size. Any plane containing the axis cuts the solid in such a vertical angle, and the surface in its sides (elements of the cone). The plane containing the axis and being perpendicular to the base of the cone forms the "principal section"; any plane perpendicular thereto and inclined equally but inversely (with the base) to the generator-elements therein is called a "subcontrary section." This cuts the cone in a circle, as do all planes parallel to it or to the base, all which are therefore called "cyclic planes" (fig. 3).

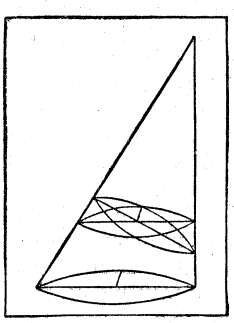


FIG. 3.—CYCLIC PLANES

Cone as Surface.—It was natural to regard and define the solid first rather than the bounding curved surface, and hence the early Greek achievements were largely in stereometry. Only very gradually it came to be felt that the surface alone possessed peculiar properties, the enclosed space being indifferent. Hence the very recent change in definition and treatment from three to two dimensions. From the new point of view the cone concept undergoes a broad generalization, designating any path of (or surface traced by) a right line (the *generatrix, g*) that passes always through a fixed point V. This path, to be definite, is directed by some curve (the *directrix* D), along which the line glides always (fig. 4). Thus, in the right circular cone, *D* is the circle bounding the cone's base, the track of the moving end of the hypotenuse (g). In the oblique circular D is still a circle, but no longer traced by one certain point of the line g. If D be a conic (as an ellipse) the surface is called a "quadric cone." If a fixed direction (or line called the *axis*) be assumed as passing through the fixed vertex V, the motion of the tracing line g might be directed by ordered variation in the vertical angle between the fixed and the moving line. In the most important case, the right circular cone, this variation is the simplest possible; O, the angle is constant; the two lines are rigidly joined at V; and the generatrix swings freely round the axis (which may be thought as turning *in itself*).

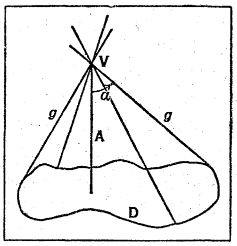


FIG. 4.—CONE AS SURFACE

Tangency.—Such seems to be the simplest and most vivid conception of the right circular cone; the two halves meeting at V and extending oppositely without end are called *nappes* or *sheets*. If slit throughout along an element, and rolled out (developed) on the plane tangent along the opposite element, the nappes would appear as centrically symmetric sectors of an infinite circle about V as centre. Any plane tangent to a cone passes through V and touches the cone along some element throughout. All such planes would touch the whole cone-surface and would envelop it completely. The tangent plane at any given point of the surface (except V) is quite definite, but at V this definiteness disappears. All tangent-planes pass alike through V—a matter of importance in treating the umbilical points in Fresnel's wave-surface, in connection with Hamilton's discovery of the conical refraction of light.

Equation.—In analytic geometry the equation of the right circular cone traced by rotating the line $y=mx$ round the y axis is $y^2=m^2\ (x^2+z^2)$. This simply means that, as any point P (of the line) rotates round the y axis, its y remains unchanged and also its distance $\sqrt{x^2+z^2}$ from the y axis (OY), and the fixed ratio of these two lengths is m.

Intersection.—The doctrine of the intersection of a cone with other surfaces belongs rather to constructive geometry, where it is developed and applied. Its importance may be presumed from the fact that central projection is cone-like, the lines of projection issuing like rays of light from a point, the vertex of the cone. An interesting special case is the *sphero-conic*, the intersection of any quadric cone with a sphere about the vertex of the cone as centre.

Truncation.—In more elementary measurement we meet with the *frustum* (fig. 5), especially of the right circular cone. The word, meaning *piece*, denotes a truncated cone, or the portion of a cone (viewed as a solid) between the base and a cutting plane generally parallel thereto. The problem of computation was apparently first proposed with respect to truncated pyramids, and very naturally in Egypt. Indeed, one of the earliest extant computations of volume is Egyptian and relates to such a figure. Much later, and in the *Stereometrica* of the encyclopedic Heron "the mechanic" of Alexandria (*c.* A.D. 50? or as late as A.D. 200?) the volume is calculated for a pyramid-frustum on a square base (100), the top-section a square (4), the oblique edge 9; the height is found to be 7, which multiplied by $\left\{\left(\frac{10+2}{2}\right)^2+\frac{1}{3}\left(\frac{10-2}{2}\right)^2\right\}$ gives $289\frac{1}{3}$, a correct result as seen by the now well known rule or formula, one-third the product of height by the sum of the bases and their geometric mean. But in a second example the sides of the square (base and top) are given as 28 and 4, and the slant edge as 15, which is impossible, since even the projection of any such slant on the base plane would be $\sqrt{12^2+12^2}$ or $\sqrt{288}$, which is more than $15=\sqrt{225}$. Accordingly the reckoner in applying his method, of which the foregoing rule is the resultant formula, meets with $\sqrt{-63}$, which he treats as $\sqrt{63}$. Whether or not this be the work of Heron, it is notable as the oldest known appearance of the so-called "imaginary," the square root of a negative number. (*See* COMPLEX NUMBERS.) The rule or formula used above holds for all such frustums of cones and pyramids. It was used much later by the leading Hindu mathematician Brahmagupta (*c.* 628) in his *Brāhma-sphuta-sidd'hānta.* The surface of such a frustum is plainly the difference between two circular sectors of the same angle and centre, into which the cone and the top could be rolled out on a tangent-plane (fig. 5). Heron recommends similar practical methods for measuring other surfaces, as wrapping the solid in a thin cover and then spreading this out (*Metrica*, I. Fin.).

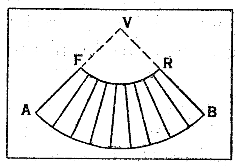


FIG. 5.—SURFACE OF A FRUSTUM

Limiting Case.—If the vertex of the right-circular cone retire indefinitely along the axis, the cone passes over into a cylinder (*q.v.*) or cylindric surface, and the frustum becomes an ordinary (right-circular) cylinder, its volume the product of base and altitude, its curved surface the product of the circle of the base by the altitude. This limiting case of the cone-frustum is of course much simpler than the general case. (*See* also ANALYTIC GEOMETRY; CONIC SECTION: *Bibliography*.) (W. B. SM.)

CONECTE, THOMAS (d. 1434), French Carmelite, was born at Rennes. He travelled through Flanders and Picardy, denouncing the vices of the clergy and the extravagant dress of the women. He taught that he who is a true servant of God need fear no papal curse, that the Roman hierarchy is corrupt, and that marriage is permissible to the clergy, of whom only some have the gift of continence. In Italy, despite the opposition of Nicholas Kenton (d. 1468), provincial of the English Carmelites, he introduced several changes into the rules of that order. He was finally condemned and burnt for heresy.

An account of his preaching and its effect is given by Enguerrand de Monstrelet, provost of Cambrai (d. 1453), in his continuation of Froissart's *Chronicles*.

CONE-FLOWER, the popular name given in North America to species of *Rudbeckia* and other closely related genera of the family Compositae, many of which are cultivated as ornamentals. The large, solitary flower heads, often 4 in. or more across, consist of a cone-shaped central portion (disk) surrounded by numerous brightly coloured ray flowers. A striking example is the purple cone-flower (*Echinacea purpurea*), called also red sunflower and black sampson, native to the central United States. It is a coarse, stout perennial herb, 2 ft. to 5 ft. high, bearing lance-shaped leaves and long leafless flower stalks each ending in a single head, sometimes 5 in. across, with a purplish centre and purple or crimson rays.

CONEGLIANO, a town and episcopal see of Venetia, Italy, province of Treviso, 17 mi. N. by rail from the town of Treviso, 230 ft. above sea level. Pop. (1936) 7,544 (town); 15,434 (commune). It is commanded by a large castle and contains many picturesque old houses. It was the birthplace of the painter Cima da Conegliano, a fine altar-piece by whom is in the cathedral (1493). The place is noted for its wine, chiefly sweet champagne. A branch railway runs north-west to Vittorio Veneto (9 miles).

CONESTOGA, an extinct tribe of North American Indians of Iroquoian stock. Their country was Pennsylvania and Maryland on the lower Susquehanna river and at the head of Chesapeake bay. They were sometimes known as Susquehannas.

CONEY ISLAND, a seaside resort about 9m. S.E. of Manhattan island, New York, U.S.A. It was formerly an island separated from the mainland by Gravesend bay, Sheepshead bay, Coney island creek, a tidal inlet, and a broad stretch of salt marshes, much of which has been filled in. It lies within the limits of the borough of Brooklyn, New York city. The island is the westernmost of a chain of outlying sandbars that extends along the southern shore of Long Island for about 100 miles; it is about 5 mi. long and varies from $\frac{1}{4}$ mi. to 1 mi. in width. It is served by several lines of electric railway and (in summer) by steamboats.

The island is the most popular seashore resort of the United States. It is now a popular all-year residential community. Its all-year population is close to 100,000. At the extreme western extremity is the district known as Sea Gate, lying between Gravesend bay and lower New York bay. It is an exclusive residential section which in later years has become an all-year community with the natural influx of summer residents. Surf avenue connects it on the east with the part of Coney Island usually of interest to the average visitor. Coney Island's wide expanse of white sandy beach, its 3½-mi. boardwalk running from Sea Gate to Manhattan beach, its amusement parks, amusement devices of all kinds, "side shows," rides, cafes, annual Mardi Gras and weekly fireworks displays have helped Coney Island retain its popularity throughout the years. To the east are Brighton and Manhattan beach.

CONFALONIERI, FEDERICO, Count (1785–1846), Italian revolutionary, was born at Milan, descended from a noble Lombard family. In 1806 he married Teresa Casati. During the Napoleonic period Confalonieri was among the opponents of the French régime, and was regarded as one of the leaders of the *Italiani puri,* or Italian National Party. At the time of the Milan riots of 1814, when the minister, Prina, was assassinated, Confalonieri was unjustly accused of complicity in the deed. After the fall of Napoleon he went to Paris with the other Lombard delegates to plead his country's cause, advocating the formation of a separate Lombard State under an independent prince. But neither there nor in London, where he subsequently went, did he receive any encouragement. He then joined the freemasons and returned to Milan, where he found the Austrians in possession.

Early in 1821 he visited various parts of Italy to sound the liberal leaders, and also corresponded with the Piedmontese officers who, believing that they had the approval of Prince Charles Albert of Carignano, the heir to the throne, were planning a military revolt. Confalonieri warned them that Lombardy was not ready. On the outbreak of the Piedmontese revolt (March–April 1821) the Austrian authorities arrested Silvio Pellico and Maroncelli and afterwards Confalonieri. After a long trial Confalonieri was condemned to perpetual imprisonment in the fortress of Spielberg (Jan. 1824). He was taken to Vienna and had a long interview with Prince Metternich, who tried, without success, to extract confessions incriminating other persons, especially Charles Albert. His wife died in 1830, and in 1836, on the death of the emperor, Francis, he was pardoned and exiled to America. He came back to Europe after a year's absence, and in 1840 obtained permission to return to Milan to see his dying father. He himself, broken in health and spirits, died on Dec. 10, 1846.

Bibliography.—*Memorie e Lettere di Federico Confalonieri* (ed. by G. Casati, Milan, 1890). A. D'Ancona's *Federico Confalonieri* (Milan, 1898) is based on the memoirs and a large number of secret documents from the archives of Vienna and Milan. A. Luzio's *Antonio Salvotti e i processi del Venturo* (1901), in T. Casini and V. Florini's *Biblioteca storica del risorgimento italiano.* Ser. 3. Nos. 1, 2 (1897, etc.), contains many fresh documents which to some extent exonerate Salvotti from the charge of cruelty; among other papers Metternich's account of his interview with Confalonieri is given in full. *See* also A. Luzio, *Nuovi documenti sul processo Confalonieri* (1908), in T. Casini, etc., *Biblioteca storica del risorgimento,* etc., Ser. 5. No. 5; R. Huch, *Das Leben des Grafen Federigo Confalonieri,* 2 vol. (Leipzig, 1910).

CONFARREATIO, the ancient patrician form of marriage among the Romans, especially necessary at the nuptials of those whose children were intended to be vestal virgins or flamens of Jupiter. The name originated in the bride and bridegroom sharing a cake of spelt (*far* or *panis farreus*), in the presence of the *pontifex maximus, flamen dialis,* and ten witnesses. This form of marriage could only be dissolved by another equally solemn ceremony, which was called *diffarreatio.* In later republican times, confarreatio became obsolete except in the case of the most sacred priesthoods—the *flamines* and the *rex sacrorum.* Confarreatio was the most solemn of the three forms of marriage (*see* Marriage, Law of), but later the ceremony fell into disuse, and Cicero mentions but two, *coemptio* and *usus.* (*See* Roman Law.)

CONFECTIONERY MANUFACTURE. Confectionery is a term of wide application, covering all food preparations of the nature of sweetmeats which have sugar as their principal constituent.

The manufacture of confectionery on a large scale has grown in half a century from an insignificant trade into an industry of international importance. This rapid advance is largely due to the remarkable development of automatic machinery and to the greatly increased purchasing power of the people of the white nations.

In America, according to the 1925 report of the census bureau of the department of commerce, the establishments manufacturing confectionery to the extent of not less than $5,000 in value per annum numbered 1,931. The total value of the products of these establishments in that year was $379,081,441. In addition, some 60 establishments were engaged primarily in the manufacture of chocolate, cocoa and cocoa butter, the value of their products being $106,642,474. The value of the ice cream products in 1925 was $317,554,289, and of chewing gum, $47,838,150.

Great Britain produced in 1924 5,350,800cwts. of confectionery, (including chocolate confectionery), the value being £31,197,000; of manufactured chocolate and cocoa the output was 1,171,400 cwts., valued at £8,479,000. The third census of production, from which these figures were obtained, also showed that the output of manufactured chocolate and confectionery exceeded that of 1907 (the time of the second census) by nearly 90%, and that the increase in confectionery (including chocolate confectionery) was about 42%.

Chocolate and confectionery are manufactured on a large scale in nearly all the British Dominions. Other large producing countries are Switzerland (where milk chocolate is the specialty), Holland, Germany, France and Belgium.

Sugar Boiling.—The principal ingredient of all confectionery is sucrose, the ordinary sugar of commerce, and the main process in confectionery manufacture is sugar boiling. A saturated solution of sugar and water can be boiled to a number of stages between 220° F. and 360° F., at each of which a definite change in the solution is produced. At 240° F., for instance, the syrup, if agitated, becomes fondant, a mass of crystals so minute that they are not visible to the naked eye. At a further stage the syrup becomes of the consistency required for toffee, and finally it becomes a solution of brittle sugar used in hard boiled goods.

For hard boiled goods the latest method of manufacture involves the use of the automatic continuous cooker. The main part of this machine consists of a steam-jacketted vertical tube containing a hollow taper-spiral of gunmetal. The sugar solution is pumped into the machine at the top of the spiral and in a thin film is propelled downwards, at the same time being subjected to the action of the heat from the outer steam jacket. The syrup is in contact with the heat only from eight to ten seconds, but the heat is so intense and the quantity of syrup in contact with it so minute that the syrup issues from the spiral completely cooked and of perfectly transparent colour. The cooked syrup is poured on to a warm table, mixed with essence and colour as required, and passed through rollers to take the desired shape.

In order to obtain the beautiful and popular "satin" effects, the candy-pulling machine is used and this is necessary also for such goods as butter-creams and other light confections.

Toffee, in which butter is added to the sugar syrup, may be made in a continuous cooker which has been adapted for the purpose. It is also made in steam-jacketted mixing pans fitted with beaters or mixers which are driven at a high speed, the apparently immiscible ingredients thus being completely blended in a highly efficient manner. This is the basic principle also in the manufacture of caramels and similar goods.

Fondant.—Fondant is produced by cooking a sugar syrup, to which glucose is added, to 240° F., at which point the syrup quickly dries on stirring and is easily powdered, the sugar crystallizing spontaneously. If it is slowly cooled and there is an absence of movement, large crystals are formed; but if it is cooled and stirred rapidly the result is small crystals. The mass becomes dry because the water in the syrup is driven off entirely by the rapid evolution of heat as the sugar crystallizes. The best fondant is soft and smooth, and is produced by rapid cooling and heating.

The large scale method of manufacturing fondant is by the use of a complete automatic cream-boiling and fondant-making plant. The syrup is cooked as in the continuous cooker and passed to a gunmetal revolving water-cooled drum which cools it practically instantaneously, the film of cooled syrup being automatically scraped from the drum to fall into a continuous cream-beating machine. The latter, of which there are many types, rapidly beats the cream, to which flavouring and colouring are added, to a fine consistency.

When the fondant cream has been prepared, it is moulded for subsequent crystallizing (or dipping in sugar syrup) or for chocolate dipping or covering. This moulding is done in starch and the whole process may be completed automatically and continuously. The operations of the plant employed cover the filling of trays with starch; the levelling of the trays; the printing in the starch with moulds; the depositing of fondant cream (or other similar candy) into these imprints and the delivering of the trays filled with freshly cast goods for setting; the emptying of the set creams and the starch from the trays; the final cleaning of the creams, and their ejection for crystallizing or chocolate dipping.

The manufacture of lozenges requires the preparation of powdered sugar with gelatine and other ingredients made into a dough which is compressed and stamped out by machine. Other confectionery is made by one or other of the foregoing processes.

Chocolate Confectionery.—The constituents of chocolate are cocoa, sugar and cocoa butter. (*See* CHOCOLATE.)

The chocolate covering of confectionery may be performed either by hand or by machine. If by hand, the liquid chocolate is placed in slightly heated shallow pans; the centres are thrown into the mass and quickly withdrawn with a special fork, coated. They are then placed on glazed papers ready for cooling. Sometimes the covering is done almost entirely by hand.

The most up-to-date plant for covering automatically is the enrober. The centres are fed into this machine on a travelling canvas belt. They pass over a bath of chocolate on a wire belt conveyor and receive a bottom coating. They then pass within an enclosed case on a second wire belt conveyor and travel through a shower of liquid chocolate, which is made continuous by means of a pumping arrangement. The surplus chocolate is removed from the covered pieces by an air blast and a slight automatic tapping movement, and the goods, leaving the case, pass on to plaques on another travelling conveyor, where their tops are decorated by girl operatives. To secure the much desired gloss on chocolates rapid cooling is an essential, and accordingly the goods are taken on the travelling conveyor through a cooling chamber and emerge at the other end ready for packing. (C. T. J.)

UNITED STATES

The basic principles of the manufacture of confectionery in the United States are practically the same as obtain in England, with the possible exception that more open-fire, pure sugar hard candy is used. Hard candy is manufactured by cooking over gas or coke stoves at 320° to 340° F. The gloss or satin-finish obtained is the result of manipulation on the part of the spinner. The spinner takes the finished batch after it has been pulled and, protected by heavy buckskin gloves, feeds it into machines, frictional heat being caused by rubbing. This brings a high gloss which is known as the finish to the surface of the candy.

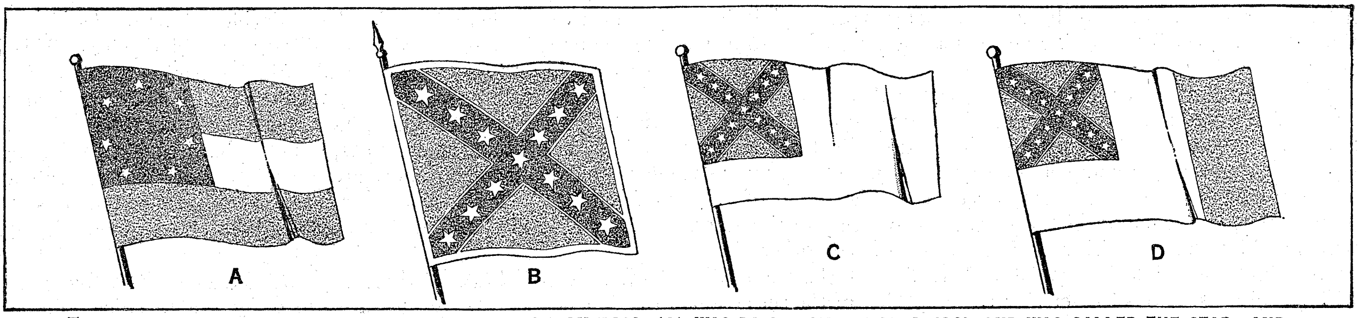
The greatest volume of confectionery business in the United States is done in the lower prices, particularly the penny-goods class. Next in sales, is the 5 cent chocolate-covered bar. The third class of confectionery in volume of sales is the candy sold in bulk, principally in small candy and grocery stores and in the chain stores. The consumption of milk chocolate, both in solid-bar form and as a coating for candies, has been steadily increasing and in 1928 had reached approximately 40% of the total consumption of chocolate. The increase in the consumption of 5 and 10 cent bars, accentuated by the popularity created for this type of goods during and after the World War, has been somewhat responsible for a decrease in the sale of chocolates in bulk. This decrease has been offset, however, by the advance in the sale of finished, packaged chocolates. The sale of 5 cent bars has so developed that some large manufacturers have devoted their entire plant facilities to one or more bars. In some instances it has been necessary to establish three or four factories, strategically situated across the continent, to supply the demand. The penny-goods business has similarly grown, so that many large manufacturing plants have given over their entire production to this particular type of goods.

Since 1918 there has also been developed on outlet for the "home-made" type of candy retailing at popular prices. This is made up in various types of goods bringing back a number of the older kinds such as were commonly used during the last generation. These pieces are large, have home-made characteristics and embody such items as caramels, nougats, hard candy, toffees, *bon bons* and hand-rolled, chocolate-dipped creams. These goods are offered by chain store organizations that often outfit their stores to resemble kitchens, with unique fixtures and window displays. (P. F. C.)

CONFEDERATE STATES OF AMERICA, the title of the independent Government formed by the seceding Southern States—Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas and Virginia—in the early part of 1861. The causes leading to the secession had grown out of social and economic conditions, chiefly dependent upon slavery, which had been a subject of compromise for 40 years. Important among the movements toward the separation of the North and South were: the struggle over Missouri; the nullification pronouncement of South Carolina; the activities of abolitionists which caused the Southern leaders to make impossible demands on Congress for the protection of slavery; the passage of a fugitive slave law which public opinion in the North would not enforce; and finally the struggle between the representatives of the North and South over the constitutional right to exclude slavery from the Territories. The slave States, in proportion to their population, had played a more important part in the previous political history of the United States than was their share. In the election of Lincoln the Southern leaders saw the end of their preponderance of power in the Union, as well as a threat to the institution of slavery.

Secession.—South Carolina took the position that secession should not be dependent on the joint agreement of the slave States, but rather on the voluntary action of each separate State. In accordance with this policy, it adopted an ordinance of secession on Dec. 20, 1860. Its action was followed by Mississippi, Florida, Alabama, Georgia and Louisiana on Jan. 9, 10, 11, 19 and 26, 1861, respectively, and by Texas on Feb. 1. On Feb. 4, 1861, the delegates of the first six States met at Montgomery, Ala., for the purpose of framing a Government, and after the lapse of four days the convention reported a constitution for the provisional Government of the Confederate States of America, which was to last until a permanent constitution should be put into operation. All laws of the United States in force on Nov. 1, 1860, which were not inconsistent with the provisional constitution, were continued. The next day (Feb. 9), the provisional Congress elected Jefferson Davis of Mississippi president and Alexander H. Stephens of Georgia vice president. Further work of the Congress was to appoint all principal committees, including one of two representatives from each State to draw up a permanent constitution for the Confederate States as a whole.

Davis Inaugurated President.—Jefferson Davis, at the formal ceremony of his inauguration at Montgomery, Ala., on Feb. 18, delivered an address in defence of the seceded States. It was, he asserted, "wanton aggression on the part of others that justified the action of the Southern people. We have vainly endeavoured to secure tranquillity and obtain respect for the rights to which we are entitled. As a necessity, not a choice, we have resorted to the remedy of separation." The president's cabinet, as then constituted, contained Robert Toombs, of Georgia, as secretary of State; C. G. Memminger, of South Carolina, secretary of treasury; L. P. Walker, of Alabama, secretary of war; S. R. Mallory, of Florida, secretary of navy; J. H. Reagan, of Texas, postmaster-general; and Judah P. Benjamin, of Louisiana, attorney-general. Of these Benjamin was distinctly the most powerful intellectually, occupying subsequently the positions of secretary of war and secretary of State. Memminger, with little training or aptitude for his difficult position, did not distinguish himself as a financier, and was succeeded in the summer of 1864 by Trenholm, a Charleston banker of high intelligence and good training, who, however, found it impossible to save the Confederacy from financial ruin.



THE FIRST FLAG OF THE CONFEDERATE STATES OF AMERICA (A) WAS RAISED ON MARCH 4, 1861, AND WAS CALLED THE STARS AND BARS. IT CONSISTED OF ONE HORIZONTAL WHITE BETWEEN TWO RED BARS; THE FIELD WAS BLUE WITH SEVEN WHITE STARS. AT THE BATTLE OF MANASSAS, JULY 1861, THE CONFEDERATE FORCES HAD GREAT DIFFICULTY IN DISTINGUISHING THEIR OWN REINFORCEMENTS FROM THOSE OF THE ENEMY BECAUSE OF THE SIMILARITY, IN THE DUST AND HEAT OF BATTLE, BETWEEN THE STARS AND BARS AND THE STARS AND STRIPES. TO PREVENT A REPETITION OF THIS A NEW DESIGN (B) THE "BATTLE FLAG," WAS CHOSEN, HAVING A RED FIELD CROSSED DIAGONALLY BY A CROSS OF BLUE WITH THIRTEEN WHITE STARS. IN MAY 1863, THE CONFEDERATE CONGRESS ADOPTED A SECOND NATIONAL FLAG (C) KNOWN AS THE "STAINLESS BANNER," WHICH WAS PURE WHITE WITH THE "BATTLE FLAG" IN THE LEFT CORNER. THIS FLAG, HOWEVER, WHEN HANGING LIMP LOOKED LIKE A FLAG OF TRUCE, SO, ON MARCH 4, 1865, THE CONFEDERATE CONGRESS CHANGED THE NATIONAL FLAG BY PLACING A BROAD RED BAR ACROSS THE END OF IT (D). THIS WAS THE FOURTH AND LAST FLAG OF THE CONFEDERACY

The Permanent Constitution.—The provisional congress, on March 11, 1861, adopted and submitted to the several States for ratification the permanent Constitution of the Confederate States of America. It was subsequently ratified by the 11 seceded States and such portions as were adaptable to war conditions were put into operation in 1862. The document followed closely the fundamental law of the United States, but where opportunity offered the "States rights" view of the sovereign and independent position of the individual States was emphasized. It even went so far as to allow a State legislature to impeach a Confederate official acting wholly within that State; it was specifically stated that legislative powers were "delegated" rather than "granted" and that each State was accordingly acting in its "sovereign and independent character."

The Confederate constitution used the words "slave" and "slavery" in provisions regarding that institution, and forbade all legislation which might impair right of property in negro slaves. The African slave trade, however, was prohibited. The Southern attitude toward a protective tariff was emphasized by the constitutional provision that no bounty should be paid nor any protective duties levied on foreign importations for the benefit of any branch of industry; it forbade the expenditure of public money for internal improvements except for aids to navigation and these were to bear their own cost. The expenses of the post office, after the first year, were not allowed to exceed its receipts. The constitution increased the powers of the executive as against the prerogatives of Congress; it gave him the power to veto separate items in appropriation bills; and the Congress could appropriate money for particular purposes only by a two-thirds majority, unless it were asked for by the head of that department. The president's term of office was lengthened to six years, but he was declared ineligible for reëlection; members of the cabinet were recognized on the floor of Congress.

These changes all had reference to times of peace. The war powers of the Government were left unchanged from those provided for by the Federal Constitution. Provisions of that document as to suspending the writ of habeas corpus and the provisions regarding conscription were left equally vague in the new Confederate constitution. These led to acrimonious discussion and much bitter feeling against the centralized war powers of the Government at Richmond. As the war progressed, the Richmond authorities, through force of necessity, became more and more oppressive, and this aroused the "States rights" feeling of many of the outstanding leaders. Governors of States resisted the acts of Congress for the conscription of men, the control of food, the suspension of civil procedure, and the regulation of their imports and exports, as an invasion of their sphere of authority. Such conditions made it evident that a confederated form of government, such as was planned by the Southerners, was unsuited to the stringent requirements of war times and contributed doubtless somewhat to the final cataclysm.

Movements for Conciliation.—With the assemblage of the thirty-sixth U.S. Congress for its second session on Dec. 3, 1860, the question uppermost in the minds of many political leaders was, how could a compromise of sectional grievances be effected. To attain this end a special committee was appointed by each the House and the Senate, but after prolonged debate it became evident that extremists of neither side favoured compromise and as a consequence these efforts were of no avail. The public, however, had not given up hopes of an agreement. Petitions poured in upon Congress for a reconsideration of the Crittenden compromise. Virginia came forth as the champion of a "peace convention" and on Feb. 4, 1861—the same day that delegates from the seceding States met at Montgomery to form a Southern Confederacy—representatives from 14 States (later increased to 21) assembled at Washington to settle peaceably the sectional quarrel. After the selection of ex-president Tyler as chairman, the convention heard reports from various State delegations and finally gave serious consideration to the Crittenden compromise which it thought "would be acceptable by the people of this commonwealth," but after labouring for nearly a month with diminishing harmony, the conference came to naught. The Confederacy, taking no part in conciliatory movements, sent to Washington three commissioners—A. B. Roman, Martin J. Crawford and John Forsyth—to seek recognition as an independent nation and to effect a peaceable agreement regarding public property situated within the seceding States. They, although not officially received, carried on with secretary of State Seward, chiefly through the mediation of justices Campbell and Nelson of the Supreme Court, negotiations in accordance with their instructions, and, also, for the evacuation of Ft. Sumter. However, when it became known that President Lincoln intended to provision the fort rather than evacuate it, as Seward had intimated, the Southern commissioners charged the president with a breach of faith and withdrew, thus bringing to a close the last attempt at a peaceable settlement.

Preparation for War.—In the meantime the Confederate Congress had authorized an army of 100,000 men; had seized practically all the coast fortifications and arsenals within the seceded territory; had adopted a national flag; had given sanction to loans amounting to $15,000,000 for which an export duty of $\frac{1}{8}$ of a cent a pound on cotton was pledged; and had sent commissioners to Europe to enlist the sympathy of foreign Governments in the Southern cause.

On April 12 the Confederate forces opened fire on Ft. Sumter and thus was begun the terrible civil conflict which was to last for four years. (*See* AMERICAN CIVIL WAR.) President Lincoln's call for volunteers to suppress the rebellion, brought to an end the hesitant policy of the remaining slave States. Most of the border States had shown a strong Union sentiment due chiefly to a more diversified economy, closer business relations with their neighbours to the North and a greater non-slave holding population. When Virginia left the Union, on April 17, 1861, the Unionist faction of the north-west managed to tear away several disaffected counties, organized them into the State of West Virginia, and later entered the Union as a separate commonwealth. The withdrawal of Virginia was followed by Arkansas and North Carolina on May 6 and 20, 1861, respectively, and by Tennessee on June 24, 1861. Four other slave States—Delaware, Maryland, Kentucky and Missouri—remained in the Union.

Comparative Military Strength.—The final grouping of the States for the great conflict showed 11 in the Confederacy as opposed to 23 loyal to the Union; in population there was a similar inequality, approximately 9,000,000 (including about 3,500,000 slaves) confronting 23,000,000. No official records exist to show the exact military strength of the Confederacy; however, it has been estimated by competent authorities that it possibly equalled, as compared with the Federal, a ratio of two to three. It was largely owing to the strategic skill of their military leaders that the Southern armies, smaller and more poorly equipped than their opponents, maintained the unequal contest for four years. In the naval operations the North had an overwhelming advantage, which was promptly and effectively used. The blockade of the Southern ports, beginning in the spring of 1861, was much less spectacular than the operations of the army, but was quite as effective in breaking down the Confederacy. It cut off the South from foreign war supplies, and reduced it to dependence upon its own products, which were almost exclusively agricultural. Manufacturing industries hardly existed in the slave-holding States. Of the few iron works only that of the Tredegar at Richmond was capable of turning out ordnance of the larger type. The output of these plants was supplemented by arms obtained from the Federal arsenals in 1861, by capture and to some extent by eluding the blockade. Powder factories were established and vigorously operated. The scarcity and high price of clothing put a premium on the establishment of textile factories, but their product was far below the demand. As compared with those of the North, the South's railways were inadequately equipped and did not form connected systems. During the war, the inroads of the Federal troops, and the natural deterioration of the lines and rolling stock greatly reduced their value as a military factor. To offset this inequality in numbers and resources, the South had certain definite advantages. Their soldiers would fight a defensive war on familiar soil, for the protection of their homes and property; the vastness of the territory—an area slightly larger than that of the United Kingdom, the Irish Free State, Spain, France, Germany, Belgium, the Netherlands and Denmark, combined—would make a speedy subjugation of the Confederacy impossible; and with the slaves to till the soil, they felt reasonably sure of a food supply. There was also a firm conviction in the South that England would aid them rather than allow the Federal blockade to ruin her cotton-milling industry.

The harvests in the South during the war were fairly abundant, as far as they were not destroyed by the advancing Northern armies. Maize was raised in large quantities, and, in general, the raising of food products instead of tobacco and cotton was encouraged by legislation and otherwise. The scarcity of food in the armies and cities was due chiefly to the breaking down of the means of transport, and to the paper money policy with its attendant evils.

The War Administration.—The second session of the provisional Congress, which met on April 29 at Montgomery, voted to accept an invitation from the Virginia convention to make Richmond the capital of the new Government. The transfer was effected by July 20, 1861. In the November following, the Confederacy, for the first time, was to choose a president and vice president in accordance with the provisions of its permanent constitution. Personal differences (there were no parties) were forgotten, and Davis and Stephens were elected without opposition. The Provisional Government gave way to the new when the first Congress elected under the permanent Constitution met on Feb. 18, 1862. Four days later Jefferson Davis was inaugurated for a term of six years, but this was brought to an untimely close by the collapse of the Confederacy. The personnel of the new Congress and administration was materially weakened by many of the most brilliant leaders answering the call of military duty. Petty jealousies and an abhorrence of centralized Government did much to lower the effectiveness of the war administration. The first Congress, after holding four sessions, gave way to the second in Feb. 1864. The latter was able to hold two sessions before taking final adjournment, on March 18, 1865.

Financial Problems.—The Confederacy was hampered throughout its existence by an inadequate system of public finance. The effectiveness of the Federal blockade reduced the proceeds from import duties almost to nothing. A small export duty on cotton was expected to produce a large revenue sufficient to base a loan upon, but the small amount of cotton exports reduced this source to an insignificant figure. There being, besides, no manufactures to tax under an internal revenue system such as the North adopted, the Confederacy was cut off from deriving any considerable revenue from indirect taxation. The first Confederate tax law levied a direct tax of $20,000,000, which was apportioned among the States. These, with the exception of Texas, contributed their apportioned shares to the central Government by issuing bonds or notes, so that the tax was in reality but a disguised form of loan. The specie holdings of the Southern banks largely found their way into the Confederate treasury in payment for the $15,000,000 loan effected early in 1861. Other specie was secured from the various Federal offices and the mint at New Orleans. These sums were soon sent to Europe in payment for foreign war supplies. Also the gold and silver in general circulation soon left the country almost entirely, driven out by the rising flood of paper money. The first notes were issued in March 1861, and bore interest. They were soon followed by others, bearing no interest but redeemable at a stated time after the restoration of peace. New issues were continually provided so that from an initial $1,000,000 in circulation in July 1861, the amount rose to $700,000,000 by the autumn of 1863; and to no less than $1,000,000,000 by the end of the war. This policy of issuing irredeemable paper money was copied by the individual States and other public bodies. Even corporations and other business concerns issued promissory notes intended to circulate from hand to hand. As a result of this redundancy of the currency the price of gold rose to great heights. By the end of 1861 a paper dollar was quoted at 90 cents in gold; during 1863, at 6 cents; and still lower during the last months of the war. In the spring of 1865 potatoes sold in Richmond for $100 a bushel and coffee at $40 a pound in Confederate currency, but in gold this was less than the price demanded in New York. This rise of prices reflecting the inflation of the currency was no advantage to the producer. Prices were often fixed by legislative action, and supplies for the army were obtained by impressment, the price to be paid for them being arbitrarily fixed at a low figure.

The bonds of the Confederacy rapidly fell in value, and were quoted during the war at approximately the value of paper money, in which medium they were paid by the subscribers. An effort to avoid the falling price of bonds was the inauguration of a system of produce loans whereby the bonds were subscribed for in cotton, tobacco and food products. This policy enabled the Government to secure at least a part of the armies' food supplies. The South, in its monopoly of cotton, held a pawn of value in negotiating for foreign loans. In the spring of 1863, the French banking house of Erlanger and Company undertook to float a loan of $15,000,000, redeemable, six months after the conclusion of peace, in New Orleans cotton at the rate of 12 cents a pound. The placing of the bonds in Europe was mismanaged by the Confederate agents, but notwithstanding about $6,250,000 was realized from the loan.

Foreign Relations.—The foreign relations of the Confederate Government were one of its chief disappointments. Early in 1861 W. L. Yancey headed a commission sent to Europe to enlist the sympathy of foreign Governments in the Southern cause. J. M. Mason and John Slidell followed later in the same year, after a short detention by the Federal Government, which had removed them from the British vessel "Trent" while en route to Europe. They received considerable unofficial sympathy; were allowed to float Confederate loans; buy military supplies; and, in violation of neutrality, ships were built in both France and England and delivered to the Confederacy (*see* "ALABAMA" ARBITRATION). Great Britain's recognition of the Confederacy as a belligerent power on May 13, 1861, gave encouragement to the Confederate Commissioners who were seeking political recognition, but, largely due to the skill and persistence of the Federal minister in London, Charles Francis Adams, this never came.

Collapse of the Confederacy.—When it was apparent that the Southern cause was tottering, Vice-President Stephens, R. M. T. Hunter and former justice Campbell of the U.S. Supreme Court opened communications with the Federal military authorities for permission to go to Washington to confer with the Federal Government. A conference of the representatives of the two Governments was arranged for Feb. 3, 1865, at Hampton Roads. President Lincoln would consider no terms which did not include a restoration of the union, and as this point exceeded the instructions of the Confederate Commissioners, the conference failed. The surrender (April 9) of Lee and the Army of Northern Virginia marked the end of the Confederate States of America. In making its struggle for independence, the South sacrificed everything, and emerged from the war a financial and industrial wreck. (*See* article SOUTH, THE.)

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(J. A. DU.)

CONFEDERATION, primarily any league or union of people or bodies of people. The term in modern political use is generally confined to a permanent union of sovereign states, for certain common purposes, *e.g.,* the German Confederation (*Bund*), established by the Congress of Vienna in 1815. The distinction between confederation and federation (*see* FEDERAL GOVERNMENT), terms synonymous in their origin, has been developed in the political terminology of the United States. Up to 1789 these were a confederation; then the word federation, or federal republic, was introduced as implying closer union. This distinction was emphasized during the Civil War between North and South, the seceding states forming a confederation (Confederate States of America) in opposition to the Federal Union. Confederation thus comes to mean a union of sovereign states in which the stress is laid on the sovereign independence of each constituent body (*cf.* the German *Staatenbund*); Federation implies a union of states in which the stress is laid on the supremacy of the common government (Ger. *Bundesstaat*). The distinction is, however, by no means universally observed. The variant "confederacy," derived through the Anglo-French *confederacie,* and meaning generally a league or union, whether of states or individuals, was applied in America in the sense of confederation to the seceding Southern States. In its political sense, however, confederacy has generally come to mean rather a temporary league of independent states for certain purposes: as applied to individuals "confederacy" is often used to describe a secret combination, probably for illicit purposes. In trade union terminology a federation (*e.g.,* The Miners' Federation of Great Britain) is an alliance of autonomous unions; whereas a confederation (*e.g.,* the Iron and Steel Trades Confederation) is a body to which the constituent unions have handed over the majority of their powers—in other words, a disguised form of amalgamation, made necessary by the provisions of British law.

CONFERENCE, a bringing together for the purpose of discussion, particularly a meeting of members of one or more societies, of representatives of legislative or other bodies, or of different States (Lat. *conferre*). Such are the meetings between members of the upper and lower chambers of the British parliament, or of the U.S. Congress, to adjust matters of difference, and the assemblies of the prime ministers of the various British colonies, held at stated intervals to consult with the imperial government. The title of Colonial Conference was changed to that of Imperial Conference in 1907, but the proposal to change conference to council was dropped; it was felt that the administrative functions usually connoted by the word "council" made that title less suitable to an assembly with purely deliberative and consultative powers, which were more fitly expressed by "conference." In diplomacy the word "conference" is used of a meeting of the representatives of States of greater or less importance for the purpose of settling particular points, as distinguished from a "congress," which is properly a meeting of the great Powers for the settlement of questions of general interest. In practice the distinction is not consistently maintained. The meetings preliminary to a congress and the sessions of the congress are also styled "conferences" (*see* CONGRESS). The word is also applied to the annual assemblies for transacting church business in the Wesleyan Methodist Church of Great Britain and to various similar assemblies in the Methodist Episcopal Church of America (*see* METHODISM).

CONFESSION. In the Roman Catholic Church confession is regarded as one of the essential elements of the sacrament of Penance, although the term is frequently used for the whole penitential procedure of which confession forms but a part. (*See* PENANCE.) According to the teaching of the same church, a specific avowal of all serious post-baptismal sins, motivated by true sorrow of heart and a sincere purpose of amendment, is of divine precept. The scriptural foundations of this doctrine are seen in the statements of Jesus bestowing on His Apostles authority to bind and to loose (Matt. xvi, 19; Matt. xviii, 18), and, more specifically, authority to forgive and to retain sins (John xx, 23); the form of these statements implies that the power so entrusted is discretionary and judicial in character; for this reason its valid exercise demands a judicial knowledge of the case, which is supplied by the penitent's "confession."

In treating the sacrament of penance (session xiv, chaps. 1–9), the council of Trent gave a full statement of Catholic doctrine on confession: "From the institution of the sacrament of penance as already explained, the universal Church has always understood that the complete confession of sins was also instituted by the Lord, and is by divine law necessary for all who have fallen after baptism; for our Lord Jesus Christ, when about to ascend from earth to heaven, left behind Him priests, His own vicars, as rulers and judges, to whom all the mortal sins into which the faithful of Christ may have fallen should be submitted, in order that they, in virtue of the power of the keys, may pronounce sentence of remission or retention of sins. Evidently, it would be impossible for priests to exercise this judgment without a knowledge of the case, nor could they observe justice in imposing penalties, if the faithful were to declare their sins only in general, and not in particular and one by one (chap. 5)." The necessity of confession, therefore, is intimately related to the institution of the sacrament of penance as a judicial process; and this latter in turn is related to the Church's possession of the power of the keys (*see* ECCLESIASTICAL JURISDICTION). A special canon asserts the divine origin of the practice of confession: "If anyone denies that sacramental confession was instituted by divine law, or is necessary for salvation, or says that the manner of confessing secretly to a priest alone, which the Catholic Church has always observed from the beginning, and still observes, is at variance with the institutions and command of Christ and is a human invention, let him be anathema" (sess. xiv, can. 6).

Irremissible Sins.—There is historical evidence enough that the early church was persuaded of her competence to administer divine pardon; the problem concerned rather the extent of this power. On this point, the teaching of the New Testament presents an exegetical difficulty. St. John speaks of a "sin unto death" for which Christians are not asked to pray (I John v, 16), and St. Paul states that it is impossible to renew unto penance those who have apostatized from the faith (Heb. vi, 4–6); on the other hand, Christ's commission to forgive sins is expressed without limitation, and St. John (I John i, 9) assures his followers that if they confess their sins God will deliver them from every iniquity (*cf.* d'Alès, *L'Édit de Calliste,* p. 21 *ff.*). Moreover, early in the history of the church two tendencies manifested themselves. Hermas of Rome (*c.* 140) states that certain teachers of his day admitted no other remission for capital sins than the remission granted in baptism. While agreeing in principle that a Christian should have no need of a second remission, Hermas himself preached a second penance even for the adulterer and the apostate. And it is the more indulgent practice of the church of the 2nd century that is witnessed to by Clement of Rome, Ignatius of Antioch, Polycarp, Justin Martyr, Dionysius of Corinth, Irenaeus and Tertullian before his Montanist defection (*De Poenitentia,* vii, 9 *ff*).

Some 20 years later (*c.* 220), Tertullian adopted the more rigorous position in his Montanist work, the *De Pudicitia.* In an untempered outburst against the author of an episcopal edict (probably Pope St. Callistus) who promised pardon after due penance to the adulterer and the fornicator, Tertullian bitterly protested that the bishop, in reconciling those guilty of sins of the flesh, was usurping a power that belonged to God alone. For lesser sins the bishop might exercise his prerogative of loosing; but for the three sins of apostasy, impurity and bloodshed the bishop, in assigning a penance, could exercise only the prerogative of binding. The Catholic reply, as furnished by Tertullian, is reminiscent of Tertullian's earlier teaching: all sinners are admitted to penance; all sinners are therefore entitled to pardon, the fruit of penance (*De Pud.* iii, 1–2).

The same question of irremissible sins was occasioned by the Decian persecution (250–252), in which the number of those who had apostatized created a serious problem of discipline. A cursory reading of the correspondence that passed between St. Cyprian of Carthage and the Roman clergy during the papal interregnum would lead to the belief that at Rome and at Carthage there was no precedent for reconciling apostates. There is, however, good reason to believe that the question that vexed Cyprian and the Roman clergy was not whether the lapsed should be reconciled (there was ample precedent for this), but whether the normal discipline of penance should be maintained despite the threat of schism, the angry entreaties of the lapsed themselves, and the insistent intercession of the martyrs.

Exomologesis.—What this "normal" discipline of penance was may be gathered from the *De Poenitentia* of Tertullian and the letters of St. Cyprian. The procedure is called by Tertullian "exomologesis," the Greek term for confession. As used by Tertullian and later authors, the term seems to include the whole apparatus of public penance. The sinner was admitted to exomologesis by an imposition of hands; as a public penitent he wore sackcloth and was sprinkled with ashes; he restricted himself to "simple things for meat and drink," and at the celebration of the Liturgy he prostrated himself at the feet of the bishop and the clergy and knelt before the faithful. In this way the sinner was reminded that his sin affected the whole body and that reconciliation would normally follow upon the intercession of the whole Church. However, the final act in the great drama of reconciliation was reserved to the bishop, to whom had been entrusted the "power of the keys."

It is not easy to determine whether a particular confession of sins was made openly before the congregation or whether the term exomologesis is sufficiently explained by the public exposure of generic guilt inherent in the discipline itself. The Anglican authority, O. D. Watkins is persuaded "that the whole subsequent evidence of Church practice goes to show that the verbal particularization of offense before the congregation at no time formed part of the exomologesis which was required by the Church." (*Hist. of Penance,* I, p. 470.) An example of this "subsequent evidence" may be found in the celebrated letter of Pope St. Leo I (*Epistle* clxviii, A.D. 459) in which the pontiff strongly condemns a local custom of divulging secret transgressions in open assembly as an innovation and contrary to apostolic rule. It might be noted in this connection that Pope Leo is the first who plainly and unequivocally demands strict silence on the part of the confessor, and in so doing, offers the first clear evidence for what shall later be referred to as the "seal of confession."

The public penance or exomologesis as described by Tertullian and St. Cyprian was probably representative of the penitential discipline of the whole Church up to the close of the 3rd century. The discipline itself could be received but once, and during the period in question public penance was ordinarily denied to those who first sought it as danger of death approached. This last practice, however, appears to have been a temporary measure, introduced to strengthen the constancy of those who contemplated apostasy during the period of persecution, and was revoked when universal peace was restored to the church (*cf.* St. Innocent I, *Epistle* vi).

In the east, the graded penitential discipline was introduced shortly after the Decian persecution by St. Gregory Thaumaturgus, the bishop of Pontus in Neo-Caesarea, and spread rapidly to the neighbouring provinces of Cappadocia and Galatia. The grades were four in number: the Mourners, the Hearers, the Kneelers and the Bystanders. Those guilty of serious sins were obliged to pass through some or all of these grades according to the nature of their guilt. It would appear that reconciliation and forgiveness took place at the close of the third grade when the penitent was permitted to remain as a "bystander" for the Mass of the Faithful, although the further privilege of receiving the Eucharist was denied for a short time. The graded discipline did not long survive the action of Nectarius, the patriarch of Constantinople, in abolishing the office of priest-penitentiary and with that office the whole discipline of public penance. A relic of the graded discipline did survive in the eastern practice of postponing the reception of the Eucharist for those guilty of public crimes.

In the west, the public penance continued, with this change, that toward the close of the 4th century the liturgical ceremonies connected with the discipline were restricted to the season of Lent. Perhaps to compensate for this abbreviated discipline, certain disabilities were introduced which served to remind the sinner of his former penitential status; for instance, those who had been public penitents were obliged to abstain from marriage, or the use of marriage, to forego military service and other secular pursuits.

In the Celtic discipline, which is representative of Ireland and England from the 6th century on, there is little evidence of a liturgical discipline even during the Lenten period—a fact that has led many authors to conclude that the public penance did not exist in those countries. The practice was rather to commit those guilty of grave crimes to a monastery or to a penitential station such as that connected with the monastery of Iona—a bit of Celtic realism which to all intents and purposes gave to the public penitent the status of a professed religious.

Lest the public penance strike the modern spirit as oversevere and somewhat inhuman, it should be noted that the discipline was not applied indiscriminately nor without regard for the dispositions of the penitent. Exomologesis, with all its attendant severity, was never regarded as so essential an element in sacramental remission that it could not be dispensed with. We know that the public penance was waived in favour of a private, milder discipline in the case of sickbed penitents. Again, there is some evidence that the public penance was restricted to the more heinous crimes of apostasy, adultery and murder; and even in these cases the more awesome features of the public penance could, at the discretion of the bishop, be dispensed with. Even in the Celtic discipline, which became more stereotyped through the widespread use of the penitentials or handbooks for confessors, provision was made for the granting of commutations. Finally, with the growing practice of granting indulgences (*q.v.*), the public penance gave way altogether to the strictly private discipline which now finds place in the Roman Catholic Church.

Obligatory Confession.—In the early church, the penitential discipline was frequently referred to as a "second baptism," and serious doubt was entertained about the salvation of those who departed this life either unregenerated or unreconciled to the church (*cf.* St. Augustine, *Epistle* ccxxviii). The stringent character of the public penance, however, led many to postpone the reception of the sacrament until death approached. Beginning with the 5th century, the evidence for yearly confession becomes more cogent in the frequent exhortations that sinners should come to confession in the beginning of Lent and return for reconciliation on Holy Thursday. Finally, at the Fourth Lateran council in 1215, the obligation to confess one's sins at least once a year and to receive the Eucharist during the paschal season was imposed on all Latin Christians who had reached the age of discretion. This precept, colloquially known as the Easter Duty, is still in force in the Roman Catholic Church.

During the early Scholastic period the question was frequently asked, whether the intention of confessing one's sins would reconcile the sinner to God even before actual confession to a priest. The solution arrived at by the early Scholastics was the same as the later official teaching of the council of Trent: the sacrament of penance, of which confession to a priest is an essential part, is of divine precept; but where this precept is incapable of fulfillment, sorrow for sin perfected by charity will reconcile the sinner, provided he has the intention of receiving the sacrament when the opportunity presents itself (Trent, *sess.* xiv, 4).

In the separated churches of the east, the doctrinal position on the necessity of sacramental confession agrees substantially with that of the Roman Catholic Church. Among the Lutherans, obligatory confession to a minister of the Word survived the Reformation, although its sacramental character was denied in consequence of the Protestant concept of justification by faith alone. In time, however, the Lutherans followed the practice of the Calvinists, who substituted for private confession a general confession followed by a general absolution.

The Church of England resisted to some extent the attempts of the non-Conformists to have all reference to private confession expunged from the Prayer Book. It would, however, be difficult to formulate a doctrinal statement to which all Anglicans and Episcopalians would subscribe. The Oxford Movement in the middle of the 19th century fostered a revival of auricular or private confession, and the practice has received wide acceptance among Anglo-Catholics. Liberal churchmen, however, are opposed not only to the practice but more particularly to its doctrinal implications.

Public confession of a generic nature plays an important role in the revivalist meetings of Fundamentalists and certain Evangelical sects; and the year 1921 witnessed the rise of a new religious group, the Buchmanites, among whom a public and detailed confession is regarded as the first step toward a sincere conversion. The strictly psychological and therapeutic value of confession has not been overlooked by the psychiatrist, whose demands upon the sincerity and frankness of his patient are no less exacting than those made on the penitent in the early church.

BIBLIOGRAPHY.—Jean Morin (*Commentarius historicus de disciplina in administratione sacramenti Poenitentiae*), 1651, still accepted as the classic work on Penance; H. C. Lea, *History of Confession and Indulgences*, 1896, a polemic attack on Roman "sacerdotalism"; A. d'Alès, *L'Édit de Calliste*, 1914, a complete study of the problem of irremissible sins; O. D. Watkins, *A History of Penance*, 1920, the best documented study in English; Bernhard Poschmann, *Die abendländische Kirchenbusse im Ausgang des christlichen Altertums*, 1928; *Die abendländische Kirchenbusse im frühen Mittelalter*, 1930, generally recognized as the most authoritative of current works on the subject; P. Galtier, *De Penitentia*, 1931, an historical-dogmatic presentation of the Roman Catholic position; *L'Église et la Rémission des Péchés*, 1932, defends against Poschmann and others a private penance in early church; R. C. Mortimer, *The Origins of Private Penance in the Western Church*, 1939, an excellent statement of the problem and the solutions offered; John Thomas McNeill and H. M. Gamer, *Medieval Handbooks of Penance*, 1938, a translation of principal penitentials with selections from related documents. (P. F. P.)

CONFESSIONAL. A box, cabinet or stall, in which the priest in Roman Catholic churches sits to hear the confessions of penitents. The confessional is usually a wooden structure, with a centre compartment (entered through a door or curtain) in which the priest sits, and on each side a latticed opening for the penitents to speak through, and a step on which they kneel. By this arrangement the priest is hidden, and the penitent may or may not be visible to the public. Confessionals sometimes form part of the architectural scheme of the church, but, more usually, they are movable pieces of furniture. The confessional in its modern form dates no farther back than the 16th century, and Du Cange cites the year 1563 for an early use of the word *confessionale* in this sense. Originally the term was applied to the place where a martyr or "confessor" (in the sense of one who confesses Christ) had been buried. Confessional boxes were devised to guard against scandals by securing at once essential publicity and a reasonable privacy, and by separating priest and penitent. In the middle ages stringent rules were laid down, in this latter respect, by the canon law in the case of confessions by women and especially nuns. In England, before the Reformation, publicity was reckoned the best safeguard, the priest usually hearing confessions at the chancel opening or at a bench end in the nave near the chancel. With the revival of auricular confession in the English Church, confessionals were introduced into some Anglican churches. The question of their legality was raised in 1900 in the case of *Davey* v. *Hinde* (vicar of the church of the Annunciation, Brighton), tried before Dr. Tristram in the consistory court of Chichester. They are condemned as illegal.

CONFESSION AND AVOIDANCE. A plea in confession and avoidance neither simply admits nor denies alleged facts; it admits that the facts alleged by the opposite party make out a good *prima facie* claim or defense, but it proceeds to destroy the effect of these allegations either by showing some justification or excuse of the matter charged, or some discharge or release from it. (*See* PRACTICE AND PROCEDURE.)

CONFESSOR, a word used in the Christian Church to denote (1) a male saint who is not included in any of the categories martyr, apostle, evangelist; (2) a priest empowered to hear confessions.

(1) In the early church the title was restricted to those who had suffered persecution and torture, though not actual death, for the faith, but after the ages of persecution it came to be applied to those who had lived a holy life and died in peace. From about the 4th century persons so honoured became objects of cultus. As in the case of "saint," the right of declaring the holy dead to be "confessors" was ultimately reserved to the Holy See; King Edward of England thus was made a "Confessor" on his canonization by Alexander III in 1161. (2) For the functions of the confessor in the second sense, *see* the article CONFESSION.

CONFIRMATION in the Christian sense is one of the three sacraments of initiation into the church, the other two being baptism and the Eucharist. In the primitive church, confirmation followed baptism as its complement, and confirmation in turn was followed by the Eucharist. If baptism made of its recipients children of God and members of the church on earth, confirmation gave to the newly baptized the gift of the Holy Ghost in His fullness, in order to strengthen them in the faith.

In the New Testament there are clear indications that Christ promised to give the Holy Ghost to His followers: "You shall receive the power of the Holy Ghost coming upon you, and you shall be witnesses unto me . . . even to the uttermost parts of the earth" (Acts i, 8). This promise was strikingly fulfilled on Pentecost when the Holy Spirit descended in visible form upon the apostles and disciples (Acts ii). What this descent of the Holy Spirit was for the apostles and disciples on Pentecost, the sacrament of confirmation has been for the members of the church in succeeding ages.

In the primitive church the coming of the Holy Spirit was sometimes accompanied by certain extraordinary gifts (*charismata*), such as the gift of speaking strange tongues. There was no necessary connection between the two, however, for often the Holy Spirit was given without the *charismata*, and vice versa. When Philip the deacon had baptized the Samaritans, the apostles Peter and John "laid their hands upon them and they received the Holy Ghost" (Acts viii, 17). No mention is made of any extraordinary manifestations accompanying this gift of the Holy Spirit.

Confirmation in the New Testament is represented as a distinct rite and not merely as part of the baptismal ceremony. The Samaritans (Acts viii) and the Ephesians (Acts xix) were first baptized and then, after a lapse of time, they received the gift of the Spirit through the imposition of hands. Prayer and the imposition of hands are the regular means of conferring this gift in the Scriptures. It is possible, but by no means certain, that in apostolic times an anointing with oil was also part of the rite (*cf.* II Cor. i, 21–22; I John ii, 20, 27). The Gospels do not record the actual institution of the sacrament of confirmation by Christ. The presumption is, however, that He did institute it, since He not only promised to send the Holy Spirit upon His followers but meant this to be a normal process in His Church.

Outside the New Testament explicit references to confirmation begin as early as the 3rd century. Tertullian (d. *cir.*, 240), describing the rite of Christian initiation, says that, after baptism and an anointing, "the hand is laid upon us through the blessing, calling and inviting the Holy Spirit" (*De Baptismo*, viii). The name confirmation goes back at least to St. Leo the Great (pope from 440–461). Before this time the rite was more commonly known as the "imposition of hands," "unction," "chrism," "sealing" and "strengthening." The imposition of hands seems to be the only rite for the first three centuries; in the fourth, an anointing with chrism (a mixture of olive oil and balsam blessed by a bishop) came into use especially in the east, where it supplanted the imposition of hands altogether. In the west the older imposition of hands was retained but it became more and more closely associated with the chrismation.

In the east confirmation is conferred as a rule upon infants immediately after their baptism. The priest, however, uses chrism blessed by the bishop for this purpose. Among the Greeks the form of words said during the anointing is: "The seal of the gift of the Holy Ghost. Amen." In the Latin Church it is customary to wait until the seventh year before conferring this sacrament. It is normally administered by the bishop, who simultaneously imposes his hand and anoints with chrism the forehead of the candidate (*see* Canon 780 of the *Code of Canon Law*). Only in exceptional cases may a priest administer this sacrament, and then only with proper authorization.

The Latin form is the following: "I sign thee with the sign of the cross, and I confirm thee with the chrism of salvation, in the name of the Father and of the Son and of the Holy Ghost. Amen."

At the Reformation, confirmation ceased to be regarded as a sacrament on a par with baptism and the Eucharist by those who separated from the Church of Rome. Where it was retained, it came to mean not so much a rite whereby one was confirmed as a means of confirming one's baptismal vows, as among the Lutherans.

Because of their emphasis upon the importance of personal faith and conviction, the Reformers laid it down as a rule that confirmation should be put off until the candidate could learn the catechism and the fundamentals of the faith. In the Anglican Church confirmation is classed among the "five commonly called Sacraments" which "are not to be counted for Sacraments of the Gospel" (art. 25 of the 39 Articles).

In 1661 a solemn renewal of baptismal vows by the candidates was added to the confirmation service in the Book of Common Prayer. In England this has often been taken as the essential feature of the rite, although the tendency today is to deny this and to see the essence of the confirmation ceremony in the laying on of hands of the bishop "after the example of the holy Apostles" (prayer in the Confirmation Service). In recent years, considerable discussion has arisen among Anglican theologians as to the nature and relation of the gifts conferred in baptism and confirmation respectively. According to Darwell Stone (*Holy Baptism*, 3rd ed., 1901, ch. v, pp. 66–85), the personal indwelling of the Holy Spirit is given in baptism; the complement of this, or a fresh gift of the same Holy Spirit, is conveyed in confirmation.

Confirmation among the Jews is a modern rite, dating from 1810. It bears a close resemblance to Bar Mizwah, with the exception that it provides for the consecration of Jewish maidens as well as boys to their religious duties (*see Jewish Encyclopedia*, "Confirmation").

Bibliography.—Various writers, *Confirmation*, 2 vols. (S. P. C. K.), 1926; Adhémar d'Ales, *Baptism and Confirmation*, 1929; A. Villien, *The History and Liturgy of the Sacraments*, 1932; Matthias Laros, *Confirmation in the Modern World*, 1938; and Joseph Pohle-Arthur Preuss, *The Sacraments*, Vol. 1, 1942. (W. R. O.)

CONFIRMATION OF BISHOPS. In canon law confirmation is the act by which the election of a new bishop receives the assent of the proper ecclesiastical authority. In the early centuries of the history of the Church the election or appointment of a suffragan bishop was confirmed and approved by the metropolitan and his suffragans assembled in synod. By the 4th canon of the first council of Nicaea (A.D. 325), however, it was decreed that the right of confirmation should belong to the metropolitan bishop of each province, a rule confirmed by the 12th canon of the council of Laodicaea. For the appointment of a metropolitan no papal confirmation was required either in the West or East; but the practice which grew up, from the 6th century onwards, of the popes presenting the pallium (*q.v.*) at first *honoris causa*, to newly appointed metropolitans gradually came to symbolize the licence to exercise metropolitan jurisdiction. By the 8th and 9th centuries the papal right of confirmation by this means was strenuously asserted; yet as late as the 13th century there were instances of metropolitans exercising their functions without receiving the pallium, and it was not till after this date that the present rule and practice of the Roman Catholic Church was definitively established. (*See* Hinschius, *Kirchenrecht*, ii. p. 28 and notes.) The canonical right of the metropolitan to confirm the election of his suffragans was still affirmed by Gratian; but from the time of Pope Alexander III. (1159–81) the canon lawyers, under the influence of the False Decretals, began to claim this right for the pope (Febronius, *De statu ecclesiae*, 2nd ed., 1765, cap. iv. § 3, 2). From the 13th century onwards it was effectively exercised, though the all but universal practice of the popes of reserving and providing to vacant bishoprics, initiated by Clement V., obscured the issue, since in the case of papal nominations no confirmation was required. The question, however, was raised, in connection with that of the papal reservations and provisions, at the councils of Constance and Basel. The former shelved it in the interests of peace; but the latter once more formulated the principle that elections in the churches were to be free and their result confirmed according to the provisions of the common law (*juxta juris communis dispositionem*), *i.e.*, by "the immediate superior" to whom the right of confirmation belonged (Febronius, *op. cit.* Appendix, p. 784).

In England, where the abuse of provisors had been most acutely felt, the matter was dealt with during the vacancy of the Holy See between the deposition of John XXIII. at Constance (May 1415) and the election of Martin V. (Nov. 1417). During the interval the only possible way of appointing a bishop was by the ancient method of canonical election and confirmation. Shortly after the deposition of John XXIII., Henry V. assented to an ordinance that during the voidance of the Holy See bishops-elect should be confirmed by their metropolitans (*Rotuli Parliamentorum*, iv. p. 71); but the ordinance was not recorded on the Statute Roll. Three bishops only, namely, John Chaundeler of Salisbury, Edmund de Lacey of Hereford and John Wakering of Norwich, were confirmed by the archbishop of Canterbury during the papal vacancy. When Martin V. was elected pope in 1417 he resumed the practice of providing bishops, and from this time until the Reformation the canonical election and confirmation of a bishop in England was a rare exception.

In Roman Catholic countries the complete control of the papacy over the election and appointment of bishops has since the Reformation become firmly established, in spite of the efforts of Gallicans and "Febronians" to assert what they held to be the more Catholic usage (*see* GALLICANISM; FEBRONIANISM; BISHOP).

In England at the Reformation the share of the papacy in appointing bishops was abolished, but the confirmation became almost formal in character. By 25 Hen. VIII. c. 20, s. 4, it is provided that after an episcopal election a royal mandate shall issue to the archbishop of the province "requiring him to confirm the said election," or, in case of an archbishop-elect, to one archbishop and two bishops, or to four bishops, "requiring and commanding" them "with all speed and celerity to confirm" it. This practice still prevails in the case of dioceses which have chapters to elect. The confirmation has usually been performed by the archbishop's vicar-general, and, in the southern province, at the church of St. Mary-le-Bow, London; but after 1901 it was performed, in part, at the Church House, Westminster. All objectors are cited to appear on pain of contumacy after the old form; but although the knowledge that opposition might be offered has been a safeguard against improper nominations, *e.g.*, in the case of Dr. Clarke the Arian, confirmation has never been refused since the Reformation. *See* also BENEFICE; PROVISION.

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CONFISCATION, in Roman law the seizure and transfer of private property to the *fiscus* by the emperor; hence the appropriation, under legal authority, of private property to the State. In common law the term embraces forfeiture (*q.v.*) in the case of goods, and escheat (*q.v.*) in the case of lands, for crime or in default of heirs. Goods may also be confiscated for breaches of statutes relating to customs, excise or explosives. The word is used, popularly, of spoliation under legal forms, or of any seizure of property without adequate compensation. (*See* COMPENSATION.)

CONFOLENS, a town of south-western France, capital of an arrondissement in the department of Charente, 44 mi. N.E. of Angoulême by rail. Pop. (1936) 2,118. The ancient town, with steep narrow streets occupies a fine situation on the Vienne, which is crossed by a 15th century bridge. On the left bank is the 11th century church of St. Barthélemy. The ruined castle and the church of St. Maxime (15th century) are on the right bank. Confolens possesses a subprefecture and a tribunal of first instance: laces and paper are made.

CONFORMAL REPRESENTATION. Conformal geometry had its origin in the practical problem of so mapping the earth's curved surface upon a flat leaf of paper that differences of directions at any point of the surface shall be indicated by equal differences of direction at the corresponding point on the map. By the term *conformal representation* (also called isogonal, orthomorphic) is understood any continuous mapping of one surface or region upon another, with a one-to-one correspondence of their points, and in such manner that corresponding angles in the two surfaces or regions are equal. The term *conform* is due to Gauss, who referred thereby to the equivalent property that corresponding infinitesimally small triangles on the two surfaces tend to *conform, i.e.*, approach similarity, when their dimensions are indefinitely diminished. Thus suppose ABC to be a small triangle on one surface formed by three intersecting curves, and $A'B'C'$ the corresponding triangle on a second surface. As B and C approach

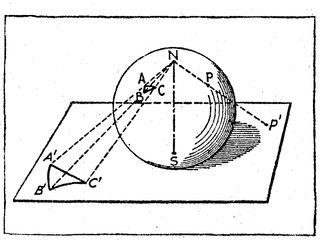

FIG. 1

A along BA and CA, correspondingly B' and C' will approach A' along $B'A'$ and $C'A'$. When the transformation is conformal, the sides of the rectilinear triangles ABC and $A'B'C'$ tend to become proportional, and the three angles of the two triangles to be respectively equal. Consequently the angle between the two curves meeting at A must be equal to the angle between the two corresponding curves at A'. A net of infinitesimal triangles closing around A so as to make up a curvilinear polygon enclosing A, is transformed into a similar polygon around A'. The ratio of magnification in passing from the triangles at A to those at A' varies in general with the position of A.

The earliest known conformal representation is the stereographic projection of Hipparchus (*c.* 140 B.C.) and Ptolemy (*c.* A.D. 150). Another early conformal representation was afforded by the familiar Mercator's projection (1568). (*See* MAP: *Map Projections.*)

Lambert (1772) was the first to seek the general conformal representation of the earth's surface on a plane, and Lagrange first noted its connection with functions of the complex variable. In 1822 the Society of Sciences at Copenhagen proposed as prize subject "the general solution of the problem to so build the parts of one given surface upon another given surface that the image shall be similar in its smallest parts to the (surface) imaged." The solution of this problem was obtained by Gauss and published in 1825 in a memoir (*Collected works*, vol. 4) which marks the beginning of a general theory of conformal representation. The next great step was due to Riemann (1859), and among the important contributors in the last 50 years Schwarz and Klein should be particularly mentioned.

Conformal Representation in a Plane.—If the points of the ordinary plane are represented by $z=x+iy$ where $i=\sqrt{-1}$, the bilinear transformation $z'=(az+b)/(cz+b)$ with real or complex coefficients, transforms the plane conformally upon itself, changing circles (inclusive of straight lines) into circles. This transformation may be resolved into a proper succession of simpler elementary transformations, viz., translations, rotations, magnifications, inversions and reflections on the axis of reals. The totality of these transformations and their combinations form a *group*, any succession of them resulting in a single bilinear transformation, or the same with z replaced by its conjugate. In an inversion, and likewise in a reflection, the *sense* of the angle is reversed; *i.e.*, clockwise angles are changed into anti-clockwise angles and vice versa. Correspondingly two classes of conformal transformations are distinguished—those with and those without change of angle-sense.

In his famous *Erlanger Program*, Klein revealed how the different kinds of geometry are associated each with a different collection or group of transformations. Each particular geometry is a study of the properties and theorems invariant under application of all transformations of the group. Ordinary Euclidean geometry rests on the so-called *principal group*, which results in combining in all possible ways translations, rotations, magnifications and reflections, and contains the theorems which are unaltered by these transformations. If with this group we combine all inversions of the plane with respect to its circles, we obtain a special conformal group, known as the *group of reciprocal radii.*

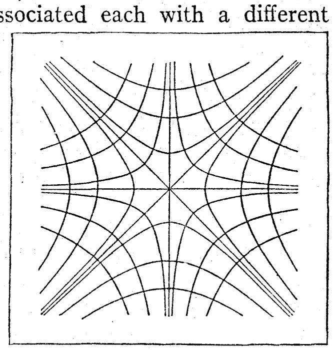

FIG. 2.—DIAGRAM ILLUSTRATING ORTHOGONAL SYSTEM OF HYPERBOLAS

The *general* conformal group of a plane or plane region comprises all conformal transformations into itself. Properties which are unaltered under this group constitute a *conformal geometry*, which has been only fragmentarily developed.

Consider a continuous reversible point-to-point transformation of the interior of a region of the ordinary (x,y)-plane into the interior of a region of the (u,v)-plane, by means of the functions $u=u(x,y)$, $v=v(x,y)$ provided with continuous first derivatives.

It is easily established (*see* W. F. Osgood, *Lehrbuch der Funktionentheorie*) that the necessary and sufficient condition that the two regions shall thereby be built conformally one on the other, without change of angle-sense, is that u and v shall satisfy the Cauchy-Riemann differential equations, $\frac{\partial u}{\partial x}=\frac{\partial v}{\partial y}$, $\frac{\partial u}{\partial y}=-\frac{\partial v}{\partial x}$, the conformality ceasing only in the points where these derivatives are all zero. In other words, $w=u(x,y)+iv(x,y)$ must be an *analytic* function of $z=x+iy$ in the region considered. Conformal geometry enters, therefore, into the very warp and woof of the theory of analytic functions. To obtain a conformal transformation we have only to select any analytic function, $w=f(z)$—for instance, z^n, e^z, or $\sin z$,—with restricted or unrestricted domain, and split the function into its real and imaginary parts, $f(z)=u(x,y)+iv(x,y)$. The equations $u=u(x,y)$, $v=v(x,y)$ then map any portion of the z-domain, in which $f(z)$ is analytic, into a corresponding domain of the w-plane. The conformality ceases only at the isolated points for which $f'(z)=0$. The w-region may overlap itself if too large a portion of the z-plane is taken, giving rise then to an overlapping *Riemann surface*.

By the analytic transformation $w=f(z)$ just indicated, families of orthogonal straight lines $x=c_1$, $y=c_2$ are mapped into orthogonal families of curves in the (u,v)-plane, and likewise the curves $u=c_1$, $v=c_2$ into an orthogonal system in the (x,y)-plane. For example, if $f(z)=(x+iy)^2$, we get $u=x^2-y^2$, $v=2xy$, and the orthogonal system $u=c_1$, $v=c_2$ consisting of straight lines parallel to the axes of the (u,v)-plane, is mapped into an orthogonal system of equilateral hyperbolas, $x^2-y^2=c_1$, $2xy=c_2$. This is perhaps the simplest method of securing orthogonal systems of curves, which are of fundamental importance in hydrodynamics, electricity and potential theory where the curves of one system are interpreted as lines of force or stream lines, and those of the orthogonal system as equipotential or level lines.

Riemann's Problem.—In his inaugural dissertation (1851) Riemann proposed the problem whether any simply connected region of a plane can be built conformally upon any other such region. This is undoubtedly the central problem in the conformal geometry of the plane. To answer the question affirmatively it is obviously sufficient to show that each of the regions can be mapped conformally upon a circle. Riemann's proof of this fact was vitiated by the famous Dirichlet principle, later recognized to be true only under limitations, and he failed to distinguish between the problem of merely building their interiors conformally upon each other and the more complicated problem arising when their boundaries are also brought under consideration. The first complete proof that the interior (R) of any simply connected region, no matter how intricate its boundary, can be built conformally upon the interior of a circle, was given by Osgood in 1900. If its boundary is a Jordan curve, it will simultaneously be mapped continuously point-to-point on the perimeter of the circle (C. Carathéodory, article in *Math. Ann.*, Leipzig, 1913). Satisfactory results regarding the conformal mapping of doubly connected regions, etc., have been obtained by Koebe (1915–18).

The uniqueness of the conformal transformation of the region (R) into the circle or its equivalent, the half-plane, can be secured in various ways, for instance, by requiring that three boundary points of (R) shall pass over into three preassigned perimeter points of the circle or half-plane. The analytic function $w=f(z)$ which effects the transformation is thereby uniquely defined. For example, the requirement that a rectangle $E_1E_2E_3E_4$ shall be built upon the half-plane of z above its real axis defines the analytic function

$$(wz)\equiv\int_{e_1}^{z}\frac{dz}{\sqrt{(z-e_1)\,(z-e_2)\,(z-e_3)\,(z-e_4)}},$$

in which e_1, e_2, e_3, e_4, are the points on the real z-axis (three of them arbitrarily selected) which correspond to the vertices E_1, E_2, E_3, E_4 of the rectangle and at which the conformality of the representation breaks down. Properties of the function $w=f(z)$ manifest themselves in the shape of the region (R), and accordingly conformal representation can be used for their study. In particular, it has been an invaluable aid in the development of the theory of hypergeometric, elliptic modular, and automorphic functions.

Conformal Representation of One Surface upon Another.—It is easily established that any ordinary surface can be built conformally upon any other with, of course, the admission of points where the conformality ceases. For suppose the position of the points on one of these surfaces to be fixed by $x_1=f_1(u,v)$, $x_2=f_2(u,v)$, $x_3=f_3(u,v)$; then the formula for the length of arc on the surface has the form $ds^2=dx^2+dy^2+dz^2=Edu^2+2Fdu\,dv+Gdv^2$, in which E, F, G are functions of u and v. Let ds^2 be resolved into its factors $\frac{Edu+Fdv\pm i\sqrt{EG-F^2}\cdot dv}{\sqrt{E}}$, in which the quantity under each radical is necessarily positive, inasmuch as ds^2 is positive irrespective of the relative values of du and dv. Let $\mu(u,v)\pm i\lambda(u,v)$ be the integrating factors by which we must multiply these two factors to make them complete differentials, and denote these differentials by $d\phi(u,v)\pm i\psi(u,v)$; then ds^2 takes the form $\frac{d\phi^2+d\psi^2}{\lambda^2+\mu^2}$. If ϕ,ψ are plotted as ordinary rectangular co-ordinates in a plane, the corresponding arc in the plane is $ds_1=\sqrt{d\phi^2+d\psi^2}$. Since ds and ds_1 are proportional, it follows that the surface is built conformally upon the plane. Similarly, the other surface can be built upon the plane. Then, since by Riemann's theorem any two simply connected pieces of the plane can be built conformally the one on the other, it follows that the two surfaces can be mapped conformally on each other, as stated above. When *isothermic* co-ordinates ϕ,ψ are used to fix the position of a point on one surface and likewise isothermic co-ordinates ϕ_1, ψ_1 on the other, $\phi+i\psi$ is an analytic function of $\phi_1+i\psi_1$.

A special case of note is that in which corresponding infinitesimal arcs ds, ds_1 on the two surfaces are not merely proportional but equal. The two surfaces are then *applicable* one to the other; *i.e.*, they can be applied one to the other without stretching, somewhat as we would roll a leaf of paper into a cylinder. Another important case is that in which a minimal surface is built conformally on a sphere. This is accomplished very simply by drawing the normal at each point P of the minimal surface, and then taking, as the corresponding point P' on the sphere, the point in which it is cut by a ray drawn through the centre of the sphere, parallel to the normal and like directed. In this and other cases the conformal representation is of value in studying the surface.

Conformal Representation for a Space of Three or More Dimensions.—Quite contrary to what might be naturally expected, the conclusions for two dimensions cannot be carried over bodily to a space of three or more dimensions. According to a notable theorem of Liouville the group of all conformal transformations for $n\geqq 3$ is identical with the group of reciprocal radii, that is, with the group resulting from combination of the principal group of rigid transformations (translations, rotations, magnifications and reflections) with inversions with respect to hyperspheres $\Sigma\,(x_i-a_i)^2=a^2$, $(i=1,2\cdot\cdot\cdot,n)$. Accordingly there is nothing analogous to the conformal representation of a region of the z-plane upon a w-region by means of an arbitrarily selected analytic function $w=f(z)$.

Klein has pointed out a second noteworthy fact which is also without analogue in two dimensions, viz., for $n>2$ the conformal geometry of an Euclidean space of n-dimensions is identical with the projective geometry of a hypersphere in $n+1$ dimensions which is transformed into itself projectively in the most general manner. Various topics have been treated in conformal geometry of n-dimensions such as the possibility of referring non-Euclidean to Euclidean space conformally, but the development must be regarded as fragmentary.

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CONFUCIANISM, a misleading general term for the teachings of the Chinese classics upon cosmology, the social order, government, morals and ethics. Confucius is not the founder of the system, but is the transmitter of the teachings of antiquity and the editor of some of the classics. Mencius (372–289 B.C.) interpreted the work of Confucius. Confucianism was formulated in the Han dynasty (206 B.C.–A.D. 221). In the first century of our era the system came into contact with Buddhism and underwent certain changes which were interpreted by Chu Hsi (1130–1200) and by Wang Yang Ming (1472–1528). Though the government of the Manchu dynasty (1644–1912) made Chu Hsi's commentaries the standard, scholars attempted to restore the primitive teaching of Confucius and the ancients but were hindered by the impact of the West upon Chinese culture.

Cosmology.—In cosmology Confucianism starts out with an impersonal cosmic energy and principle which produced the *yin* and the *yang*, the negative and the positive principles. These by their interaction produced Heaven and Earth and all beings. The social order evolved from the universal order and models of government, social life and morals existed in the universal order as ideas or images. These were transmitted as symbols to the saints and the sages and interpreted and adapted by them to the needs of the people.

Government.—The government was modelled upon that of the patriarchal family, the country being regarded as a large family. The emperor was considered as appointed by Heaven to be the father and the mother of the people and ruled as a benevolent patriarch. The conception of the State as an abstract entity was never developed. The emperor was assisted by the officials recruited from the people on the basis of a civil examination in the classics. They were arranged in ranks, each possessing certain rights and duties and were bound together and to the emperor by a rigid ceremonial. The emperor and officials united all the functions of government, being the priests, executives, the law-makers and the judges. The government was one of men rather than of laws.

Moral System.—The moral system started with the axiom that all men were by nature good, formulated by Mencius. A corollary to this was the dogma that goodness is developed by the study of the classics. Society was divided into five relations: ruler-subject, father-son, husband-wife, older brother-younger brother, friend-friend. The fundamental theory underlying these relations was that of reciprocity expressed by the words, "What you do not wish done to yourself do not do to the other man," essentially the principle of the Golden Rule.

The virtues were finally grouped under five: love, the root of all the others, corresponding to our word humanity in its old meaning; justice, which assigns to each one his place and his duties and rights in that status; reverence, through which the rights are acknowledged and the duties performed; wisdom, which discriminates between good and evil; sincerity, which imparts reality to all. The outstanding virtue was filial piety, which also includes loyalty and is the outgrowth of reverence.

As Ethics.—Confucianism as an ethical system was a mixture of nature worship and ancestor worship. There were three classes of sacrifices under the last dynasty: the great sacrifices, namely, Heaven, Earth, the imperial ancestors and the gods of the grain and of the ground; the middle sacrifices, to the sun, moon, certain cultural heroes including Confucius and nature gods; the general sacrifices, performed entirely by the officials, including cultural heroes, nature gods and departmental deities. To the people were left their ancestors and gods approved by the State. The emperor as the high priest of the nation worshipped Heaven at the winter solstice and Earth at the summer solstice. The purpose of the worship was the conservation and the perpetuation of this system.

In China the establishment of the republic in 1912 brought with it far-reaching changes. The relation between Heaven and the emperor upon which the government was based was abandoned and the new idea that the people are the real rulers of China is being inculcated. Confucianism ceased to be a State system, though certain practices have survived. It has become a type of church and is slowly trying to collect and organize its heritage. The new cult is being established about Confucius. Religious toleration, however, is granted by the constitution and Confucianism after over 2,000 years as the dominant State system is taking its place as one of the cults of China. *See* CONFUCIUS.

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CONFUCIUS (550 or 551–478 B.C.), the famous Sage of China. He was born, according to the historian Sze-ma Ch'ien, in the year 550 B.C.; according to Kung-yang and Kuh-liang, two earlier commentators on his *Annals of Lu*, in 551; but all three agree in the month and day assigned to his birth, which took place in winter. His clan name was K'ung, and Confucius is merely the latinized form of K'ung Fu-tze, meaning "the philosopher or master K'ung." He was a native of the state of Lu, a part of the modern Shan-tung, embracing the present department of Yen-chow and other portions of the province. Shuh-liang Heih, the father of Confucius, was commandant of the district of Tsow. Confucius was the son of Heih's old age.

Heih died in the child's third year, leaving his family in straitened circumstances. Long afterwards, when Confucius was complimented on his acquaintance with many arts, he accounted for it on the ground of the poverty of his youth. When he was five or six, people took notice of his fondness for playing with his companions at setting out sacrifices, and at postures of ceremony. He tells us himself that at fifteen his mind was set on learning; and at 19 he was married,—his wife being from his ancestral state of Sung. A son was born in the following year; and he had subsequently two daughters. Immediately after his marriage we find him employed under the chief of the Ki clan to whose jurisdiction the district of Tsow belonged, first as keeper of stores, and then as superintendent of parks and herds.

In his 22nd year Confucius established a school, not of boys to be taught the elements of learning, but of young and enquiring spirits who wished to be instructed in the principles of right conduct and government. He accepted the substantial aid of his disciples; but he rejected none who could give him even the smallest fee, and he would retain none who did not show earnestness and capacity. Thereafter, in 517 B.C. two scions of one of the principal houses in Lu joined the company of his disciples in consequence of the dying command of its chief; and with them he visited the capital of the kingdom. There he examined the treasures of the royal library, and studied the music which was found in its highest style at the court. There, too, according to Sze-ma Ch'ien, he had several interviews with Lao-tsze, the father of Taoism. It is characteristic of the two men that the latter, a transcendental dreamer, appears to have thought little of his visitor, while Confucius, an inquiring thinker, was profoundly impressed with him.

On his return to Lu, in the same year, that State fell into great disorder. The marquis was worsted in a struggle with his ministers, and fled to the neighbouring state of Ts'i. Thither also went

Confucius, for he would not countenance by his presence the men who had driven their ruler away. He was accompanied by many of his disciples. As they passed by the T'ai mountain, the attention of the travellers was arrested by a woman weeping and wailing at a grave. The sage stopped, and sent one of his followers to ask the reason of her grief. "My husband's father," said she, "was killed here by a tiger, and my husband also, and now my son has met the same fate." Being asked why she did not leave so fatal a spot, she replied that there was there no oppressive Government. "Remember this," said Confucius to his disciples, "remember this, my children, oppressive government is fiercer and more feared than a tiger."

He did not find in Ts'i a home to his liking. The marquis of the State was puzzled how to treat him. The teacher was not a man of rank, and yet the prince felt that he ought to give him more honour than rank could claim. Some counsellors of the court spoke of him as "impracticable and conceited, with a thousand peculiarities." It was proposed to assign to him a considerable revenue, but he would not accept it while his counsels were not followed. Dissatisfactions ensued, and he went back to Lu.

There for 15 more years he continued in private life, prosecuting his studies, and receiving many accessions to his disciples. He had a difficult part to play with the different parties in the State, but kept aloof from them all; and at last, in his 52nd year, he was made chief magistrate of the city of Chung-tu. A marvellous reformation, we are told, forthwith ensued in the manners of the people; and the marquis, a younger brother of the one that fled to Ts'i and died there, called him to higher office. He was finally appointed minister of crime,—and there was an end of crime. Two of his disciples at the same time obtained influential positions in the two most powerful clans of the State, and cooperated with him. He signalized his vigour by the punishment of a great officer, and in negotiations with the State of Ts'i he laboured to restore to the marquis his proper authority, and as an important step to that end, to dismantle the fortified cities where the great chiefs of clans maintained themselves like the barons of feudal Europe. "He strengthened the ruler," it is said, "and repressed the barons. A transforming Government went abroad. Dishonesty and dissoluteness hid their heads. Loyalty and good faith became the characteristics of the men, and chastity and docility those of the women. He was the idol of the people, and flew in songs through their mouths."

But the marquis of Ts'i and his advisers saw that if Confucius were allowed to prosecute his course, the influence of Lu would become supreme throughout the kingdom, and Ts'i would be the first to suffer. A large company of beautiful women, trained in music and dancing, and a troop of fine horses, were sent to Lu. The bait took; the women were welcomed, and the sage was neglected. Confucius felt that he must leave the State. The neglect of the marquis to send round, according to rule, among the ministers portions of the flesh after a great sacrifice, furnished a plausible reason for leaving the court. He withdrew, though very unwillingly and slowly, hoping that a change would come over the marquis and his counsellors, and a message of recall be sent to him. But no such message came; and he went forth in his 56th year to a weary period of wandering among various States.

His Ideas of Government.—A disciple once asked Confucius what he would consider the first thing to be done, if entrusted with the government of a State. His reply was, "The rectification of names." When told that such a thing was wide of the mark, he held to it, and indeed his whole social and political system was wrapped up in the saying. He had told the marquis of Ts'i that good government obtained when the ruler was ruler, and the minister minister; when the father was father, and the son son. Society, he considered, was an ordinance of Heaven, and was made up of five relationships—ruler and subject, husband and wife, father and son, elder brothers and younger, and friends. There was rule on the one side of the first four, and submission on the other. The rule should be in righteousness and benevolence; the submission in righteousness and sincerity. Between friends the mutual promotion of virtue should be the guiding principle. It was true that the duties of the several relations were being continually violated by the passions of men, and the social state had become an anarchy. But Confucius had confidence in the preponderating goodness of human nature, and in the power of example in superiors. "Not more surely," he said, "does the grass bend before the wind than the masses yield to the will of those above them." Given the model ruler, and the model people would forthwith appear. And he himself could make the model ruler. He could tell the princes of the States what they ought to be; and he could point them to examples of perfect virtue in former times. With his own lessons and those patterns, any ruler of his day, *who would listen to him,* might reform and renovate his own State, and his influence would break forth beyond its limits till the face of the whole kingdom should be filled with a multitudinous relation-keeping, well-fed, happy people. "If any ruler," he once said, "would submit to me as his director for 12 months, I should accomplish something considerable; and in three years I should attain the realization of my hopes."

His Disciples.—His professed disciples amounted to 3,000, and among them were between 70 and 80 whom he described as "scholars of extraordinary ability." The most attached of them were seldom long away from him. They stood or sat reverently by his side, watched the minutest particulars of his conduct, studied under his direction the ancient history, poetry and rites of their country, and treasured up every syllable which dropped from his lips. They have told us how he never shot at a bird perching nor fished with a net, the creatures not having in such a case a fair chance for their lives; how he conducted himself in court and among villagers; how he ate his food, and lay in his bed, and sat in his carriage; how he rose up before the old man and the mourner; how he changed countenance when it thundered, and when he saw a grand display of viands at a feast. He was free and unreserved in his intercourse with them, and was hurt once when they seemed to think that he kept back some of his doctrines from them. Several of them were men of mark among the statesmen of the time. It was they who set the example of speaking of him as the greatest of mortal men.

Thirteen years elapsed before Confucius returned to Lu. In this period were comprised his travels among the different States, when he hoped, and ever hoped in vain, to meet with some prince who would accept him as his counsellor, and initiate a Government that should become the centre of a universal reformation. Several of the princes were willing to entertain and support him; but for all that he could say, they would not change their ways.

It was in his 69th year, 483 B.C., that Confucius returned to Lu. One of his disciples, who had remained in the State, had been successful in the command of a military expedition, and told the prime minister that he had learned his skill in war from the master,—urging his recall, and that thereafter mean persons should not be allowed to come between the ruler and him. The State was now in the hands of the son of the marquis whose neglect had driven the sage away; but Confucius would not again take office. Only a few years remained to him, and he devoted them to the completion of his literary tasks, and the delivery of his lessons to his disciples.

His Death.—The next year was marked by the death of his son, which he bore with equanimity. But on the death of his favourite disciple, Yen Hwui, in 481 B.C., he wept and mourned beyond what seemed to his other followers the bounds of propriety, exclaiming that Heaven was destroying him. His own last year, 478 B.C., dawned on him with the tragic end of his next beloved disciple, Tze-lu. Early one morning, we are told, in the fourth month, he got up, and with his hands behind his back, dragging his staff, he moved about his door, crooning over:

> The great mountain must crumble,
> The strong beam must break,
> The wise man must wither away like a plant.

Tze-kung heard the words, and hastened to him. The master told him a dream of the previous night, which, he thought, presaged his death. "No intelligent ruler," he said, "arises to take me as his master. My time has come to die." He took to his bed, and after seven days expired. He uttered no prayer, and he betrayed no apprehension.

When their master thus died, his disciples buried him with great pomp. A multitude of them built huts near his grave, and remained there, mourning as for a father, for nearly three years; and when all the rest were gone, Tze-kung, the last of his favourite three, continued alone by the grave for another period of the same duration. The news of his death went through the States. The man who had been neglected when alive seemed to become all at once an object of unbounded admiration.

The grave of Confucius is in a large rectangle separated from the rest of the K'ung cemetery, outside the city of K'iuh-fow. A magnificent gate gives admission to a fine avenue, lined with cypress trees and conducting to the tomb, a large and lofty mound, with a marble statue in front, bearing the inscription of the title given to Confucius under the Sung dynasty: "The most sagely ancient Teacher; the all-accomplished, all-informed King." A little in front of the tomb, on the left and right, are smaller mounds over the graves of his son and grandson, from the latter of whom we have the remarkable treatise called *The Doctrine of the Mean.* All over the place are imperial tablets of different dynasties, with glowing tributes to the one man whom China delights to honour; and on the right of the grandson's mound is a small house said to mark the place of the hut where Tze-kung passed his nearly five years of loving vigil. The adjoining city is still the home of the K'ung family; and there are said to be in it some 40,000 or 50,000 of the descendants of the sage.

His Influence on China.—The dynasty of Chow finally perished two centuries and a quarter after the death of the sage at the hands of the first historic emperor of the nation,—the first of the dynasty of Ts'in, who swept away the foundations of the feudal system. State after State went down before his blows, but the name and followers of Confucius were the chief obstacles in his way. He made an effort to destroy the memory of the sage from off the earth, consigning to the flames all the ancient books from which he drew his rules and examples (save one), and burying alive hundreds of scholars who were ready to swear by his name. But Confucius could not be so extinguished. The tyranny of Ts'in was of short duration, and the next dynasty, that of Han, while entering into the new China, found its surest strength in doing honour to his name, and trying to gather up the wreck of the ancient books. It is difficult to determine what there was about Confucius to secure for him the influence which he has wielded. He left no writings in which he detailed the principles of his moral and social system. *The Doctrine of the Mean,* by his grandson Tze-sze, and *The Great Learning,* by Tsăng Sin, the most profound, perhaps, of his disciples, give us the fullest information on that subject, and contain many of his sayings. The *Lun-Yü,* or Analects, "Discourses and Dialogues," is a compilation in which many of his disciples must have taken part, and has great value as a record of his ways and utterances; but its chapters are mostly *disjecta membra,* affording faint traces of any guiding method or mind. Mencius, Hsiin K'ing and writers of the Han dynasty, whose works, however, are more or less apocryphal, tell us much about him and his opinions, but all in a loose and unconnected way.

The sage, probably, did not think it necessary to put down many of his own thoughts in writing, for he said of himself that he was "a transmitter, and not a maker." Nor did he lay claim to have any Divine revelations. He was not born, he declared, with knowledge, but was fond of antiquity, and earnest in seeking knowledge there. The rule of life for men in all their relations, he held, was to be found within themselves. The right development of that rule, in the ordering not of the individual only, but of society, was to be found in the words and institutions of the ancient sages.

China had a literature before Confucius. All the monuments of it, however, were in danger of perishing through the disorder into which the kingdom had fallen. The feudal system that had subsisted for more than 1,500 years had become old. Confucius did not see this, and it was impossible that he should.

China was, in his eyes, drifting from its ancient moorings, and the expedient that occurred to him to arrest the evil was to gather up and preserve the records of antiquity, illustrating and commending them by his own teachings. For this purpose he lectured to his disciples on the histories, poems and constitutional works of the nation. What he thus did was of inestimable value to his own countrymen, and all other men are indebted to him for what they know of China before his time, though all the contents of the ancient works have not come down to us.

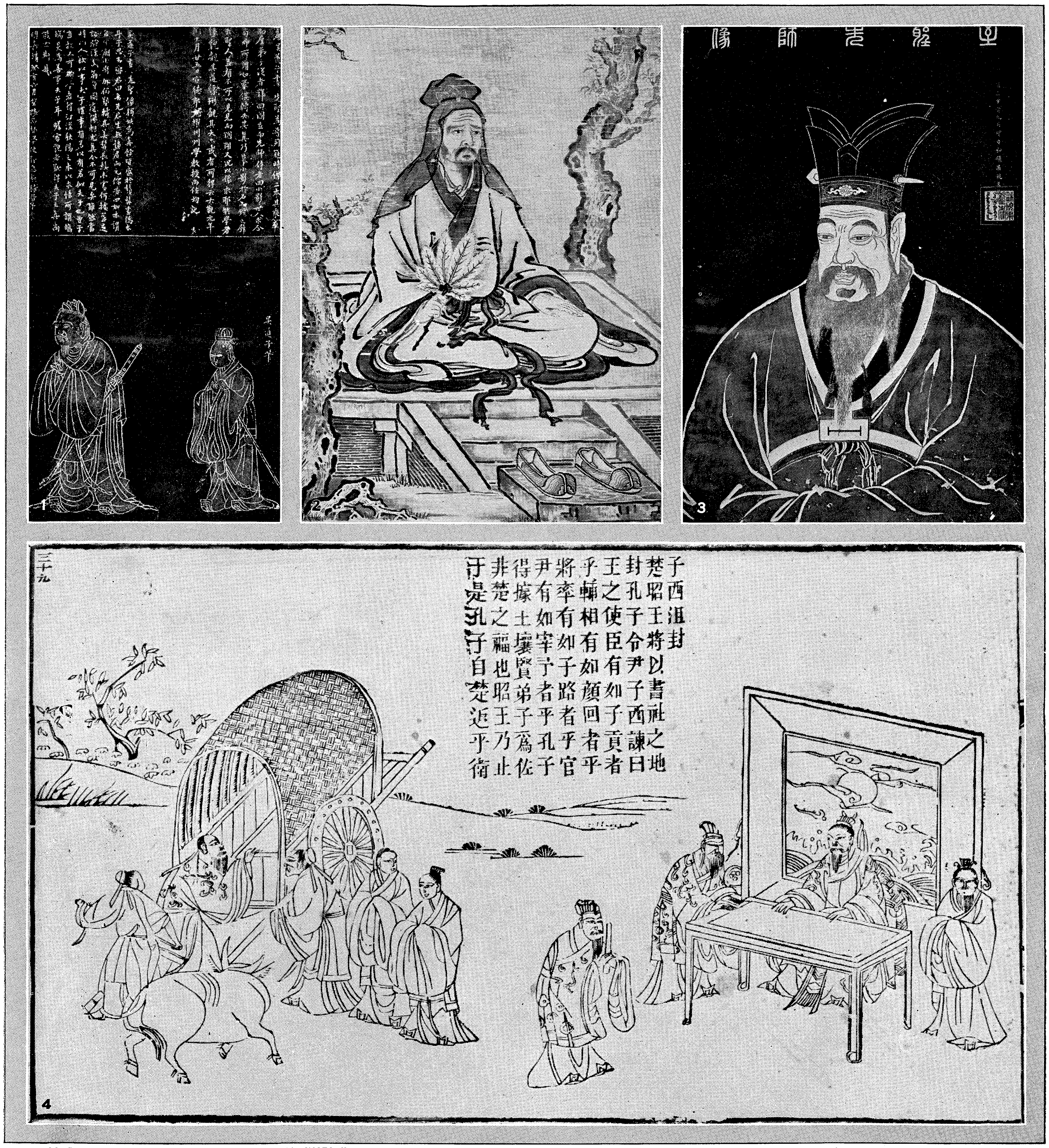
He wrote, we are told, a preface to the *Shu King,* or Book of Historical Documents. The preface is, in fact, only a schedule, without any remark by Confucius himself, giving the names of 100 books, of which it consisted. Of these we now possess 59, the oldest going back to the 23rd century, and the latest dating in the 8th century B.C. The credibility of the earlier portions, and the genuineness of several of the documents, have been questioned, but the collection as a whole is exceedingly valuable.

The *Shih king,* or Ancient Poems, as existing in his time, or compiled by him (as generally stated, contrary to the evidence in the case), consisted of 311 pieces, of which we possess 305. The latest of them dates 585 years B.C., and the oldest of them ascends perhaps twelve centuries higher. It is the most interesting book of ancient poetry in the world, and many of the pieces are really fine ballads. Confucius was wont to say that he who was not acquainted with the *Shih* was not fit to be conversed with, and that the study of it would produce a mind without a single depraved thought. This is nearly all we have from him about the poems.

The *Li ki,* or Book of Rites and Ancient Ceremonies and of Institutions, chiefly of the Chow dynasty, have come down to us in a mutilated condition. They are still voluminous, but they were edited, when recovered under the Han dynasty, with so many additions, that it is hardly worth while to speak of them in connection with Confucius, though much of what was added to them is occupied with his history and sayings.

Of all the ancient books not one was more prized by him than the *Yi-king,* or "The Book of Changes," the rudiments of which are assigned to Fuh-hi about the 30th century B.C. Those rudiments, however, are merely the 8 trigrams and 64 hexagrams, composed of a whole and a broken line (——, — —), without any text or explanation of them earlier than the rise of the Chow dynasty. The leather thongs, by which the tablets of Confucius's copy were tied together, were thrice worn out by his constant handling. He said that if his life were lengthened he would give 50 years to the study of the *Yi,* and might then be without great faults. This has come down to us entire. If not intended from the first for purposes of divination, it was so used both before and after Confucius, and on that account it was exempted, through the superstition of the emperor of the Ts'in dynasty, from the flames. It is supposed to give a theory of the phenomena of the physical universe, and of moral and political principles by the trigrams and the different lines and numbers of the hexagrams of Fuh-hi. Almost every sentence in it is enigmatic. As now published, there are always subjoined to it certain appendixes, which are ascribed to Confucius himself. Pythagoras and he were contemporaries, and in the fragments of the Samian philosopher about the "elements of numbers as the elements of realities" there is a remarkable analogy with much of the *Yi.*

A greater and more serious difficulty is presented by his last literary labour, the work claimed by him as his own, and which has already been referred to more than once as the *Annals of Lu.* Its title is the *Ch'un Ch'iu,* or "Spring and Autumn," the events of every year being digested under the heads of the four seasons, two of which are used by synecdoche for the whole. Mencius held that the composition of the *Ch'un Ch'iu* was as great a work as Yu's regulation of the waters of the deluge with which the *Shu King* commences, and did for the face of society what the earlier labour did for the face of nature. This work also has been preserved nearly entire, but it is excessively meagre. The events of 242 years barely furnish an hour or two's reading. Confucius's annals do not bear a greater porportion to the events which they indicate than the headings in our Bibles bear to the contents of the chapters to which they are prefixed. Happily Tso K'iu-ming took it in hand to supply those events, incorporating also others with them, and continuing his narratives over some additional



BY COURTESY OF (1, 3) THE CHICAGO NATURAL HISTORY MUSEUM, (2) THE MUSEUM OF FINE ARTS, BOSTON; FROM (4) "SHENG CHI T'U," (K'UNG HSIEN-LAT)

PORTRAITS OF CONFUCIUS

1. Confucius and his favourite disciple, Yen-tse, both carrying swords, from a rubbing of an engraving on stone dated A.D. 1563, after an earlier stone engraving dated 1107. Style of Ku K'ai-chih, painter of the 4th century
2. Centre panel of "Confucius at the 'Apricot Altar,'" a painting by Kano Tanyu (1602–1674), of the Kano school
3. Confucius, after a rubbing of a stone engraving dated A.D. 1734 in the Pei lin (the Museum of Inscriptions) at Sian. This portrait is typical of those representing Confucius as a kind-hearted old gentleman. The large ears, a sign of sincerity, and the rather flat nose, curved inward, are characteristic of his appearance as usually described some centuries after his death, and these features are emphasized in most of his portraits
4. Scene with inscription relating to the visit of Confucius to the court of Ch'u, where King Chao intended to confer on him as a fief the district Shu Shieh. According to the inscription, objections were raised by one of the king's ministers, who asked the king if he had another ambassador as brilliant as Tzu Kung, a minister as learned as Yen Hui or a general as clever as Tzu Lu, all disciples of Confucius. Upon the king's admitting that he had not, the minister pointed out that the interests of Ch'u would be endangered if power were conferred on Confucius, who had these talented disciples to assist him; and the king was thus dissuaded from his purpose. The ox cart at the left is supposed to have carried Confucius in his wanderings through the provinces and is depicted in many paintings of his life

years, so that through him the history of China in all its States, from year to year, for more than two centuries and a half, lies before us. Tso never challenges the text of the master as being incorrect, yet he does not warp or modify his own narratives to make them square with it; and the astounding fact is, that when we compare the events with the summary of them, we must pronounce the latter misleading in the extreme. Men are charged with murder who were not guilty of it, and base murders are related as if they had been natural deaths. Villains, over whose fate the reader rejoices, are put down as victims of vile treason, and those who dealt with them as he would have been glad to do are subjected to horrible executions without one word of sympathy. Ignoring, concealing and misrepresenting are the characteristics of the *Spring and Autumn.*

And yet this work is the model for all historical summaries in China. The want of harmony between the facts and the statements about them is patent to all scholars, and it is the knowledge of this, unacknowledged to themselves, which has made the literati labour with an astonishing amount of fruitless ingenuity and learning to find in individual words, and the turn of every sentence, some mysterious indication of praise or blame. But the majority of them will admit no flaw in the sage or in his annals. His example in the book has been very injurious to his country. One almost wishes that critical reasons could be found for denying its authenticity. Confucius said that "by the *Spring and Autumn* men would know him and men would condemn him." It certainly obliges us to make a large deduction from our estimate of his character and of the beneficial influence which he has exerted. The examination of his literary labours does not on the whole increase our appreciation of him. We get a higher idea of the man from the accounts which his disciples have given us of his intercourse and conversations with them, and the attempts which they made to present his teachings in some systematic form. If he could not arrest the progress of disorder in his country, nor throw out principles which should be helpful in guiding it to a better state under some new constitutional system, he gave important lessons for the formation of individual character, and the manner in which the duties in the relations of society should be discharged.

The Golden Rule.—Confucius on several occasions gave his "golden rule" deduced from his study of man's mental constitution. "What you do not like when done to yourself do not do to others." It has been said that he only gave the rule in a negative form to give force to a positive statement.

Another valuable contribution to ethical and social science was the way in which he inculcated the power of example, and the necessity of benevolence and righteousness in all who were in authority. He taught emphatically that a bad man was not fit to rule. As a father or a magistrate, he might wield the instruments of authority and punish the transgressors of his laws, but no force would countervail the influence of his example.

A few of his more characteristic sayings may here be given, the pith and point of which attest his discrimination of character, and show the tendencies of his views:

"What the superior man seeks is in himself; what the small man seeks is in others."

"The superior man is dignified, but does not wrangle; social, but not a partisan. He does not promote a man simply because of his words, nor does he put good words aside because of the man."

"A poor man who does not flatter, and a rich man who is not proud, are passable characters; but they are not equal to the poor who yet are cheerful, and the rich who yet love the rules of propriety."

"Learning, undigested by thought, is labour lost; thought unassisted by learning, is perilous."

"In style all that is required is that it convey the meaning."

"Extravagance leads to insubordination, and parsimony to meanness. It is better to be mean than insubordinate."

"A man can command his principles; principles do not master the man."

"The cautious seldom err."

Sententious sayings like these have gone far to form the ordinary Chinese character. Hundreds of thousands of the literati can repeat every sentence in the classical books; the masses of the people have scores of the Confucian maxims, and little else of an ethical nature in their memories,—and with a beneficial result.

His Ethics and Philosophy.—Confucius laid no claim, it has been seen, to Divine revelations. Man as he is, and the duties belonging to him in society, were all that he concerned himself about. Man's nature was from God; the harmonious acting out of it was obedience to the will of God; and the violation of it was disobedience. But in affirming this, there was a striking difference between his language and that of his own ancient models. In the *King* the references to the Supreme Being are abundant. With Confucius the vague, impersonal term, Heaven, took the place of the Divine name.

There were, we are told in the *Analects,* four things of which he seldom spoke—extraordinary things, feats of strength, rebellious disorder and spiritual beings. Whatever the institutions of Chow prescribed about the services to be paid to the spirits of the departed, and to other spirits, he performed reverently, up to the letter; but at the same time, when one of the ministers of Lu asked him what constituted wisdom, he replied: "To give one's self earnestly to the duties due to men, and while respecting spiritual beings, to keep aloof from them,—that may be called wisdom." Again, "While you cannot serve men," he once replied to the inquiry of Tze-lu, "how can you serve spirits?" The oracle of Confucius was equally dumb on another question. "While you do not know life," he said to the same enquirer, "what can you know about death?"

His teaching was thus hardly more than a pure secularism. He had faith in man, man made for society, but he did not care to follow him out of society, nor to present to him motives of conduct derived from the consideration of a future state. Good and evil would be recompensed by the natural issues of conduct within the sphere of time,—if not in the person of the actor, yet in the persons of his descendants. Confucius never appeared to give the evils of polygamy a thought. He mourned deeply the death of his mother; but no generous word ever passed his lips about woman as woman. Nor had he the idea of any progress or regeneration of society. It was no doubt the moral element of his teaching, springing out of his view of human nature, which attracted many of his disciples, and still holds the best part of the Chinese men of learning bound to him; but the conservative tendency of his lessons—nowhere so apparent as in the *Ch'un Ch'iu*—is the chief reason why successive dynasties have delighted to do him honour. (J. Le.; X.)

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CONGÉ D'ÉLIRE, a licence from the Crown in England issued under the great seal to the dean and chapter of the cathedral church of the diocese, authorizing them to elect a bishop or archbishop, as the case may be, upon the vacancy of any episcopal or archiepiscopal see in England or in Wales. According to the *Chronicle* of Ingulphus, abbot of Crowland, who wrote in the reign of William the Conqueror, the bishoprics in England had been, for many years prior to the Norman Conquest, royal donatives conferred by delivery of the ring and of the pastoral staff. Disputes arose for the first time between the Crown of England and the see of Rome in the reign of William Rufus, the pope claiming to dispose of the English bishoprics; and ultimately King John, by his charter *Ut liberae sunt electiones totius Angliae* (1214), granted that the bishops should be elected freely by the deans and chapters of the cathedral churches, provided the royal permission was first asked, and the royal assent was required after the election. This arrangement was confirmed by subsequent statutes passed in the reigns of Edward I. and Edward III. respectively, and the practice was ultimately settled in its present form by the statute Payment of Annates, etc., 1534. According to the provisions of this statute, upon the avoidance of any episcopal see, the dean and chapter of the cathedral church are to certify the vacancy of the see to the Crown, and to pray that they may be allowed to proceed to a new election. The Crown thereupon grants to the dean and chapter its licence under the great seal to elect a new bishop, accompanied by a letter missive containing the name of the person whom the dean and chapter are to elect. The dean and chapter are thereupon bound to elect the person so named by the Crown within 12 days, in default of which the Crown is empowered by the statute to nominate by letters patent such person as it may think fit, to the vacant bishopric. Upon the return of the election of the new bishop, the metropolitan is required by the Crown to examine and to confirm the election, and the metropolitan's confirmation gives to the election its canonical completeness. In case of a vacancy in a metropolitical see, an episcopal commission is appointed by the guardians of the spiritualities of the vacant see to confirm the election of the new metropolitan. (*See* CONFIRMATION OF BISHOPS.)

CONGLETON, HENRY BROOKE PARNELL, 1ST BARON (1776–1842), was the second son of Sir John Parnell. He was educated at Eton and Cambridge. From 1806–32, he was returned to parliament for Queen's county, and from 1833–37 for Dundee. He was raised to the peerage in 1841 as Baron Congleton of Congleton, but in 1842, he committed suicide. He was a liberal Whig, being commissioner of the treasury for Ireland in 1806, secretary at war in 1830–31 and paymaster of the forces and treasurer of the ordnance and navy from 1835–41. His most important treatise is that *On Financial Reform* (1830).

CONGLETON, municipal borough, east Cheshire, England, on the L.M.S.R. 8½ mi. S.S.W. of Macclesfield. Pop. (1938) 14,940. Area 8.7 sq.mi. It is in a deep valley, on the banks of the Dane, a tributary of the Weaver, with an important "gap" through the Pennines behind.

Congleton (*Congulton*) was held in Domesday by Hugh, earl of Chester. In the 13th century, the manor passed to Henry, earl of Lincoln, who by a charter dated 1282 declared the town a free borough, with a gild merchant. This charter was confirmed by successive sovereigns, with additional privileges. The governing charter, which held force until the Municipal Corporation Act of 1835, was granted by James I in 1624. Charters were also granted by Charles II and George IV. In 1272 Henry, earl of Lincoln, obtained a Saturday market and a three days' fair. This market is still held. In 1311 a Tuesday market is mentioned, and a fair at the feast of St. Martin. Henry VI granted a fair at the feast of SS. Philip and James. James I confirmed these and granted one on the Thursday before Quinquagesima Sunday. Congleton suffered severely from the plagues of 1603 and 1641. The grammar school was in existence as early as 1553. In the 16th and 17th centuries the leather laces known as "Congleton points" were in high repute. The town manufactures silk, which was introduced in 1752 by a Mr. Pattison of London. Coal is raised, and the other industries include weaving, finishing, stitching, etc., of textiles, agriculture and tobacco making. Congleton is served by the Macclesfield canal. It is in the Macclesfield parliamentary division of Cheshire.

CONGLOMERATE, in petrology, the term used for a coarsely fragmental rock consisting of rounded pebbles set in a finer grained matrix (from the Lat. *conglomerare,* to form into a ball, *glomus, glomeris;* so also the general term "conglomeration" for a miscellaneous collection of things gathered together in a mass). If the pebbles are angular, the rock is termed a *breccia* (*q.v.*). Conglomerate is thus merely consolidated gravel or shingle. The coarser constituents have attained their present rounded shapes by weathering and by attrition during transport by streams and the waves and currents of the sea. Their size varies considerably; occasionally they are 10 or 20ft. in diameter, but are usually a foot or less. Quartzites, cherts and flints, and vein-quartz being among the hardest and most durable of all rocks, are specially abundant in conglomerates; but granite, gneiss, sandstone and limestone are also of frequent occurrence. Although conglomerates occur in geological formations of all ages, they reach a considerable thickness only in the Palaeozoic rocks in Britain. In the old red sandstone of Scotland, for example, they are thousands of feet in thickness and consist largely of boulders of andesite, granite, quartzite, gneiss, etc.

The matrix in which the pebbles are embedded is usually formed of sandy material cemented by a siliceous, ferruginous, calcareous, dolomitic or clayey bond. The "Brockram" of the North of England is a well-known Permian limestone-conglomerate. The Dolomitic conglomerate of the Bristol district is a similar rock of Triassic age. The pebble-beds of the Bunter (Trias) are a valuable source of underground water-supply. For Crush-conglomerate *see* BRECCIA. (P. G. H. B.)

CONGO, formerly known as Zaire, the largest of the rivers of Africa and exceeded in size among the rivers in the world by the Amazon only. The Congo has a length of fully 3,000 m. and a drainage area estimated at 1,425,000 sq.m., with a diameter of some 1,400 m. either way. This vast area includes the equatorial basin of Central Africa and much of the surrounding plateaus. West and north the Congo basin is bounded by comparatively narrow bands of higher ground, while east and south the drainage area of the river includes considerable portions of the high plateau of east and south Central Africa. The main drainage of the Congo system is thus north and west, and these two directions dominate the great bow-like sweep of the main stream before it is deflected south on approaching the western highlands, through which it finally forces a way to the Atlantic Ocean. From the high lands of the south and east in which the headstreams of the Congo have their origin, the land falls in a succession of steps, generally marked by gorges or rapids in the upper courses of the streams. Besides the main stream most of the affluents are navigable for considerable distances; in all there are over 6,000 m. of navigable water in the Congo basin and 20,000 m. of overhanging wooded banks. On the Congo alone are over 4,000 islands, many of considerable length—some fifty of them are over ten miles long. The volume of water poured into the Atlantic is calculated at 1,200,000 cubic ft. or more per second.

Head-streams.—The easterly head-streams are regarded generally as marking the true course of the parent river. The most remote of these rivers is the Chambezi, which rises (in British territory) on the southern slope of the plateau between lakes Nyasa and Tanganyika at an elevation of about 6,000 feet. The watershed is formed by the crest of the plateau, and is perfectly distinguishable, save at a spot called Ikomba, about half-way between the lakes, where is a swamp which drains to both the Atlantic and the Indian oceans. The Chambezi source is in 9° 6′ S., 31° 20′ E. Its chief tributary, the Karungu, rises in 9° 50′ S., 33° 2′ E. After the junction of the Karungu and Chambezi the river flows in a south-westerly direction through a fairly fertile country. In its lower course it passes through papyrus marshes, and dividing into several channels, enters the vast swamp which adjoins the southern part of Lake Bangweulu (*q.v.*). The river, known as the Luapula (Great River), which issues from this swamp is a continuation of the Chambezi. The Luapula on leaving the swamp bends west and then south and approaches the watershed of the Zambezi. The source of its most southern affluent, and therefore the most southern point in the Congo basin, is approximately in 13° 30′ S. Turning north the Luapula precipitates itself down the Mumbatuta (or Mambirima) falls (12° 17′ S., 29° 15′ E.), the thunder of which can be heard on a still night for 8 or 9 miles. The river, the width of which varies from 250 to 1,200 yd., is almost unnavigable until below the Johnston falls, a series of rapids extending from 11° 10′ to 10° 30′ S. Below the falls the river is navigable by steamer all the way to Lake Mweru—a distance of 100 miles. Before entering Lake Mweru (*q.v.*), 100 m. below the Johnston falls, the Luapula again passes through a swampy region of deltaic character. The river (known now as the Luvua) makes its exit at the north-west corner of the lake, and bending westwards, passes across the zone of the Kebara and Mugila mountains, falling during this interval nearly 1,000 feet. In about 6° 45′ S., 26° 50′ E. it joins the Kamolondo (otherwise Lualaba), the main western branch of the Congo, which, as it flows in a broad level valley at a lower level than the eastern branch, is held by some to be the true head-stream.

The Kamolondo is formed by the junction of several streams having their source on the northern slope of the south-central plateau as it dips towards the equatorial basin. The streams flowing south from it belong to the Zambezi basin, but the watershed is not everywhere clearly defined. There is, however, no connection between the Zambezi and Congo systems. The Lualaba, also known as Nzilo, which is the main stream of the Kamolondo, rises at an altitude of 4,700 ft., in 26° 40′ E., just north of 12° S. East of the Lualaba—between it and the Luapula—rises the river Lufira. With many windings the Lualaba and Lufira pursue a generally northerly direction, passing through the Mitumba range in deep gorges, their course being broken by rapids for 40 or 50 miles. Below Konde rapids in 9° 20′ S. the Lualaba is, however, free from obstructions. (Just above the last of the series of rapids it is joined by the Lubudi, a considerable river and the westernmost of the Kamolondo affluents.) Between the rapids named and 7° 40′ S. its valley is studded with a chain of small lakes and backwaters. In the rainy season the whole region becomes a marsh; various grasses, especially papyrus, form floating islands, and the conditions generally recall the sudd region of the Nile. In about 8° 20′ S. the Lualaba and Lufira unite in one of these marshy lakes—Kisale—through which there is a navigable channel. The region watered by these western head-streams of the Congo includes Katanga and other districts, which are among the most valuable parts of the Belgian Congo. For practical purposes navigation down stream begins at Bukama, in about 9° 50′ N., the Lualaba there being some 300 yd. wide and 10 ft. deep. Bukama is in railway connection with Cape Town and with the lower Kasai.

The Upper Congo or Lualaba.—After the junction of the Luapula (Luvua) and the Lualaba (Kamolondo) the united stream, known as the Lualaba or Lualaba-Congo, and here over half a mile wide, pursues a north-north-west course towards the equator. The Dia rapids, some 300 m. below the Konde rapids, are the first obstruction to navigation encountered. A mile or two lower down the Lualaba passes through a narrow gorge called the Porte d'Enfer. From this point to as far north as 3° 10′ S. the course of the river is interrupted by falls and rapids. In this part of its course the Congo becomes a majestic river, often over a mile wide, with flat wooded banks. Between the junction of the two main upper branches, about 1,700 ft. above the sea, and the first of the Stanley falls (1,520 ft.), the fall of the river is less than 200 ft., in a distance of 500 m. Of the tributaries it receives in this section the Lukuga connects Lake Tanganyika with the Congo system (*see* TANGANYIKA).

Stanley Falls.—Stanley falls, which mark the termination of the upper Congo, begin a few miles south of the equator. At this point the river forsakes the northerly course it has been pursuing and sweeps westward through the great equatorial basin. The falls consist of seven cataracts extending along a curve of the river for nearly 60 miles. They are not of great height—the total fall is about 200 ft.—but they effectually prevent navigation between the waters above and those below except by canoes. The first five cataracts are near together; only 9 m. separate the first from the fifth. The sixth cataract is 22 m. lower down, and the seventh, the most formidable of all, is 26 m. below the sixth. The fall, divided into two portions by an islet, is 800 yd. wide. The channel is narrowed at the foot of the fall to some 450 yd. by an island close to the left bank; on the right bank is the island of Wane Rusari (2 m. long by $\frac{1}{4}$ m. broad), separated from the mainland by a channel 30 yd. wide. The fall is only about 10 ft.; but the enormous mass of water, and the narrow limits to which it is suddenly contracted, make it much more imposing than many a far loftier cataract.

The Middle Congo.—Below Stanley falls the Congo is unbroken by rapids for 980 m., and is navigable throughout this distance all the year round. The river here makes a bold north-westerly curve, attaining its most northerly point (2° 13′ 50″ N.) at 22° 13′ E., and reaches the equator again after a course of 630 m. from the falls—the distance in a direct line being 472 miles. For another 250 m. the river flows south-westerly, until at Stanley pool the limit of inland navigation is reached. For the greater part of this section the Congo presents a lacustrine character. Immediately below the falls the river, from $\frac{1}{2}$ to 1 m. broad, flows between low hills, which on the south give place to a swampy region, the river-bank marked by a ridge of clay and gravel. After receiving the waters of the Aruwimi—130 m. below the falls—the Congo broadens out to 4 or 5 m.; its banks, densely wooded, are uniformly low, and the surface of the water is studded with alluvial islands and innumerable sandbanks. The velocity of the current decreases as the waters spread out, though there is always a channel from $4\frac{1}{2}$ to 5 ft. deep. About 100 m. below the Aruwimi confluence the Loika or Itimbiri joins the main stream from the north, the Congo narrowing considerably here, owing, it is supposed, to the matter deposited by the Loika. At two or three other places lower down, the river is contracted to $2\frac{1}{2}$ or 2 m. as a result of a slight elevation in the ground, but for a distance of 500 m. no real hill is met with.

On the southern curve of the horseshoe bend are found the largest islands of the Congo—Esumba, 30 m. long, and Nsumba, 50 m. long, and over 5 m. across at its broadest part. At this point the river from bank to bank is 9 m. wide. Opposite Nsumba, the Mongala, a northern affluent, enters the main stream, whilst lower down (just north of the equator) the Lulanga, Ikelemba and Ruki rivers, southern tributaries, mingle their black waters with the dark current of the Congo. Thirty miles south of the equator the river is joined by the Ubangi (*q.v.*), its greatest northern affluent. Here the Congo is fully 8 m. wide. Opposite the Ubangi confluence is the mouth of a narrow channel, some 10 m. long, which connects the Congo with Lake Ntomba, a sheet of water about 23 m. long by 8 to 12 broad. In flood time the water flows from the Congo into the lake. Immediately below ferruginous conglomerate hills of slight eminence reduce the river to a width of less than 2 m., and in comparatively close succession are two or three other narrows. With these exceptions the Congo continues at a width of 5 to 6 m. until at 2° 36′ S. it abruptly contracts, being confined between steep faced hills.

This stretch of the river, known as the "Chenal," is 125 m. long and is free from islands, though long reefs jut into the stream. Its width here varies from 2 m. to less than 1 mile. About 40 m. after the Chenal is entered the Kasai (*q.v.*), coming from the south, empties its brick-coloured waters at right angles into the Congo through a chasm in the hills 700 yd. wide. The confluence is known as the Kwa mouth. The Chenal ends in the lake-like expansion of Stanley pool, 20 m. long by 14 broad. The middle of the pool is occupied by an island (Bamu) and numerous sandbanks. The banks offer considerable variety in character. On the north bank are the Dover cliffs, so named by H. M. Stanley from their white and glistening appearance, produced, however, not by chalk but by silver sand. On the south side stands the great red cliff of Kallina Point (about 50 ft. high). Round the point rushes a strong current $7\frac{1}{2}$ knots an hour, difficult to stem even for a steamer. On the northern bank of the river at the western end of the pool is Brazzaville, the capital of French Equatorial Africa. South of the pool, hills, low but steep, reappear, and 4 m. lower down begin the cataracts which cut off the middle Congo from the sea. Some 300 yd. above the first of these cataracts is Leopoldville, the capital of the Belgian Congo Colony, connected with the lower river at Matadi by railway. At Stanley pool the elevation of the river above the sea is about 800 ft., a fall of over 500 ft. in the 980 m. from Stanley falls. The velocity of the stream in the middle Congo varies considerably. At the Aruwimi confluence the rate is from 300 to 350 ft. a minute; in the broader stretches lower down the current is not more than 200 ft. a minute. Through the Chenal the pace is greatly accelerated, and as it flows out of Stanley pool the current is not less than 600 ft. a minute.

The Lower Congo.—The cataracts below Stanley pool are caused by the river forcing its way through the mountains which run parallel to the western coast of the continent. About 30 main rapids are distinguished, and in 215 m. the river falls 800 feet. The highlands (known as the Serro do Crystal) consist of two mountain zones with an intermediate zone of lower elevation. The passage of this intermediate zone is marked by a fairly navigable stretch of river extending from Manyanga to Isangila, a distance of 70 m. The last rapid is a little above Matadi, whence the river is navigable for large vessels to the sea, a distance of about 85 miles. At Matadi the river widens out into an estuary with many mangrove-bordered creeks and forest-clad islands of a deltaic character. This estuary is traversed by a deep cañon, in which soundings of 900 ft. have been obtained. The mouth of the river is in 6° S. and 12° 20′ E. The cañon or gully is continued into the open sea for over 100 m., with depths as much as 4,000 ft. below the general level of the sea floor. Just below Matadi, where the width of the river is about half a mile, depths of 276 and 360 ft. have been found, the current here running at from 4 to 8 knots, according to the season; while the difference in level between high and low water is 20–25 feet. The difference is caused by the rainy or dry seasons, of which there are two each during the year. In the middle Congo May and November are the times of greatest flood; in the lower river the floods are somewhat later. At Stanley pool the maximum rise of water is about 15 ft. The tides are felt as far as Boma, 49 m. from the mouth of the river, but the rise is there less than a foot; while at the mouth it is 6 ft. The cañon above mentioned is occupied by salt water, which is nearly motionless. Above it the fresh water runs with increasing velocity, but decreasing depth, so that just within the mouth of the river it is only a few feet deep.

The river at its mouth between Banana Point on the north and Sharks Point on the south is over 7 m. across. Banana Point (which grows no bananas) is the end of a long sandy peninsula, its highest spot not more than 6 ft. above high water; Sharks Point is bolder and shaped somewhat like a reaping-hook with the point turned inward, thus enfolding Diegos bay. The current of the river is perceptible fully 30 m. out to sea, the brown waters of the Congo being distinguishable from the blue of the ocean.

Northern Tributary Rivers.—Of the many affluents of the middle river the Ubangi on the north and the Kasai on the south, with their tributary streams, are noticed separately. Other notable affluents which join the river on its right bank include the Lindi, which enters the Congo about 15 m. below Stanley falls in 25° 4′ E. and is navigable from its mouth for over 100 m., and the great Aruwimi, which rises, as the Ituri, in close proximity to Albert Nyanza, flowing generally from east to west. The Aruwimi is formed of many branches and its upper basin extends over 2½° of latitude. The river flows almost entirely through the great equatorial forest, which here seems to reach its maximum density. Its confluence with the Congo is in 1° 12′ N., 23° 38′ E., and it is navigable for 90 m., up to the Yambuya rapids. The Loika, Itimbri or Lubi river, rises in about 26° E., and joins the Congo by two mouths, 22° 35′–46′ E. The Loika is navigable as far as the Lubi falls, a distance of 150 miles. The Mongala, which drains the country between the Loika to the east and the Ubangi to the west, rises in about 3° N., 23° 20′ E., and flows in a somewhat similar curve (on a smaller scale) to that of the Ubangi. The Mongala is navigable for over 300 m. The Mongala confluence is in 1° 53′ N., 19° 49′ E. Below the Ubangi confluence the Sanga, in 1° 12′ S., 16° 53′ E., joins the Congo. The Sanga rises in the north-west verge of the Congo basin and flows in a general north to south direction. The main northern branch rises in southern Adamawa in about 7° N., 15° E. An almost equally large western branch, the Dscha (or Ngoko), rises about 3° N., 13½° E., and in its course traverses a vast tract of dense forest. The Sanga is navigable by steamers as far as the south-east corner of the Cameroons, a distance of approximately 350 miles. The Likuala and Alima, which join the Congo within 30 m. of the mouth of the Sanga, are much smaller streams.

Southern Tributaries.—The first of the southern tributaries of the middle Congo, the Lomami, enters the main stream in 0° 46′ N., 24° 16′ E. It has a length of over 700 m., rising in nearly 9° S. It flows south to north, the greater part of its course being parallel to and from 40 to 150 m. west of the upper Congo. For the last 200 m. it is navigable by steamers. Below the mouth of the Lomami there is a long stretch with no southern tributary, as the great plain within the Congo bend is drained by streams flowing in the same direction as the middle Congo—east to west. The Lulanga (or Lulongo), about 400 m. long, enters in 0° 40′ N., 18° 16′ E. The main branch of the Ruki or Juapa, which enters a little north of the equator in 18° 21′ E., has its rise between 24° and 25° E. and about 3° S., in the swampy region traversed by the Lomami. It is about 600 m. long and has two large southern tributaries. A few miles above the Ruki confluence the Ikelemba (some 150 m. in length) joins the Congo. The Lulanga, Ikelemba and Ruki, and their sub-streams, have between them over 1,000 m. of navigable waters. No rapids intercept their course.

Exploration.—Unlike the Nile there are no classic associations with the Congo. A single mention made of the Zaire by Camoens in the *Lusiads* exhausts its connection with literature (up to the beginning of the 19th century), other than in little known and semi-fabulous accounts of the ancient kingdom of Congo. The mouth of the river was discovered by Diogo Cão or Cam either in 1482 or 1483. To mark the discovery and to claim the land for the Portuguese crown he erected a marble pillar on what is now called Sharks Point. Hence the river was first called Rio de Padrão (Pillar river). It soon, however, became known as Zaire (*q.v.*), a corruption of a native word meaning "river," and subsequently as the Congo. In the three centuries succeeding Diogo Cão's discovery strangely little was done to explore the river though various European firms established "factories" in the estuary, trading in slaves and other commodities. At length the British Admiralty took action, and in 1816 despatched Captain J. K. Tuckey, R.N., at the head of a well-equipped mission. The expedition was prompted by the suggestion that the Congo was identical with the Niger. Captain Tuckey reached the Congo on July 6, 1816, and managed to push up stream as far as Isangila, beyond the lowest series of rapids; but sickness broke out, the commander and 16 other Europeans died and the expedition had to return. Captain Tuckey and several of his companions are buried on Prince's island, just above Boma, the point where the Congo widens into an estuary. For 60 years, though two or three attempts were made no other European reached even as far as Isangila. Lieutenant W. Grandy, R.N., who was sent from England in 1872 to the relief of David Livingstone, started from Ambriz, south of the Congo estuary, and, after many vicissitudes, reached, late in 1873, a point on the Congo below the cataracts. The death of Livingstone was soon afterwards reported; and in April 1874, just as Grandy was prepared to ascend the river, letters of recall brought the expedition to a close.

It was by working down from its source that the riddle of the Congo was solved. In 1868 David Livingstone traced the course of the Chambezi to Lake Bangweulu. In March 1871 he reached the town of Nyangwe on the Lualaba, and died (1873) whilst endeavouring to trace the head-streams of that river, which he believed to be the Nile. "I have no fancy," he once said, "to be made into 'black man's pot' for the sake of the Congo." But by 1872 geographers were able to affirm, from Livingstone's own reports, that the great river system he had explored must belong to the Congo and not to the Nile. Actual proof was lacking, and of the course of the main river there was absolute ignorance. In Oct. 1876, H. M. Stanley arrived at Nyangwe from Zanzibar and from that point navigated the river over 1600 m. to Isangila—"Tuckey's Furthest"—reached in July 1877, thus demonstrating the identity of the Lualaba with the Zaire of the Portuguese. Stanley's great journey marked an epoch in the history of Africa, politically and commercially as well as geographically. Of the travellers who followed Stanley none did more to add to the exact knowledge of the main river and its greatest tributaries than the Rev. George Grenfell (1849–1906) of the Baptist Missionary Society, while the Aruwimi was partly explored by Stanley in 1887 in his last expedition in Africa. The detailed survey of the river system was mainly done by Belgian officers, notably by Captains A. Delacommune and C. Lemaire. In 1913 Captain R. Walker, R.E., showed that the Luapula did not issue from Lake Bangweulu, as had been supposed, but was a direct continuation of the Chambezi. Alongside all the non-navigable reaches of the river railways have been built (*see* BELGIAN CONGO).

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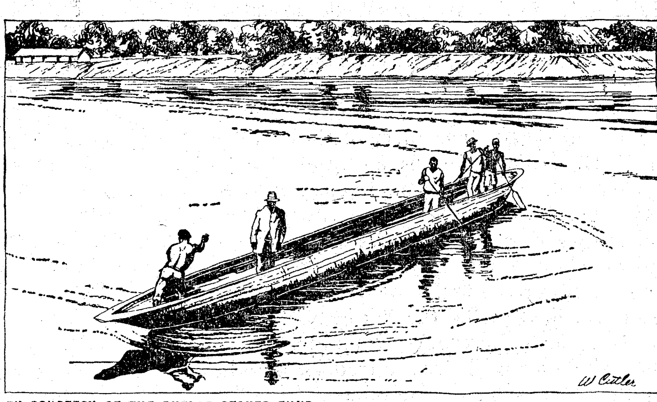
CONGO FREE STATE, the name frequently used for the *État Indépendant du Congo,* a state of equatorial Africa which occupied most of the basin of the Congo river. After its annexation by Belgium in 1908, it became known as *Congo Belge* or the BELGIAN CONGO (*q.v.* for events after 1908).

The state owed its existence to the ambition and force of character of a single individual, Leopold II., king of the Belgians. Interest in Central Africa had been greatly stimulated in the middle of the 19th century by the discoveries of David Livingstone, J. H. Speke, Richard Burton and others, and in 1876 King Leopold summoned in Brussels a conference of geographical experts which resulted in the creation of "The International Association for the Exploration and Civilization of Africa." National committees were formed in various countries and an international commission was instituted with headquarters in Brussels. The Belgian committee devoted attention first to East Africa, but the arrival in Aug. 1877 of H. M. Stanley at the mouth of the Congo, which marked the end of the great journey in which he discovered the course of that magnificent river, at once turned Leopold's thoughts to the immense possibilities offered by the development of the Congo basin. Having tried in vain to interest British merchants in the development of the region, Stanley in Nov. 1878, accepted Leopold's offer to return to the Congo, build a chain of stations on the banks of the river, open a road through the cataract region separating the estuary from the navigable waters above, and to conclude agreements with the native chiefs. A separate committee of the International Association was formed in Brussels, under the name of *Comité d'études du Haut Congo;* this committee afterwards became the International Association of the Congo. Though international in name the association soon came entirely under the



BY COURTESY OF THE PHELPS STOKES FUND

ON THE CONGO RIVER AT STANLEYVILLE, BELGIAN CONGO

direction of King Leopold and his associates. Stanley, as agent of the association, spent four years in the Congo, founding stations and making friendly agreements with various chiefs. The first station was founded at Vivi in Feb. 1880.

Recognition by the Powers.—Before Stanley's return to Europe the work of the association had attracted much attention among the powers interested in Africa. A little tardily the importance of the newly-discovered regions was realized. On behalf of France M. de Brazza had reached the Congo from the north and had established various posts, including one, the present Brazzaville, on Stanley Pool (*see* FRENCH EQUATORIAL AFRICA). Portugal, on the strength of the discovery of the mouth of the Congo by her navigators in the 15th century, advanced claims to sovereignty over both banks of the estuary of the river. These claims were recognized by the British Government in a convention concluded in Feb. 1884. This convention aroused much opposition, especially in Great Britain and Germany, and was never ratified. It led directly to the summoning of the Berlin Conference of 1884–85, and to the recognition of the International Association as a sovereign state. Such recognition had been King Leopold's aim. In any case the position of the association was anomalous. On the Congo itself there was no one great native state; the region was under the rule of a vast number of petty chiefs. This made it comparatively easy for the association, locally, to assume supreme authority. The United States of America, where Leopold's aims and Stanley's work attracted much sympathy, was the first great power, in a convention signed April 22, 1884, to recognize the association as a properly constituted state. At this time King Leopold was negotiating with France not only for recognition of the association but on boundary questions. Negotiations were conducted by and in the name of the president of the association, Col. M. Strauch, a Belgian officer. By a note of April 23, 1884, Col. Strauch gave France the right of pre-emption—the first right to purchase—should the association be compelled to sell its possessions.

In 1887 it was announced by the Congo State that this preferential right granted to France in 1884 was not intended to be opposed to the rights of Belgium, and in fact Belgium ultimately acquired the Congo State. While the negotiations with France were proceeding Germany recognized the independence of the association (Nov. 8, 1884). This was followed by recognition by Great Britain (Dec. 16, 1884) and other Powers. Owing to difficulties in reaching agreement as to boundaries, French recognition was delayed until Feb. 5, 1885; that of Portugal followed on Feb. 14.

While the negotiations for recognition were going on the Berlin congress on African affairs met. Some of its decisions directly affected the International Association. A conventional basin of the Congo was defined, and in this conventional basin it was declared that "the trade of all nations shall enjoy complete freedom." Freedom of navigation of the Congo and all its affluents was also secured, and differential dues on vessels and merchandise were forbidden. Trade monopolies were prohibited, and provisions made for the suppression of the slave trade, and the protection of missionaries, scientists and explorers. Provision was also made for the Powers owning territory in the conventional basin to proclaim their neutrality. The International Association not having possessed, at the date of the assembling of the conference (Nov. 15, 1884) any recognized status, was not formally represented at Berlin, but the flag of the association having, before the close of the conference, been recognized as that of a sovereign state by all the powers, with the exception of Turkey, the association formally adhered to the General Act signed by the delegates to the conference on Feb. 26, 1885.

Leopold's next step was to assume his place as the sovereign of the new state. The Belgian Chamber in April 1885 authorized the king "to be the chief of the state founded in Africa by the International Association of the Congo" and declared that "the union between Belgium and the new state of the Congo shall be exclusively personal." The formal proclamation of the king's sovereignty was made on July 1, 1885, at Boma (on the north bank of the lower Congo) by Colonel (later Sir) Francis de Winton, who had succeeded Stanley as head of the local administration. This was followed by a circular letter sent to the Powers on Aug. 1 by King Leopold in which he declared the perpetual neutrality of "the Independent State of the Congo" and set out the frontiers then claimed by the state. The king had been compelled to yield to France considerable areas in the Congo basin, including the north bank of the river itself from Stanley Pool to the confluence with the Ubangi; Portugal obtained the south bank of the river from its mouth up to Noki. In a race with British agents for unappropriated regions Leopold succeeded in securing for the Congo Free State the highly mineralized region of Katanga and the only part of the Congo basin where white settlement on any scale is possible.

It was not until 1894 that an agreement was made with Great Britain defining the frontier with British possessions in Central Africa. By this agreement King Leopold also attained, for a time, an outlet on the Nile for the Congo State. This was one of his great ambitions and he had sent more than one expedition to the Upper Nile. Now by the 1894 agreement he obtained a lease from Great Britain of the Bahr-el-Ghazel province. However, in 1906 the lease was annulled, though King Leopold was permitted during his reign to hold the Lado Enclave. The whole episode was part of the struggle for supremacy in the Upper Nile and of the British efforts to obtain an "All-Red" route from the Cape to Cairo. (*See* AFRICA: *History*.)

The Arab War.—While seeking to extend the boundaries of the state the administration had many internal difficulties to overcome. Much energy was shown in establishing posts along the Congo itself and its main affluents; from the first steamers had been placed on the river and it was early determined to build a railway round the cataract region so that the produce of the upper river could be brought more easily to the markets of the world. The avowed object of the Free State was to develop the resources of the country with the aid of the natives and to the mutual benefit of blacks and whites. But it soon became apparent that the Arab slave-traders, mostly of Zanzibar origin, who had established themselves in the country between Lake Tanganyika and Stanley Falls were a serious obstacle to any progress over a large region. The state was poor—its revenues had to be supplemented from the private purse of King Leopold—and a cautious policy was enjoined on its officers who were brought into relations with the Arabs on the upper river, of whom Tippoo-Tib was the chief. In 1886 the Arabs had destroyed the state station at Stanley Falls, and it was apparent that a struggle for supremacy was inevitable. But the Free State was at that time ill prepared for a trial of strength, and at Stanley's suggestion the bold course was taken of appointing Tippoo-Tib governor of Stanley Falls, as the representative of King Leopold. This was in 1887, and for five years the *modus vivendi* thus established continued. During those years fortified camps were established by the Belgians on the Sankuru, the Lomami, and the Arumiwi, and the Arabs were quick to see that each year's delay increased the strength of the forces against which they would have to contend. In 1891 the imposition of an export duty on ivory excited much ill-will, and when it became known that, in his march towards the Nile, van Kerckhoven had defeated an Arab force, the Arabs on the upper Congo determined to precipitate the conflict. In May 1892 the murder of M. Hodister, the representative of a Belgian trading company, and of ten other Belgians on the upper Lomami, marked the beginning of the Arab war. When the news reached the lower river a Belgian expedition under the command of Commandant (afterwards Baron) Dhanis was making its way towards Katanga. This expedition was diverted to the east, and, after a campaign lasting several months, during which the Arab strongholds of Nyangwe and Kasongo were captured, the Arab power was broken and many of the leading Arabs were killed. The political and commercial results of the victory of the Free State troops were of great importance; henceforth the Free State was master of its own house. Rather it was master over the greater part. In 1895 there was a revolt of the Batetelas in the Lulua and Lomami districts. The mutineers were defeated; but in 1897 the Batetelas again revolted and took possession of a large area of the eastern portion of the state. The mutineers were not finally dispersed until near the end of 1900. In other parts of the country the state had difficulties with native chiefs, several of whom preserved their autonomy. In the central Kasai region the state had been unable to make its authority good up to the time it ceased to exist.

PYGMIES OF THE BELGIAN CONGO

Although in 1885 the Belgian Parliament had declared that the union between Belgium and the Congo was purely personal it had been foreseen that the union would become closer. In 1889 King Leopold made public certain terms of his will, dated Aug. 2 of that year, in which he bequeathed to Belgium "all our sovereign rights over the Independent State of the Congo." This was a preliminary to a request for financial help, and in 1890 Belgium granted a loan, receiving in return the option of annexing the Congo state at the end of a period of ten years and six months. Further financial difficulties led to a proposal, eventually defeated, for the annexation of the state to Belgium as from Jan. 1, 1895, and this proposal led to a Franco-Belgian convention (Feb. 5, 1895) in which the Belgian Government recognized "the right of preference possessed by France over its Congolese possessions in case of their compulsory alienation in whole or in part." In 1901 the question of the annexation of the Free State again formed the subject of prolonged discussion in the Belgian Parliament. It was decided at that time not to exercise the option possessed under the terms of the 1890 loan. At that period (1901) King Leopold opposed the immediate annexation of the state.

The Charges of Maladministration.—By this time charges highly injurious to the administration of the Free State had been publicly made. It was admitted that the state, as far as it could, had suppressed cannibalism, that it had strictly enforced anti-liquor laws, and had broken the power of the Arab slavers, but it was accused of robbing the natives of their rights, of suppressing freedom of trade and even of countenancing "atrocities." The discussions in the Belgian Parliament on the affairs of the Congo State were greatly embittered by these charges. The administration of the state had indeed undergone a complete change since the early years of its existence. A decree of July 1, 1885, had, it is true, declared all "vacant lands" the property of the state (*Domaine privé de l'état*), but it was not for some time that this decree was so interpreted as to confine the lands of the natives to those they lived upon or "effectively" cultivated. Their rights in the forest were not at first disputed, and the trade of the natives and of Europeans was not interfered with. But in 1891—when the wealth in rubber and ivory of vast regions had been demonstrated—a secret decree was issued (Sept. 21) reserving to the state the monopoly of ivory and rubber in the "vacant lands" constituted by the decree of 1885, and circulars were issued making the monopoly effective in the Aruwimi-Welle, Equator and Ubangi districts. The agents of the state were enjoined to supervise their collection, and in future natives were to be obliged to sell their produce to the state. By other decrees and circulars (Oct. 30, Dec. 5, 1892, and Aug. 9, 1893) the rights of the natives and of white traders were further restricted. The effect of these later decrees was to assign to the Government an absolute proprietary right over nearly the whole country; a native could not even leave his village without a special permit. The oppressive nature of these measures drew forth a weighty remonstrance from the leading officials, and C. Janssen, the governor, resigned. Vigorous protests by the private trading companies were also made against this violation of the freedom of trade provided for by the Berlin Act, and eventually an arrangement was made by which certain areas were reserved to the state and certain areas to private traders, but the restrictions imposed on the natives were maintained. The "concession" companies were first formed in 1891. In all of the companies the state had a financial interest as shareholder or as entitled to part profits.

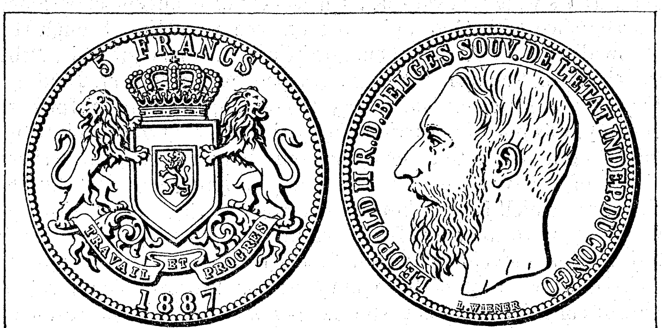
This monopolist system of exploitation was fruitful of evil. It involved, in many cases, oppressive treatment of the natives. Only in the lower Congo and a narrow strip of land on either side of the river above Stanley pool was there any freedom of trade. The situation was aggravated by the creation in 1896, by a secret decree, of the *Domaine de la couronne*, a vast territory between the Kasai and Ruki rivers, covering about 112,000 sq.m. To administer this domain, carved out of the state lands and treated as the private property of Leopold II., a *Fondation* was organized and given a civil personality. It was not until 1902 that the existence of the *Domaine de la couronne* was officially acknowledged.

The *Fondation* controlled the most valuable rubber region in the Congo, and in that region the natives appeared to be treated with great brutality. In the end of the 19th century and the early years of the 20th the charges brought against the state assumed a more and more definite character and gave rise to a strong agitation against the Congo State in the United States and elsewhere.

Action by Great Britain.—The agitation was particularly vigorous in Great Britain, and the movement entered on a new era when on May 20, 1903, the House of Commons agreed without a division to a motion requesting the Government to confer with the other signatories of the Berlin Act, "by virtue of which the Congo Free State exists, in order that measures may be adopted to abate the evils prevalent in that state."

Representations to the powers made by the British Foreign Office followed, but evoked no official response—except from Turkey. In Great Britain however the agitation was greatly strengthened by the publication of a report made by Mr. (later Sir) Roger Casement (*q.v.*), then British consul at Boma, on a journey he had made in 1903 on the Congo above Stanley Pool.[1] The Congo administration denied most of the charges made in the Casement report—in particular it adduced evidence going to show that the cases of mutilation of natives which had occurred were neither the work of nor approved by the agents of the state, but were customary punishments inflicted by the chiefs on their people; methods of barbarism which the state had not so far been able to eradicate. The efforts to disprove the charge that the state had become a monopolistic trading concern, to the detriment of the natives as well as to would-be white merchants, were not successful. Belgian public opinion was aroused and critical, and this led to the appointment by King Leopold in July 1904 of a commission of enquiry to visit the Congo.

The Commission of Enquiry.—The commission was composed of M. Edmond Janssens, advocate-general of the Belgian Cour de Cassation, who was appointed president; Baron Giacomo Nisco, president *ad interim* of the court of appeal at Boma; and Dr. E. de Schumacher, a Swiss councillor of state and chief of the department of justice in the canton of Lucerne. Its stay in the Congo State lasted from Oct. 5, 1904, to Feb. 21, 1905, and its



FROM "NUMISMATIQUE DU CONGO," BY PERMISSION OF A. MAHIEU

FIVE FRANC PIECE, REVERSE AND OBVERSE, STRUCK FOR THE CONGO FREE STATE THREE YEARS AFTER ITS ORGANIZATION

report appeared in Nov. 1905. While expressing admiration for the signs which had come under its notice of the advance of civilization in the Congo State, the commission confirmed the reports of the existence of grave abuses in the upper Congo, and recommended a series of measures which would, in its opinion, suffice to ameliorate the evil. It approved the concessions system in principle and regarded forced labour as the only possible means of turning to account the natural riches of the country, but recognized the need for a liberal interpretation of the land laws, effective application of the law limiting the amount of labour exacted from the natives to 40 hours per month, the withdrawal from the concession companies of the right to employ compulsory measures, the regulation of military expeditions, and the freedom of the courts from administrative tutelage. Simultaneously with the report of the commission of enquiry, a decree was published appointing a commission to study the recommendations contained in the report, and to formulate detailed proposals. The report of the reforms commission was not made public, but as the fruit of its deliberations King Leopold signed on June 3, 1906, decrees embodying various changes in the administration of the Congo State. By the advocates of radical reforms these measures were regarded as utterly inadequate, and even in Belgium, among those friendly to the Congo State system of administration, some uneasiness was excited by a letter which was published along with the decrees, wherein King Leopold intimated that certain conditions would attach to the inheritance he had designed for Belgium. Among the obligations which he enumerated as necessarily and justly resting on his legatee was the duty of respecting the arrangements by which he had provided for the establishment of the *Domaine de la couronne* and the *Domaine privé de l'état.*

Annexation by Belgium.—The Belgian Parliament looked with disfavour on this latest indication of King Leopold's policy and in Dec. 1906 resolved that a committee appointed in 1901 to study the conditions which should govern the Congo State when it became a Belgian possession should "hasten its labours." While the committee was sitting, further evidence was forthcoming that the system complained of on the Congo remained unaltered, and that the "reforms" of June 1906 were illusory. Not only in Great Britain and the United States did the agitation against the administration of the Congo State gain ground, but in Belgium and France reform associations enlightened public opinion. The Government of Great Britain let it be known that its patience was not inexhaustible, while the Senate of the United States declared that it would support President Roosevelt in his efforts for the amelioration of the condition of the inhabitants of the Congo.

It was clear that Belgium would have to undertake responsibility for the Free State before long, and in Nov. 1907 a treaty was signed for the cession of the state. Some of its terms revealed clearly the proprietorial attitude Leopold adopted. These terms stipulated for the maintenance of the *Fondation de la couronne.* This "government within a government" was secured in all its privileges, its profits as heretofore being appropriated to allowances to members of the royal family and the maintenance and development of "works of public utility" in Belgium and the Congo, those works including schemes for the embellishment of the royal palaces and estates in Belgium and others for making Ostend "a bathing city unique in the world." The state was to have the right of redemption on terms which, had the rubber and ivory produce alone been redeemed, would have cost Belgium about £8,500,000. These terms were preposterous and had not long been published before it was realized that the treaty would not be accepted by the Belgian Parliament unless they were modified. So negotiations were begun again. While they were in progress the British Government again expressed its views, and in very monitory language. In Feb. 1908 a British parliamentary paper was issued (*Africa No. 1,* 1908) containing consular reports on the state of affairs in the Congo. Mr. W. G. Thesiger, consul at Boma, in a memorandum on the application of the labour tax, after detailing various abuses, added, "The system which gave rise to these abuses still continues unchanged, and so long as it is unaltered the condition of the natives must remain one of veiled slavery." On the same day the British foreign secretary, Sir Edward Grey (afterwards Viscount Grey of Fallodon, *q.v.*), declared that the Congo State had "morally forfeited every right to international recognition."

This declaration by Sir Edward Grey, together with the report of W. G. Thesiger, a man whose testimony was unimpeachable, virtually ended the conflict. King Leopold hastened to make such terms as he could. On March 5, 1908, an additional act was signed in Brussels annulling the clauses in the treaty of cession concerning the *Fondation,* though the king obtained very generous compensation for the surrender of that domain. Finally the Belgian Chamber, after some four months' debate adopted, Aug. 20, 1908, the treaty of cession, the additional act and a law setting out the principles upon which the new colony should be governed.

[1]Roger Casement's association with Germany during World War I led to a legend that Germany had fomented the Congo atrocities agitation for its own purposes. There was no evidence to support this legend. Neither did Casement's treason in 1914–16 affect the truth of a report made in 1903.

These measures were voted by the senate on Sept. 9, 1908, and on Nov. 14 the "Congo Free State" ceased to exist. On Nov. 15 the Belgian government assumed authority without ceremony.

This assumption of authority by Belgium was not lightly undertaken. The legislature had the matter under consideration for 14 years and public opinion in Belgium was perturbed by the prospect of taking over the administration of a vast, distant and badly administered territory, likely to be a financial drain upon the resources of Belgium for years. But Belgium assumed its heavy task with the determination that as a colonial possession the Congo territory should be honestly governed, and in real agreement with the humanitarian principles which Leopold II had never ceased to profess.

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CONGREGATION, an assembly of persons, especially a body so assembled for religious worship, or habitually attending a particular church, and hence the basis of the religious system known as Congregationalism (*q.v.*) (Lat. *congregatio*, a gathering together, from *cum*, with, *grex*, a flock). In the English versions of the Bible "congregation" is used to translate Heb. *'edāh*, the whole community of the Israelites, and *kāhāl*, the assembly of the people; but in the Revised Version "congregation" is kept for the first (LXX. συναγωγή) and "assembly" for the second (LXX. ἐκκλησία). In the Roman Church the word is used in several senses.

(1) The congregations or committees of the college of cardinals which form administrative departments, *e.g.*, the congregations of Propaganda, Rites, etc. (*see* CURIA ROMANA).

(2) The committees of bishops for the regulation of procedure at general councils.

(3) The branches of a religious order, following its general rule, but forming separate groups, each with its special constitution and observances. Thus the Trappists are a congregation of the Cistercian order, itself an offshoot of Benedictine monasticism.

(4) Communities of religious under rule, composed of persons who have taken no vows or have not taken "solemn" vows, such as the Oratorians, Oblates and Lazarists.

(5) In France, religious associations of lay persons, male or female, for some pious, charitable or educational purpose (*see* FRENCH LAW AND INSTITUTIONS).

In secular usage there are two congregations or governing bodies of the university of Oxford, viz., the "Ancient House of Congregation," which, consisting of the vice-chancellor, proctors and regent masters, grants and confers degrees, and the "Congregation of the University of Oxford," created by act of parliament in 1854, and consisting of all members of convocation who are technically resident. All statutes must be passed by this congregation before their introduction in convocation, and it alone has the power of amending statutes. In the university of Cambridge congregation is the term used of the meeting of the senate. In Scottish history, the frequent occurrence of the word, in the sense of "church," in the national covenant of 1537, gave the name of "congregation" to the reforming party, and the signatories of the covenant were generally known as "lords of the congregation."

CONGREGATIONALISM, the name given to that type of church organization in which the autonomy of the local church, or body of persons wont to assemble in Christian fellowship, is fundamental. Varied as are the forms which this idea has assumed under varying conditions of time and place, it remains distinctive enough to constitute one of the three main types of ecclesiastical polity, the others being Episcopacy and Presbyterianism. It regards church authority as inherent in each local body of believers, as a miniature realization of the whole Church, which can itself have only an ideal corporate being on earth. But while in practice it is religious democracy, in theory it claims to be the most immediate form of theocracy, God Himself being regarded as ruling His people directly through Christ as Head of the Church, whether Catholic or local. So viewed, Congregationalism is essentially a "high *church*" theory, as distinct from a high *clerical* one. It springs from the religious principle that each body of believers in actual church-fellowship must be free of all external human control, in order the more fully to obey the will of God as conveyed to conscience by His Spirit. Here responsibility and privilege are correlatives. This, the negative aspect of the congregational idea, has emerged at certain stages of its history as Independency. Its positive side, with its sense of the wider fellowship of "the Brotherhood" (1 Pet. v. 9, *cf.* ii. 17), has expressed itself in varying degrees at different times, according as conditions were favourable or the reverse. But catholicity of feeling is inherent in the congregational idea of the church, inasmuch as it knows no valid use of the term "church" intermediate between the local unit of habitual Christian fellowship and the church universal. On such a theory confusion between full catholicity and loyalty to some partial expression of it is minimized, and the feeling for Christians as such, everywhere and under whatever name, is kept pure.

Congregationalism proper, as a theory of the organized Christian life contemplated in the New Testament, emerges at the Reformation, with its wide recovery of such aspects of evangelic experience as acceptance with God and constant access to Him through the sole mediation of Christ. The practical corollary of this, "the Priesthood of Believers," though grasped by Luther (*cf.* Lindsay, *Hist. of the Reformation*, i. 435 ff.) and continental reformers generally, was not fully carried out by them in church organization. This was due partly to a sense that only here and there was there a body of believers ripe for the congregational form of church-fellowship, which Luther himself regarded as the New Testament ideal, partly to fear of Anabaptism, the radical wing of the Reformation movement, which first strove to recover primitive Christianity apart altogether from traditional forms. The development of congregational churches proper was gradual, the result of constant study of "the Word of God" in the light of experience. The process can be traced most clearly in London.[1] There, owing to measures taken in 1565–1566 to enforce clerical subscription to the authorized order of worship, especially touching vestments, certain persons of humble station began to assemble in houses "for preaching and ministering the sacraments" (Grindal's *Remains*, lxi.). This led in June 1567 to the arrest of some fifteen out of a hundred men and women assembled in Plumbers' Hall (ostensibly for a wedding), none of whom, to judge from the eight examined, was a minister. Probably they were not long kept in prison, for six of them were among a similar body of 77 persons "found together" in a private house on March 4, 1568, the leaders of whom were imprisoned, and liberated only after "one

[1]Here in 1561, appeared *A Confession of faith, made by common consent of divers reformed Churches beyond the seas; with an Exhortation to the Reformation of the Church.* It advocated "the polity that our Saviour Jesus Christ hath established," with "pastors, superintendes, deacons"; so that "all true pastors have equal power and authority . . . and for this cause, that no church ought to pretend any rule or lordship over other"; and none ought "to thrust himself into the government of the Church [as by ordination at large], but that it ought to be done by election." *See* C. Burrage, *The Church-Covenant Idea* (1904), p. 43.

whole year," early in May 1569 (*ibid.* pp. 316 ff.). Perhaps it was between 1567 and 1568 that they began to organize themselves more fully in conjunction with four or five of the suspended clergy, with elders and deacons of their own appointing (Grindal, *Zürich Letters,* lxxxii.; *Remains,* lxi.). This act of ordaining ministers, probably after the Genevan order—which they certainly used from May 1568—and their excommunication of certain deserters from their "church" (so Grindal), clearly mark the fact that this body of some 200 persons had now deliberately taken up a position outside the national church, as being themselves a "church" in a truer sense than any parish church, inasmuch as they conformed to the primitive pattern. Their ideal is embodied in a manifesto set forth about 1570 under the title *The True Marks of Christ's Church,* etc., and signed by "Richard Fytz, Minister," as being "the order of the Privy Church in London, which by the malice of Satan is falsely slandered."

"The minds of them that by the strength and working of the Almighty, our Lord Jesus Christ, have set their hands and hearts to the pure, unmingled and sincere worshipping of God, according to his blessed and glorious Word in all things, only abolishing and abhorring all traditions and inventions of man whatsoever, in the name of Religion and Service of our Lord God, knowing this always: that the true and afflicted Church of our Lord and Saviour Jesus Christ either hath, or else ever more continually under the cross striveth for to have,

"First and foremost, the Glorious word and Evangel preached, not in bondage and subjection [*i.e.,* by episcopal licence], but freely and purely.

"Secondly, to have the Sacraments ministered purely, only and altogether according to the institution and good worde of the Lord Jesus, without any tradition or invention of man.

"And last of all, to have not the filthy Canon law, but discipline only and altogether agreeable to the same heavenly and almighty worde of our good Lord, Jesus Christ."

Here we have essential Congregationalism, formulated for the first time in England as the original and genuine Christian polity, and as such binding on those loyal to the Head of the Church. All turns, as we see from the petition addressed in 1571 to the queen by twenty-seven persons (the majority women, possibly wives in some cases of men in prison), upon the duty of separation with a view to purity of Christian fellowship (2 Cor. vi. 17 f.), and upon moral discipline "by the strength and sure warrant of the Lord's good word, as in Matt. xvii. 15–18 (1 Cor. v.)" were it only in a church of "two or three gathered in the Name." Whatever may be thought of the application of these principles, there is no mistaking the deeply religious aim of these separatists for conscience' sake, viz., the realizing of the Christian ideal in personal conduct, in a fellowship of souls alike devoted to the Highest; nor can it be doubted that the "mingled" communion of the parish churches made church "fellowship" in the apostolic sense a practical impossibility. This was confessed alike by the bishops (*e.g.,* Whitgift) and by the Puritans, who maintained the paramount duty of remaining within the queen's church and there working for the further reformation which they recognized as sadly needed by English religion. But the radical "Puritans" (the above documents in the State Paper Office are endorsed "Bishop of London: Puritans") felt that this meant treason to the Headship of Christ in His Church; and that until the prince should set aside "the superstition and commandments of men," and "send forth princes and ministers (like another Josiah), and give them the Book of the Lord, that they may bring home the people of God to the purity and truth of the apostolic Church, they could do no other than themselves live after that divine ideal. They were not separated of their own choice, but by the word of God acting on their consciences."

Robert Browne.—"Reformation without tarrying for Anie" was the burden laid on the heart of these Congregational pioneers; and it continued to press heavily on many, both "Separatists" and conforming "Puritans" (to use the nicknames used by foes), before it became written theory in Robert Browne's work under that title, published at Middelburg in Holland in 1582 (*see* BROWNE, ROBERT). The story of the many attempts made in the interval by "forward" or advanced Puritans to secure vital religious fellowship within the queen's Church, and of the few cases in which these shaded off into practical Separatism, is still wrapped in some obscurity.[1] But tentative efforts within parochial limits, by accustoming the more godly sort to feel an inner bond peculiar to themselves, prepared many for the congregational idea of the church, and on the other hand made them feel more than ever dissatisfied with the "mixed" services of the parish church. It seemed to them impossible that vital religion could be inculcated, unless there were other guarantee for ministerial fitness than episcopal licensing, unless in fact the godly in each parish had a voice in deciding whether a man was called of God to minister the Word of God (*see* C. Burrage, *The True Story of Robert Browne,* pp. 7, 11 f.). But this implied the gathering of the earnest "professors" in each locality into a definite body, committed to the Gospel as their law of life. Such a "gathered church" emerges as the great desideratum with Robert Browne between 1572, when he graduated at Cambridge, and 1580–81 when he first defined his Separatist theory. It involved for him a definite "covenant" entered into by all members of the church, with God and with God's people, to abide by Christ's laws as ruling all their conduct, individually and collectively.

From Browne's idea of a holy people, covenanted to walk after Christ's mind and will, all else flowed, as is set forth in his *Book which sheweth the life and manners of all true Christians.* As it may be called the primary classic of congregational theory, its leading principles must here be summarized. Since the hearing of the word of God unto obedience is due to "the gift of His Spirit to His children," every church member is a spiritual person, with a measure of the spirit and office of king, priest and prophet, to be exercised directly under the supreme Headship of Christ. Thus mutual oversight and care are among the duties of the members of Christ's body; while their collective inspiration, enabling them to "try the gifts of godliness" of specially endowed fellow-members, is the divine warrant in election to church office. Thus the "authority and office" of "church governors" is not derived from the people, but from God, "by due consent and agreement of the church." Conference between sister churches for counsel is provided for; so that, while autonomous, they do not live as isolated units. Such were the leading features of Browne's Congregationalism, as a polity distinct from both Episcopacy and Presbyterianism. Any varieties in the congregational genus which emerge later on, keep within his general outlines. To this fact the very nickname "Brownists," usually given to early "Separatists" by accident, but Congregationalists in essence, is itself witness.

"The kingdom of God was not to be begun by whole parishes, but rather of the worthiest, were they never so few." This sentence from Browne's spiritual autobiography contains the root of the whole matter, and explains the title of his other chief work, also of 1582, *A Treatise of Reformation without tarrying for any, and of the wickedness of those Preachers which will not reform till the Magistrate command or compel them.* Here he, first of known English writers, sets forth a doctrine which, while falling short of the Anabaptist theory that the civil ruler has no standing in the affairs of the Church, in that religion is a matter of the individual conscience before God, yet marks a certain advance upon current views. Magistrates "have not that authority over the church as to be . . . spiritual Kings . . . but only to rule the commonwealth in all outward justice. . . . And therefore also because the Church is in a commonwealth, it is of their charge; that is, concerning the outward provision and outward justice, they are to look to it. But to compel religion, to plant churches by power, and to force a submission to ecclesiastical government by laws and penalties, belongeth not to them . . . neither yet to the Church" (*Treatise,* etc., p. 12). Here Browne distinguishes acceptance of the covenant relation with God (religion) and the forming or "planting" of churches on the basis of God's covenant (with its laws of government), from the enforcing of the covenant voluntarily accepted, whether by church-excommunication or by civil penalties—the latter only in cases of flagrant impiety, such as idolatry, blasphemy or Sabbath-breaking. In virtue of this distinction which implied that the nation was not actually in

[1] *See,* however, *The Presbyterian Movement in the reign of Queen Elizabeth, as illustrated by the Minute Book of the Dedham Classics 1582–1589* (Camden Society, 3rd series, vol. viii., 1905).

covenant with God, he taught a relative toleration. In this he was in advance even of most Separatists, who held with Barrow[1] "that the Prince ought to compel all their subjects to the hearing of God's Word in the public exercises of the church." As, however, the prince might approve a false type of Church, in spite of what they both *assumed* to be the *clear* teaching of Scripture, and should so far be resisted, Browne and Barrow found themselves practically in the same attitude towards the prince's religious coercion. It was part of their higher allegiance to the King of kings.

Between 1580 and 1581, when Browne formed in Norwich the first known church of this order on definite scriptural theory, and Oct. 1585, when, being convinced that the times were not yet ripe for the realization of the perfect polity, and taking a more charitable view of the established Church, he yielded to the pressure brought to bear on him by his kinsman Lord Burghley, so far as partially to conform to parochial public worship as defined by law (*see* BROWNE, ROBERT), the history of Congregationalism is mainly that of Browne and of his writings. Their effect was considerable, to judge from a royal proclamation against them and those of his friend Robert Harrison, issued in June 1583. But the repression of "sectaries" was now, and onwards until the end of the reign, so severe that the organization of churches was impossible. We can trace none in England, until we come in 1586 to Greenwood and Barrow, the men whose devotion to a cause in which they felt the imperative call of God seems to have rallied into church-fellowship the Separatists in London, whether those of Fytz's day or those later convinced by the failure of the Puritan efforts at reform and by the writings of Browne. At what exact date this London church—which had a more or less continuous history down to and beyond 1624—was actually formed, is open to doubt. It was only in Sept. 1592 that it elected officers, viz., a pastor (Francis Johnson), a teacher (Greenwood), two deacons and two elders. Yet as Barrow held that a church could exist prior to its ministry, this settles nothing. In 1589 Greenwood and Barrow composed "A true Description out of the Word of God of the visible Church," which represents the ideal entertained in their circle. It was practically identical with that set forth by Browne in 1582, though they were at pains to deny personal connection with him whom they now regarded as an apostate.

Exile in Holland.—After the execution of Greenwood, Barrow and the ex-Puritan Penry (a recent recruit to Separatism), in the spring of 1593, it seemed to some that Separatism was "in effect extinguished." This was largely true for the time as regards England, thanks to the rigour of Archbishop Whitgift, aided by the new act which left those who denied the queen's power in ecclesiastical matters no option but to leave the realm. Even this hard fate the bulk of the London church was ready to endure. Gradually they resumed church-fellowship in Amsterdam, where the learned Henry Ainsworth (*q.v.*) became their leader in place of Greenwood. More important historically is the church which was formed originally at Gainsborough (?1602), by "professors" trained under zealous Puritan clergy in the district where Nottinghamshire, Yorkshire and Lincolnshire meet, but which about 1606 reorganized itself for reasons of convenience into two distinct churches, meeting at Gainsborough and in Scrooby Manor House. Ere long these also were forced to seek refuge, in 1607 and 1608 respectively, at Amsterdam, whence the Scrooby church moved to Leiden in 1609 (Bradford's *History of Plymouth Plantation*, chs. 1–3). The permanent issues of the Gainsborough-Amsterdam church are connected with the origins of the Baptist wing of Congregationalism, through John Smyth and Thomas Helwys (*see* BAPTISTS). As for the Scrooby-Leiden church under John Robinson (*q.v.*), it was in a sense the direct parent of historical "Congregationalism" in England and America (*see* U.S. section, p. 251).

Separatism was now passing into Congregationalism,[2] both in sentiment and in language. The emphasis changes from protest to calm exposition. In the freer atmosphere of Holland the exiles lose the antithetical attitude, with its narrowing and exaggerative tendency, and gain breadth and balance in the assertion of their distinctive testimony. This comes out in the writings both of Robinson and of Henry Jacob, both of whom passed gradually from Puritanism to Separatism at a time when the silencing of some 300 Puritan clergy by the canons of 1604, and the exercise of the royal supremacy under Archbishop Bancroft, brought these "brethren of the Second Separation" into closer relations with the earlier Separatists. In a work of 1610, the sequel to his *Divine Beginning and Institution of Christ's true Visible and Ministerial Church,* Jacob describes "an entire and independent[3] body-politic," "endued with power immediately under and from Christ, as every proper church is and ought to be." But his claim for "independent" churches no longer denies that true Christianity exists within parish assemblies. Similarly Robinson wrote about 1620 a *Treatise of the Lawfulness of hearing of the Ministers of the Church of England* which shows a larger catholicity of feeling than his earlier *Justification of Separation* (1610). These semi-separatists still set great store by the church-covenant, in which they bound themselves "to walk together in all God's ways and ordinances, according as He had already revealed, or should further make them known to them." But they realized that "the Lord had more truth and light yet to break forth of his Holy Word"; and this gave them an open-minded and tolerant spirit, which continued to mark the church in Plymouth Colony, as distinct from the Puritans of Massachusetts Bay. Such, then, was the type of church formed in 1616 by Henry Jacob when he returned to London. It was founded under the tolerant Archbishop George Abbot (1562–1633), and would have been content with toleration such as the French and Dutch churches in England enjoyed. But Charles I. and Archbishop Laud would make no terms with those who denied royal supremacy in religion, and in 1632 this church was persecuted.

Independency.—Besides such regular churches in London and the provinces under the early Stuarts, there were also numerous "conventicles" composed of very humble folk, such as the eleven scattered about London which Bishop Joseph Hall (1574–1656) reports in 1631, and which he states in 1640 had grown to some eighty. In these latter the earlier Brownist or even Anabaptist spirit probably prevailed. Further there was arising a new type of "Independent," to use the term now coming into use. Conjoint repression of civil and religious liberty had made thoughtful men ponder matters of church polity. The majority, indeed, even of determined opponents of personal rule in state and church favoured Presbyterianism, particularly before 1641, when Henry Burton's *Protestation Protested* brought before educated men generally the principles of Congregationalism, as distinct from Puritanism. But besides this telling pamphlet and the controversy which ensued, the experience of New England as to the practicability of Congregationalism, at least in that modified form known as the "New England Way," produced a growing impression, especially on parliament. Hence even before the Westminster Assembly met in July 1643, Independency could reckon among its friends men of distinction in the state, like Cromwell, Sir Harry Vane, Lord Saye and Sele; while Milton powerfully pleaded the power of Truth to take care of herself on equal terms. In the assembly, too, its champions were fit, if few. They included Thomas Goodwin and Philip Nye, who had practised this polity during exile abroad and now strove to avert the substitution of Presbyterian uniformity for the Episcopacy which, as the ally of absolutism, had alienated its own children. Yet the "Five Dissenting Brethren" would have failed to secure toleration even for themselves as Congregationalists—such was the dread felt by the assembly for Anabaptists, Antinomians, and other "sectaries"—had it not been for the vaguer, but widespread Independency existing in parliament and in the army. Here, then, we meet with a distinction (*cf.* Dale, p. 374 ff.) of moment for the Commonwealth era, between "Independency" as a prin-

[1] *See* F. J. Powicke, *Henry Barrow Separatist (1550?–1593) and the Exiled Church of Amsterdam (1593–1622)* (1900), pp. 128 foll., for his views on the topic.

[2] The abstract term dates only from 18th century. But "congregational" (due to rendering of *ecclesia* by "congregation" in early English Bibles) appears about 1642, to judge from *New English Dictionary*.

[3] "Independent" is not yet used technically, as it came to be about 1640.

ciple and "Congregationalism" as an ideal of church polity. Independency, like nonconformity, is primarily a negative term. It simply affirms the right of any society of private persons to meet together for worship, without being interfered with by any external authority.[1] Such a right may be asserted on other theories than the congregational or even the Christian. Congregationalism, however, denotes a *positive* theory of the organization and powers of Christian churches, having as corollary independency of external control, whether civil or ecclesiastical. Historically the two terms have been used interchangeably during the last two hundred years. But under the Commonwealth many professed the one without fully accepting the other.

During the Civil War Congregationalism broadened out into reciprocal relations with the national life and history. Thenceforth it involves not only the story of Nonconformity and the growth of religious liberty, but also the whole development of modern England. To sketch even in outline "The Evolution of Congregationalism" in correspondence with so complex an environment is here impossible. Only salient points can be indicated.

Development After the Restoration.—During the Protectorate, with its practical establishment of Presbyterians, Independents and Baptists, the position of Congregationalism was really anomalous, in so far as any of its pastors became parish ministers,[2] and so received "public maintenance" and were expected to administer the sacraments to all and sundry. But the Restoration soon changed matters, and by forcing Presbyterians and Congregationalists alike into Nonconformity, placed the former, instead of the latter, in the anomalous position. In practice they became Independents, after trying in some cases to create voluntary presbyteries, like Baxter's associations, adopted partially in 1653–1660, in spite of repressive legislation. But though Presbyterians did not in many instances become Congregationalists also, until a later date, the two types of Puritanism were drawn closer together in the half-century after 1662. The approximation was mutual. Both had given up the strict *jure divino* theory of their polity as apostolic. The Congregationalism of the Savoy Declaration (Oct. 12, 1658), agreed on by representatives—the majority non-ministerial—from 120 churches, is one tempered by experience gained in Holland and New England, as well as in the Westminster Assembly. Hence when, after the Toleration Act of 1689, a serious attempt was made to draw the two types together on the basis of *Heads of Agreement assented to by the United Ministers in and about London, formerly called Presbyterian and Congregational,* the basis partook of both (much after the fashion of the New England Way), though on the whole it favoured Congregationalism (*see* Dale, pp. 474 ff.). In many trust-deeds of this date (which did not contain doctrinal clauses), and for long after, the phrase "Presbyterian or Independent" occurs. Yet the two gradually drifted apart again owing to doctrinal differences, emerging first on the Calvinistic doctrine of grace, and next on Christology. In both cases the Congregationalists took the "high," the Presbyterians the "moderate" view. These specific differences revealed different religious tendencies,[3] the one type being more warmly Evangelical, the other more "rational" and congenial in temper with 18th-century Deism. The theological division was accentuated by the Salters' Hall Controversy (1717–1719), which, nominally touching religious liberty *versus* subscription, really involved differences as to Trinitarian doctrine. Ere long Arianism and Socinianism were general among English Presbyterians (*see* UNITARIANISM). Congregationalists, on the other hand, whether Independents or Baptists, remained on the whole Trinitarians, largely perhaps in virtue of their very polity, with its intimate relation between the piety of the people and that of the ministry. Yet the relation of Congregational polity to its religious ideal had already become less intimate and conscious than even half a century before: the system was held simply as one traditionally associated with a serious and unworldly piety. "Church privileges" meant to many only the sacred duty of electing their own ministry and a formal right of veto on the proposals of pastor and deacons. The fusion into one office of the functions of "elders" and "deacons" (still distinguished in the Savoy Declaration of 1658) was partly at least a symptom of the decay of the church-idea in its original fulness, a decay itself connected with the general decline in spiritual intensity which marked 18th-century religion, after the overstrain of the preceding age. Yet long before the Evangelical Revival proper, partial revivals of a warmer piety occurred in certain circles; and among the Independents in particular the new type of hymnody initiated by Isaac Watts (1707) helped not a little.

The Methodist movement touched all existing types of English religion, but none more than Congregationalism. While the "rational" Presbyterians were repelled by it as "enthusiasm," the Independents had sufficient in common with its spirit to assimilate—after some distrust of its special ways and doctrines—its passion of Christlike pity for "those out of the way," and so to take their share in the wider evangelization of the people and the Christian philanthropy which flowed from the new inspiration. For underneath obvious differences, like the Arminian theology of the Wesleys and the Presbyterian type of their organization, there was latent affinity between a "methodist society" and the original congregational idea of a church; and in practice Methodism, outside the actual control of the Wesleys, in various ways worked out into Congregationalism (*see* Mackennal, *op. cit.* pp. 156 ff., Dale, pp. 583 ff.). So was it in the long run with the Countess of Huntingdon's Connection, springing from Whitefield's Calvinistic wing of the Revival, not to mention the congregational strain in some minor Methodist churches.

But whilst Congregationalism grew thereby in numbers and in a sense of mission to all sorts and conditions of men, it modified not only its Calvinism but also its old church ideal in the process. During most of the next century it inclined to an individualism untempered by a sense of mystic union with God and in Him with all men (*see* Dale, pp. 387 ff., for an estimate of these and other changes). It lost, however, its exclusive spirit. Its pulpit, which had always been the centre of power in the churches, has for a century or more taken a wider range of influence in a succession of notable preachers. Congregationalists generally have been to the fore in attempts to apply Christian principles to matters of social, municipal, national and international importance. They have been steady friends of foreign missions in the most catholic form (supporting the London Missionary Society, founded in 1795 on an inter-denominational basis), of temperance, popular education and international peace. Their weakness as a denomination has lain latterly in their very catholicity of sympathy. Thus it was left to the Oxford Revival, with its emphasis on certain aspects of the Church idea, to help to re-awaken in many Congregationalists a due feeling for specific church-fellowship, which was the main passion with their forefathers. Another influence making in the same direction, but in a different spirit, was the Broad Church ideal represented in various forms by Thomas Erskine of Linlathen, F. W. Robertson of Brighton and F. D. Maurice. In the last of these the conception of Christ's Headship of the human race assumed a specially inspiring form. This conception, in a more definitely Biblical and Christian shape, attained forcible expression in the writings of R. W. Dale of Birmingham, the most influential Congregationalist in the closing decades of the 19th century, in whom lived afresh the high Congregationalism of the early Separatists.

Modern Tendencies.—Modern Congregationalism, as highly sensitive to the *Zeitgeist* and its solvent influence on dogma, shared for a time the critical and negative attitude produced by the first impact of a culture determined by the conception of

[1]The opposite of this external Independency, admission of civil oversight even for churches enjoying internal ecclesiastical self-government, was also common, being the outcome of the traditional Puritan attitude to the state. *See* A. Mackennal, *The Evolution of Congregationalism* (1901), pp. 43 ff.

[2]For the distinction between "Gathered" and "Re-formed" churches in this connection, *see* Dale, p. 376.

[3]A parallel is afforded by the history of Congregationalism in Scotland, which arose early in the 18th century through the evangelistic fervour of the Haldanes in an era of "moderatism"; also by the rise of the kindred Evangelical Union, shortly before the Disruption in 1843. These two movements coalesced in a single Congregational Union in 1896.

development as applying to the whole realm of experience. But it has largely outgrown this, and is addressing itself to the progressive re-interpretation of Christianity, in an essentially constructive spirit. Similarly its ecclesiastical statesmen have been developing the full possibilities of its polity, to suit the demands of the time for co-ordinated effort. While its principle of congregational autonomy has been gaining ground in the more centralized systems, whether Episcopal or Presbyterian, its own latent capacity for co-operation has been evoked by actual needs to a degree never before realized in England. Association for mutual help and counsel, contemplated in some degree in the early days, from Browne to the Savoy Declaration of 1658, but thereafter forced into abeyance, began early in the 19th century to find expression in County Unions on a voluntary basis, especially for promoting home missionary work. These in turn led on to the Congregational Union of England and Wales, formed in 1832, and consisting at first of "County and District Associations, together with any ministers and churches of the Congregational Order recognized by an Association." Later it was found that an assembly so constituted combined the incompatible functions of a council for the transaction of business and a congress for shaping or expressing common opinion: and its constitution was modified so as to secure the latter object only. But after half a century's further experience, public opinion, stimulated by growing need for common action in relation to certain practical problems of home and foreign work, proved ripe for the realization of the earlier idea in its double form. In 1904 the Union was again modified so as to embrace (1) a council of 300, representative of the county associations, to direct the business for which the Union as such is responsible, and (2) a more popular assembly, made up of the council and a large number of direct representatives of the associated churches. Association, however, remains as before voluntary, and some churches are outside the Union; nor has a resolution of the assembly more than moral authority for any of the constituent churches. As regards the "Declaration of Faith, Church Order and Discipline" adopted in 1833, and still printed in the official Year Book "for general information" as to "what is commonly believed" by members of the Union, what is characteristic is the attitude taken in the preliminary notes to "creeds and articles of religion." These are disallowed as a bond of union or test of communion, much as in the Savoy Declaration of 1658 it is said that constraint "causeth them to degenerate from the name and nature of Confessions," "into Exactions and Impositions of Faith."

Among topics which have exercised the collective mind of modern Congregationalism, and still exercise it, are church-aid and home missions, church extension in the colonies, the conditions of entry into the ministry and sustentation therein, Sunday school work, the social and economic condition of the people (issuing in social settlements and institutional churches), and, last but not least, foreign missions. Indeed the support of the London Missionary Society has come to devolve almost wholly on Congregationalists, a responsibility recognized by the Union in 1889 and again in 1904. To afford a home for the centralized activities of the Union, the Memorial Hall, Farringdon Street, London, was built on the site of the Fleet prison—soil consecrated by sacrifice for conscience under Elizabeth—and opened in 1875. There the Congregational Library, founded a generation before, is housed, as well as a publication department. A congregational hymn-book (including Watts' collection) was issued by the Union in 1836, and again in fresh forms in 1859, 1873 and 1887.

The *theological colleges* which train for the Congregational ministry have themselves an interesting history, which goes back to the private "academies" formed by ejected ministers. They underwent great extension owing to the evangelical revival, and became largely centres of evangelistic activity (Dale, p. 593 ff.). But they were burdened by the necessity of supplying literary as well as theological training, owing to the disabilities of nonconformists at Oxford and Cambridge till 1871. Even before that, however, owing partly to the impulse given by the university of London after 1836, the standard of learning in some of the colleges had been rising; and the last generation has seen marked advance in this respect. In 1886 Spring Hill college, Birmingham, was transplanted to Oxford, where it was refounded under the title of Mansfield college, purely for the post-graduate study of theology (first principal, Dr. A. M. Fairbairn); in 1905 Cheshunt college, founded by the countess of Huntingdon, was transferred to Cambridge, whilst the creation of the university of Wales, the reconstitution of London University, and the creation of Manchester University, led, between 1900 and 1905, to the affiliation to them of one or more of the other colleges. Indeed in all cases the students are now in some sort of touch with a university or university college. There are eight colleges in England, viz., besides Mansfield and Cheshunt, New and Hackney colleges, London; Western college, Bristol; Yorkshire United college, Bradford; Lancashire Independent college, Manchester; the Congregational Institute, Nottingham.

The outstanding features in the development of Congregationalism during the first quarter of the 20th century have been an intensifying of the denominational consciousness and a strengthening of the tendency towards Connectionalism. On its practical side this forward movement took the form of collecting £500,000 in order to establish the various organizations of Congregationalism on a sounder financial basis, and to supply more adequate retiring pensions for aged ministers. The latter object was the main element in the scheme, proving conclusively that the Congregational Union is now more prepared than it was to recognize some corporate responsibility for its ministers. This point was further emphasized by certain new and more stringent regulations for the admission and recognition of ministers. The normal entry to the ministry is through a recognized college. Failing this, exceptional cases may be provided for by a three years' probation and periodic examinations under the supervision of a county union. Nothing here interferes with the autonomy of the individual church. Churches are still at liberty to call whom they will to minister to them. But recognition by the union and a share in the union grants and superannuation funds is only available for those who submit to the conditions which the union imposes. The churches generally have accepted these conditions which safeguard their interests as well as those of the ministers and establish the status of the ministry on a much more satisfactory footing.

In 1919 the country was divided into nine administrative areas called provinces and a moderator appointed over each area to act as adviser and "Father in God" to the churches within it. The tentative scheme then adopted was after a few years' trial amended in 1924. It was provided that the provinces should be formed by the grouping of county unions, and that a moderator, who might be either a minister or a layman, should be appointed for each such group. The moderators act in concert with the county union executives, and with special provincial committees elected *ad hoc*. The fear that these arrangements would interfere unduly with the autonomy of the churches has not been realized.

British Dominions.—The growth of Congregationalism in the British dominions and colonies has steadily proceeded during the last hundred years, and was fostered by the union of 1832. In Canada an interesting development has to be recorded. The Congregational churches, with a few negligible exceptions, are now merged along with the Methodists and Presbyterians in the United Church of Canada. This reunion is the culmination of negotiations and discussions which have been going on for some years. Congregationalists have taken a leading part in the reunion movement. They have shown themselves willing to accept a central organization and a closely-knit church fellowship, while safeguarding spiritual liberties. In the doctrinal basis of the United Church they helped to secure that the declaration of faith accepted by the partners to the union should be purely declaratory and should not be made "an imposition upon any." Their college at Montreal, affiliated with others in the theological faculty of McGill University, is doing fine work in training men for the very varied types of ministry which the country requires.

Congregationalism in Australia has not kept pace with the growth of population. In spite of its freedom and adaptability it has made less progress than the more closely organized churches. It maintained too long an individualist type of independency and tended to live on the reputation of certain large and prosperous churches led by men of outstanding ability. But the general level of the ministry is higher than it ever was, and with three colleges in Sydney, Adelaide and Victoria it should not be difficult to maintain it. The Congregational Unions foster a sense of corporate responsibility among all the churches. The down-town and country churches now feel themselves part of a living organism and they and their stronger brethren stand or fall together. The establishment of provident, sustentation and building funds has done much to increase the denominational consciousness and makes for efficiency and home missionary enterprise. The failure of the recent negotiations for reunion among the Australian churches may prove a blessing in disguise. It is said that Congregationalism now breathes more freely and is preparing to give itself more heartily to its distinctive witness. The difficulties are very great in a country where practical materialism and religious conservatism seem to go hand in hand. But these very difficulties constitute a challenge and an opportunity, and there are many indications that the Congregational churches are alive to the need and are preparing themselves to meet it.

The Congregational problem in South Africa is much complicated by the existence of native and coloured churches. These greatly outnumber the white churches, and since the withdrawal of control by the London Missionary Society, have tended to interpret their independency very literally. But guidance and fostering are supplied partly by the white churches, which have to find men for administrative posts and most of the money, and partly by the Colonial Missionary Society. The Congregational Union of South Africa now comprises all the churches under a central organization and is creating a new sense of corporate fellowship and responsibility. It is tackling the educational problem among the natives, training teachers and preachers and initiating social work.

In the smaller Congregational Unions of Nova Scotia, British Guiana, New Zealand, Jamaica, Tasmania and Newfoundland, the new spirit of fellowship, co-operation and denominational responsibility is making itself felt to the great advantage of the churches themselves and to the increase of their capacity for aggressive work. They represent a new and very effective type of federated independency.

BIBLIOGRAPHY.—The literature bearing on the subject is given with some fulness in the appendix to R. W. Dale's *History of English Congregationalism* (1907), the most authoritative work at present available. For the ancient church the data are collected in T. M. Lindsay's *The Church and the Ministry in the early Centuries* (1902), and in papers by J. V. Bartlet in the *Contemp. Review* for July 1897 and April 1902. For the modern period in particular *see* H. M. Dexter's *Congregationalism of the Last Three Hundred Years, as seen in its Literature* (1880), supplemented by bibliographies in the first vols. of the *Congregational Historical Society's Transactions* (1901 ff.), themselves a growing store of fresh materials. Of the older histories Waddington's *Congregational History* in 5 vols. (1869–1880) contains abundant data; while for more detailed study reference may be made to various county histories, such as T. Coleman, *Independent Churches of Northamptonshire* (1853), T. W. Davids, *Annals of Evangelical Nonconformity in Essex* (1863), R. Halley, *Lancashire, its Puritanism and Nonconformity* (1869); G. H. Pike, *Ancient Meeting-Houses in London* (1870); J. Browne, *History of Cong. in Norfolk and Suffolk* (1877); W. Urwick, *Nonconformity in Hertfordshire* (1884); W. Densham and J. Ogle, *Congr. Churches of Dorset* (1899); W. H. Summers, *History of the Berks, S. Bucks, and S. Oxon. Cong. Churches* (1905); and F. J. Powicke, *History of the Cheshire Cong. Union,* 1806–1906. *The Victoria County Histories* (Constable) may also be consulted. Important documents for Congregational Faith and Order, with historical introductions, are printed in Williston Walker's *Creeds and Platforms of Congregationalism* (1893). Statistical and other information relating to the churches of the Congregational connection is set forth systematically in the annual issues of the *Congregational Year Book.* Two magazines have been successfully established: *The Congregational Church Monthly* and the *Congregational Quarterly.* For a brief but brilliant account of the Congregational connection at the present time *see* W. B. Selbie, *Congregationalism* (1928), in the series "The Faiths" edited by L. P. Jacks. (X.)

UNITED STATES

The history of Congregationalism in the United States is bound up with the development of the Protestant reformation in England. This resulted in the Puritan movement, whose purpose was, as its name indicates, still further to purify both the creeds and the practices of the Anglican Church as by law established. This movement developed an aggressive left wing, which carried its demand for change so far that its leaders finally insisted on separating, not only from what it regarded as the errors in the Church of England, but from the Anglican Church itself. Robert Browne (1550–1631) was a pioneer in this radical protest and those who followed him were first known as Brownists and later as Separatists, both of which names were greatly disliked by those who were forced to bear them. In the early years of the 17th century a congregation, among other groups whose history is uncertain and whose existence was unstable, gathered at Scrooby in the north of England, where William Brewster was postmaster. Their leaders were Richard Clyfton and John Robinson. This congregation sought refuge in Holland, arriving at Leyden in 1608. Here they enjoyed the wise and devoted leadership of John Robinson, won the respect of the Dutch, drew many members from England, and finally reached a membership of about 300. This Scrooby-Leyden group became the first permanent Congregational Church. Finally, however, they were convinced that there was no hope of their persistence in Holland. The economic struggle was too severe, and the second generation was intermarrying with the Dutch and tending to lose the sharpness and fervour of the principles which had guided their fathers in the emigration from the mother country. Return to England was impossible; they therefore turned to America. After long negotiations their plans won the support of certain English merchant adventurers, a charter was secured, and, after many vicissitudes, the stronger part of the congregation reached Plymouth, Mass., in 1620. The remainder of the group, under John Robinson's leadership, expected to follow in due time, as many did, although Robinson himself died in Holland in 1625. These Plymouth immigrants have always borne the name of the Pilgrim fathers. They met the rigours of the climate and the hard conditions of the new country, lived in comparative peace with the native Indians, and assumed a position of great influence in the subsequent settlement of New England.

The next step in the development of the Congregational Churches in the United States is concerned with the Puritan exodus from England, chiefly due to the persecution of nonconformists under the leadership of Laud. These immigrants were not Separatists when they left home. They still thought of the Church of England as their mother church, although they were forced to protest against and separate from the errors which they discovered in it. Laud's policy, however, was uncompromising. There is no more conspicuous example of a foolish programme of persecution than is seen in this relentless policy to "harry out of the land" a group of people of such quality as the English Puritans. They chose a better location for their new homes than the Pilgrim fathers had done. Boston had an excellent harbour; the region was favourable to agriculture; profitable fishing was within easy reach. The high tide of this Puritan exodus was reached between 1630 and 1640. The settlements were made at Salem, Boston, Charlestown, Watertown and other favourable locations around Massachusetts bay. The significant factor in this story, however, is not the number or quality of the immigration, but the changes which took place in their ideas of church organization and government after they had reached the new country and were forced to organize their churches. According to the statements which they had made before leaving England, it would have been their policy to establish a purified Anglican Church order in Massachusetts. They had said: "We esteem it our honour to call the Church of England our dear mother." Their leaders had never looked with favour upon the independent congregation at Plymouth. In the winter of 1628–29, however, there was dire sickness at Salem, and Samuel Fuller, deacon of the church of the Pilgrim Fathers at Plymouth, hurried to render such help as he could. He was both an ardent defender of the Congregational way in church government and a beloved physician. Our knowledge of this period is scanty, but when the colonists of Massachusetts bay organized their churches they followed the Plymouth model, and the New England colonies became Congregational and not Anglican, after the Salem practice.

The Covenant.—The peculiar factor in this form of church government was the use of the covenant instead of a creed as the basis of fellowship. There was little need of a doctrinal statement to guarantee their church government, for they were uniformly Calvinists, assenting to such precise enunciations as were to be found in the statement sanctioned by the Synod of Dort. Their covenant was short and simple:

"We covenant with the Lord and one with another; and do bind our selves in the presence of God, to walk together in all His ways, according as He is pleased to reveal Himself unto us in His blessed word of truth."

Another significant factor in this entrance upon a new church order was taken when Francis Higginson and Samuel Skelton, both of whom were ordained clergymen of the Church of England, were ordained at Salem by the laying on of hands. This broke with the entire doctrine and practice of Episcopal succession, as maintained in England, and recognized the essential Congregational principle that every congregation is endowed with the full right to choose and ordain its own ministers.

First Period.—The first period in the history of the Congregational Churches in the United States extends from 1620 to 1740. During these 120 years the principal interest in the development is concerned with church government rather than doctrine. It is an era of quite uniform Calvinism in theology. The two chief factors deserving attention are the beginning of missions to the Indians, and among the expanding settlements, the founding of schools and colleges. Clearly defined among the purposes which inspired the movement of the Pilgrim fathers from Holland to America was the desire to convert to the Christian religion the natives of the country, concerning whom fascinating reports had been brought back and given wide currency in England, especially from Virginia. When John Robinson learned that the death of certain natives had been a result of a collision between the Plymouth colonists he deplored the fact that it had been necessary to kill them before any had been converted. The beginning of missions to the Indians was first successfully made by John Eliot, minister of the Roxbury church, who learned the Indian language, reduced it to writing, translated the Bible into the native tongue, and established communities of "praying Indians" in the colony. He was one of many successors to carry on the effort to Christianize the Indians. The Congregational Churches have actively maintained their Indian missions from the day when Eliot first preached to them in their own language in 1646. Schools and churches are still maintained for the Indians on their reservations. Another noteworthy activity of the Congregational Churches has been their devotion to education. This was due to the importance placed by them upon accurate knowledge of the Bible and their firm conviction that ignorance is not the mother but rather the real foe of true religion. Therefore, as soon as they had built their houses and made a beginning with the agriculture which was necessary to their economic support, they laid the foundations of their common school system and soon after provided for higher education in colleges. They expressed their purpose clearly in the language of the legislature, or general court, to provide for a more thorough understanding of the Bible, "it being one chief project of that old deluder, Satan, to keep men from the knowledge of the Scriptures." In 1636 the legislature of Massachusetts voted funds for a college, to which the name of John Harvard was given in 1639. Thus began the continuous programme of organizing and sustaining colleges by the Congregational Churches, until the entire country where these churches have been in action is dotted with them. An educated ministry and an intelligent church membership have been insisted upon from the earliest days and institutions of learning to guarantee this result have been supported with sacrificial devotion.

The second period in the history of the Congregational Churches in the United States extends from 1740 to 1850. During this period the paramount interest was in questions of theology rather than church organization. Periods of spiritual fervour generally follow periods of decline. The upward movement is registered by a spiral rather than a uniform curve.

The loss in religious fervour of the colonial period was a source of profound distress to the ministers of the Congregational Churches, and under their efforts to stem the tide various religious manifestations took place. The general tendency of the time, however, was to lay stress upon "good works" as the effective means of producing a religious experience. Preaching was therefore concerned largely with ethical idealism. It was not until about 1734 that a widespread and profound movement of religious revival began, which has come to be known as the Great Awakening. Its origin was in the preaching of Jonathan Edwards of Northampton, Mass. Edwards was both a theologian and preacher of unique power and he ranks as perhaps the greatest intellectual leader produced in the Congregational Churches. In 1740, George Whitefield came from England to help in the Awakening, news concerning which had produced a profound impression in the mother country. The movement then swept rapidly on. Many physical expressions of excitement accompanied the revival and created sharp divisions between the leaders. The good results of the Great Awakening are unquestioned, however. The moral standards of communities were lifted and religion became a vital factor in human experience such as it had not been before. A most conservative estimate of the number added to the churches as a result of the revival is 25,000 out of a population of perhaps 300,000 in New England at that time.

The differences in opinion brought out by the Great Awakening quickly deepened and soon the churches were filled with controversy. The old, stable Calvinism, which had been generally dominant, was sharply assailed by those who were not satisfied with its affirmations of the absolute sovereignty of God, the total depravity of man, the inability of the human will in the process of salvation, and the doctrines of foreordination and election. Out of the discussions came at last the only distinctive system of divinity which has been contributed by the United States to the history of doctrine. It was a form of modified Calvinism which is generally known as the New England theology. The heart of it was an emphasis upon the love of God in relation to men and the power of man in responding to the divine influences in the experiences of religion. Theology became less austere and formal; it was humanized by the definers of the new point of view. In various aspects the New England theology was dominant in the pulpits and theological schools of the Congregational Churches until about the year 1800. As was inevitable, however, the theological developments issuing from the Great Awakening swung to a left wing, and a strong Unitarian movement was incipient even when the Awakening was at its height. This did not come to full strength, however, until about 1800. Then the anti-Trinitarians became aggressive. In 1805 they secured the election of one of their number to the Hollis Professorship of Divinity at Harvard, thus entrenching themselves in the oldest college of Congregational heritage. A strong group of leaders of the liberal movement arose, prominent among whom was William Ellery Channing. The conflict centred in New England. By 1815 the Unitarians had assumed such strength that they were able to carry a majority in many of the oldest and strongest of the New England Congregational churches, and, as a result of a favourable court decision, to maintain possession of the records and property of the organizations. In Boston, for example, out of 14 Congregational churches all but two became Unitarian, involving immense loss in members and money to the orthodox group, as they were currently known. In Massachusetts alone, 96 churches thus separated from the Congregational organization.

The period from 1800–1850 was marked by close union in missionary expansion with the Presbyterians, who had little strength in New England, but possessed larger resources in New York and Pennsylvania. In doctrine the two bodies were in practical agreement, both being Calvinists in their earlier history. In church government they were not sharply separated. When the westward emigration demanded organized agencies to follow the settlers with religious influences, it was therefore most natural that the Congregationalists and Presbyterians should seek to work together. They therefore adopted in 1801 a Plan of Union to govern their missionary expansion. The New England Congregational leaders felt that the more closely organized Presbyterian system fitted the needs of the isolated settlements of the expanding frontier and therefore were quite willing that their missionaries should use this form of government for the new churches. The financial support during this half century came principally from Congregational sources in New England and the missionaries were generally members of Congregational churches. They were not guided by any strong denominational consciousness and in the end the results of their work accrued far more to the Presbyterian than to their own fellowship. No statistics are accurate at this point; but one of the most careful students of the period has estimated that fully 2,000 churches which would naturally have been Congregational became Presbyterian in the country west of the Hudson river under the operation of the Plan of Union.

The third period in the history of the Congregational Churches in the United States, from 1850 onward, has been one of growing self-consciousness in purpose, and the creation of sufficient administrative machinery to carry on its common religious enterprises at home and abroad. No profound doctrinal controversies have rent the churches, which suffered great material losses from the Unitarian separation and the Plan of Union. The most significant developments of the period may be summed up as indicated below.

Missionary Expansion.—In 1810 the American Board of Commissioners for Foreign Missions was organized to sponsor the work indicated by its name. While entirely Congregational in origin, it included in its membership at first, representatives of the Presbyterian and Dutch Reformed Churches. Later both these bodies withdrew. After 1840 the board extended its work widely and it has borne a part in missionary work in foreign lands, quite out of proportion to the numbers and wealth of its supporting churches. This has been especially significant in Turkey. During the same time the boards established for home missions and education have been vigorously at work. The contribution of the American Missionary Association to the education of the negroes and other races in the United States has been conspicuous, particularly since the close of the Civil War in 1865.

Administration.—The ideals of Congregational Church government are the independence of the local congregation and the fellowship of the independent churches for mutual counsel and for the prosecution of those enterprises which no single church alone could compass. Harmonious balance between these two principles involves and assures the symmetry and success of the whole plan. The years since 1910 have witnessed a striking development of the fellowship of the churches. This appears in the growth of the influence of the state conferences and the larger function of the State superintendent, not merely because of counsel and financial support given to the small or missionary-aided congregations, but also through increasing co-operation in the affairs of the larger and self-supporting churches. In effecting pastoral relations, organizing and carrying out their own community programmes, and in all matters of policy, the churches have come to look for guidance to the superintendent and also, through him to the board of directors of the State conference. This service is rendered without assuming any rights of judicature, and it issues in a gratifying increase of practical efficiency.

National Organization.—The development of the national organization of the Congregational Churches has kept pace with that of the state units. The effort to perfect closer organization, cut down overhead cost, and increase the community service of the churches has been strongly influenced by similar movements in the economic world. After a period of careful study by a commission chosen for its representative character, the first step in advance was taken at Kansas City in 1913. The national council was given larger functions in the work of the church, still safeguarding the autonomy of the individual congregation. A general secretary was chosen to represent the churches of the nation in their relations with small congregational groups, other denominations and in international relationships. The various societies through which the churches had carried on their missionary work were more closely integrated with the national council. Again, after intensive study by a commission, new plans were adopted by the national councils in 1925 and 1927 by which the work of the denomination is divided into two groups, home and foreign, and the administrative costs are further simplified.

Doctrinal Position.—The Congregational Churches always have laid more emphasis upon their covenant with God and with one another, entered into in order to constitute church membership, than upon formal creeds. All Congregational creeds have been looked upon as platforms for action and testimonies as to faith generally accepted rather than as dogmatic statements and tests. No single statement can be indicated as the authoritative creed of all the Congregational Churches, since each congregation adopts its own creed and there is wide variety. During a period of intense doctrinal debate, which has caused division in other bodies of American Protestantism, the Congregational Churches have not been seriously disturbed. All shades of opinion are represented among the clergy and laity; their deepest unity seems to be in their worship and their programmes of service. They occupy in general a liberal evangelical position. Interdenominational movements towards comity and unity have been shared largely by the Congregational churches and their missionary programme has been sustained with growing power and enthusiasm. The Congregational Year Book for 1926 gives the number of churches as 5,608; total membership 914,695; number of ministers (in the United States and foreign mission lands, with and without pastorates), 5,571; Sunday School members, 769,372; gifts for benevolence, $4,618,660; home expenses, $22,104,535.

See Leonard Bacon, *The Genesis of the New England Church* (1874); Williston Walker, *The Creeds and Platforms of Congregationalism* (1893) and *A History of the Congregational Churches in the United States* (1894); Frank Hugh Foster, *A Genetic History of the New England Theology* (1907); William E. Strong, *The Story of the American Board* (1910); William E. Barton, *The Law of Congregational Usage* (1916); Ozora S. Davis, *The Pilgrim Faith* (1918).

(O. S. D.)

CONGRESS, in diplomacy, a solemn assembly of sovereigns or their plenipotentiaries met together for the purpose of definitely settling international questions of common interest. In this sense the word first came into use in the 17th century; an isolated instance occurs in 1636, when it was applied to the meeting of delegates summoned by the pope to Cologne, to attempt to put an end to the Thirty Years' War. In 1647 the meetings of delegates for the conclusion of peace, assembled at Osnabrück and Münster, were termed a congress; and in spite of objections to it on the ground that it was "coarse and inappropriate," based on the physiological sense of the word (Lat. *congressus*), it continued thenceforward in use.

The adoption of the name Congress for the national legislative body in the United States (and so for other American countries) was simply a development from this usage; for the "continental congresses" of 1774 and 1775–81, and the "congress of the confederation" (1781–88) were, as inter-state representative deliberative bodies, analogous to international congresses, and the Congress established under the Federal Constitution of 1789 ultimately consists of representatives of the sovereign States composing the Union (*see* UNITED STATES: *Constitution and Government*). The more general analogous use of the term (Church Congress, etc.) is of modern origin.

In its international sense the term "congress" has usually only been applied to gatherings of first-class importance, attended either by the sovereigns themselves or by their secretaries of State for foreign affairs, less important meetings being termed "conferences." The dividing-line between the congress and conference is, however, historically ill-defined, the two terms having often been used indifferently in official diplomatic correspondence even of such dignified assemblages as the meetings of sovereigns and statesmen at Aix-la-Chapelle (1818), Troppau (1820) and Laibach (1821). Since the World War, indeed, the word "congress" has fallen into disuse, even the great assemblage of its representatives of the Allied and Associated Powers which settled the terms of the Treaty of Versailles being known as the Conference of Paris.

The results of the work done at various international congresses and conferences in developing a sense of the common interests of nations are dealt with under INTERNATIONAL LAW, PUBLIC, and allied articles; while the more important congresses are treated under their topographical headings.

Convocation and Constituent Elements of a Congress.—Any sovereign Power has the right to issue invitations to a congress or conference. In principle, moreover, every State directly concerned in the matters to be discussed has the right to be represented. But this principle, though affirmed by the Powers at Aix-la-Chapelle in 1818, has rarely been translated into practice. At the congress of Vienna (1814–15), the decisions of which affected every State in Europe, a committee of the five great Powers claimed and exercised the right to settle everything of importance; and this set the precedent which has been followed ever since. At the congresses of Paris (1856) and Berlin (1878), as at that of Vienna, the great Powers regulated the affairs of lesser States without consulting the representatives of the latter. Similarly, at the conference of 1869 on the affairs of Crete no representative of Greece was present; and at the conference of London (1883), on the international regulation of the Danube, the sovereign state of Rumania, though a Danubian power, was not represented.

This procedure naturally caused much dissatisfaction among the lesser Powers, and led to frequent protests on their part from the Congress of Vienna onward. But, although the principle of the equality of all sovereign States was admitted in theory, such attempts as were made to apply it in practice, *e.g.,* at the Hague Conferences, proved most unsatisfactory. At the Peace Conference of Paris, though lip-service was paid to the rights of small nationalities, all matters of importance were settled by the Big Four in secret conference, the full public sessions being mere dress parades. Under the Covenant of the League of Nations, however, an attempt was made to secure the rights of small States, and so far as the right to be heard is concerned, this was done; but effective decisions can only be made by the Council, in which the great Powers preponderate, or with its consent. The Council and Assembly together form, in effect, a permanent congress, though the name is not applied to the Geneva meetings. The practical inconvenience of the theoretical equality of all sovereign states, and of the necessity for unanimity in all decisions, was well illustrated when the protracted efforts of the Assembly to "interpret" the obnoxious article X of the Covenant were defeated by the isolated vote of Persia.

Procedure.—When the congress assembles the first business is the verification of powers, which is done by a commission specially appointed to examine the credentials of the plenipotentiaries. If the foreign minister himself attend, he needs no credentials; those of his colleagues are countersigned by him. The verification being completed, questions of procedure, of precedence and the like, are settled. The question of precedence which, in earlier times caused much trouble, was settled by the rule observed at the congress of Berlin (1878), according to which the plenipotentiaries took their seat at a horse-shoe table in the alphabetical order of the states they represented, according to the French alphabet.

The presidency of the congress is by courtesy reserved for the minister for foreign affairs of the state in which the meeting is held; if, however, he decline to serve, a president is elected; or, if there be a mediating Power, the minister representing this presides.

The discussions are governed by carefully defined rules. Thus every proposition must be presented in writing, and all decisions to be binding on all must be unanimous. The secretary keeps the minutes (*procès-verbal*) of each session, which are signed by all present and read at the next meeting. This *protocol*—as it has been called since the congress of Vienna—takes the form of a bald, but very exact résumé of important points discussed, ending with a record of the conclusions and resolutions arrived at. If there be no such results, opinions are recorded. If any plenipotentiary dissent from the general opinion, such dissent must be recorded in the protocol. Sometimes short signed memoranda, known as a *vote* or *opinion,* are attached to the protocol, stating the reasons that have governed the Powers in question in agreeing to a given conclusion. Individual Powers may express their dissent in two ways: either by placing such dissent on record, or by withdrawing altogether from the sessions of the congress. The conclusions arrived at after the discussion of the various subjects before the congress are usually embodied in separate conventions, duly signed by the Powers who are a party to them. Finally, these separate conventions are brought together in an inclusive treaty, signed by all the plenipotentiaries present, known as the Final Act.

See P. Pradier-Fodéré, *Cours de droit diplomatique* (2nd ed., Paris, 1899); Ernest Satow, *A Guide to Diplomatic Practice* (1922). (W. A. P.)

CONGRESS OF INDUSTRIAL ORGANIZATIONS, a federation of labour unions in the U.S.A., was formed as the Committee for Industrial Organization Nov. 9, 1935, when John L. Lewis of the United Mine Workers and representatives of seven other unions decided to launch an independent drive to unionize unorganized labour. The type of organization promoted was the *vertical,* or industrial union (including all branches of a single industry) as opposed to the *horizontal,* or craft union long favoured by the American Federation of Labor. In Sept. 1936, the C.I.O., as it came to be known, was suspended with its adherents from the A.F. of L. But it proceeded to organize such key industries as steel, rubber, and motor cars, and reached agreements with such large corporations as U.S. Steel and General Motors. In the following years the C.I.O. and the A.F. of L. engaged in a bitter struggle for leadership of American labour. The C.I.O. held its first convention at Pittsburgh Nov. 14–18, 1938, adopted its new name and a constitution, and elected Mr. Lewis president.

CONGREVE, RICHARD (1818–1899), English Positivist, was born at Leamington on Sept. 4, 1818, was educated at Rugby and Oxford, and was a fellow of Wadham college. In 1878 he caused the split in English Positivism by refusing to admit the authority of P. Laffitte, Auguste Comte's successor. Congreve translated several of Comte's works, and in 1874 published a volume of essays advocating the renunciation by Britain of her foreign possessions. He died at Hampstead July 5, 1899.

His publications were: *Roman Empire of the West* (1855); annotated edition of Aristotle's *Politics* (1855; 2nd ed., 1874); *Catechism of the Positive Religion, translated from the French of A. Comte* (1858; 3rd ed., 1891); *Elizabeth of England* (1862); *Essays, political, social, and religious* (1874; 2nd series, 1892); *Historical Lectures* (collected in one volume, 1902).

See P. Thomas, *Auguste Comte and Richard Congreve,* 1910.

CONGREVE, SIR WILLIAM, BART. (1772–1828), British artillerist and inventor, was born on May 20, 1772, being the eldest son of Lieut.-Gen. Sir William Congreve (d. 1814), comptroller of the royal laboratory at Woolwich, who was made a baronet in 1812. He was educated at Singlewell school, Kent, and (1788–93) at Trinity college, Cambridge. He is chiefly remembered for his war rockets which, first fired at Boulogne in 1806 in salvos from boats of special construction, were very effective; and in 1807, 1808 and 1809 they were employed with excellent results on land and afloat at the siege of Copenhagen, in Lord Gambier's fight in the Basque Roads and in the Walcheren expedition. In 1810 or 1811 Congreve became equerry to the prince regent, with whom he was a great favourite, and in 1811 he was elected a fellow of the Royal Society; in the same year he at last received military rank, being gazetted lieut.-colonel in the Hanoverian artillery. In 1812 he became member of parliament for Gatton. In 1813, at the request of the Admiralty, he designed a new gun for frigates. That same year the new "Rocket Troop" of the Royal Artillery rendered excellent service at Leipzig. Congreve's rocket was replaced by Hale's, which had no stick.

In 1814, on the death of his father, Col. Congreve succeeded to the baronetcy and also to the office of comptroller of the royal laboratory. In 1820 Sir William Congreve was elected member of parliament. He died at Toulouse on May 16, 1828.

Congreve was an ingenious and versatile man of science. Besides the war rocket he invented a gun-recoil mounting, a time-fuse, a parachute attachment to the rocket, a hydro-pneumatic canal lock and sluice (1813), a perpetual motion machine, a process of colour printing (1821) which was widely used in Germany, a new form of steam-engine, and a method of consuming smoke (which was applied at the royal laboratory); he also took out patents for a clock in which time was measured by a ball rolling on an inclined plane; for protecting buildings against fire; inlaying and combining metals; unforgeable bank-note paper; a method of killing whales by means of rockets, improvements in the manufacture of gunpowder, stereotype plates; fireworks; gas meters, etc. The first friction matches made in England (1827) were named after him by their inventor, John Walker. He published a number of works, including three treatises on *The Congreve Rocket System* (1807, 1817, and 1821); *An Elementary Treatise on the Mounting of Naval Ordnance* (1812); *A Description of the Hydropneumatical Lock* (1815); *A New Principle of Steam Engine* (1819); *Resumption of Cash Payments* (1819); *Systems of Currency* (1819), etc.

See Col. J. R. J. Jocelyn, *Journal of the Royal Artillery*, vol. xxxii. No. 2 (1905).

CONGREVE, WILLIAM (1670–1729), English dramatist, the greatest English master of comedy, was born at Bardsey, near Leeds, where he was baptized on Feb. 10, 1670, although the inscription on his monument gives the date of his birth as 1672. He was the son of William Congreve, a soldier who was soon after his son's birth placed in command of the garrison at Youghal. To Ireland, therefore, is due the credit of his education—as a schoolboy at Kilkenny from 1681 to 1685, and then as an undergraduate at Dublin under St. George Ashe, where he was a contemporary and friend of Swift. His family moved from Ireland to Staffordshire, probably at the Revolution, and it seems to have been there, in 1690, that Congreve wrote *The Old Bachelor,* to amuse himself, as he says, during convalescence from an illness. From college he came to London, and was entered as a student of law at the Middle Temple in 1691. The first-fruits of his studies appeared under the boyish pseudonym of "Cleophil," in the form of a novel (*Incognita, or Love and Duty reconciled,* 1692), whose existence is now remembered only through the avowal of Dr. Johnson that he "would rather praise it than read it." Tradition has it that *Incognita* was written at the age of 17, but there are evidences of revision at a maturer age. Congreve took his place in the London of William and Mary very quickly. He had some poems in Gildon's *Miscellany* (1692), and was enlisted by Dryden among those who collaborated in his translation of Juvenal, contributing also the complimentary poem that was prefixed to Dryden's translation of Persius that accompanied it (1692).

In 1693 Congreve's career of fame began with the brilliant appearance and instant success of his first comedy *The Old Bachelor* (1693) under the generous auspices of Dryden, then, as ever, a witness to the falsehood of the vulgar charge which taxes the greater among poets with jealousy or envy. The discrowned laureate had never, he said, seen such a first play; and, indeed, the graceless grace of the dialogue was as yet only to be matched by the last and best work of Etherege, standing, as till then it had done, alone among the barefaced brutalities of Wycherley and Shadwell. The types of Congreve's first work were the common conventional properties of stage tradition, but the fine and clear-cut style in which these types were reproduced was his own. The gift of one place and the reversion of another were the solid fruits of his splendid success, but the tradition that portrays him as living in wealth on lavish sinecures does not need Swift's exaggerated picture of his poverty to refute it. Swift wrote of him that

> Congreve spent on writing plays
> And one poor office half his days.

Next year a better play from the same hand met with worse fortune on the stage, and with yet higher honour from Dryden. The noble verses, as faultless in the expression as reckless in the extravagance of their applause, prefixed by Dryden to *The Double Dealer* (1694) must naturally have supported the younger poet, if, indeed, such support can have been required, against the momentary annoyance of assailants whose passing clamour left uninjured and secure the fame of his second comedy; for the following year witnessed the crowning of his art and life, in the appearance of *Love for Love* (1695). The production of this play is a landmark in the theatrical history of the period. For some time the patentees of Drury Lane, in spite of their monopoly, had allowed the affairs of the theatre to get into such a condition that there seemed some danger of London being left without a theatre at all. Seeking to counteract falling profits by cutting salaries, they drove their players to the edge of mutiny, and the murder of Mountfort, closely followed by the deaths of Leigh and Nokes, had brought affairs to a crisis which even the brilliant success of *The Old Bachelor* could only mitigate. At last William III. was persuaded that he was not bound by his predecessor's monopoly, and the malcontents of the Theatre Royal opened a new theatre in the tennis-court in Lincoln's Inn Fields. The patentees did their best to wreck the scheme, seeking to recover some of the deserters by offers of increased salaries, but only two were tempted back (*see* the prologue of *Love for Love*), and the venture opened successfully on April 30, 1695, with *Love for Love.* In 1697 Congreve's ambition, rather than his genius, adventured on the foreign ground of tragedy, and *The Mourning Bride* (1697) began such a long career of good fortune as in earlier or later years would have been closed against a far better work. He was now manager of the new Lincoln's Inn theatre, and under contract to supply them with a new play every year—which he entirely failed to do. His health was already indifferent. Next year he attempted, without his usual success, a reply, *Amendments of Mr. Collier's False and Imperfect Citations* (1698) to the attack of Jeremy Collier, the nonjuror, "on the immorality and profaneness of the English stage"—an attack for once not discreditable to the assailant, whose honesty and courage were evident enough to prove him incapable alike of the ignominious precaution which might have suppressed his own name, and of the dastardly mendacity which would have stolen the mask of a stranger's. Against this merit must be set the mistake of confounding in one indictment the levities of a writer like Congreve with the brutalities of a writer like Wycherley—an error which, ever since, has more or less perverted the judgment of succeeding critics. The general case of comedy was then, however, as untenable by the argument as indefensible by the sarcasm of its more brilliant and comparatively blameless champion. Art itself, more than anything else, had been outraged and degraded by the recent school of the Restoration, and the comic work of Congreve, though different rather in kind than in degree from the bestial and blatant licence of his immediate precursors, was inevitably for a time involved in the sentence passed upon the comic work of men in all ways alike his inferiors. The true and triumphant answer to all attacks of honest men or liars, brave men or cowards, was then as ever to be given by the production of work unarraignable alike by fair means or foul, by frank impeachment or furtive imputation. In 1700 Congreve thus replied to Collier with *The Way of the World*—the unequalled and unapproached masterpiece of English comedy, which may fairly claim a place beside or just beneath the mightiest work of Molière. On the stage which had recently acclaimed with uncritical applause the author's more questionable appearance in the field of tragedy this final and flawless evidence of his incomparable powers met with a rejection then and ever inexplicable on any ground of conjecture. There is a persistent but insufficiently authenticated tradition that the author himself rushed in front and rated the unappreciative audience. Whether from disgust at this treatment or not, at any rate, he wrote no more plays, though there are two more pieces of more or less dramatic work from his pen. It is known that Congreve, Vanbrugh and Walsh collaborated to translate Molière's *M. de Pourceaugnac,* under the title of *Squire Trelooby;* it is, however, a matter of conjecture whether the anonymous work of this name, published in 1704, represents their work. The general opinion is that it does, and Summers includes it in his edition of Congreve's complete works (Nonesuch Press, 1925). The other is an opera *Semele,* set to music by Handel; it was performed at Cambridge in 1925.

In 1705 he was associated with Vanbrugh in the management of the Queen's theatre, while still retaining an interest in the Lincoln's Inn venture. But increasing gout made him unfit for the work and he soon retired definitely from theatre management. During the rest of his life Congreve produced little beyond a volume of fugitive verses, published ten years after the miscarriage of his masterpiece. But mention should be made of the *Discourse on the Pindaric Ode,* which accompanied his *Pindaric Ode to the Queen,* in 1786. This essay, based on the work of Lesueur and Schmid, is a valuable piece of literary criticism, bringing out clearly the true structure of the Pindaric ode, and helping to dam the flood of purposeless aggregations of long and short lines that had been assuming the name. His even course of good fortune under Whig and Tory Governments alike was counterweighed by the physical infirmities of gout and failing sight. He died on Jan. 19, 1729, in consequence of an injury received on a journey to Bath by the upsetting of his carriage; was buried in Westminster Abbey, after lying in state in the Jerusalem chamber; and bequeathed the bulk of his fortune to the chief friend of his last years, Henrietta, duchess of Marlborough, daughter of the great duke, rather than to his family, which, according to Johnson, was in difficulties, or to Mrs. Bracegirdle, the actress, with whom he had lived longer on intimate terms than with any other mistress or friend, but who inherited by his will only £200.

The one memorable incident of his later life was the visit of Voltaire, whom he astonished and repelled by his rejection of proffered praise and the expression of his wish to be considered as any other gentleman of no literary fame. The great master of well-nigh every province in the empire of letters, except the only one in which his host reigned supreme, replied that in that sad case Congreve would not have received his visit. His portrait, painted by Kneller, for the Kitcat club, depicts him as handsome and inclined to be stout. We get hints of taste rather in advance of his age in his collections of pictures and old ballads, and his love for his country house in Buckinghamshire. But it is remarkable how indefinite an impression we get of him. Dr. Protopopesco, in his study of him (*Un classique moderne*), says: "Hôte assidu de la maison des Marlborough, nous n'entendons que le bruit de ses mâchoires; avec ses amis, il ne fait que boire." We know him to have been a wit, but none of his talk is preserved. He had no enemies, and the most varying figures of his time, bitterly at war with each other, succeed each other in his rooms without embarrassment. Gay calls him "unreproachful."

We may conclude with the estimate of Congreve's work which A. C. Swinburne wrote for the ninth edition of the *Encyclopædia Britannica* in an article largely retained above, with certain additions of matters of fact.

"The fame of the greatest English comic dramatist is founded wholly or mainly on but three of his five plays. His first comedy was little more than a brilliant study after such models as were eclipsed by this earliest effort of their imitator; and tragedy under his hands appears rouged and wrinkled, in the patches and powder of Lady Wishfort. But his three great comedies are more than enough to sustain a reputation as durable as our language. Were it not for these we should have no samples to show of comedy in its purest and highest form. Ben Jonson, who alone attempted to introduce it by way of reform among the mixed work of a time when comedy and tragedy were as inextricably blended on the stage as in actual life, failed to give the requisite ease and the indispensable grace of comic life and movement to the action and passion of his elaborate and magnificent work. Of Congreve's immediate predecessors, whose aim had been to raise on French foundations a new English fabric of simple and unmixed comedy, Wycherley was of too base metal and Etherege was of metal too light to be weighed against him; and besides theirs no other or finer coin was current than the crude British ore of Shadwell's brutal and burly talent. Borrowing a metaphor from Landor, we may say that a limb of Molière would have sufficed to make a Congreve, a limb of Congreve would have sufficed to make a Sheridan. The broad and robust humour of Vanbrugh's admirable comedies gives him a place on the master's right hand; on the left stands Farquhar, whose bright light genius is to Congreve's as female is to male, or 'as moonlight unto sunlight.' No English writer, on the whole, has so nearly touched the skirts of Molière; but his splendid intelligence is wanting in the deepest and subtlest quality which has won for Molière from the greatest poet of his country and our age the tribute of exact and final definition conveyed in that perfect phrase which salutes at once and denotes him—'ce moqueur pensif comme un apôtre.' Only perhaps in a single part has Congreve half consciously touched a note of almost tragic depth and suggestion; there is something well-nigh akin to the grotesque and piteous figure of Arnolphe himself in the unvenerable old age of Lady Wishfort, set off and relieved as it is, with grace and art worthy of the supreme French master, against the only figure on any stage which need not shun comparison even with that of Célimène."

Bibliography.—(1) Works: The *Works* of William Congreve were published in 1710 (3 vols.). *The Dramatic Works of Wycherley, Congreve . . .* (edit. Leigh Hunt, 1840), contains a biographical and critical notice. *See* also *The Comedies of William Congreve* (1895), with an introduction by W. G. S. Street; *Semele* (edit. D. D. Arundell, 1925); *Incognita* (edit. Brett-Smith, Percy reprint no. 5, 1922). *The Complete Works of William Congreve* (4 vols., 1923, Nonesuch Press, edit. M. Summers) includes *Squire Trelooby* and his letters to the Keallys, as well as a full critical and biographical introduction. The theatrical history is prefixed to each play. It should be added that the productions of *Love for Love* (1917) and *The Way of the World* (1918) by the Stage Society caused a considerable revival of interest in Congreve, and *The Way of the World* was produced at the Lyric theatre, Hammersmith, in 1923, and ran for over 100 nights, being again successfully revived at Wyndham's in 1927. A few fragments otherwise unedited will be found in *A Sheaf of Poetical Scraps* (edit. D. Protopopesco, Bucharest, 1923).

(2) Biography: *Memoirs of the Life, Writings and Amours of William Congreve* by "C. Wilson" (London, 1730) is one of Curll's more blatant frauds, and is quite valueless; E. Gosse, *The Life of William Congreve* (1881, new ed., 1924); D. Protopopesco, *Un classique moderne, William Congreve* (Bucharest, 1925). *See* also Swift, *Journal to Stella,* and G. Meredith, *An Essay on Comedy* (1897).

CONGRUENCE, a mathematical term employed in several senses, each of them connoting harmonious relation, agreement or correspondence.

Two geometric figures are said to be *congruent,* or to be in the relation of *congruence,* if it is possible to superpose one of them on the other so that they shall coincide throughout. Thus two triangles are congruent if two sides and their included angle in the one are equal to two sides and their included angle in the other. This idea of congruence seems to be founded on that of a "rigid body," which may be moved from place to place without change in the internal relations of its parts. But it must rest on a previous concept of metrical relations among the parts of the body, since otherwise there would be no basis on which to determine whether the body had changed in shape and size.

The position of a (straight) line (of infinite extent) in space may be specified by assigning four suitably chosen co-ordinates. A *congruence* of lines in space is the set of lines obtained when the four co-ordinates of each line satisfy two given conditions. For example, all the lines cutting each of two given curves form a congruence. The co-ordinates of a line in a congruence may be expressed as functions of two independent parameters; from this it follows that the theory of congruences is analogous to that of surfaces in space of three dimensions. An important problem for a given congruence is that of determining the simplest surface into which it may be transformed.

Two integers a and b are said to be congruent modulo m if their difference a-b is divisible by the integer m. It is then said that a is congruent to b modulo m, and this statement is written in the symbolic form $a \equiv b \bmod m$. Such a relation is called a *congruence.* Congruences, particularly those involving a variable x, such as $x^p \equiv x \bmod p$, p being a prime number, have many properties analogous to those of algebraic equations. They are of great importance in the theory of numbers (*see* Numbers, Theory of).

(*See* also Differential Geometry; Line Geometry.)

CONGRUOUS, that which corresponds to or agrees with anything (Lat. *congruere,* to agree); the derivation appears in "congruence," a condition of such correspondence or agreement, a term used particularly in mathematics, *e.g.,* in the theory of numbers, for the relation of two numbers, which, on being divided by a third number, known as the *modulus,* leave the same remainder. (*See* Number.)

CONIBOS, a tribe of South American Indians belonging to the Panoan (*q.v.*) linguistic stock. The Conibos, one of the largest tribes of this group, live to-day on the upper Ucayali river in the vicinity of Cumarea. By tradition their former home was further south on the lower Urubamba. They are a sedentary, agricultural people, living in large rectangular thatched houses. They make excellent cotton textiles and beautifully decorated pottery, and are expert in the management of their dug-out canoes. The dead were formerly buried in large urns, beneath the floors of the houses. Monogamy is the rule except for chiefs, and each girl prior to marriage has to go through an artificial defloration ceremony.

See W. C. Farabee, "Indian Tribes of eastern Peru" (*Papers of the Peabody Museum of American Archaeology and Ethnology,* Harvard university, vol. x.).

CONICAL REFRACTION: *see* LIGHT.

CONIC SECTION, the intersection of a plane with a cone (*q.v.*). In Greek geometry and for centuries after the cone was regarded as a solid; hence any section was looked upon as a surface bounded by a curve. Later geometers feeling that conical properties belong to cones as surfaces, the bounded space within being relatively indifferent, define a cone as a surface. Hence the plane section becomes not an area but a plane-curve, though questions of areal content of course remain in place. The study of conics seems to have issued from Plato's Academy, with its inscription, "Let none unversed in geometry enter." Plato himself was abreast but hardly ahead of the mathematics of his day, such as was afterwards enshrined in Euclid's thirteen books of *Elements* (*c.* 300 B.C.), but the interest and enthusiasm he aroused accomplished wonders.

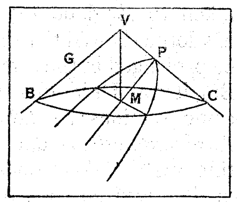

FIG. 1

The Triad.—Plato's associate, Menaechmus, was the brother of Deinostratus who was the exploiter if not inventor of the quadratrix of Hippias (*c.* 420 B.C.). It was Menaechmus who is said to have told Alexander that there is "no royal road to geometry," and who saw (*c.* 359 B.C.) that finding the mean proportional involved relations such as, for us, determine two parabolas and an hyperbola, defined by the equations $x^2=ay$, $y^2=bx$, $xy=ab$. But such curves did not exist in his day and it became necessary to invent them, as possessing geometric properties symbolized now in these equations. This he is said to have done (as appears probable from the epigram of Eratosthenes, *c.* 230 B.C., "Do not . . . cut the cone in triads of Menaechmus") by imagining a right circular cone cut by a plane perpendicular to the edge or generatrix, and in one of three curves (bounding the plane section) according as the cone was right-, acute- or obtuse-angled at the vertex. In the first and simplest case the plane, being parallel to the opposite edge, could never meet it. The section then extended indefinitely, yielding a curve, now named *parabola* (*q.v.*), always the same in shape though varying in size. In the second case the plane cut the opposite edge, the section was closed and finite, and was later named the *ellipse* (*q.v.*). In the third case the plane, diverging more and more from the opposite element of the cone, never meets it (except in the opposite nappe, as recognized by Apollonius),—the curve is now known as the *hyperbola* (*q.v.*). By help of this triad (figs. 1, 2, 3), says Eutocius of Ascalon (*c.* A.D. 560), its inventor found two solutions for the cube problem. Both the ellipse and the hyperbola change shape on varying the vertical angle, which in the parabola cannot vary. As the plane nears the vertex, the ellipse shrinks to a point, but the parabola and the hyperbola straighten out, each into a pair of right lines, divergent in the hyperbola but coincident in the parabola.

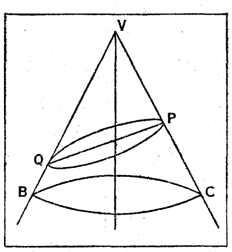

FIG. 2

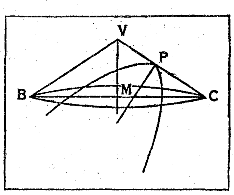

FIG. 3

Through more than a century much progress was made by such writers as Aristaeus, Euclid and Archimedes. Euclid's four books on conics, now lost but mentioned by Pappus (*fl. c.* 300) and Proclus (*c.* 412–485), were probably summed up in the first four books of the conics of Apollonius. Archimedes (287–212 B.C.) also may have written such a treatise, now lost. His extant works contain weighty contributions, such as the quadrature of the parabola, the first of its kind, improving Eudoxus's method of *exhaustion,* and inserted as a tract between the two books on mass-centres and the equilibrium of plane areas. Also in his books on *Conoids and Spheroids* he effected the cubature of these solids by like means (of compression), slicing each into thin parallel laminae, then forming two series of thin cylinders with bases respectively the larger and smaller bases of these layers, between which two series the volume sought must lie. As the strata become ever thinner, the two series close down upon the volume, lying always between,—a rigorous method suggesting integration. He also found the area of the ellipse (props. 5, 6 in the same work), but not of the hyperbola. The crowning peak in Greek mathematics, though not so broad-based as Archimedes, is Apollonius, born (*c.* 262 B.C.) in Perga, Pamphylia, a student in the Euclid-school at Alexandria and the author of eight books (387 propositions) on *Conics,* monumentally edited in two folios by Edmund Halley (Oxford, 1710), with commentaries. Books I.–IV. resume the science as known down to Conon of Samos, almost a contemporary, and books V.–VIII. contain higher developments by the author himself.

According to Geminus of Rhodes (*c.* 70 B.C.), cited by Eutocius, Apollonius first showed that all conics are sections of any circular cone, right or oblique; also, as Pappus tells us, he gave the names parabola (application or equality, literally, casting alongside), ellipse (defect), and hyperbola (excess), to express certain facts in the comparison of areas. He assumed the axis of the cone oblique to its circular base, also a principal plane through the vertex and upright on that base, cutting the cone in the axial triangle, its sides being elements of the cone, its base a diameter of the circle, and the diameter perpendicular thereto being conjugate. His section planes were all at right angles to this axial triangle, but at varying angles to the base (*e.g.,* rotating round the conjugate as axis), each section being thus symmetric as to the principal plane. He showed that all earlier types of conics (right-, acute- and obtuse-angled cones) result as follows: the right-angled cone gives a parabola when the rotating plane becomes parallel to a cone-element; the ellipse when it turns away from parallelism and from the axis; and hyperbola when it turns away oppositely toward the axis,—in which case it would cut the opposite congruent nappe traced by the same generatrix g prolonged backward (figs. 1–3).

The Parameter.—The intersection of the cutting plane with the axial triangle he called πλαγία πλευρά (transverse side, Lat. *latus transversum*); it is also called a diameter of the conic, as halving a system of parallel chords. The point where the diameter meets the cone surface (and conic) is named the vertex of the conic. Through the vertex is now drawn in the cutting plane a perpendicular to the diameter, tangent to the curve and of a length p determined by the Pythagorean *application of areas,* a favourite process in Greek geometry, as in Euclid, I., 44. This p may be defined for the ellipse and hyperbola as a third proportional to the length d of the diameter, and the length d' of its conjugate; that is, $d:d'=d':p$, whence $p=2b^2/a$. If in such application (the more familiar English is "construction upon") the area-length goes beyond the line-length, there is excess (hyperbole); but if the former falls short of the latter, there is defect (ellipsis, leaving out). This is what happens in the hyperbola and the ellipse, the two sections being named accordingly, whereas exact equality (or application) obtains in the midsection, therefore named parabola (fig. 4). This third proportional p he named ὀρθία (erect, whence *latus rectum,* for *latus erectum*); it is now

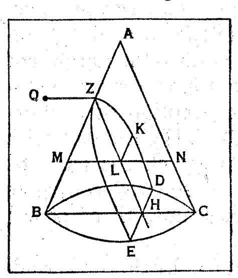

FIG. 4

called *parameter* (side-measure, condensing a long Apollonian clause).

These distinctive areal properties are expressed in cartesian co-ordinates, the rectangular axes being the diameter and the tangent at the vertex, by the equation $y^2=px-\frac{p}{d}x^2$ for the ellipse; $y^2=px$ for the parabola; and $y^2=px+\frac{p}{d}x^2$ for the hyperbola. Either form, the ellipse or hyperbola, would hold for the parabola, since $p/d=0$ for an infinite d; the parabola thus appears as a common limit of the ellipse and the hyperbola. Such equations were of course unknown to Apollonius, who employed their equivalents in their picturesque but cumbrous forms of areal relation.

Eccentricity.—In the parabola only one vertex seems actual, but in the ellipse the other side of the axial triangle is also cut by the plane, giving a second vertex; also in the hyperbola the other side prolonged is cut by the plane in a second vertex; in both cases the line joining the vertices is called a diameter, and its mid-point is called the conic's centre. With the notion of centre comes that of any diameter and its conjugate, each bisecting all chords parallel to the other, though in the hyperbola the conjugate's ends can be seen only on the conjugate hyperbola. Naturally Apollonius deals throughout with areas, parallelograms and proportions, so that his proofs now seem laboured and awkward, however ingenious. In Bk. III., Prop. 45, he first attains the notion of foci as "the points arisen from the application," a vague denotation, but a focus (so named by Kepler, 1604) is defined as dividing the major axis into parts whose rectangle equals one fourth the figure (*i.e.,* the rectangle of major axis and parameter). The focus of the parabola escaped the attention of Apollonius, but not of Pappus, his worthiest commentator, who "wrote under Diocletian" (284–305) and in a lemma of Bk. VII. of his mathematical collection (συναγωγή) shows that the ratio of the distances of any point on any conic from a fixed point (*focus*) and a fixed line (*directrix*) is constant, thus adding this latter concept to the Apollonian list. The constant ratio e is called the eccentricity; originally a term of Ptolemaic astronomy, it has passed from sense to sense till lodged at length in that just given. The conic is an ellipse, a parabola, or an hyperbola according as $e<1$, $e=1$, or $e>1$; in the circle, it is 0.

Other Definitions.—In Bk. II. Apollonius defines *asymptote:* On the tangent to an hyperbola at V lay off VA=VA′, making the whole length AA′ equal to the parallel diameter; then the lines MA, MA′, from the centre M, will continually approach but never meet the hyperbola. In Bk. IV. he discusses the mutual intersection of conics, showing that any two meet at most in four points (tangent points counting double), and continues the harmonic division begun in Bk. II. under the name of proportion. Bks. V.–VII.(I.) advance to brilliant original work on maximal and minimal lengths from any point (in the plane) to the conic, introducing the sub-normal found constant in the parabola. Apollonius determines centres of curvature, but neither the notion nor the measure of *curvature* itself, and may well have reached without realizing or comprehending fully the conception of evolute, the highest summit of Greek geometry. Bk. VII. develops with much ingenuity the doctrines of complementary chords (parallel to conjugate diameters), the constant sum of squared conjugate diameters, and the areas of related parallelograms, all of course strictly geometrically.

Greek mathematics culminated in Apollonius. Little further advance was possible without new methods and higher points of view. Much later, the Arabs and other Muslims absorbed the classic science greedily; it was the Persian poet Omar Khayyam (*c.* 1044–1123/4), one of the most prominent of mediaeval mathematicians, with his remarkable classification and systematic study of equations, which he emphasized, who blazed the way to the modern union of analysis and geometry. In his *Algebra* he considered the cubic as soluble only by the intersection of conics, and the biquadratic not at all.

Modern Treatment.—The first modern treatment of conics (1522), a *libellus* of 34 pages, ushered in a volume of collected papers of a theologian, Johann Werner of Nürnberg (1468–1528). It out-Greeked the Greeks in dealing with the conic, figuring the cone always, whereas Apollonius figures generally only plane curves, and treats not the ellipse but only the parabola and hyperbola, as they count only in the duplication of the cube, Werner's main concern. Also Francesco Maurolico (1494–1575) published in translation Bks. I.–IV. of Apollonius, with a mistaken attempt at restoring the others (1564).

Johann Kepler (1571–1630) was the first to proclaim the regnance of the conic in the sky. Apollonius had rightly ranked it among things worth study on their own account (Bk. V., Pref.); Kepler placed the sun in a world-focus, with planets rolling round it in ellipses, as confirmed and rationalized in Newton's Law of Inverse Squares. But Kepler's main advance in pure conic-doctrine lay in enunciating (1604) as "analogy" the principle or law of continuity, Leibniz's *lex continuationis,* which supplies the parabola with a "blind focus" and with a vertex at infinity, all diameters being parallel, therewith preparing a path for projective geometry (*see* PROJECTIVE GEOMETRY). He also found $\pi(a+b)$ as the approximate length of the ellipse, a and b being the semi-axes.

Projective Geometry and Co-ordinates.—Meantime Claude Mydorge (1585–1647), Girard Desargues (1593–1662), and Blaise Pascal (1623–62) made France the continuator of Greece in pure geometry. The first of these scholars published two books on conics in 1631 and two more in 1639. Four others were lost, being taken to England by Lord Cavendish and Lord Southampton. Mydorge showed that if all rays to a conic from a point in its plane be prolonged in the same ratio, their ends will form a similar conic. But it was Desargues who published (1639) a "Rough Draft" on conic sections so far beyond the age that, like Grassmann's *Ausdehnungslehre* and Möbius's *Statik,* it was cast into the scientific waste-basket; fortunately, however, Philippe De La Hire had made a written copy of it in 1679. This work introduced the Infinite, regarded the cylinder as a cone with its vertex at infinity, and grounded the notion of involution. The so-called Desargue's Theorem declared that a chord cuts a conic and an inscribed quadrangle in six points in involution ($OP.OP'=\pm c^2$); also if two triangles have their corresponding vertices on three compunctal lines, then their corresponding sides meet in three collinear points (and conversely),—the basis of homology (Poncelot) (fig. 5).

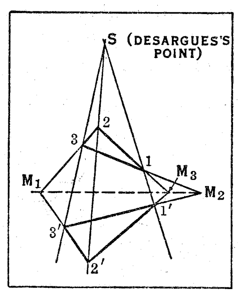

FIG. 5

Only Pascal seemed able to keep step with Desargues. He attended mathematical meetings with his father and before 1640 composed a book on conics. Leibniz wrote to Pascal's nephew (Aug. 30, 1676) vainly urging its publication; it perished, save for a small introductory fragment, so that the most that is known about it is only from Leibniz's letter. Pascal avows the leadership of Desargues, stating without proof, as the first lemma to the latter's theorem, his own about the hexagram inscribed in a circle, that the three intersections of its three pairs of opposite sides are collinear. The reciprocal, Bianchon's Theorem, was first published in 1806. Since both regarded the cone solely without any axial triangle, and viewed any conic as a shadow or projection on a plane of any circle of the cone from its vertex, such a property of the circle-hexagram would in their minds pass over into the corresponding *Hexagramma mysticum* of the conic. From this proposition Père Mersenne (1588–1648) declares that Pascal deduced 400 corollaries.

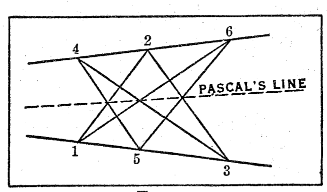

FIG. 6

To René Descartes (1596–1650) the algebraization and consequent transfiguration of geometry, especially of conics, is commonly ascribed, although his *Géométrie* (1637) reads more like a geometrization of algebra (*see* ANALYTIC GEOMETRY). Pierre de

Fermat (1601–65), keener and deeper in mathematical insight as well as earlier in his inventions, nevertheless was later in publication. Their chief achievement was to introduce motion into Greek static conceptions, by using a pair of variables (x, y) to represent a moving point tracing a curve. An equation connecting the variables defined the motion of the point. Thus all is life and motion, "mouvement continu." Equations symbolize the classic τοποι (*loci*), and conversely loci depict equations. All conics are grouped in a single equation of the second degree, $ax^2+2hxy+by^2+2gx+2fy+1=0$, each particular conic being determined by a set of values (a, h, b, f, g) constant for any one curve but varying from conic to conic, while individual points are fixed by special value-pairs (x, y), each pair satisfying the curve's equation.

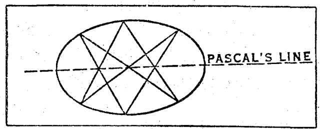

FIG. 6A

Thus the pair $x=3$, $y=4$ satisfies the equation $x^2+y^2=25$; hence the point (3, 4) is on the curve, a circle of radius 5 about the origin O (*see* CO-ORDINATES). Hints of this kind had already been put forth in Muslim works, and in France by François Viète (1540–1603), but not the notion of the moving point (x, y). This mutual depiction of value-pair (x, y) and moving point P, by its effecting a union of algebra and geometry, marks the birth of modern mathematics.

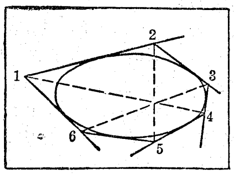
FIG. 7

A prompt reaction to the stimulus of Descartes's *Géométrie* was seen in John Wallis's *Tractatus* on conics, spreading the "new method," quite ignoring the classics, and notable for introducing the sign ∞: "Esto ∞ Nota numeri infiniti" (1655). A similar reaction appears in the writings of De l'Hôpital (1707), although De La Hire still followed his master's method of projection (1685). Despite the wide and clear vision thus opened, the classic precedent retained a fascination, more or less determining later works, which introduced new synthetic ideas even while following analytic paths. Thus Newton (1642–1727) conceived the conic as envelope of two sides of two constant angles rotating round fixed vertices, the other two sides meeting always on the same right line; and Colin Maclaurin (*Geometrica organica,* 1710) imagined the conic as a locus of the vertex of a triangle, each side fixed at one point, the other vertices moving each on a fixed line. Michel Chasles (1793–1880) employed and extended both these conceptions.

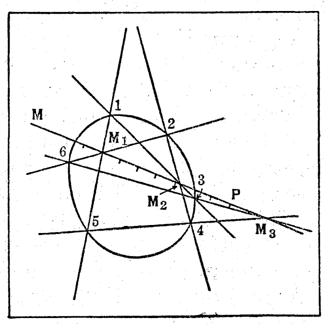
FIG. 8

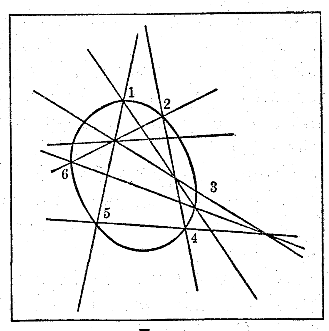
FIG. 9

Later advances in the doctrine of conics have been made mainly in connection with analytic and especially the projective geometry and co-ordinates (*qq.v.*). Nevertheless the Greek synthetic spirit found extraordinary reincarnation in the work of Jacob Steiner (1796–1863). As a pupil of Pestalozzi, he naturally laid especial stress on intuition and envisagement, while unjustly disliking all forms of analysis and eschewing its use as a reproach to geometry proper. But his insight and ingenuity were alike amazing and not only levelled the way for Von Staudt (1798–1867) and his followers in the geometry of position, but may also be said to have rounded out and filled in apparently the whole circuit of the theory of conic sections.

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CONIC SURFACE: *see* CONE.

CONIFERS or **CONIFERALES:** *see* GYMNOSPERMS.

CONIINE. This alkaloid, first isolated by Giesecke in 1827, occurs in hemlock (*q.v.*) along with several closely related alkaloids (*see* ALKALOIDS) and can be prepared in a crude state by the process described for nicotine (*q.v.*); these alkaloids are all highly toxic. Coniine, $C_8H_{17}N$, is a colourless, strongly alkaline liquid, which boils at 166–167° C, and solidifies at −2° C to a crystalline mass. Its specific rotation is $[a]_D+15.7°$. It dissolves water, but is itself sparingly soluble in that solvent though readily soluble in ether or alcohol. The salts crystallize well; the picrate, which melts at 75° C, and the double compound with potassium cadmium iodide, which melts at 118° C, are characteristic and suitable for identification of the alkaloid. Coniine is one of the simplest of the natural alkaloids and was the first to be synthesized (Ladenburg, 1886).

CONINGTON, JOHN (1825–1869), English classical scholar, was born at Boston in Lincolnshire. He had a distinguished career at Oxford. In 1852 he began, in conjunction with Prof. Goldwin Smith, a complete edition of Virgil with a commentary, of which the first volume appeared in 1858, the second in 1864, and the third, in which H. Nettleship replaced Prof. Goldwin Smith, soon after Conington's death. In 1866 Conington published his most famous work, the translation of the *Aeneid* of Virgil into the octosyllabic metre of Scott.

His edition of Persius with a commentary and a spirited prose translation was published posthumously in 1872. In the same year appeared his *Miscellaneous Writings,* edited by J. A. Symonds, with a memoir by Prof. H. J. S. Smith (*see* also H. A. J. Munro in *Journal of Philology,* ii., 1869). Among his other editions are Aeschylus, *Agamemnon* (1848), *Choëphori* (1857); English verse translations of Horace, *Odes* and *Carmen Saeculare* (1863), *Satires, Epistles,* and *Ars Poëtica* (1869).

CONINXLOO, GILLIS VAN (1544–1607), Flemish painter, born on Jan. 24, 1544, probably at Antwerp. He studied under Lenaert Kroes and Gillis Mostert. After a period of travel in France he returned to Antwerp in 1570 and was made a member of the Guild of Painters. He had, however, to leave his home again in 1585 to escape from religious persecution, and stayed at Frankenthal in Germany for ten years. In 1595 he settled at Amsterdam. Van Mander (Hymens ed., 1884), calls him the best landscapist of his time. His work represents the gradual transition from the phantastic conception of landscape of the 16th century as seen in the early work of Paul Brill to the realistic representation of the 17th, and may accordingly be divided into three periods. His early work at Antwerp is well represented by "The Judgment of Midas" at Dresden; the second, or Frankenthal period by two landscapes, one at the Biblioteca Ambrosiana, Milan, the other at Schwerin; the last period, where all colours are blended in one harmonious tone, by "Landscape with Figures" (1598) in the Leichtenstein Gallery at Vienna. He brought the Flemish tradition to Holland and Germany.

See E. Plietzsch, *Die Frankenthaler Maler* (1910).

CONJEEVERAM, a town of British India, in the Chingleput district of Madras, 45 mi. W.S.W. of Madras by the South Indian railway. The population (74,635 in 1941) has largely increased in recent years. It is esteemed by the Hindus as one of the holiest places in southern India, ranking among the seven sacred cities of India, and is remarkable for the number of its temples and shrines. Of these the old Jain temple, situated in a hamlet some 2 mi. south of the Weavers' quarter of the city (Pillapalaiyam), dates from the time when the Chola power was at its height (12th or 13th century); the inscriptions contain an almost perfect record of the dynasties who held the country. Older than this temple are the great temples of Vishnu and Siva, which date from the time of the Pallava kings. The latter is remarkable for its lofty towers and the extreme irregularity of its design. It contains fine porches, great tanks, and a hall with 540 carved columns. About 2 mi. distant, in Little Conjeeveram, is the Vara-daraja-swami Vaishnava temple, also containing a hall of pillars, beautifully carved, and possessing a rich treasury of votive jewels. For a century or more quarrels between the Tangalai and Vadagalai sects, connected with the worship of the temple, as to the form of a symbol on the wall of the inner enclosure have led to much litigation. The general aspect of the city is pleasing, with broad streets lined with fine trees. Its only important industry is the weaving of superior silk and cotton cloths and *sārīs,* which supports a large proportion of the population.

Conjeeveram, a British corruption of Kanchipuram (the golden city), is very ancient, having been an influential place before the Christian era, and in its early centuries the capital of the Pallava dynasty. In the 11th century the city was conquered by the Cholas. Later it came to the Muslims, the kings of Vijayanagar, the Mahrattas and the emperor Aurungzeb. It remained in Muslim hands until 1752, when it was captured by Clive.

CONJUGAL RIGHTS: *see* DIVORCE.

CONJUNCTION, a general term signifying the act or state of being joined together. It is used technically in astronomy and grammar. In astronomy, two bodies are said to be in conjunction in right ascension or longitude when they have the same right ascension or longitude. The conjunction of Mercury or Venus with the sun is "superior" when the planet lies beyond the sun, and "inferior" when the planet is between us and the sun. In grammar the term "conjunction" is applied to one of the so-called "parts of speech," viz., those words which are used to "join together" words, clauses or sentences. Conjunctions are variously classified according to their specific function; *e.g., adversative* ("but," "though") which contrast, *illative* ("therefore") where the second sentence or clause is an inference from the first, *temporal* where a time-relation is expressed, and so forth.

CONJURING, the art of entertaining by pretended performance of those things which cannot be done. The conjurer is an actor who, to perform his feats, combines psychology with manual dexterity, and, frequently, with mechanical apparatus. Because the entertainment an audience derives from conjuring depends largely upon complete mystification, the profession always tries to keep its methods secret and permits the public to think what it will. Even into the 18th century, a majority of the people of the world believed the tricks they saw performed were the result of the aid of demons. The two most common terms used for the art, conjuring and magic, have in their earlier meanings association with devils, spirits and unholy powers. In the 18th century, more enlightened people began using the words Natural Magic, or White Magic, to indicate the entertainment. It still was confusing, for White Magic also has the meaning of curative magic, as opposed to Black Magic which destroys. Natural Magic, as well as White Magic, are unusual terms since 1875.

The newer words, *legerdemain, prestidigitation, sleight of hand,* also are confusing because all three suggest rapidity of movement and the elimination of apparatus. Conjuring does not depend upon the quickness of the hand deceiving the eye, and unseen, secret equipment frequently is used.

Only in a minority of feats does the magician attempt to deceive the eye, and, even in those, he designs his tricks primarily to fool the minds of the spectators. By his acting, the magician so presents his work that the mind will take no notice of a great many things which the eyes can see. This focussing of attention of the audience on some actions, in order that others will be disregarded, is called, by magicians, *misdirection.* That term, too, is a misnomer for the magician directs attention towards one action, rather than away from another. It is done, generally, by creating an unusual situation while acting as if it were quite normal. As an example: Much of the knowledge man has gathered through all time can be discovered by the use of these three magic words:

Acin nat irb

While the eyes can see the letters, the mind makes no sense of them. Taking out the spaces and reading the letters backwards gives "Britannica." First, by giving the mind something to mull over in the introduction to the "three magic words" and, second, by confusing the details of presentation, the mind, rather than the eyes, is deceived. While this one example serves to show a phase of the psychology of deception, the subject in entirety is much more involved. Another indispensable branch of psychology makes the work of the performer both more interesting and entertaining and is termed *showmanship.*

A magician's manual operations, though not performed rapidly, require great deftness of touch and complete certainty of action. Independent use of the digits and other unusual hand and arm movements are used in many tricks with the added handicap of each having to appear to be entirely normal. The magician's dexterity, unlike the musician's, is similar to the surgeon's in the type of deftness. Unlike the surgeon, the magician also must keep in mind the appearance of his movements. The magician is like the musician only in that he must have precision of time and exactness of rhythm.

Apparatus is of three types: 1. equipment which is exactly as it appears to the audience; 2. equipment which, secretly, has been prepared to aid the performance of the trick without altering its appearance; 3. equipment which is hidden from sight and used without the knowledge of the audience. Among those feats dependent upon apparatus some require but one type, while others need a combination of two, or even all three forms.

While tricks vary greatly, about 80% of the success of a conjurer's performance depends upon the use of psychology, 10% upon skilled manipulation, and 10% upon the use of equipment.

A performance of the impossible is not only an intriguing show, but one which can be understood and enjoyed by all types of people of every country. Magic is the one art of the theatre which is completely international. Most of the old and basic feats in magic are performed by the magicians of all nations, and, while slight variations exist in performance or equipment, the underlying principles are identical. It is unlikely that these basic tricks were taken from one land to another, but, rather, that they were developed locally and the methods were alike because each nationality adopted the most simple means of performance. As magicians advanced through the ages, different and more elaborate feats of magic were devised in various countries. With the 19th century, magicians of the world began interchanging their mysteries so that more and more oriental feats came into the programs of occidental performers and the eastern conjurers augmented their shows with the tricks of their western colleagues.

Early History.—Many scholars have written of the methods for the tricks shown in ancient times by the pagan priests of Egypt, Greece and Rome. It is known that optical illusions were used, apparently to bring forth divinities; that tubing was used to carry the voices of hidden humans, thus giving the effect of speaking idols; and that a variety of mechanical contrivances were used to produce weird occurrences before the altars. However, it is most unlikely that conjurers of the period, in any country, had such close association with the priests as to be told the methods of the temple illusions. It is also doubtful whether the conjurers even knew of the existence of the priestly magic. At any rate, the feats of the ancient conjurers were quite different. The conjurers were able to perform their mysteries anywhere, while, because of the required equipment and preparation, the pagan priests could show their magic only in the temples. Some of the conjurers, however, did turn to their own advantage the superstitious awe in which many held their work.

By the time people were civilized enough to record history, they described the performances of conjurers. These ancient notes are sketchy, but enough is told to know that conjurer's feats were much like those of later periods about which there are more complete reports. Throughout the entire world, the more skilful of the early conjurers were entertainers at the courts of the rulers, and those of lesser skill performed in the market places for the people, or at the feasts of the wealthy. Their feats were very much alike and quite limited in number. The principal trick, which, known as the "Cups and Balls," still is popular, was one in which three inverted cups and a ball were used. The ball mysteriously would jump about invisibly from cup to cup, then multiply into three balls with each seemingly having the ability of undiscernible locomotion. The basis for this mystery is a secret additional ball which, by skilled manipulation, is put under one cup while the known ball, as secretly, is removed from another cup. The manipulative work in this trick, as in most, is aided by the distracting conversation of the conjurer. Because the trick was in the program of every early conjurer, and always a favourite with audiences, magicians received more recognition for the performance of the Cups and Balls than for all their other feats. The ancient Greek term for conjurer was *Psephopaiktes,* and one of the old Roman words was *Calcularius.* Both meant "he who deals with pebbles." In different countries pebbles, or other small objects, were used for the trick instead of balls. The shape and type of cup used also varied. Another Roman word for conjurer, *Acetabularius,* meant, "he who deals with vinegar cups." Descendants of the Roman conjurers used the cylindrical boxwood measures, instead of vinegar cups, and a popular old Italian term for magic was *giuoco di bussolotti,* "the game with the measures." Similarly in France, a conjurer was called *joüeür de goubelets.* A usual adjunct of equipment for the Cups and Balls was a bag, with strings, tied around the waist of the conjurer, like an apron. It was not only a serviceable way to carry the properties of the trick, but was a handy place for the conjurer secretly to acquire or dispose of the balls. Throughout Europe the conjurer's pocket-apron was the badge of the profession and *Taschenspieler,* "pocket-player," became the common term for magician in German. The Cups and Balls is one of the basic tricks of magic, and the Egyptian, East Indian, Chinese and other eastern magicians performed the feat exactly as did the Europeans, except, because of the differences in clothing, the pocket-apron never was needed by oriental magicians. Other universal tricks of the early conjurers were the restoration of a piece of string, which had been severed, and apparently thrusting knives into the body. The first was accomplished by failing to cut the string in the manner suggested, and the second by substituting special, harmless knives for the real ones offered for inspection. Other generally used magic was performed with borrowed rings and coins. Any trick done with a borrowed object always has been doubly interesting.

The mediaeval magicians travelled more than had their predecessors, and, as itinerant mountebank performers, even toured countries other than their own. Their equipment was limited to what could be carried on their backs and, while the old tricks still were used, the performances were augmented with feats done with borrowed fruit, vegetables and small fowl, as well as with men's hats, and women's kerchiefs. With the advent of the printed playing cards, a whole new field of magic was opened, as an infinite number of tricks could be done with cards, and a deck could be carried easily. More and more, the magicians in their travels followed a regular itinerary and built a following for their annual appearances. Many cities had a *Street of the Conjurers* where performances could be seen daily. Some magicians were able to give more impressive shows by having extra equipment carried on a donkey or horse, while others joined with entertainers of various other types, ballad singers, story tellers, acrobats and musicians, to give more elaborate performances. These larger shows were given in rented barns, or store houses, and for more people than could see a street or market-place exhibition. The increased remuneration was, and is, the magician's greatest interest in the size of his audience.

At least the majority of the feats of the conjurers of olden times were recorded. The first book to describe the secrets of sleight of hand and magic equipment was the *Discoverie of Witchcraft* (1584), and it was written by Reginald Scot, who was not a magician, for the sole purpose of convincing the public that sorcery had no part in such performances. The first book devoted solely to the subject, *The Art of Jugling, or Legerdemain* (1614), by S.R. (probably Samuel Rid), and the anonymous later volume *Hocus Pocus Junior* (1634), both gave clearer descriptions of the methods employed in the art. It is likely both volumes were unsigned because their authors feared those who still believed that magicians had contact with devils. Scot's book was burned by the common executioner by order of such believers. Juggler (from the Latin *joculator*) was an early term for conjurer as was Hocus Pocus, used, with other pretended magic words, by performers throughout Europe. These books showed that magicians were learning more about mechanics and knew how to construct boxes with false bottoms, and to make a keg out of which several liquors could be drawn from the one spigot. A number of books describing the same tricks, written by other magicians, appeared on the continent during the 17th century, though *Engaños a Ojos Vistas* (Madrid, 1733), by Pablo Minguet e Yrol, was the single volume to stress the use of the pocket-apron. By the time the more advanced and literate conjurers began to write about their work, they not only had discovered better hiding places for the balls, but realized that the success of a trick depended more upon the acting ability and manner of the performer than on any piece of equipment.

Beginning of Stage Performances.—In the 18th century, many more books on magic appeared, but the only advance recorded of the art was the use of magical automata and apparent transference of thought from a magician to his assistant. The latter was first shown (1781) by Philip Breslaw (1726–1803), and later (1783), by Guiseppe Pinetti de Wildalle (1750–1800). Occasionally, magicians exhibited true automata (*i.e.,* motivated entirely by mechanics), though usually their figures were pseudo-mechanical masks for the tricks performed. While such automata as a doll, which would play on a flute any tune requested, or a toy bird, which would blow out the flame of one candle and light another by a further gust, were tricks, not mechanics, they added interest and variety to the performances. Real automaton figures were publicly exhibited, usually by the mechanics who made them, and were interesting to the public because of their ingenuity of construction. Magical automata did what was impossible for the mechanical kind.

The great increase in equipment made necessary semi-permanent quarters, with stages, the better to display the tricks, so conjurers rented stores and halls, and made them into small theatres. The portability of equipment no longer being the first consideration, magicians started using large and completely draped tables with trap doors operated by hidden assistants. An object placed on such a table, and momentarily covered from the sight of the spectators, could be caused to disappear, or to become totally different, by the mere command of the magician, plus the work of the hidden assistant. Because of the quantities of apparatus, magicians avowed super-mechanical knowledge and based their wonders on a scientific claim, rather than the magic words previously used. The public did not object, for people were becoming conscious of the remarkable possibilities of mechanics and were losing interest in the pretense of magic spells. *Professor* as a title for magician, invariably self-bestowed, became generally accepted. Many of the travelling conjurers also were using more equipment and had built special wagons for travelling. The rear of such a wagon would open to form a stage, the front would make the living quarters. In short, the wagon was both a home and a stage on wheels.

Of course, some magicians continued to perform in market places, at fairs, in barns and taverns, but changes were occurring in magic. Notable conjurers of this period were: Isaac Fawkes

(1675?–1731), Christopher Pinchbeck (1670–1732), Philadelphia (Jacob Meyer, 1735–90), Kalterfelto (1730?–99), Flockton (1740?–94), and Lane, about whom there is little personal data. Possibly, greater public interest in magicians and their work, than previously had been given, was accorded performers of the 18th century, because they advertised themselves in newspapers and further attracted personal attention by wearing striking costumes at all times. Though certain of the conjurers added to their magic exhibitions ventriloquism, juggling, sword swallowing or even fire eating and other heat resistant feats, such demonstrations are no more a part of conjuring than is medicine, because some conjurers sold curatives in connection with their shows.

Once magicians had theatres to play in, and could use quantities of equipment, their shows became extremely elaborate and, in the early 19th century, stages were filled with apparatus frequently claimed to be constructed of solid silver. Only a part of the equipment was employed in any one performance and some of the most ornate pieces had no use, other than to add to the number of articles displayed. The printed programs carried long lists of the names of tricks possessed by the magician "from which a selection will be made for each entertainment." While many of the tricks were performed by all the magicians, new program names for the tricks were devised by each one. The elaborate paraphernalia-decked stages, and the costly and fanciful costumes assumed by the magicians, lent a grandeur to the performances earlier shows had lacked. The greatest conjurers of this type were: Bartolomeo Bosco (1790–1863), Ludwig Leopold Döbler (1801–64), Philippe (Jacques Noel Talon, 1802–78), and Alexander (Johann Frederick Alexander Heimburger, 1819–1909). All were great travellers who gave their shows in many countries.

One of the last of these great ornamental conjurers was Henri Robin (Dunkell, 1805–74), a native of the Netherlands, who pretended to be French. He claimed to be the inventor and was, at least, the first to show (1847) the illusion later known as "Pepper's Ghost." It was based on an optical principle Baptista Porta, the Italian philosopher, had described in effect 300 years earlier (*Magia Naturalis,* 1588), by which, on an inclined plate glass, a transparent reflection, or ghost, could be made of a person hidden to the audience. The ghostly effect was enhanced because the spectre, on the unseen glass, seemed to walk about among living people. These actors were behind the glass and had rehearsed their parts carefully so that their actions coincided with those of the actor, who, in a different part of the theatre, was the original of the ghost. The illusion depended largely upon the arrangement of the lights, which could be controlled to give any amount of substantiability to the ghost, or cause it to disappear altogether. For the few years until the public learned of the method employed, the ghost illusion had great popularity. Its importance to the history of conjuring is that it was the first of the tricks utilizing glass. Later conjurers made full use of the sheet-glass, both plain and silvered, in designing magical illusions. Spectres, having little or no action, and lacking the ability to mingle with humans, had been produced earlier by means of magic lanterns. This method to produce ghosts had been mentioned, in a vague way, by writers long before the magic lantern's accredited invention by Athanasius Kircher in the 17th century. While such lanterns probably had long been used by charlatans to bring forth ghosts and demons, there is no evidence of their use for entertainment by conjurers until 1784 in a show produced by Robertson (Etrienne Gaspard Robert, 1763–1837), a Belgian optician and magician, even though they had been described most inadequately, since 1727, in books on magic.

Beginning of Modern Magic.—In contrast to the elaborately equipped, fantastically dressed school of conjurers, another group went to the opposite extreme. Actually Conus (sometimes called Comus, and whose real name was Cotte, d. 1836), was the forerunner of the advocates of simplicity of performance, though Wiljalba Frikell (1818–1903), was the real leader. Frikell was the first magician to appear in conventional evening clothes. His magic depended almost entirely upon his personal skill and he eschewed most of the usual equipment. He wrote (*Lessons in Magic,* 1858) that "the use of complicated and cumbrous apparatus diminishes the amount of astonishment conjurers are enabled to produce which is a defect not compensated by the external splendor and imposing effect of such paraphernalia." Johann Nepomuk Hofzinser (1806–75), an Austrian, who appeared only in his own country, was among the other conjurers to eliminate displays of apparatus from their shows. These simplified exhibitions required new tricks, and Hofzinser devised many varied feats of magic and was the most prolific inventor of card tricks. While comparatively few magicians went to the extreme of Frikell and Hofzinser, their work had an enormous effect on the shows of all later conjurers.

John Henry Anderson (1812–74), a Scot who called himself "The Great Wizard of the North," while considerably influenced by advocates of simplification in later life, was in another field a leader of magicians. Anderson was the first great advertiser and, by example, showed the tremendous public interest which could be invoked in exhibitions of magic, particularly when the interest first was directed towards the performer himself. The people showed their concern in Anderson and his magic by paid attendance at his shows.

Robert-Houdin (Jean Eugene Robert, 1805–71), a Frenchman, made so many improvements in magic equipment and so carefully and systematically classified all that was known about presentation that he is called the father of modern conjuring. While he claimed to have originated almost all the tricks he performed, as well as the innovations in performance, actually his work was based largely on the best ideas of his predecessors. Robert-Houdin followed Frikell in adopting gentlemen's attire, and though he did not do away with apparatus, he did, in the main, use what appeared to be common and familiar objects. He modernized the mechanical marvels originated by Pinchbeck and others, and improved the table mechanisms, which Pinetti had devised, to eliminate the necessity for draped tables with hidden assistants. Pinetti had used tables with tops which, while no thicker than normal tables, concealed levers with cords running to off-stage assistants, by which to operate mechanical tricks placed on the tables. Robert-Houdin ran electric wires to his tables which operated electro-magnets instead of levers, as well as cords, motivating pistons. He was the first, and one of the very few, magicians ever to utilize electro-magnetism though Döbler, previously, had used electricity in his feat of causing two hundred candles to light simultaneously upon the firing of a pistol, and Philip Breslaw had used a common magnet to control the activities, on the surface of water in a bowl, of "The Learned Swan," a wooden figure with an iron core.

In 1849, Robert-Houdin made a sensation with his floating boy. It was a marked improvement on a mysterious suspension which, in 1826, Ling Lau Lauro had been the first to show in the occident, although there are records of its having been shown several years earlier in Madras and, possibly, was of Indian invention. In the original effect, a person sat cross-legged, several feet in the air, upon nothing. The fingers of the floating man's one outstretched arm lightly touched a perpendicular bamboo rod set upon a stool, or platform, raised above the stage. The secret was that inside the bamboo pole, affixed to the platform, ran an iron bar bent at the top at right angles, and to which was attached a metal support to uphold the body. The body support, and such of the iron outside the bamboo pole, was covered by the sleeve and clothing of the subject, and, necessarily, screens or curtains had to mask the preparation for suspension. Robert-Houdin made a metal body rest which could be worn inside the subject's clothing and had a mechanical method by which the support and the pole could be connected, in full sight of the audience, to allow the boy to lie horizontally in the air. He added to the presentation by giving an acceptable, though false, reason for the suspension. It was claimed to be the effects of ether, which had the property of making a body totally devoid of weight. Ether was then a new discovery and its real qualities were known only to a few scientists. Robert-Houdin also materially improved the signalling method for apparent "thought-transference," which had been a feature of Pinetti and others. Many of Robert-

Houdin's "inventions" may be shown to be of earlier origin, but he brought each to a point of perfection undreamed of by the originators. Robert-Houdin influenced a number of magicians, including Anderson, and was copied slavishly by Robert Heller (William Henry Palmer, 1830–78) and others. Heller, an Englishman, even went to the length of dyeing his hair and assuming a French accent in his attempt to be like the other man. Heller's success waited upon resumption of his own personality, his brilliantly witty style of performance, and in following Robert-Houdin only in ideas.

Robert-Houdin led also in writing professional books on magic. Prior to his works there had been but one real manual on the subject, *Le Sorcellerie Ancienne et Moderne Expliquée, ou Cours Complet de Prestidigitation* (1853), by Jean Nickolas Ponsin (1777–1853), a French amateur. All the earlier publications, including Henri Decremps (1746–1826?), *La Magie Blanche Dévoilée* (1784), and later works, and Pinetti's *Amusemens Physiques, et Différentes Experiences Divertissants* (1784), while tremendously interesting as historical records, merely exposed, with little detail, the methods by which tricks were done and contained nothing on how to learn to do them. While Ponsin actually describes how to do tricks, Robert-Houdin, possibly because of his greater knowledge of the subject, gives an understanding of the underlying art of magic, as well as superb lessons in *Les Secrets de la Prestidigitation et de la Magie* (1868). Robert-Houdin's other books also are excellent and all have been translated into several languages. Following Robert-Houdin, hundreds of other magicians have contributed, in many languages, to the literature of the subject a total of several thousand volumes. A large proportion of the books on the art are privately circulated professional publications.

Two of the best known conjurers were Compars (Carl) Herrmann (1816–87) and his younger brother Alexander (1843–96), known as Herrmann The Great. They used comparatively little equipment and were most skilled manipulators, though, in later life, Alexander performed a number of large illusions which had come into vogue. Other prominent performers of the period were: Signor Antonio Blitz (1810–77), Joseph Michael Hartz (1836–1903), Louis Haselmayer (1839–85), Baron Hartwig Seeman (1833–86), Le Commander Bernard Marius Cazeneuve (1839–1913), The Fakir of Oolu (Alfred Sylvester, 1831–86), Dr. Lynn (Hugh Simmons, 1838?–96), and Colonel Stodare (John English, 1831–66). Through their constant travels they gathered the magic of the entire world and added it to their shows and all invented some magic. The Fakir of Oolu devised an improvement on the suspension, which permitted the floating person to be shown in several changes of position and permitted also the final removal of the supporting rod. The rod was removed only in a dim light and was accomplished by having a shell stick which could be taken off the iron rod. The iron rod was covered with dull material matching the back curtain and became invisible in dim light. Hartz and Stodare invented many small tricks which remain popular. Stodare, with an illusion the "Sphinx," invented by Thomas William Tobin of the Polytechnic institution, was the first magician to make use of mirrors to hide objects. The effect of the illusion was that a live (though bodiless) head of a man rested on a light three-legged table in the center of the stage. The secret was that between the legs of the table were mirrors set at the proper angles to reflect the sides of the stage which had hangings identical with those behind the table. The spectators apparently would be able to see the back curtain through the legs of the table, though actually they saw the reflections of the side curtains. The mirrors were invisible because the edges were masked by the table legs. Behind the mirrors was ample space for the body of the man who, through a hole in the table top, exhibited his "detached" head.

Beginning of Magic of Present Times.—John Nevil Maskelyne (1839–1917) played an enormous part in the advancement of magic. He invented a number of magical effects; he founded a theatre of magic in London, which he, his sons and grandsons, ran for over 50 years; he encouraged, engaged in and advised with the inventions of scores of other magicians. He originated (1865) the feat of escape from a box which was locked and roped after he had entered. He was the first (1875) to cause a levitated person to rise and fall in the air, and the first to eliminate all visible means of support. His son Nevil Maskelyne (1863–1924), added the use of a large solid hoop to pass over the floating lady, a convincing way of showing an absence of support. Again in "Cleopatra's Needle" (1875), Maskelyne was the first to use the counter-weight principle to make a heavy object void of weight. In this illusion, an obelisk-shaped box was carried about the stage as if it were extremely light, though two persons, who later appeared, were hidden inside all the time. Maskelyne, also, constructed the two best magical automaton figures: "Psycho" (1875) was a card player and calculator built on an idea of John Algernon Clarke; and "Zoe" (1877) was a portrait artist who drew likenesses of various celebrities. For many years, Maskelyne had George A. Cooke as a business associate and the names of Maskelyne and Cooke became synonomous with conjuring. After Cooke's death (1904), Maskelyne took David Devant (David Wighton, 1868–1941), into a partnership, which lasted until 1915. Devant, the greatest of English conjurers, was prolific with new ideas in magic. Buatier De Kolta (Joseph Buatier, 1845–1903), who appeared in many of Maskelyne's shows, invented some of the most striking magic ever performed. His "Vanishing Lady" (1886) and the "Flying Bird Cage" (1873) were the best of his many inventions. Both depended more upon the manner of performance than on the secret equipment used. De Kolta also improved "Black Art," or "Modern Black Magic," a series of effects first shown by Max Auzinger (1839–1928), who usually performed under the name of Ben-Ali-Bey. Black Art is based on the optical principle that, with proper lighting conditions, both shadow and form can be eliminated and objects will become invisible when covered with light-absorbing material (usually black, hence the name), identical with the background. Using this principle, anything can be caused to disappear upon being covered with cloth, or be made to appear by reversing the operation. Assistants, handling the covers, were themselves invisible, due to the material of their completely enveloping costumes.

Harry Kellar (1849–1922), first great American born magician, made many refinements in magic and performed superbly the large as well as the small tricks. Beginning with the final decade of the 19th century, American magicians were the first to specialize in their magic. Among these specialists were: Howard Thurston (1869–1936), who performed only with cards; Thomas Nelson Downs (1867–1938), who did magic only with coins; and Harry Houdini (1874–1926), who exhibited feats of extrication from ropes, handcuffs and shackles. These conjurers had, of necessity, to originate a large proportion of their tricks and, particularly in modes of manipulation, added materially to methods in magic. Thurston later took over the Kellar show and Houdini also added diverse magic to his performances. Other specialists were Horace Goldin (1873–1939), who featured large effects shown with extreme rapidity, and Nate Leipzig (1873–1939), who did only small tricks requiring great dexterity. Goldin invented many famous illusions among which was "Sawing a Woman in Half," with a motor driven circular saw.

Magicians strive constantly to add new material to their shows, but not all possess inventive abilities. Some of those who devise the best magic are not good showmen and the public will remember the tricks of a great performer rather than the original magic of one less skilled in presentation. As example, the performances of The Great Lafayette (Siegmund Neuberger, 1872–1911), or those of Chung Ling Soo (William Ellsworth Campbell, 1861–1918), who styled his stage name after the great Chinese magician, Ching Ling Foo (Chee Ling Qua, 1854–1918), advanced magic and the professional status of magicians more than did the inventions of Selbit (Percy Tibbles, d. 1938), one of the most original magicians.

The mechanical advance in the objects of everyday life has caused magicians to simplify their equipment in order to convince the spectators that the marvels of magic supersede science. Today's audiences, in the belief that the skill of the performer accounts for all his mysteries, are entertained quite as much as those of earlier times who believed the conjurer to be either a superscientist, or one possessed of truly magical words and spells. Never has conjuring been as popular an entertainment as it is today. Today one conjurer shows the "Cups and Balls" and another exhibits the newest mystery. One entertains kings, and another performs in taverns. One has a stageful of equipment, while another uses only the properties he can carry. In conjuring, one of the oldest and most delightful arts, the best of the old is kept and added to the best of what is new.

Qualifications for a Conjurer.—What makes an exhibition of mysteries effective is the agreeable personality of the conjurer, and the timing, naturalness and smoothness of his performance. Properly to enact the role of purveyor of the impossible, a conjurer must be assured in every word and action. His confident manner can come only from complete certainty that he knows precisely what he is doing and has practised thoroughly all the details of every trick until the performance can be done without thought or difficulty. A conjurer does not have to be of any particular type, nor have any unusual physical qualifications, but he must have, or develop, a pleasing manner. He should inherently like people and must study group psychology, as well as the psychology of deception and presentation. He must acquire a sense of rhythm and a precision of time in order to be able to execute his secret operations invisibly and apparently without effort. Real proficiency in conjuring comes only through experience. A conjurer must present all his tricks in a manner fitting his own personality, so he also has to be original. He does not need to devise his own magic, for there are thousands upon thousands of feats already invented, from which to form a program. However, a person original enough to plan new combinations of old ideas usually, also, can contrive new principles as well. Finally, a conjurer either must be able to talk convincingly, interestingly, even amusingly, with good diction and sufficiently loud voice, or he must be so skilled in pantomime as to express his thoughts without speech. The conjurer has to make the audience aware of the purpose of each mystery.

Bibliography.—H. Kellock, *Houdini's Life Story* (1928); Howard Thurston, *My Life of Magic* (1929); David Devant, *My Magic Life* (1931); and Horace Goldin, *It's Fun To Be Fooled* (1937). Maskelyne and Devant, *Our Magic* (1911) is the best book on the theory of the subject. Professor Louis Hoffmann, *The Secrets of Conjuring and Magic or How To Become a Wizard* (1877) is a translation of Robert-Houdin, *Secrets de la Prestidigitation et de la magie*. Hoffmann's own books, *Modern Magic, More Magic,* and *Later Magic,* cover both sleight of hand and equipment. *See* also: D. Devant, *Lessons in Magic* (1922); J. Mulholland, *The Art of Illusion* (1944). (J. Mu.)

CONKLIN, EDWIN GRANT (1863–), American biologist, was born at Waldo, O., on Nov. 24, 1863. He graduated at Ohio Wesleyan university in 1886 and received from Johns Hopkins university in 1891 the degree of doctor of philosophy. He was professor of biology at Ohio Wesleyan university in 1891–94, and professor of zoology at Northwestern university from 1894 to 1896 and at the University of Pennsylvania from 1896 to 1908 when he was appointed to a similar chair in Princeton university. He made valuable researches in embryology and cytology and in the mechanism of heredity and evolution, and by his skill as an investigator, teacher and writer, rose to foremost rank among American zoologists. Besides numerous and varied contributions to scientific journals, his writings include *Heredity and Environment in the Development of Men* (1915–21); *Direction of Human Evolution* (1921); *Problems of Organic Adaptation* (1921); and *A Synopsis of the General Morphology of Animals* (1921). He retired from active teaching in 1933.

CONKLING, ROSCOE (1829–1888), American lawyer and political leader, was born in Albany, N.Y., on Oct. 30, 1829. He was the son of Alfred Conkling (1789–1874), who was a representative in Congress from New York in 1821–23, a Federal district judge in 1825–52, and U.S. minister to Mexico in 1852–53. Roscoe Conkling was admitted to the bar at Utica, N.Y., in 1850, was appointed district attorney of Oneida county in the same year, and soon attained success in the practice of his profession. At first a Whig, he joined the Republican party at its formation, and was a Republican representative in congress from 1859 to 1863. He refused to follow the financial policy of his party in 1862, and delivered a notable speech against the passage of the Legal Tender act. In 1863 he resumed the practice of law, and in April 1865 was appointed a special judge advocate by the secretary of war. He was again a representative in congress from Dec. 1865 until 1867, when he entered the senate. After the war he allied himself with the radical wing of his party, was a member of the joint committee that outlined the congressional plan of reconstructing the late Confederate states, and laboured for the impeachment of President Johnson. During President Grant's administration he was a member of the senatorial coterie that influenced most of the president's policies. In the Republican national convention of 1876 Conkling sought nomination for the presidency, and after the disputed election of this year he took a prominent part in devising and securing the passage of a bill creating an electoral commission. In 1880 he was one of the leaders of the unsuccessful movement to nominate Grant for a third presidential term. With Grant's successors, Hayes and Garfield, his relations were not cordial; an opponent of civil service reform, he came into conflict with President Hayes over the removal of Chester A. Arthur and other federal officeholders in New York; and when in 1881 President Garfield, without consulting him, appointed William H. Robertson, a political opponent of Conkling, as collector of the port of New York, and when this appointment was confirmed by the senate in spite of Conkling's opposition, Conkling and his associate senator from New York, Thomas C. Platt, resigned their seats in the senate and sought re-election as a personal vindication. Being unsuccessful, Conkling took up the practice of law in New York city. While in public life Conkling attracted attention by his abilities, his keenness and eloquence in debate, his aggressive leadership and his striking personality. Though a strenuous worker in congress, he was not the originator of any great legislative measures, and his efficiency as a lawmaker is thought to have been much impaired by his personal animosities. His hostility to James G. Blaine, a fellow Republican senator, was especially marked. He died in New York city on April 18, 1888.

See A. R. Conkling (ed.), *The Life and Letters of Roscoe Conkling* (1889); James Barnet Fry, *The Conkling and Blaine-Fry Controversy in 1866* (1893); George S. Boutwell, "Blaine and Conkling and the Republican Convention of 1880," in *McClure's Magazine*, vol. xiv., p. 281–286 (1900); Venila Lovina Shores, "The Hayes-Conkling Controversy, 1877–79," in *Smith College Studies in History*, vol. iv., No. 4 (1919).

CONN (d. A.D. 157?), king of Ireland, known as Conn of the Hundred Battles. Few facts about his reign have been definitely authenticated but it is thought that he became king in about 123, after he had killed in battle Cathair Mor, who had seized the throne after the death of Conn's father. One of the first of the wars which gave Conn his nickname occurred shortly after the beginning of his reign when he gave to one of his old tutors the province of Leinster. An officer in Conn's army, Cumhall, felt that Leinster should have been his for his services in gathering together the army and he therefore seized the territory for himself. In the ensuing battle Cumhall was killed and his forces defeated. Conn next became embroiled in the controversy over which of three princes was to be the ruler of the province of Munster. He espoused the cause of Aongus, who came to Conn for help after he had been defeated by the powerful armies of Modha Nuagat. Conn supplied him with 15,000 troops but Aongus was defeated and Modha Nuagat led his armies against Conn's, subsequently defeating the king in 10 battles. Conn was forced to divide the kingdom of Ireland with Modha Nuagat, taking for himself the territory north of a line of small hills running from Dublin to Galway and giving to Modha Nuagat the territory south of it. The wars between the two kings continued for many years. Finally, Modha Nuagat was killed, probably at the battle of Magh Lena, although some authorities hold that he was murdered by Conn. Conn continued to rule until 157 when he himself was assassinated by Tiobraidhe Tireach, king of Ulster. There is a legend that that king hired 50 men dressed as women to perform the murder.

CONN, LOUGH, a lake of western Eire, in Co. Mayo. Its length (N.N.W. to S.S.E.) is 9 mi. and its extreme breadth

5 mi. On the south a narrow passage communicates with Lough Cullin. The total length of the two loughs is nearly 12 mi. They drain eastward by a short channel tributary to the Moy. Lough Conn lies 42 ft. above sea level. It contains a few islands, and its shores are generally low.

CONNAUGHT, ARTHUR WILLIAM PATRICK ALBERT, DUKE OF (1850–1942), third son and seventh child of Queen Victoria, was born at Buckingham Palace on May 1, 1850. In 1874 he was created duke of Connaught and Strathearn and earl of Sussex. He was entered at the Royal Military Academy, Woolwich, in 1866, and gazetted to the Royal Engineers in 1868. Promoted captain in the Rifle Brigade in 1871, and lieutenant-colonel in 1876, he became general in 1893. The duke served with the expeditionary force in Egypt (1882), and commanded the Guards brigade at Tel-el-Kebir. In 1886 he went to India, where he commanded the Bombay army until 1890. On his return home he held command in the southern district (1890–93), and at Aldershot (1893–98), and in 1900 succeeded Lord Roberts as commander-in-chief in Ireland. On the re-organization of the War Office in 1904, he held the new office of inspector-general to the forces until 1907, when he was made commander-in-chief in the Mediterranean. In 1910 the duke opened the Union Parliament of South Africa on behalf of King George V. He succeeded Earl Grey as governor-general and commander-in-chief of Canada (1911–16); and in 1920 he went to India as the representative of the king, to inaugurate the provincial legislative councils of Madras, Bengal and Bombay.

On March 13, 1879, the duke married Princess Louise Marguerite of Prussia, third daughter of Prince Frederick Charles, who died in London on March 14, 1917. The duke's only son, Prince Arthur of Connaught (1883–1938), married, 1913, Princess Alexandra, Duchess of Fife, daughter of the Princess Royal, who had succeeded in 1912 to her father's dukedom by special remainder. Prince Arthur held the post of governor-general of the Union of South Africa from 1920 until Dec. 1923. The duke of Connaught's elder daughter, Margaret (1882–1920) was married in 1905 to the crown prince of Sweden, and died at Stockholm on May 1, 1920. The younger daughter, Patricia (1886–), resigned her royal title on her marriage, in 1919, with the Hon. Alexander Robert Maule Ramsay, third son of the 13th earl of Dalhousie. The duke of Connaught died Jan. 16, 1942.

CONNAUGHT (kŏn′ącht *or* kŏn′awt), a northwestern province of Eire, having as the greater part of its eastern boundary the river Shannon, over its middle course. It includes the counties Mayo, Sligo, Leitrim, Galway and Roscommon (*qq.v.* for topography, etc.). Population (1936) 525,468.

In early times, Connaught (*Connachta*) was a Firbolg or pre-Celtic state, but about A.D. 150 it passed under the Gaelic dynasty which ruled at Cruachu, now Croghan, in Co. Roscommon. This dynasty pushed over the Shannon and founded a new kingdom of Meath, with Tara as its capital about 250. Connaught and Meath then remained a joint kingdom till 483, when the former became a separate state which lasted till 1224. In the 12th century Connaught produced a great High King in Turloch O'Connor. On the death of Cathal "Crovderg," Henry III. made a grant of Connaught to Richard de Burgh, saving a few cantreds in Co. Roscommon to the O'Connors (1227). Richard's son Walter became earl of Ulster as well as lord of Connaught, but when Earl William was murdered in 1333 his heiress, marrying prince Lionel of Clarence, ultimately carried these titles to the Crown. Connaught was, however, occupied by junior branches of the de Burghs, who took respectively the appellations of MacWilliam "Uachtair" and "Iochtair" ("the Upper and Lower MacWilliam"), or the Clanrickard and Mayo Burkes. In 1543 Ulick Burke was created earl of Clanrickard, and in 1603 "MacWilliam Iochtair" Viscount Mayo. In 1576 Connaught was divided into shires by Sir Henry Sidney, who also placed it, like Munster, under a president, a system which lasted 70 years. In 1585 Sir John Perrot made with the resident gentry and chiefs the "Composition of Connaught," which confirmed them in their lands by knight-service of the Crown. The result was that the province remained loyal on the whole during the Tyrone rising, and till 1640 was the most Gaelic and Norman part of Ireland. Its history is henceforth part of the national history.

CONNAUGHT TUNNEL, on the main line of the Canadian Pacific railway, pierces Mt. Macdonald in the Selkirk Range east of Glacier, British Columbia. It reaches an elevation of 3,790ft., above sea level, has a concrete lined cross-section 23 by 29ft., is double tracked and 5mi. long. It was driven through rock and earth by the pioneer tunnel method involving a small working tunnel with cross-cuts to the main tunnel permitting the working of several faces simultaneously. The line change involved lowered the railway summit 552ft., eliminated 2,300 degrees of curvature, 4·3mi. of distance and 4·5mi. of snowsheds. Fans at the West portal drive 500,000 cu.ft. of air per minute through the tunnel. The total cost was $9,200,000.

CONNEAUT (kŏnny ŏtt), a city in northeast Ohio, U.S.A., in Ashtabula county; at the mouth of the Conneaut river, on lake Erie. It is on federal highway 20, and is served by the Bessemer and Lake Erie, the New York Central, and the Nickel Plate railways. The population in 1930 was 9,691; in 1940, 9,355 by the federal census. It is a port of entry, and its fine harbour has a large traffic, chiefly in receipts of iron ore, coal and steel (11,938,637 tons in 1940). The city has railroad shops, canneries, tin can and textile factories, lamp works, tanneries and various other manufacturing industries. Conneaut was settled in 1798, and was chartered as a city in 1898.

CONNECTICUT (kŏ-nĕt′ĭ-kŭt), called the "Nutmeg State," is one of the 13 original states of the union, and one of the New England group. It is bounded north by Massachusetts, east by Rhode Island, south by Long Island sound, and west by New York; the southwest corner projects along the sound indenting New York for about 13 miles. The state is situated between 40° 54′ and 42° 3′ N. and between 71° 47′ and 73° 43′ W., and its total area is 5,009 sq.mi., of which 110 are water surface. Only two states of the Union, Rhode Island and Delaware, are smaller in area. The state has 169 towns which are the principal units of local government. The counties, of which there are eight, have so little governmental importance that there are no county seats. There are 21 incorporated cities.

Physiography.—Connecticut lies in the south portion of the peneplain region of New England. Its surface is in general that of a gently undulating upland divided near the middle by the lowland of the Connecticut valley, the most striking physiographic feature of the state. The upland rises from the low south shore at an average rate of about 20 ft. in a mile until it has a mean ele-

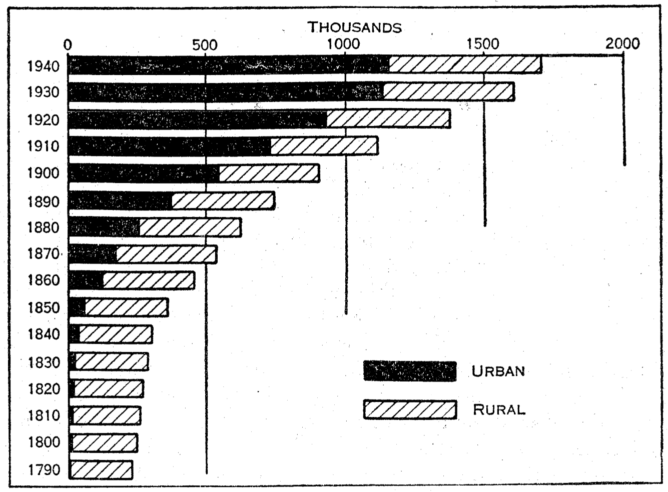
BY COURTESY OF THE U.S. DEPARTMENT OF AGRICULTURE

HARVESTING A FIELD OF BROADLEAF TOBACCO IN CONNECTICUT

vation along the north border of the state of 1,000 ft. or more, and a few points in the northwest rise to a height of about 2,000 ft. above the sea. The lowland dips under the waters of Long Island sound at the south and rises slowly to a height of only 100 ft. above them where it crosses the north border. At the north the lowland is about 15 mi. wide; at the south it narrows to only 5 mi., its total area is about 600 sq.mi. Its formation was caused by the removal of a band of weak rocks by erosion after the general upland surface had been first formed near sea level and then elevated and tilted gently south or southeast; in this band of weak rocks were several sheets of hard igneous rock (trap) inclined from the horizontal several degrees, and so resistant that they were not removed but remained to form the "trap ridges," such as West Rock ridge near New Haven and the Hanging hills of Meriden. These are identical in origin and structure with Mt. Tom range and Holyoke range of Massachusetts, being the south continuation of those ranges. The ridges are generally deeply notched, but their highest points rise to the upland heights directly to the east or west. The west section of the upland is more broken than the east section, for in the west are several isolated peaks lying in line with the south continuation of the Green and the Housatonic mountain ranges of Vermont and Massachusetts, highest among them being: Bear mountain, 2,355 ft.; Gridley mountain, 2,200 ft.; Mt. Riga, 2,000 ft.; Mt. Ball and Lion's Head, each 1,760 ft.; Canaan mountain (North Canaan), 1,680 ft.; and Ivy mountains (Goshen) 1,640 ft. Just as the surface of the lowland is broken by the notched trap-ridges, so that of the upland is often interrupted by rather narrow deep valleys, or gorges, extending usually from north to south or to the southeast. The lowland is drained by the Connecticut river as far south as Middletown, but here this river turns to the southeast into one of the narrow valleys in the east section of the upland, the turn being due to the fact that the river acquired its present course when the land was at a lower level and before the lowland on the soft rocks was excavated. The principal rivers in the west section of the upland are the Housatonic and its affluent, the Naugatuck; in the east section is the Thames, which is really an outlet for three other rivers (the Yantic, the Shetucket and the Quinebaug). In the central and north regions of the state the course of the rivers is rapid, owing to a relatively recent tilting of the surface. The Connecticut river is navigable as far as Hartford, and the Thames as far as Norwich. The Housatonic river, which in its picturesque course traverses the whole breadth of the state, has a short stretch of tide-water navigation. The lakes which are found in all parts of the state and the rapids and waterfalls along the rivers are largely due to disturbances of the drainage lines by the ice invasion of the glacial period. To the glacial action are due also the extensive removal of the original soil from the uplands and the accumulation of morainic hills in many localities. The sea coast, about 100 mi. in length, has a number of bays, making several good harbours which have been created by a depression of small valleys.

The climate of Connecticut, though temperate, is subject to sudden changes, yet the extremes of cold and heat are less than in the other New England states. The mean annual temperature is 49° F., the average temperature of winter being 27° and that of summer 72°. Since the general direction of the winter winds is from the northwest, the extreme of cold (−10° or −15°) is felt in the northwestern part of the state. The prevailing summer winds, which are from the southwest, temper the heat of summer in the coast region, but extreme heat (100°) is found in the central part of the state. The annual rainfall varies from 45 to 50 inches.

Government.—The present constitution of Connecticut is that framed and adopted in 1818 with subsequent amendments (41 up to 1941). Amendments are adopted after approval by a majority vote of the lower house of the general assembly, a two-thirds majority of both houses of the next general assembly, and ratification by the electors. The executive and legislative officials are chosen by the electors for a term of two years, the attorney-general for four years; the judges of the supreme court of errors and the superior court, appointed by the general assembly on nomination by the governor, serve for eight years, and the judges of the courts of common pleas (in Hartford, New London, New Haven, Litchfield and Fairfield counties) and of the district courts, chosen in like manner, serve for four years. In providing for the judicial system, the constitution says: "the powers and jurisdiction of which courts shall be defined by law." The general assembly has interpreted this as a justification for interference in legal matters. It has at various times granted divorces, confirmed faulty titles, annulled decisions of the justices of the peace, and validated contracts against which judgment by default had been secured. Qualifications for suffrage are: the age of 21 years, citizenship in the United States, residence in the state for one year and in the township for six months preceding the election, a good moral character, and ability "to read in the English language any article of the constitution or any section of the statutes of this state." The right to decide upon a citizen's qualifications for suffrage is vested in the selectmen and clerk of each township. A property qualification, found in the original constitution, was re-



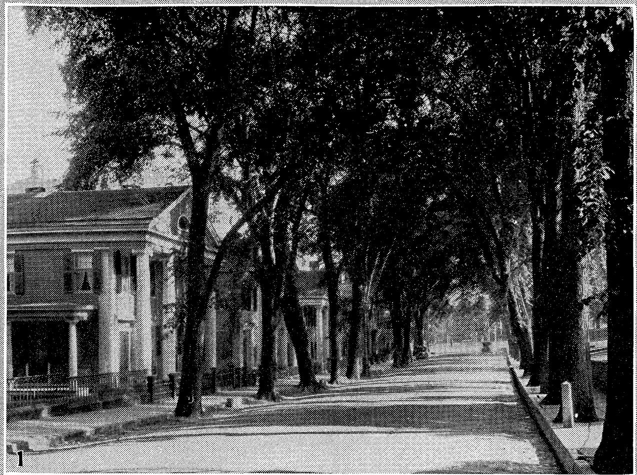
BY COURTESY OF THE U.S. BUREAU OF THE CENSUS
URBAN AND RURAL POPULATION OF CONNECTICUT, 1790 TO 1940

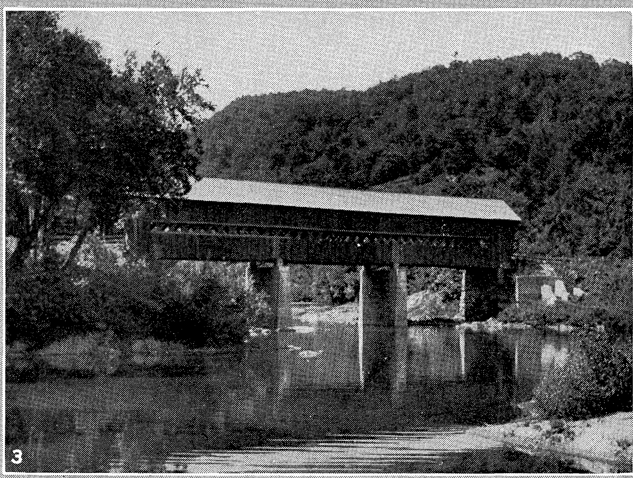
moved in 1845. The 15th amendment to the federal constitution was ratified (1869) by Connecticut, but Negroes were excluded from the suffrage by the state constitution until 1876.

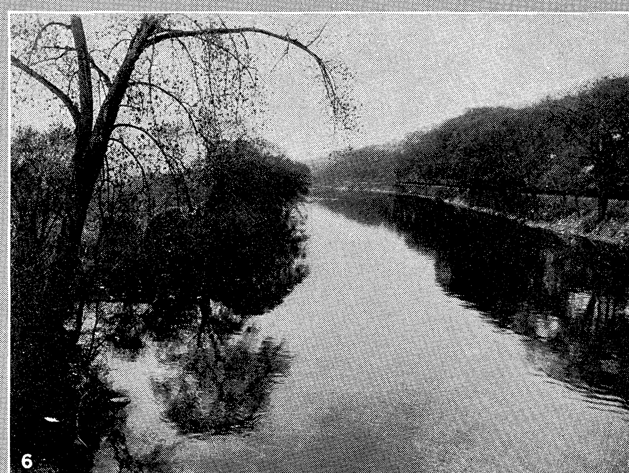
The jurisprudence of Connecticut, since the 17th century, has been notable for its divergence from the common law of England. In 1639 inheritance by primogeniture was abolished, and this resulted in conflict with the British courts in the 18th century. At an early date, also, the office of public prosecutor was created to conduct prosecutions, which until then had been left to the aggrieved party. A homestead entered upon record and occupied by the owner is exempt from liability for debts to the extent of $1,000 in value. There were 35 members in the senate and 267 in the house of representatives in 1939.

Population.—The population of Connecticut in 1790 was 237,946; in 1820 it was 275,248; in 1850, 370,792; in 1880, 622,700; in 1910, 1,114,756; and in 1940, 1,709,242. This last figure represents an increase of 6·4% over the population in 1930. The population per square mile was 348·9, as compared with 44·2 for the United States as a whole. Of the 1940 population, 1,158,162, or 67·8%, lived in urban areas, comprising all cities and boroughs of 2,500 or more and four large densely populated towns. The number of occupied dwelling units returned in the housing census of 1940 was 448,887, which is approximately the same as the number of families. The average population per family (occupied dwelling unit) declined from 4·1 in 1930 to 3·8 in 1940. The white population of Connecticut formed 98·1% of the total in both 1940 and 1930. The number of males in the population of the state was practically the same as the number of females. The population of the state and of its principal cities is summarized in the following table:

Area	Population			Per cent of increase	
	1940	1930	1920	1930–40	1920–30
The State	1,709,242	1,606,903	1,380,631	6·4	16·4
Urban	1,158,162	1,131,770	936,339	2·3	20·9
Rural	551,080	475,133	444,292	16·0	6·9
Per cent urban	67·8	70·4	67·8	..	..
Principal cities:					
Hartford	166,267	164,072	138,036	1·3	18·9
New Haven	160,605	162,655	162,537	−1·3	0·1
Bridgeport	147,121	146,716	143,555	0·3	2·2
Waterbury	99,314	99,902	91,715	−0·6	8·9
New Britain	68,685	68,128	59,316	0·8	14·9
Stamford	47,938	46,346	35,096	3·4	32·1
Norwalk	39,849	36,019	27,743	10·6	29·8
Meriden	39,494	38,481	29,867	2·6	28·8
New London	30,456	29,640	25,688	2·8	15·4
Bristol	30,167	28,451	20,620	6·0	38·0





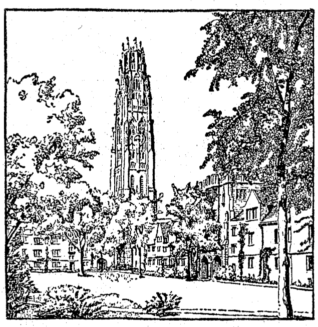
PHOTOGRAPHS, (1, 2) EWING GALLOWAY, (3) DE COU FROM EWING GALLOWAY, (4) E. O. HOPPE, FROM A CAMERA STUDY, (5) PUBLISHERS PHOTO SERVICE, (6) BROWN BROTHERS

VIEWS OF CONNECTICUT AND THE CONNECTICUT RIVER

1. A street in New London, Connecticut, showing houses of the second quarter of the nineteenth century
2. Hartford, Connecticut's State capital and the head of water traffic on the Connecticut river. This photograph shows the Hartford vehicular bridge and the railroad bridge over the Connecticut
3. Covered bridge over the Connecticut river in the White Mountains. These bridges were built partly with the object of protecting horses from the sight of running water
4. Midwinter scene at Middletown on the Connecticut river, showing another house of the eighteenth century type common throughout the State
5. Growing tobacco under cheesecloth on the plantations of the American Sumatra Company in the Connecticut Valley near Avon
6. View of the Naugatuck river, which joins the Housatonic. These are the two chief rivers in the western section of the Connecticut upland

Finance.—The report of the state for the fiscal year ending June 30, 1940 showed state government revenue receipts of $74,596,669; governmental costs, $72,195,799, including capital outlay of $12,078,901. The state debt of $25,000,000 was largely offset by treasury balances. The principal sources of revenue were: the motor vehicle licence fees; an inheritance tax; a gasoline tax of two cents per gallon; a net income corporation tax; a tax on steam railways; a state tax on towns; taxes on savings banks; and a tax on stock insurance companies. The state has no personal income tax. There is a military commutation tax of $2, and all persons neglecting to pay it are liable to imprisonment. In 1937, taxes for local government purposes yielded $77,294,724. The legal rate of interest is 6% and days of grace are not allowed.

Education.—Education has always been a matter of public interest in Connecticut. Soon after the foundation of the colonies of Connecticut and New Haven, schools similar to the English grammar schools were established. The Connecticut code of 1650 required all parents to educate their children, and every township of 50 householders (later 30) to have a teacher supported by the men of family, while the New Haven code of 1656 also encouraged education. In 1672 the general court granted 600 ac. of land to each county for educational purposes; in 1794 the general assembly appropriated the proceeds from the sale of western lands to education, and in 1837 made a similar disposition of funds received from the federal treasury.



BY COURTESY OF THE NEW HAVEN CHAMBER OF COMMERCE

HARKNESS MEMORIAL TOWER AND QUADRANGLE, YALE UNIVERSITY, NEW HAVEN, CONNECTICUT

Beginning on July 15, 1909, the organization of public education was changed from the district type to town management type. In 1921 there were less than ten townships that had not availed themselves of the law by which all the schools are under the direction of the town school committee. Appropriations for the support of the schools are made at a town meeting. Compulsion was made more rigid by the enactment providing that after Sept. 1, 1911, no employment certificate should be accepted by any employer, except certificates issued by the state board of education.

There were 312,713 children between the ages of 4 and 16 inclusive, in 1939. Of this number, 242,427, or 77·5%, were enrolled in the public schools, and 53,065 of the remainder attended private or parochial schools. The public school attendance consisted of 164,874 in the kindergarten and elementary schools and 100,960 in the secondary schools. Fifty-six private high schools and academies helped to lessen the public secondary school attendance. In 1937 the total number of teachers in the public schools was 10,399. The public school expenditure for 1937 was $26,896,857—or $99.62 per capita of average attendance. The state maintains 11 trade schools, which had an enrolment of 10,391 in 1940 and helps in the maintenance of two others. Supplementing the educative influence of the schools are the public libraries, 199 in number in 1940.

Higher education is provided by Yale university (*q.v.*); by Trinity college (non-sectarian), at Hartford, founded in 1823; by Wesleyan university, at Middletown, founded in 1831; by the Hartford theological seminary (1834); by the University of Connecticut (1881) at Storrs, which has an experiment station; by the Connecticut experiment station at New Haven, which was established in 1875 at Middletown and was the first in the United States; by teachers' colleges at New Britain (established 1881), Willimantic (1890), New Haven (1894), and Danbury (1903); by Connecticut College for Women (1911), at New London; and by a women's college, Albertus Magnus, Roman Catholic, at New Haven, opened in 1925. Graduate institutions include the Berkeley Divinity school, at New Haven, and Hartford Seminary foundation. Since 1936 nine junior colleges have been established in the state.

Charities and Corrections.—A Commissioner of Welfare, assisted by an advisory Public Welfare Council, has supervision over all philanthropic and penal institutions. The institutions supported in whole or in part by the state are: a state prison at Wethersfield; ten county jails; Connecticut reformatory, at Cheshire; Connecticut state farm for women, at Niantic; Connecticut school for boys, at Meriden; Long Lane farm for girls, at Middletown; House of the Good Shepherd, at Hartford; Florence Crittenton mission, at New Haven; the Connecticut state hospital, at Middletown; the Norwich state hospital, at Norwich; the Fairfield state hospital, at Newtown; state training schools for feeble-minded at Mansfield and Southbury; the American school for the deaf, in Hartford; the oral school for the deaf, at Mystic; the Connecticut institute and industrial home for the blind, at Hartford; the Newington home for crippled children; Fitch's Home for soldiers and sailors, at Noroton Heights and Rocky Hill; a home for disabled soldiers under the direction of the Women's relief corps; five tuberculosis sanatoria for adults and one for children, 57 town alms-houses, eight county temporary homes for dependent and neglected children, and 40 public hospitals. Private institutions under the supervision of the state board include 12 hospitals for the insane, 27 homes for the aged, and 24 institutions for children.

The greatest part of these institutions are supported by religious or benevolent organizations.

Industry, Trade and Transportation.—Connecticut is not an agricultural state. Although one-half of the land surface is included in farms, only 11·5% of the land area was cropped in 1939, but agriculture is of considerable economic and historic interest. The accounts of the fertility of the Connecticut valley were among the causes leading to the English colonization, and until the middle of the 19th century agriculture was the principal occupation. In 1940, 32·2% of the population was classed as rural, though the actual farming population was somewhat smaller. In 1940 the farms of the state numbered 21,163, a loss of 5,652 since 1910. The average value of land and buildings per acre in 1940 was $135.41 as compared with $63.28 in 1910. Tobacco is one of the most important agricultural products; the crop decreased from 28,110,453 lb. valued at $4,415,948 in 1910, to 14,276,000 lb., valued at $4,844,000 in 1934, to 19,470,968 lb. in 1939, value not given. In the season of 1922 the Connecticut Valley Tobacco association, a pool with a Connecticut membership of 2,400 growers farming 90% of the acreage of outdoor tobacco in the state, was formed for the collective marketing of the crop. The association sorts, packs, sweats and sells the leaf. Dairying is practised on more than three-fifths of the farms of the state. The quality of the milk is being steadily improved through a system of inspection put into effect by the Milk Regulation board and administered by the Dairy and Food commission. The number of milch cows fluctuates around 115,000.

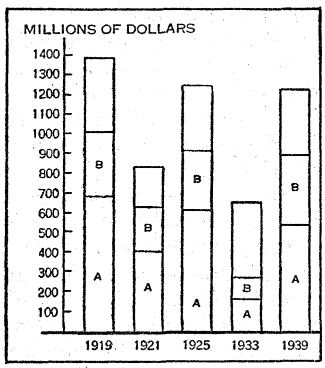
The production of milk increased from 45,749,849 gal. in 1909 to 71,983,767 gal. in 1939. In the same period the output of butter fell from 3,498,551 lb. to 364,190 lb. The poultry industry increased very rapidly, owing to the favourable climate and the large market close at hand, there being produced in 1940 20,289,094 doz. of chicken eggs.

For the same reason market gardening increased, the gardeners being organized into one state and 16 local organizations; the 1939 crop of farm garden vegetables was valued at $6,300,000. The values of five leading crops in 1939 were: hay, $6,826,000; tobacco, $10,442,000; potatoes, $3,238,000; Indian corn, $1,384,000; and apples, $978,000.

The mineral industries of Connecticut have had a declining fortune. The early settlers soon discovered metals and began to work them. About 1740 the production of iron became an important industry in the vicinity of Salisbury, and from Connecticut iron many of the American military supplies in the Revolutionary War were manufactured. The quarries of granite near Long Island sound, those of sandstone at Portland, and of feldspar at Branchville and South Glastonbury, however, have furnished building and paving materials for other states. The total production of mines and quarries of Connecticut in 1929 was valued at $3,810,000, and in 1938 at $3,059,688.

The fisheries are still a source of wealth but are not as important as formerly. According to the U. S. bureau of fisheries, there were 1,161 persons and 70 vessels of all types engaged in the industry in 1933. The fisheries products of the state in 1938 were 11,838,000 lb. and were valued at $1,420,000. The principal products, according to value, were market oysters, seed oysters, lobsters, flounders and bluefish.

Manufacturing has encountered none of the vicissitudes of other industries. Indeed, manufacturing in Connecticut is notable for its early beginning and its development of certain branches beyond their development in other states. Iron products were manufactured throughout the 18th century, nails were made before 1716 and were exported from the colony, and it was in Connecticut that cannon were cast for the continental troops and the chains were made to block the channel of the Hudson river to British ships. Tinware was manufactured in Berlin, Hartford county, as early as 1740, and tin, steel and iron goods were peddled from Connecticut through the colonies. The Connecticut clockmaker and clock pedlar was the 18th century embodiment of Yankee ingenuity; the most famous of the next generation of clockmakers were Eli Terry (1772–1859), who made a great success of his wooden clocks; Chauncy Jerome, who first used brass wheels in 1837 and founded in 1844 the works of the New Haven Clock company; Gideon Roberts, and Terry's pupil and successor, Seth Thomas (1786–1859), who built the factory at Thomaston carried on by his son Seth Thomas (1816–88). In 1732 the London hatters complained of the competition of Connecticut hats in their trade. From 1802 brass works were in operation at Waterbury—the great brass manufacturing business there growing out of the making of metal buttons. In 1768 paper mills were erected at Norwich, and in 1776 at East Hartford. In 1788 the first woollen mills in New England were established at Hartford, and about 1803 100 merino sheep were imported by David Humphreys, who in 1806 built a mill in that part of Derby which is now Seymour and which was practically the first New England factory town; in 1812 steam was first used by the Middletown Woollen Manufacturing company. In 1804 the manufacture of cotton was begun at Vernon, Hartford county; mills at Pomfret and Jewett City were established in 1806 and 1810 respectively. Silk culture was successfully introduced about 1732; and there was a silk factory at Mansfield, Tolland county, in 1758. The period of greatest development of manufacturing began after the war of 1812. The decade of greatest relative development was that of 1909–19, during which the value of the products increased 184%. During the period 1850–1900, when the population increased 145%, the average number of wage earners employed in manufacturing establishments increased 248·3%, the number so employed constituting 13·7% of the state's total population in 1850 and 19·5% of that in 1900. The average number of wage earners in establishments conducted under the factory system in 1923 was 263,232, or 17·6% of the total population.



GRAPH OF VALUE OF MANUFACTURED PRODUCTS (ENTIRE COLUMN), COST OF MATERIALS USED IN THEIR PRODUCTION (A), AND WAGES PAID (B)

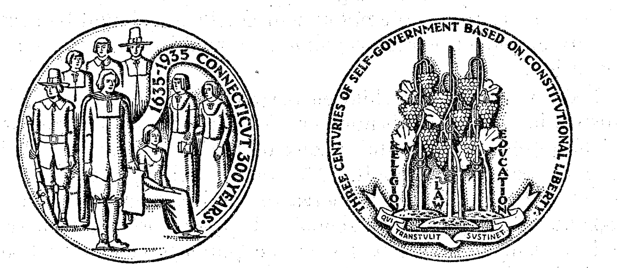
The war of 1914–18 brought a great volume of orders to Connecticut factories and caused large numbers of plants to change the character of their products. In May 1918, 80% of Connecticut's manufacturing was directly or indirectly engaged in producing munitions, rifles, machine guns, clothing and other articles used by the military forces, and there were five plants where ships and power boats were constructed. Wages were high during this period. In the years of rapid expansion there were a great many strikes, and labour organizations increased in membership. During the two years following the armistice the factories began the process of readjustment to peace-time conditions, which was completed by the depression of 1920–21. In 1922 the situation steadily improved; unemployment declined, and in Dec. 1922 the department of labour reported an actual shortage of labour in the state. The growth of industry after 1922 was indicated by the fact that in 1923 and 1924 the cost of new factory construction and additions was $16,807,775.

The 3,062 industrial establishments operating within the state in 1925 gave employment to 242,362 wage earners, and had an output valued at $1,274,951,562. Connecticut's decrease in rank as a producer of textiles, especially cotton goods, was caused, in part, by industrial readjustments and, in part, by the increase in cotton manufacturing in the south. On the other hand, new industries have been developed. Connecticut is one of the leading producers in the aeroplane industry.

In 1933, when the depression was at its worst, the 2,410 industrial establishments operating within the state gave employment to 183,322 wage earners and had an output valued at $634,705,000, but at the close of 1940 the 1929 records for employment, wage earnings and production were being surpassed. The following table for 1937 shows production as a whole practically at the 1925 level, but with fluctuations in the several industries.

Industry	*Wage earners*	*Value of products*
Electrical machinery	16,741	96,512,785
Hardware	14,143	48,305,548
Foundry and machine shop products	15,573	71,469,578
Hats, fur felt	6,936	28,458,885
Woollen goods	5,045	23,542,873
Silverware and plated ware	3,669	20,026,822
Cotton goods	13,283	36,529,572
Silk and rayon goods	5,408	19,200,666
Nonferrous metal products	22,210	155,725,947

Transportation of products is facilitated by water routes and 890 mi. (1940) of steam railways. The New York, New Haven and Hartford company controls the greater part of this railway mileage. Electric railways developed rapidly after 1895 until a maximum of 1,618 mi. was reached in 1922. The state highway system on June 30, 1940, was 2,817 mi., of which nearly all were surfaced. Motor vehicles registered in 1939 were 476,837. It is estimated that motor traffic on Connecticut roads averages over 500,000 mi. an hour. Motor trucks handle an extraordinarily large proportion of freight business in the state.



Connecticut Tercentenary Medal. Obverse (left): The founders of Connecticut with the figure of Thomas Hooker holding the Fundamental Orders. Reverse (right): The transplanted grapevines of the State Seal, and the motto, *"Qui transtulit sustinet"* ("He who brought us hither sustains us")

History.—The first settlement by Europeans in Connecticut was made on the site of the present Hartford in 1633 by a party of Dutch from New Netherland. In the same year a trading post was established on the Connecticut river, near Windsor, by members of the Plymouth colony, and John Oldham (1600–36) of Massachusetts explored the valley and made a good report of its resources. Encouraged by Oldham's account of the country, the inhabitants of three Massachusetts towns, Dorchester, Watertown and Newtown (now Cambridge), left the colony for the Connecticut valley. The emigrants from Watertown founded Wethersfield in the winter of 1634–35; those from Dorchester settled at Windsor in the summer of 1635; and in the autumn of the same year people from Newtown settled at Hartford. These early colonists had come to Massachusetts in the Puritan migration of 1630; their removal to Connecticut, in which they were led principally by Thomas Hooker (*q.v.*), Roger Ludlow (*c.* 1590–1665) and John Haynes (d. 1654), was caused by their discontent with the autocratic character of the government in Massachusetts; but the instrument of government which they adopted in 1639, known as the Fundamental Orders of Connecticut, reveals no radical departure from the institutions of Massachusetts. The general court—the supreme civil authority—was composed of deputies from the towns and a governor and magistrates who were elected by the freemen of the towns. Its powers were not clearly defined; there was also no separation of the executive, legislative and judicial functions, and the authority of the governor was limited to that of a presiding officer. The government thus established was not the product of a federation of townships as has often been stated; indeed, the townships had been governed during the first year by commissioners deriving authority from Massachusetts, and the first general court was probably convened by them. In 1638 the celebrated Fundamental Orders were drawn up, and in 1639 they were adopted. Their most original feature was the omission of a religious test for citizenship, though a precedent for this is to be found in the Plymouth colony; on the other hand, the union of Church and State was presumed in the preamble, and in 1659 a property qualification (the possession of an estate of £30) for suffrage was imposed by the general court.

In the meantime another migration to the Connecticut country had begun in 1638, when a party of Puritans who had arrived in Massachusetts the preceding year sailed from Boston for the Connecticut coast, and there founded New Haven. The leaders in this movement were John Davenport (1597–1670) and Theophilus Eaton, and their followers were drawn from the English middle class. Soon after their arrival these colonists drew up a "Plantation Covenant" which made the Scriptures the supreme guide in civil as well as religious affairs; but no copy of this is now extant. In June 1639, however, a more definite statement of political principles was framed, in which it was clearly stated that the rules of Scripture should determine the ordering of the Church, the choice of magistrates, the making and repeal of laws, the dividing of inheritances, and all other matters of public import; that only Church members could become free burgesses and officials of the colony; that the free burgesses should choose 12 men who should choose seven others, and that these should organize the Church and Civil Government. In 1643 the jurisdiction of the New Haven colony was extended by the admission of the townships of Milford, Guilford and Stamford to equal rights with New Haven, the recognition of their local governments and the formation of two courts for the whole jurisdiction—a court of magistrates to try important cases and hear appeals from "plantation" courts, and a general court with legislative powers, the highest court of appeals, which was similar in composition to the general court of the Connecticut colony. Two other townships were afterwards added to the colony—Southold, on Long Island, and Branford, Conn.

The religious test for citizenship was continued (except in the case of six citizens of Milford), and in 1644 the general court decided that the "judicial laws of God as they were declared by Moses" should constitute a rule for all courts "till they be branched out into particulars hereafter." The theocratic character of the government thus established is clearly revealed in the series of strict enactments and decisions which constituted the famous "Blue Laws." Of the laws (45 in number) given by Samuel Peters in his *General History of Connecticut,* more than one-half really existed in New Haven, and more than four-fifths existed in some form in the New England colonies. Among those of New Haven are the prohibition of trial by jury, the infliction of the death penalty for adultery, and of the same penalty for conspiracy against the jurisdiction; the requirement of strict observance of the Sabbath, and heavy fines for "concealing or entertaining Quaker or other blasphemous heretics."

A third Puritan settlement was established in 1635 at the mouth of the Connecticut river, under the auspices of an English company, whose leading members were William Fiennes, Lord Say and Sele (1582–1662), and Robert Greville, Lord Brooke (1608–43). In their honour the colony was named Saybrook. In 1636 George Fenwick (d. 1657), a member of the company, arrived, and as immigration from England soon afterwards greatly declined on account of the Puritan revolution, he sold the Saybrook colony to Connecticut in 1644. This early experiment in colonization at Saybrook and the sale by Fenwick are important on account of their relation to a fictitious land title. The Saye and Sele company secured in 1631 from Robert Rich, earl of Warwick (1587–1658), a quitclaim to his interest in the territory lying between the Narragansett river and the Pacific ocean. The nature of Warwick's right to the land is not stated in any extant document, and no title of his to it was ever shown. But the Connecticut authorities in their effort to establish a legal claim to the country and to thwart the efforts of the Hamilton family to assert its claims to the territory between the Connecticut river and the Narragansett bay—claims derived from a grant of the Plymouth Company to James, Marquess of Hamilton (1606–49) in 1635—elaborated the theory that the Plymouth Company had made a grant to Warwick, and that consequently his quitclaim conferred jurisdiction upon the Saye and Sele company; but even in this event Fenwick had no right to make his sale, for which he never secured confirmation.

The next step in the formation of modern Connecticut was the union of the New Haven colony with the older colony. This was accomplished by the royal charter of 1662, which defined the boundaries of Connecticut as extending from Massachusetts south to the seas and from Narragansett bay west to the South Sea (Pacific ocean). This charter had been secured without the knowledge or consent of the New Haven colonists, and they naturally protested against the union with Connecticut. But on account of the threatened absorption of a part of the Connecticut territory by the colony of New York, granted to the duke of York in 1664, and the news that a commission had been appointed in England to settle inter-colonial disputes, they finally assented to the Union in 1665. Hartford then became the capital of the united colonies, but shared that honour with New Haven from 1701 until 1875. The charter was liberal in its provisions. It created a corporation under the name of the governor and company of the English colony of Connecticut in New England in America, sanctioned the system of government already existing, provided that all acts of the general court should be valid upon being issued under the seal of the colony, and made no reservation of royal or parliamentary control over legislation or the administration of justice. Consequently there developed in Connecticut an independent, self-reliant colonial government which looked to its chartered privileges as the supreme source of authority.

Although the governmental and religious influences which moulded Connecticut were similar to those which moulded New England at large, the colony developed certain distinctive characteristics. Its policy was "to avoid notoriety and public attitudes; to secure privileges without attracting needless notice; to act as intensely and vigourously as possible when action seemed necessary and promising; but to say as little as possible, and evade as much as possible when open resistance was evident folly."

The relations of Connecticut with the neighbouring colonies were notable for numerous and continuous quarrels in the 17th century. Soon after the first settlements were made a dispute arose with Massachusetts regarding the boundary between the two colonies; after the brief war with the Pequot Indians in 1637 a similar quarrel followed regarding Connecticut's right to the Pequot lands; and in the New England Confederation (established in 1643) friction between Massachusetts and Connecticut continued. Difficulty with Rhode Island was caused by the conflict between the colony's charter and the Connecticut charter regarding the western boundary of Rhode Island; and the encroachment of outlying Connecticut settlements on Dutch territory, and the attempt to extend the boundaries of New York to the Connecticut river, gave rise to other disputes. These questions of boundary were a source of continuous discord, the last of them not being settled until 1881. The attempts of governors Joseph Dudley (1647–1720), of Massachusetts, and Thomas Dongan

(1634–1715), of New York, to unite Connecticut with their colonies also caused difficulty. The relations of Connecticut and New Haven with the mother country were similar to those of the other New England colonies. The period of most serious friction was that during the administration of the New England colonies by Sir Edmund Andros (*q.v.*), who in pursuance of the later Stuart policy both in England and in her American colonies visited Hartford on Oct. 31, 1687, to execute *quo warranto* proceedings against the charter of 1662. It is said that in the course of a discussion at night over the surrender of the charter the candles were extinguished, and the document itself (which had been brought to the meeting) was removed from the table where it had been placed. According to tradition it was hidden in a large oak tree, afterwards known as the "Charter Oak." But though Andros thus failed to secure the charter, he dissolved the existing government. After the Revolution of 1689, however, government under the charter was resumed, and the Crown lawyers decided that the charter had not been invalidated by the *quo warranto* proceedings.

Religious affairs formed one of the most important problems in the life of the colony. The established ecclesiastical system was the Congregational. The code of 1650 (Connecticut) taxed all persons for its support, provided for the collection of church taxes by civil distraint if necessary, and forbade the formation of new churches without the consent of the general court. The new Halfway Covenant of 1657, which extended church membership so as to include all baptized persons, was sanctioned by the general court in 1664. The custom by which neighbouring churches sought mutual aid and advice prepared the way for a presbyterian system of church government, which was established by an ecclesiastical assembly held at Saybrook in 1708, the Church constitution there framed being known as the "Saybrook Platform." At that time, however, a liberal policy towards dissent was adopted, the general court granting permission for churches "soberly to differ or dissent" from the establishment. Hence a large number of new churches soon sprang into being. In 1727 the court forbade any ordained minister to enter another parish than his own without an invitation and decided that only those were legal ministers who were recognized as such by the general court. Throughout the remaining years of the 18th century there was constant friction between the establishment and the nonconforming churches; but in 1791 the right of free incorporation was granted to all sects.

In the Revolutionary War Connecticut took a prominent part. At the time of the controversy over the Stamp Act the general court instructed the colony's agent in London to insist on "the exclusive right of the colonists to tax themselves, and on the privilege of trial by jury," as rights that could not be surrendered. The patriot sentiment was so strong that loyalists from other colonies were sent to Connecticut, where it was believed they would have no influence; the copper mines in East Granby were converted into a military prison; but among the nonconforming sects, on the other hand, there was considerable sympathy for the British cause. Preparations for war were made in 1774; on April 28, 1775, the expedition against Ticonderoga and Crown Point was resolved upon by some of the leading members of the Connecticut assembly; and although they had acted in their private capacity, funds were obtained from the colonial treasury to raise the force which on May 8 was put under the command of Ethan Allen. Connecticut volunteers were among the first to go to Boston after the battle of Lexington, and more than one-half of Washington's army at New York in 1776 was composed of Connecticut soldiers. Yet with the exception of isolated British movements against Stonington in 1775, Danbury in 1777, New Haven in 1779 and New London in 1781, no battles were fought in Connecticut territory.

In 1776 the government of Connecticut was reorganized as a State, the charter of 1662 being adopted by the general court as "the Civil Constitution of this State, under the sole authority of the people thereof, independent of any king or prince whatever." In the formation of the General Government the policy of the State was national. It acquiesced in the loss of western lands through a decision (1782) of a court appointed by the Confederation (*see* WYOMING VALLEY); favoured the levy of taxes on imports by Federal authority; relinquished (1786) its claims to all remaining western lands, except the Western Reserve (*see* OHIO); and in the Constitutional Convention of 1787 the present system of national representation in Congress was proposed by the Connecticut delegates as a compromise between the plans presented by Virginia and those presented by New Jersey.

For many years the Federalist party controlled the affairs of the State. The opposition to the growth of American nationality which characterized the later years of that party found expression in a resolution of the general assembly that a bill for incorporating State troops in the Federal army would be "utterly subversive of the rights and liberties of the people of the State, and the freedom, sovereignty and independence of the same," and in the prominent part taken by Connecticut in the Hartford Convention (*see* HARTFORD) and in the advocacy of the extensive amendments proposed by it. But the development of manufactures, the discontent of nonconforming religious sects with the establishment, and the confusion of the executive, legislative and judicial branches of government in the constitution opened the way for a political revolution. All the discontented elements united with the Democratic Party in 1817 and defeated the Federalists in the State election; and in 1818 the existing constitution was adopted. From 1830 until 1855 there was close rivalry between the Democratic and Whig Parties for control of the State administration.

In the Civil War Connecticut was one of the most ardent supporters of the Union cause. When President Lincoln issued his first call, for 75,000 volunteers, there was not a single militia company in the State ready for service. Gov. William A. Buckingham (1804–75), one of the ablest and most zealous of the "war governors," and afterwards, from 1869 until his death, a member of the United States Senate, issued a call for volunteers in April 1861; and soon 54 companies, more than five times the State's quota, were organized. Corporations, individuals and towns made liberal contributions of money. The general assembly made an appropriation of $2,000,000, and the State furnished approximately 48,000 men to the army. Equally important was the moral support given to the Federal government by the people. After the war the Republicans were more frequently successful at the polls than the Democrats. Representation in the lower house of the general assembly, by the constitution of 1818, was based on the townships, each township having two representatives, except townships created after 1818, which had only one each. This method constituted a serious evil when, in the transition from agriculture to manufacturing as the leading industry, the population became concentrated to a considerable degree in a few large cities and the relative importance of the various townships was greatly changed. The township of Marlborough, with a population in 1900 of 322, then had one representative, while the city of Hartford, with a population of 79,850, had only two; and the township of Union, with 428 inhabitants, and the city of New Haven, with 108,027, each had two representatives. The apportionment of representation in the State senate had become almost as objectionable. By a constitutional amendment of 1828 it had been provided that senators should be chosen by districts, and that in the apportionment regard should be had to population, no county or township to be divided and no part of one county to be joined to the whole or part of another county, and each county to have at least two senators; but by 1900 any relation that the districts might once have had to population had disappeared. The system of representation had sometimes put in power a political party representing a minority of the voters: in 1878, 1884, 1886, 1888 and 1890 the Democratic candidates for State executive offices received a plurality vote; but, as a majority was not obtained, these elections were referred to the general assembly, and the Republican Party, in control of the lower house, secured the election of its candidates; in 1901 constitutional amendments were adopted making a plurality vote sufficient for election, increasing the number of senatorial districts, and stipulating that "in forming them regard shall be had" to population.

The question of calling a constitutional convention, for which the present constitution makes no provision, was submitted to the people in 1901 and was carried. But the act providing for the convention had stipulated that the delegates thereto should be chosen on the basis of township representation instead of population. The small townships thus secured practical control of the convention, and no radical changes were made. A compromise amendment submitted by the convention, providing for two representatives for each township or 2,000 inhabitants, and one more for each 5,000 above 50,000, satisfied neither side, and when submitted to a popular vote, on June 16, 1902, was overwhelmingly defeated. The state added several amendments to its constitution, notably that of 1924 granting the governor power to veto specific sections of appropriation bills, but refused to ratify the national income tax, prohibition and proposed child labour amendments and only tardily endorsed woman's suffrage. A workmen's compensation law was adopted in 1914, but Connecticut's chief claim to rank among the more humane states rested upon her eleemosynary institutions. In 1931 the state broke another tradition by legalizing Sunday baseball. The financial crisis in 1933 forced a grant to the governor of extraordinary authority over the banks but failed to prompt an appropriation sufficient to match the desired federal allotment of $4,000,000 for relief. Discontent found expression in the election of a socialist mayor in Bridgeport and of several of that party to the legislature. Popular attention focused on the state's tercentenary in 1935. Despite a swing away from the New Deal in 1935 President Roosevelt carried Connecticut in the 1936 election, and again in that of 1940.

In 1937 the state administration was extensively reorganized by a series of legislative acts which increased the powers of the governor, centralized the administration, especially of the spending departments, placed the state civil service fully under a merit system, and provided for more effective handling of affairs in the interim between legislative sessions. In 1939 many improvements affecting the minor courts were enacted. In the decade of the '30s many important measures of social legislation were adopted, notably systems of unemployment compensation and old-age assistance. With the aid of federal funds the state conducted an extensive building program for the University of Connecticut and for humane institutions in the three years ending in 1940. Outstanding additions to the state's excellent system of highways were the Connecticut river bridge at Middletown (1938) and the Merritt parkway (1940) which is being continued by the Wilbur L. Cross highway which will complete the Connecticut section of a New York to Boston parkway route. The most notorious case of political corruption in the state's history—the Waterbury scandal—resulted in the most remarkable trial before the courts of Connecticut and ended in the sentencing of a group of offenders to long prison terms (1941).

Floods, particularly in the Connecticut river, attained record heights in March 1936 and wrought great damage as did the hurricane of Sept. 1938 which struck the eastern part of the state with terrific violence.

Beginning in 1940 the national program for military preparedness and for aid to Great Britain involved placing large contracts with Connecticut manufacturers, especially in such lines as machine tools, arms, ammunition and aeroplanes. As a result the state reached a new peak in employment and production.

Bibliography.—The "Acorn Club" has published a list of books printed in Connecticut between 1709 and 1800 (1904), and Alexander Johnston's *Connecticut* (1887) contains a bibliography of Connecticut's history up to 1887. Some of the recent histories are: E. B. Sanford, *A History of Connecticut* (1922); C. M. Andrews, *Connecticut's Place in Colonial History* (1924); G. L. Clark, *A History of Connecticut: Its People and Institutions* (1914); and N. G. Osborn, editor, *History of Connecticut in Monographic Form* (1925). Other recent works of value are: P. W. Bidwell, *Rural Economy in New England at the Beginning of the Nineteenth Century* (1916); R. J. Purcell, *Connecticut in Transition* (1918); and C. M. Douglas, *The Government of the State of Connecticut*, revised and rewritten by L. S. Mills (1917). Works dealing with colonial and early history are: *Connecticut as a Colony and as a State* (1904), which is written from secondary sources, as also is G. H. Hollister's *History of Connecticut* (1857); Alexander Johnston, *Connecticut*, a well-written work but presenting theories regarding the relationship between the townships and the state not generally accepted by historical scholars; B. Trumbull, *A Complete History of Connecticut from 1630 to 1764* (1804–18); E. E. Atwater, *History of the Colony of New Haven* (1881); and the monograph of C. H. Levermore, "The Republic of New Haven," and that of C. M. Andrews, "The River Towns of Connecticut," in *Johns Hopkins University Studies* (1886–89). There is a good chapter in H. L. Osgood's *History of the American Colonies in the Seventeenth Century* (1904). For the sources, see *Colonial Records of Connecticut* (Hartford, 1850–90); *The Records of the Colony and the Plantation of New Haven* (Hartford, 1857–58) and *Records of the State of Connecticut* (Hartford, 1894–95). *The Collections* (Hartford, 1860 *seqq.*) of the Connecticut Historical society contain valuable material, especially the papers of Gov. Joseph Talcott; and the *Papers* (New Haven, 1865 *seqq.*) of the New Haven Colony Historical society are extremely valuable for local history; but a vast number of documents relating to the colonial and state periods, now in the state library at Hartford, have never been published. For information concerning industries, agriculture, etc., *see* the *Sixteenth Census of the United States* and the *Census of Manufactures*, of 1937; for law and administration, consult the work of Douglas given above; the last two chapters on "The Constitution and Laws of Connecticut" in *New England States* (1897); "Town Rule in Connecticut" in *Political Science Quarterly;* B. Steiner's *History of Education in Connecticut* (1893); and the reports of the administrative boards and officials, especially those of the bureau of labour statistics, the board of education, the board of charities and the treasurer. The physical features of the state are treated in W. M. Davis's *Physical Geography of Southern New England* (1895) and the *Bulletins* of the State Geological and Natural History Survey commission. The following important works on Connecticut have appeared: J. M. Morse, *A Neglected Period of Connecticut's History, 1818–1850* (1933); Isabel M. Calder, *The New Haven Colony* (1934); C. M. Andrews, *Colonial Period of American History* (4 vol., 1934–39), of which the chapters relating to Connecticut are the best accounts now available for the topics covered; Florence S. M. Crofut, *Guide to the History and Historic Sites of Connecticut* (2 vol., 1937), containing accounts of all towns in the state and extensive bibliography; *Supplementary List* (1938) of more than 1,000 titles, prepared by A. C. Bates for the Acorn club; *Connecticut: A Guide to Its Roads, Lore and People* (American Guide Series, 1938); C. W. Burpee, *Story of Connecticut* (4 vol., 1939); Odell Shepard, *Connecticut Past and Present* (1939). The Committee on Historical Publications of the State Tercentenary commission issued a series of 60 pamphlets (1933–36), each a monograph on a topic in Connecticut history. *The Connecticut Guide* by E. L. Heermance (1935) is a convenient collection of information arranged for automobile trips to places of historic interest.

CONNECTICUT RIVER, a stream of the New England states, U.S.A. It rises in Connecticut lake in northern New Hampshire—several branches join in northeast Vermont, near the Canadian border, about 2,000 ft. above the sea—flows south, forming the boundary between Vermont and New Hampshire, crosses Massachusetts and Connecticut, and empties into Long Island sound. Its course is about 345 mi. and its drainage basin 11,085 sq.miles. The principal tributary is the Farmington, which rises in the Berkshire hills, in Massachusetts, and joins the Connecticut above Hartford. From its head to the Massachusetts border the banks are wooded, the bed narrow, the tributaries small and torrential, and the valley slopes cut sharply in crystalline rocks. In the 273 mi. of this upper portion of its course the average descent is 15 to 34 ft. a mile. In Massachusetts and Connecticut the river flows through a basin of weaker triassic shales and sandstones, and the valley consequently broadens out, making the finest agricultural region of large extent in New England.

Near Holyoke and at other points rugged hills of harder trap rock rise so high above the valley lowland that they are locally called mountains. The valley sides rise from the river channels by a series of steps or terraces noted for their perfection of form. They have been cut by the river in its work of removing the heavy deposits of gravel, sand and clay that were laid down in this lowland during the closing stages of the glacial period. In the course of this excavation of glacial deposits the river has here and there discovered buried spurs of rock over which the water now tumbles in rapids and falls. For example, 11 mi. above Hartford are the Enfield falls, where a descent of 31·8 ft. in low water (17·6 in highest water) is made in 5·25 miles. At Middletown (Conn.), the river turns abruptly southeast, leaving the belt of triassic rocks and again entering the area of crystalline rocks which border the lowland. Therefore, from near Middletown to the sea the valley again narrows. The river valley is a great manufacturing region, especially where there is a good water power derived from the stream, as at Wilder and Bellows Falls (Vt.), at Turner's Falls, and Holyoke (Mass.), and at Windsor Locks, Connecticut. Several huge power dams have been constructed for the purpose of developing commercial current.

From Hartford seaward the Connecticut is a tidal and navigable stream, with a 12 ft. channel at low water. The Connecticut, like the Hudson, is a migration route for birds going from the south to nest in Canada.

Bibliography.—See *Reports of Rivers and Harbors Committee* (U.S. House of Rep. 67 Cong. 2nd sess. 1922) and E. M. Bacon, *Connecticut River and the Valley of the Connecticut* (1906).

CONNECTING-ROD. A device to convert linear motion into circular motion, or vice versa, used in engines, pumps, compressors and machines. The connecting-rod is coupled to the piston-rod through the crosshead in steam-engines, air-compressors, pumps and the large gas and Diesel engines, but in other internal-combustion engines and in pneumatic and hydraulic engines it pivots directly in the piston. A crank and connecting-rod are employed to work slides in pressing, bending, stamping, forging, punching, shearing, sawing, slotting and shaping machines. The crank and connecting-rod were patented in 1780 by Pickard. This forced James Watt to devise the peculiar sun-and-planet motion for his beam-engines.

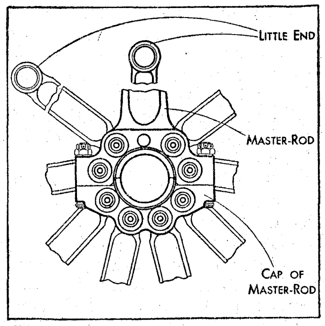


FIG. 1.—ARTICULATED ROD SYSTEM OF THE BRISTOL JUPITER RADIAL AERO-ENGINE, THE RODS OF WHICH ARE OF PRECISELY EQUAL WEIGHT

Various adjusting devices are fitted to connecting-rods to take up play in the *brasses* or *steps* as these wear down and cause knocking. In the majority of stationary engines the weight of a connecting-rod need not be considered as is necessary in the case of locomotives, motor cars and aero engines. It is, therefore, a solid circular or rectangular section. Fig. 2 shows a connecting-rod for a Galloway gas engine, of which the diameter near the forked end is 1 ft. 2 in.

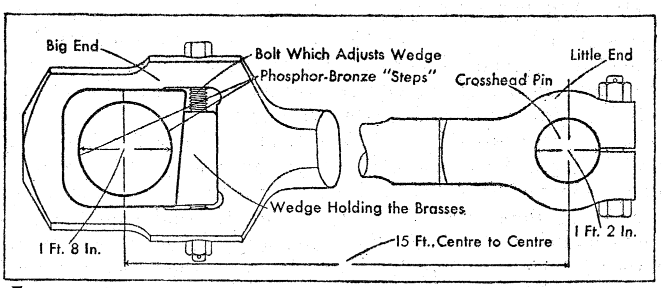


FIG. 2—CONNECTING-ROD FOR GALLOWAY GAS ENGINE, 15 FT. LONG; DIAMETER OF SMALLER END, NEAR THE FORK, BEING 1 FT. 2 IN.

Locomotive connecting-rods are either of rectangular cross-section or of girder or H-section, as are also those for car and aero engines. The articulated system, for V-engines and the radial engines, comprises a master-rod, and the other rods pivoted to its big end. This is seen in fig. 1, of a Bristol Jupiter radial outfit, with four articulated rods pivoted to the master rod, and four to its cap. Very light hollow pivot and gudgeon-pins are employed. All the rods are made of similar weights and the whole articulation is carefully hand polished so as to remove tool marks and scratches, which might possibly be the origin of fatigue cracks under the severe duties demanded.

CONNECTIVE TISSUES, in anatomy, the intercellular, supporting substances found in the tissues and organs of the animal body. They comprise the following types: areolar tissue, adipose tissue, reticular or lymphoid tissue, white fibrous tissue, elastic tissue, cartilage and bone. They are all developed from the same layer of embryonic cells and according to the nature of their work the ground substance varies in its texture, being fibrous in some, calcareous and rigid in others.

Areolar Tissue.—This is found in its most typical form uniting the skin to the deeper lying parts. It varies greatly in density according to the animal and the position of the body from which it is taken. A piece of the looser variety, microscopically, consists of bundles of fine white fibres (fig. 1) running in all directions and interlacing with one another to form a meshwork with intervening spaces. The bundles vary much in size, but the fibres of which they are composed are very uniform. A bundle may branch by sending fibres to unite with similar branches from neighbouring bundles, but the individual fibres neither branch nor fuse with one another. They are arranged parallel to one another, and in the bundles are bound together by a cement substance. The meshwork formed by these bundles is filled by a ground substance containing mucin. In this ground substance lie the cells of the tissue. In addition to the white fibres a second variety of fibres (yellow elastic fibres) is present in this tissue. They can be readily distinguished by their larger and variable size, by their more distinct outline, and by the fact that they, for the most part, run as straight lines through the preparation. Moreover they frequently branch, and the branches unite with those of neighbouring fibres. Several of these will be found torn across in any preparation especially at the edges, and the torn ends are curled up in a very characteristic manner. The two types of fibre further differ from one another both chemically and physically. Thus the white fibre swells up and dissolves in boiling water, yielding a solution of gelatin, whereas the yellow elastic fibre is quite insoluble under these conditions. The white fibres swell when treated with weak acetic acid, and are readily dissolved by peptic digestion but not by pancreatic. The yellow elastic fibres, on the other hand, are unaffected by acetic acid and resist the action of gastric juice for a long time, but are dissolved by pancreatic juice. Physically, the white fibres are inextensible and extraordinarily strong, being able, weight for weight, to carry a greater strain than steel wire. The yellow elastic fibres, on the other hand, are easily extensible and very elastic, but are far less strong than the white fibres.

Several types of cells are found in this tissue and may be classified as: (1) *Lamellar cells, i.e.,* flattened branching cells, usually attached to the bundles of white fibres or at the junction of two or more bundles. The branches commonly unite with similar branches of neighbouring cells. (2) *Plasma cells.* These have peculiar staining reactions, are small and, in the main, spherical. (3) *Granular cells:* spherical cells densely packed with granules which stain deeply with basic dyes. (4) *Leucocytes:* blood corpuscles which have left the capillaries. They vary in number and variety.

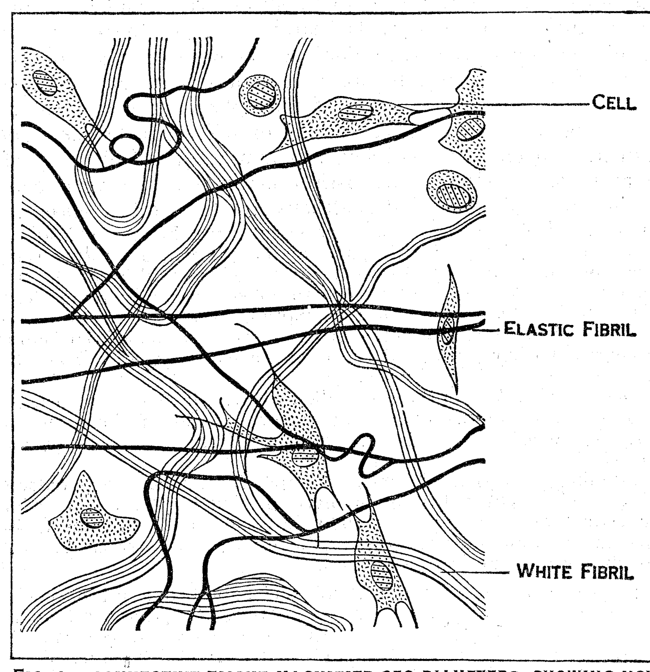


FIG. 1.—CONNECTIVE TISSUE MAGNIFIED 350 DIAMETERS, SHOWING HOW THE WHITE FIBRILS WHICH GIVE STRENGTH, AND THE ELASTIC FIBRILS, WHICH GIVE ELASTICITY, ARE DEVELOPED FROM CELLS OF THE KIND FOUND BETWEEN THE FIBRILS

Adipose or Fatty Tissue.—This is formed from areolar tissue by an accumulation of fat within certain of the cells of the tissue, especially the granular cells, though some regard fat cells as specific, and to be found in large numbers only in certain parts of the body. The fat is either taken in as such by the cell, or, more commonly is manufactured by the cell from other chemical material (carbohydrate chiefly) and deposited within it as small granules. As these accumulate they run together, and this process continuing, the cell at last becomes converted into a thin layer of living material surrounding a single large fat globule. The use of fatty tissue is as a storehouse of food. Hence, it is found where it will not interfere with the working of the tissues and organs, and in several positions as packing to fill up irregular spaces, *e.g.,* between the eyeball and the bony socket of the eye.

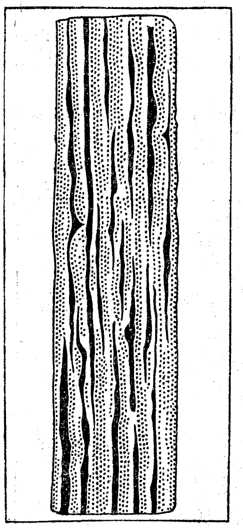


FIG. 2.—TENDON OF RAT'S TAIL STAINED WITH GOLD CHLORIDE, SHOWING INTERLACING BUNDLES OF WHITE FIBROUS TISSUE

Reticular Tissue.—Here, the reticulum of white fibres is built up of very fine strands leaving large interspaces in which the cells typical of the tissue are enclosed. The ground substance is reduced to a minimum. Many connective tissue and endothelial cells lie on the fibres which may in places be completely covered by them. Such a general scaffolding may be demonstrated in lymphatic glands, the spleen, liver and other cellular organs.

White Fibrous Tissue.—In this tissue the white fibres largely preponderate. It is found wherever great strength combined with flexibility is required and the fibres are arranged in the direction in which the stress has to be transmitted. The fibrous bundles may be parallel as in a tendon, or united to form a membrane. Such are the ligaments around the joints or the fasciae covering the muscles of the limbs, etc. In other positions, *e.g.* the *dura mater,* the fibrous bundles course in all directions, and form a very tough membrane. The cells of such tissues lie in the spaces between the bundles and are flattened in two or three directions where they are compressed by the oval fibrous bundles surrounding them (figs. 2 and 3). The cells thus lie in linear groups parallel to the bundles, presenting a characteristic appearance when examined under the microscope.

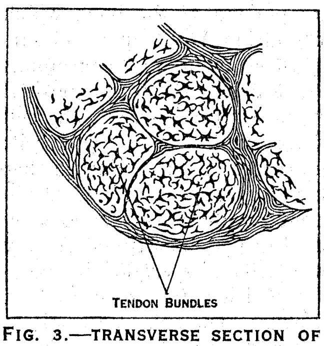


FIG. 3.—TRANSVERSE SECTION OF TENDON, SHOWING HOW THE BUNDLES OF WHITE FIBROUS TISSUE ARE BOUND TOGETHER BY CONNECTIVE TISSUE, THE STELLATE FORMS IN THE BUNDLES BEING TENDON OR CONNECTIVE TISSUE CELLS

Yellow Elastic Tissue.—This is mainly composed of elastic fibres. It is found where a continuous but varying stress has to be supported. In some positions the elastic tissue consists of branching fibres arranged parallel to one another and bound together by white fibres, *e.g., ligamentum nuchae* (fig. 4). In other cases it forms thin plates perforated in many directions and produces a fenestrated membrane. Such plates are arranged round the larger arteries forming a large proportion of the artery wall. All the connective tissues carry a small number of blood vessels and are supplied with lymphatics and nerves.

Cartilage.—Cartilage or gristle is a tough and dense tissue with a certain degree of flexibility and high elasticity. It is found where flexibility is required but a fixed shape must be retained, *e.g.* the trachea and the external ear or pinna. It is largely associated with the bones in the formation of the skeleton. The tissue consists of cells embedded in a solid matrix or ground substance. Three varieties are distinguished according to the nature of the matrix: hyaline, white fibro-cartilage and elastic cartilage. In the first the matrix is homogeneous, in the others the corresponding type of fibrous tissue is present.

Hyaline Cartilage (fig. 5).—In this variety the cells are rounded, have an oval nucleus and a granular, often vacuolated cell-body. Their number varies in different specimens, being, roughly, in inverse ratio to the age of the tissue. Cartilage grows by deposition of new matrix by the cartilage cells which thus become more and more separated from one other. They are often to be seen in groups of two, three or four cells, indicating the common origin of each group from a parent cell. Towards the surface of the cartilage they tend to become flattened in a direction parallel to the surface. Some of them near the surface of a piece of cartilage may be branched, appearing as a transition form between connective tissue corpuscles and typical cartilage cells. This is particularly the case at points where tendons or ligaments are attached. Lime salts are often deposited in the matrix of hyaline cartilage especially in old animals or in the deeper layers of articular cartilage where it is attached to bone. Such a deposit is well marked in the superficial parts of the skeleton of the cartilaginous fishes. In the development of vertebrata, the skeleton is first laid down as hyaline cartilage which is gradually removed, bone being deposited in its place. In the adult, hyaline cartilage is found at the ends of the long bones (articular cartilage), uniting the bony ribs to the sternum (costal cartilage), and forming the cartilages of the nose, trachea and bronchi, etc. All forms of cartilage are non-vascular so that the cells must obtain food and get rid of waste products by diffusion through the matrix.

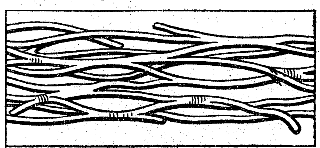


FIG. 4.—YELLOW ELASTIC FIBRES OF THE NUCHAL LIGAMENT, SHOWING THE BRANCHING AND INTERLACING CHARACTER, AND THE IRREGULARLY PLACED TRANSVERSE MARKINGS WHEN THE FIBRES HAVE BEEN TEASED OUT

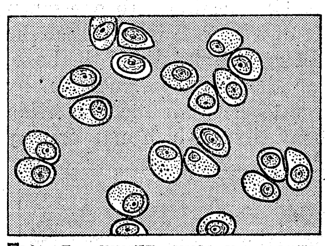


FIG. 5.—WHITE HYALINE CARTILAGE, A HOMOGENEOUS MATRIX INTERSPERSED WITH CARTILAGE CELLS WHOSE ARRANGEMENT SHOWS THEIR DEVELOPMENT BY DIVISION OF THE MOTHER CELL

White Fibro-Cartilage.—In this variety, white fibres ramify through the matrix (fig. 6). The cells lie separate and not in groups, and the amount of matrix between commonly is small. The white fibres may run in all directions or, chiefly, in one direction only. Owing to the presence of much fibrous tissue this variety of cartilage is tougher than hyaline cartilage and less flexible. It is found in places which have to withstand great compression but where a less rigid structure than bone is demanded. Thus it forms the intervertebral discs, the interarticular cartilages, or the edges of joint surfaces to deepen the surface.

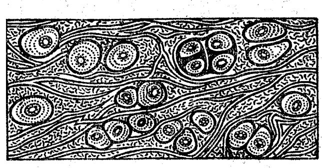


FIG. 6.—WHITE FIBRO-CARTILAGE
The matrix is permeated by numerous white fibres and contain large numbers of characteristic cartilage cells

Elastic Fibro-Cartilage.—In this variety the matrix is permeated by a complex and well-defined meshwork of elastic fibres (fig. 7). The size of the fibres varies much in different specimens. It is found in parts where flexibility and permanence of shape are requisite, as in the pinna of the ear, the epiglottis, etc.

Bone.—In bone, mineral salts are deposited in the intercellular matrix. If bone be incinerated so that the organic matter is burnt away, a residue is left which consists chiefly of calcium phosphate, and amounts to as much as two-thirds of the weight of the original bone. If, on the other hand, bone be macerated in hydrochloric or nitric acid the calcium phosphate is dissolved, leaving the organic matter practically unaffected and still showing the microscopic structure of bone. Hence it follows that the organic matrix is uniformly impregnated with the calcium salts. According to its naked-eye appearance bone is distinguished as *compact* or *cancellated.* The former is dense like ivory and forms the outer surface of all bones. The whole of the shaft of a long bone is composed of this compact form. Cancellated bone has a spongy structure and contains large interspaces filled with a fatty tissue rich in blood vessels. This variety forms the interior of most bones, especially the heads of the long bones, the interior of the ribs, etc. The cavity of the shaft of a long bone is filled, as are the smaller cavities in cancellated bone, with bone marrow (*see* below).

The minute structure of bone may be seen in a piece of dried bone which has been ground down until sufficiently thin for microscopic purposes. In a thin transverse slice of a long bone are seen (fig. 8) a number of circular units bound into a compact whole by intervening material showing in the main the same structural details. Each of these units is an Haversian system. Centrally, there is a dark area, the Haversian canal, around which the bone matrix is deposited as concentric laminae. Between the laminae are the bone lacunae and spreading away from them in directions generally transverse to the laminae are fine branching lines—the canaliculi. All dark parts of the specimen are natural spaces filled with debris during preparation. In the living bone the Haversian canal contains an artery and vein, some capillaries, a flattened lymph space, fine medullated nerve fibres—the whole being supported in a fine fatty tissue. Each lacuna is filled with a cell (the bone corpuscle) and the canaliculi contain fine branching processes of these cells. On comparing such a section with one taken parallel to the long axis of the shaft of a bone it is seen that the Haversian canals run some distance along the length of the bone, and frequently unite with one another or communicate by obliquely coursing channels. The spaces between the Haversian systems are filled in with further bony tissue which may or may not be arranged in laminae. Cancellous bone only differs from compact bone in the arrangement of the bone tissue. This encloses a number of irregular, communicating spaces strengthened in places by parallel trabeculae that run in the direction in which the bone has to support its maximum strain. Usually the bone trabeculae are so fine that they do not contain Haversian systems, but they include bone corpuscles.

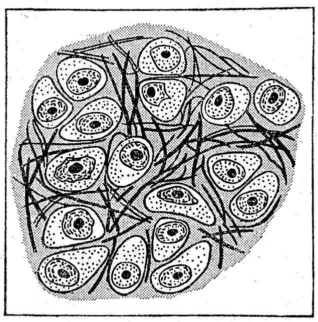


FIG. 7.—ELASTIC FIBRO-CARTILAGE, SHOWING NUMEROUS CARTILAGE CELLS AND ELASTIC FIBRES

SECTION OF BONE SHOWING FOUR HAVERSIAN SYSTEMS AND INTERLYING BONE MATERIAL THIS IS A DRY PREPARATION HENCE ALL THE CAVITIES (SUCH AS THE HAVERSIAN CANALS THE LACUNAE AND CANALICULI) BEING FILLED WITH DEBRIS FROM THE GRINDING APPEAR DARK

FIG. 8.—TRANSVERSE SECTION OF BONE SHOWING MINUTE STRUCTURE

Bone Marrow.—This fills the central cavity of tubular bones and the cavities of spongy bone tissue. It is largely composed of fat cells and is red or yellow in colour. Red marrow consists of fat cells lying in a tissue made up of large and small marrow cells and giant cells or myeloplaxes (fig. 9). The whole of these elements are supported in a delicate connective tissue. Some of the marrow cells are typical leucocytes and lymphocytes as found in circulating blood. Others (myelocytes) are larger than leucocytes, with round or oval nuclei, and a protoplasm containing small or large granules. These different types of cell probably develop into leucocytes. The giant cells are large spherical cells with several nuclei. In addition to fully developed red blood corpuscles there are also present numerous young nucleated red blood cells (erythroblasts or haematoblasts).

Development of Bone.—New bone is formed from a vascular fibrous membrane, either directly, or with interpolation of a cartilaginous stage. The development of bone from cartilage is the more complicated of the two because in it bone formation is taking place in two positions at the same time and in two rather different manners. Thus bone is being laid down from the outside by the fibrous membrane surrounding the cartilage, (perichondrium) and also within the substance of the cartilage (endochondral formation). Perichondral formation takes place somewhat earlier than endochondral, and in a long bone is first seen around the centre of the shaft, *i.e.* in that portion of the bone which forms the diaphysis. Here the perichondrium is vascular and carries on the surface next to the cartilage an almost continuous layer of cuboid cells, the *osteoblasts.* Calcium salts are deposited in the matrix of the immediately subjacent cartilage and the cell spaces of the cartilage increase in size while the cartilage cells shrink. Further growth of cartilage ceases in this region so that at one time the shaft of the cartilage may appear constricted in the middle. The formation of bone endochondrally is ushered in by the ingrowth of blood vessels from the perichondrium. A way through the calcified matrix of the cartilage is eroded by polynucleated giant cells, the *osteoclasts,* which apply themselves to the matrix and gradually dissolve it away. The enlarged cartilage spaces are thus opened to one another, and soon the only remnants of the matrix consist of irregular calcified trabeculae. In this way the primary marrow spaces are produced, the whole structure representing the future spongy portion of the bone. The next step in both perichondral and endochondral bone formation consists in the deposition of bone matrix by the osteoblasts. In the spongy portion they deposit a layer upon the surfaces of the calcified cartilage matrix, and thus in newly formed bone we find a central framework of cartilage enclosed in a layer of bone (*see* fig. 10). In the perichondral formation the deposition is effected in the same manner but is not uniformly spread over the whole surface, trabeculae being formed. These become confluent at places, thus leaving spaces through which blood vessels and osteogenetic tissue pass to reach the interior of the bone. As the deposition of bone matrix proceeds, some of the osteoblasts become included within the matrix, and ceasing to form fresh matrix become bone corpuscles. Increase in thickness of the new bone

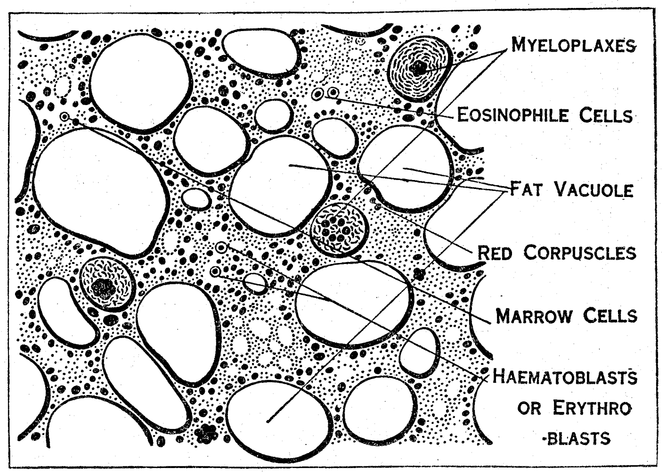


FIG. 9.—SECTION OF BONE MARROW TO SHOW THE COMPOSITION OF THE MAIN FACTORY OF CELLS OCCURRING IN THE BLOOD

is effected by the deposition of fresh matrix followed again by the inclusion of further osteoblasts. The spaces within the trabeculae become in this way gradually narrowed by the deposition of matrix until at last a centre is left only large enough to contain the blood vessels and their accompanying nerves, lymphatics and a small number of osteoblasts. Bone formation then ceases. In this manner the Haversian systems are produced.

Growth of the bone proceeds by deposition of more matrix on the exterior, but absorption is also taking place. This is most typically seen within the spongy portion. The absorption of the trabeculae is effected by the osteoblasts. These become applied to the trabeculae and gradually eat their way into the matrix thus coming to lie within lacunae. They possess the power of dissolving both bone and cartilage matrix. Side by side with this solution process we may often see new formation taking place by the activity of the osteoblasts (fig. 10). In this manner the whole framework of the bone may be gradually replaced. The process is most active in embryos and very young animals, but also continues during the whole life of an animal, thus effecting alterations in shape and structure of the whole bone. Growth in the length of a bone is effected by formation of new bone at either end of the shaft. After the ossification centre has been formed in the shaft (diaphysis) of the bone subsidiary centres make their appearance in the heads of the bones. These form, by a similar process of bone formation, fresh bone masses which, however, are not continuous with the bone tissue of the shaft. They form the epiphyses. They are attached to the diaphysis by an intermediate piece of cartilage, and it is by a process of growth of this cartilage and its subsequent replacement by bone that growth in length of the whole bone is effected (fig. 10). This piece of intervening cartilage can be easily seen in a young bone and persists as long as the bone can increase in length. Thus in man the last junction of epiphysis to diaphysis may not take place until the 28th year.

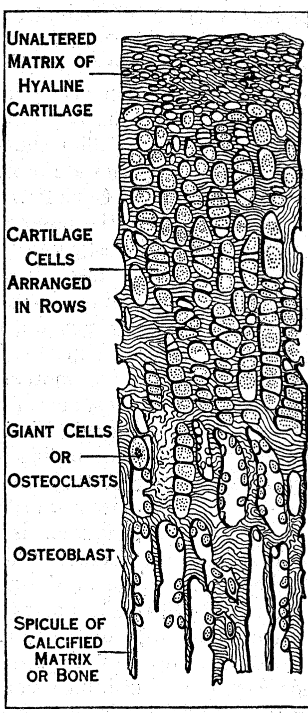


FIG. 10.—BONE DEVELOPMENT FROM CARTILAGE

Development of bone in membrane shows a course in all respects very similar to perichondral bone formation. A layer of osteogenetic tissue makes its appearance in the membrane from which the bone is to be formed. In this tissue a number of stiff fibres are deposited which soon become covered and impregnated with calcium salts. Around these bundles of fibres numbers of osteoblasts are deposited and by them bone matrix is deposited in irregular trabeculae. The bone increases by the deposition of fresh matrix just as in perichondral bone formation and Haversian systems are formed after precisely the same manner.

CONNELLITE, a rare mineral species, a hydrous copper chloro-sulphate, of very complex composition, crystallizing in the hexagonal system. It occurs as velvety tufts of delicate acicular crystals of a fine blue colour, and is associated with other copper minerals of secondary origin, such as cuprite and malachite.

CONNELLSVILLE, a city of Fayette county, Pa., U.S.A., on the Youghiogheny river, 60m. S.S.E. of Pittsburgh. It is on Federal highway 119, and is served by the Baltimore and Ohio, the Pennsylvania, the Pittsburgh and Lake Erie and the Western Maryland railways. Population, 1930 was 13,290; in 1940 it was 13,608. The city is the centre of the Connellsville coal-field which is famous for the coking qualities of its coal. The production of the entire district has ranged from 6 to 18 million tons of coke (one-sixth to one-third of the entire output of the country); before the development of the by-product process it sometimes amounted to 50% of the total. The city also manufactures coking and mining machinery, mine pumps, safes, iron, electrical steel, fire glass, paving brick, flour, lumber, candy and other products. Connellsville was settled in 1770 and was laid out in 1793 by Zachariah Connell.

CONNEMARA, a district in the west of Co. Galway, Eire. (*See* GALWAY.)

CONNERSVILLE, a city of Indiana, U.S.A., on the west fork of Whitewater river, 59 mi. E.S. of Indianapolis; the county seat of Fayette county. It is served by the Baltimore and Ohio, New York Central and the Nickel Plate railways, buses and nine commercial truck lines. Population (1940) was 12,898. Connersville is a manufacturing city set in a good farming community notable for production of corn and hogs. Products include positive rotary blowers, centrifugal blowers, gas meters, gas exhausters, automobile engine parts, delivery trucks, cabinets for electrical refrigeration, automobile and cabinet hardware, steel kitchen sinks and cabinets, bottle coolers, caskets, casket hardware, commercial rug cleaning equipment, flour, aeroplane parts.

Connersville was named after John Conner, frontiersman and Indian trader, reared by the Indians, who in 1813 laid out the town. It received a city charter in 1869.

CONNING TOWER: *see* SUBMARINE.

CONNOLLY, JAMES (1870–1916), Irish Socialist, was born in Clones, Co. Monaghan, Ulster, on June 5, 1870. He was the first effective propagandist of Socialism in Ireland, but did not come into prominence until 1913 when, in collaboration with James Larkin, he directed the six-months' strike of 20,000 Dublin transport and other workers against the combination of employers headed by William Murphy. Though the strike failed, it left behind an immensely increased semi-revolutionary Labour movement and the drilled but not armed Citizen Army. During the World War, Connolly decided Socialism could come in Ireland only after the Nationalist question was settled and the war stopped: for these reasons he joined with Sinn Fein and was commander-in-chief in the Easter week rebellion. He was executed by the British on May 12, 1916.

See Connolly's *Labour in Ireland* (1917), and D. Ryan, *James Connolly* (1924).

CONNOTATION, in logic, a term (largely due to J. S. Mill) sometimes equivalent to intension, which is used to describe the sum of the qualities regarded as belonging to any given thing, or, more usually, class of things, and suggested by the name by which it is known; thus the term "elephant" connotes the having a trunk, a certain shape of body, texture of skin, and so on. It is clear that as scientific knowledge advances the connotation or intension of terms increases, and, therefore, that the connotation of the same term may vary considerably according to the knowledge of the person who uses it. Again, if a limiting adjective is added to a noun (*e.g.*, African elephant), the connotation obviously increases. More usually the term connotation is now used for the conventionally fixed implication of a term, and is practically equivalent to definition. In all argument it is essential that the speakers should be in agreement as to the connotation of the words they use. General terms such as "socialism," "slavery," "liberty," and technical terms in philosophy and theology are frequently the cause of controversies which would not arise if the disputants were agreed as to the connotation of the terms. In addition *connotative* terms, as those which *denote* things and imply attributes, are opposed to *non-connotative,* which merely *denote* things, without implying attributes, or (in the case of abstract terms) which designate or name attributes, relationships, etc., instead of merely implying them, and which do not denote things.

See J. S. Mill *System of Logic,* 1874, etc.; J. N. Keynes, *Formal Logic,* 1906; H. W. B. Joseph *Introduction to Logic* (1916); A. Wolf *Essentials of Logic,* 1926, also articles EXTENSION, MEANING.

CONOID, in geometry, any surface traced by a conic section rotating round either of its axes. Hence there are more varieties of conoids than of conics. These include (1) the *ellipsoid,* which may be (*a*) a *prolate spheroid,* shaped like a lemon, formed when an ellipse rotates round its major axis, or (*b*) an *oblate spheroid*, shaped like an orange or the earth, formed when the rotation is round the minor axis; a special limiting case is (*c*) the *sphere*, formed when the ellipse becomes a circle, all diameters then being equal. Archimedes (287–212 B.C.) preferred the term *spheroid* to ellipsoid, as seen in his work on conoids and spheroids. (2) The *paraboloid* generated by a parabola rotating about its axis, rounded near the *vertex* but spreading out indefinitely more and more like a cylinder. All rays emerging from the focus would be reflected from the paraboloid, considered as a mirror, these rays being parallel to the axis, as one immense beam—whence the construction of such reflectors approximately paraboloidal. (3) The *hyperboloid*, either of one sheet (nappe), by rotation round the conjugate axis—funnel-like, spreading out from a narrow neck, asymptotic outside to the "asymptote-cone"; or of two symmetric congruent sheets, asymptotic inside to an "asymptote-cone," formed when rotation is round the transverse axis. (*See* ANALYTIC GEOMETRY; ELLIPSOID; PARABOLOID; HYPERBOLOID.)

The equations of the conoids are: $x^2+y^2+z^2=a^2$, for the sphere; $\frac{x^2}{a^2}+\frac{y^2+z^2}{b^2}=1$, for the prolate spheroid; $\frac{x^2+z^2}{a^2}+\frac{y^2}{b^2}=1$, oblate spheroid; $y^2+z^2=4px$, for the paraboloid; $\frac{x^2+z^2}{a^2}-\frac{y^2}{b^2}=1$, for the hyperboloid of one sheet; $\frac{x^2}{a^2}-\frac{y^2+z^2}{b^2}=1$, for the hyperboloid of two sheets. These "surfaces of rotation," or "revolutes," are only special cases of ellipsoid, paraboloid, hyperboloid (*q.v.*) as named in analytic geometry.

CONOLLY, JOHN (1794–1866), English physician, was born at Market Rasen, Lincolnshire, of an Irish family, on May 27, 1794. He graduated M.D. at Edinburgh in 1821, and in 1828, after practising at Lewes, Chichester and Stratford-on-Avon, was appointed professor of the practice of medicine at University college, London. In 1830 he published a work on the *Indications of Insanity*. In co-operation with Sir Charles Hastings and Sir John Forbes, he founded in 1832 the association which finally became the British Medical Association. In 1839 he was elected resident physician to the Middlesex County asylum at Hanwell, where he carried out on a large scale the principle of non-restraint in the treatment of the insane. The principle was ultimately accepted as fundamental despite continued and strong opposition. In 1844 he ceased to be resident physician at Hanwell, but remained visiting physician until 1852. He died on March 5, 1866, at Hanwell, where in the later part of his life he had a private asylum. His works include *Construction and Government of Lunatic Asylums* (1847); *The Treatment of the Insane without Mechanical Restraints* (1856); and an *Essay on Hamlet* (1863).

CONON, son of Timotheus, Athenian general. After having held several commands during the Peloponnesian War (*q.v.*), he was chosen as one of the ten generals who superseded Alcibiades in 406 B.C. He was defeated at sea and shut up in Mytilene. The Athenian victory at Arginusae (*q.v.*) rescued him (406), and as he had not been present at the battle, he was not tried with the other generals, and was allowed to retain his command. In 405, however, the Athenian fleet was defeated at Aegospotami, and Conon with difficulty escaped to Cyprus. On the outbreak of the war between Sparta and the Persians (400) he obtained from Artaxerxes joint command with Pharnabazus of a Persian fleet. In 394 he defeated the Lacedaemonians near Cnidus, and thus deprived them of the empire of the sea. He expelled the Lacedaemonian harmosts from most of the maritime towns of the Aegean, and restored the long walls and the fortifications of the Peiraeus. According to one account, he was put to death by Tiribazus, when on an embassy from Athens to the Persian court to counteract the intrigues of Sparta; but it seems more probable that he escaped to Cyprus and died there about 390.

See Xenophon, *Hellenica*, iv. 3. 8; Justin vi. 3; Cornelius Nepos, *Conon;* Lysias, *De bonis Aristophanis*, 41–44; Isocrates *Panegyricus* 41.

CONON, grammarian and mythographer, flourished at Rome in the time of Caesar and Augustus. He was the author of a collection of myths and legends, relating chiefly to the foundation of colonies. The work, dedicated to Archelaus Philopator, king of Cappadocia, contained 50 *Narratives;* an epitome, with brief criticisms, has been preserved in Photius (*cod.* 186). Nicolaus of Damascus is said to have made considerable use of the work (edition by U. Höfer, 1890).

CONON of Samos, Greek astronomer and geometer (3rd century B.C.), made astronomical observations in Italy and Sicily, but settled in Alexandria. He was the friend of Archimedes, who survived him. Conon is best known in connection with the *Kome Berenikes* (Hair of Berenice). Berenice, the wife of Ptolemy Euergetes, had in accordance with a vow dedicated her hair in the temple of Arsinoë of Zephyrium as an offering on the safe return of her husband from his Syrian expedition. It disappeared from the temple, and was declared by Conon to have been placed among the stars. Callimachus wrote a poem on the subject, of which only a few lines are preserved, but we possess the imitation of it by Catullus. Conon wrote on astronomy in seven books, and made a list of the observations of solar eclipses recorded in Egypt. He also investigated the question of the maximum number of points of intersection of two conics, and of a conic and a circle. (*See* Apollonius, *Conics*, Bk. iv., Pref.)

CONQUEST, in general, the subjugation of one belligerent force by another; in international law, the subjugation of one independent State by another, which may be followed by the acquisition by the conqueror of territory which admittedly belonged to the conquered. When this occurs the rights of conquest arise. These rights according to one view rest solely upon force; according to another they are governed by the principle of succession. Where the acquisition of territory is only partial, the title of the conqueror is usually confirmed by a treaty of peace. This may operate either expressly, by way of cession; or impliedly, by virtue of the principle of *uti possidetis*, whereby each belligerent retains possession of such territory as is under his control at the time of the termination of the war. In either case the title rests upon treaty rather than upon conquest alone. Where, however, the acquisition involves the whole of the territory, and there is no longer in existence any authority to cede, then the title of the conqueror rests upon conquest. But the conquest must be complete. There should be "firm possession" on the part of the conqueror, coupled with "intention," and "ability" to retain the acquired territory. The former will be manifested by some formal proclamation or declaration of annexation (*q.v.*). But proclamation will be premature unless the subjugation of the enemy is complete. The latter will be shown by the complete establishment of the authority of the conqueror indicated either by some formal act of surrender, such as the compact of Vereeniging of 1902, or by the cessation of substantial resistance. But the conquest will not be regarded as complete if the war is continued by a third Power in alliance with the particular State which is subjugated.

The rights and liabilities of the conqueror ought, according to modern opinion and practice, to be governed by the principle of succession subject to certain qualifications. Thus the conqueror succeeds to the rights and obligations of his predecessor in title, to the extent at any rate of the assets acquired. But he is not bound to recognize or to discharge the obligations incurred by his predecessor or by individuals for purposes of the war, nor by obligations arising out of tort, nor by the personal debts of the former head of the State. nor by obligations of a mixed public and private character.

Private rights, interests and property, to whomsoever belonging in the conquered territory are now generally understood not to be affected by conquest and annexation or cession. The municipal law relating to such rights, interests and property is not affected and remains in force until altered by the conqueror in the ordinary course of legislation, subject however to any provisions of the new constitution. (H. H. L. B.)

CONRAD or KONRAD, a German masculine proper name, borne by four German kings and emperors (M.H. Ger. *Kuonrât*, "keen in counsel"). The last of the Hohenstaufen, Conrad the younger, duke of Swabia, is known by the diminutive form Conradin (*q.v.*).

CONRAD II. (*c.* 990–1039), Roman emperor, son of Henry, count of Spires, and a descendant of Emperor Otto the Great. He was a member of the Conradine house, counts of Franconia, and he founded the Salian or Franconian imperial dynasty. After a contest with a younger member of his family, and in the face of much opposition on the part of the Polish and Burgundian kings and the duke of Swabia, Conrad was finally crowned at Rome on March 26, 1027. He did much to establish the imperial authority in Italy (he had been crowned with the Iron Crown of Lombardy in 1026) and might have done more if he had not had to face continual revolts among the German princes. He was very successful in crushing these outbreaks, and he left Germany far stronger and greater in territory than he found it. He sought to establish the hereditary principle in Italy, and in a lesser degree in Germany, and to unite the two countries by marriage ties; his ecclesiastical policy was firm and autocratic, and he substituted Justinian's Code in Lombardy for the old Lombard laws. He died at Utrecht on June 4, 1039, and was buried in the cathedral he had begun to build at Spires.

See Wipo, *Gesta Chuonradi II imperatoris,* Herimann of Reichenau, *Chronicon, Annales Sangallenses majores, Annales Hildisheimenses,* all in the *Monumenta Germaniae historica. Scriptores* (Hanover and Berlin, 1826–92). An edition of Wipo, together with parts of the *Chronicon* and the *Annales Sangallenses,* edited by H. Bresslau, was published at Hanover in 1878.

H. Bresslau, *Jahrbücher des deutschen Reichs unter Konrad II* (Leipzig, 1879–84); H. Bresslau, *Die Kanzlei Kaiser Konrads II* (Berlin, 1869); W. Arndt, *Die Wahl Conrad II* (Göttingen, 1861); J. von Pflugk-Harttung, *Untersuchungen zur Geschichte Kaiser Konrads II* (Stuttgart, 1890); M. Pfenninger, *Die kirchliche Politik Kaiser Konrads II* (Halle, 1880); M. Pfenninger, *Kaiser Konrads II Beziehungen zu Aribo von Mainz Pilgrim von Köln, und Aribert von Mailand* (Breslau, 1891); O. Blümcke, *Burgund unter Rudolf III und der Heimfall der burgundischen Krone an Kaiser Konrad II* (Greifswald, 1869).

CONRAD I. (d. 918), German king, son of Conrad, count of Lahngau. When Louis the Child died, in 911, Conrad was chosen German king at Forchheim on Nov. 8, 911, owing to the efforts of Hatto I., archbishop of Mainz, and to the reputation he appears to have won in war and peace alike. He found the unity of Germany threatened by the Magyars and the Normans from without, and by the growing power of the stem-duchies from within. He failed to bring Lorraine into subjection, and was equally unsuccessful in his struggle with Henry, duke of Saxony, afterwards King Henry the Fowler. He died on Sept. 23, 918, and was buried at Fulda. He named his former enemy, Henry of Saxony, as his successor.

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CONRAD III. (1093–1152), German king, second son of Frederick I., duke of Swabia, and Agnes, daughter of the emperor Henry IV., was the first king of the Hohenstaufen family. His father died in 1105, and his mother married secondly Leopold III., margrave of Austria. In 1115 his uncle the emperor Henry V. appointed him duke of Franconia. In 1116, together with his elder brother Frederick II., duke of Swabia, he was left by Henry as regent of Germany, and when the emperor died in 1125 he became titular king of Burgundy, or Arles. In 1126 he took part in the war between his brother Frederick and the new king, Lothair the Saxon, and was chosen king in opposition to Lothair on Dec. 18, 1127. Hastening across the Alps he was crowned king of Italy at Monza in June 1128, and in spite of the papal ban was generally acknowledged in northern Italy. The rival popes, Innocent II. and Anacletus II., both declared against him; the Romans repudiated him; and after failing to seize the extensive possessions left by Matilda, marchioness of Tuscany, he returned to Germany in 1132. He continued the struggle against Lothair till Oct. 1135, when he submitted, was pardoned, and recovered his estates. In 1136 he accompanied the imperial forces to Italy in the capacity of standard-bearer, and sought to win the favour of Pope Innocent II.

In Dec. 1137 Lothair died, and some of the princes met at Coblenz and chose Conrad for a second time as German king on March 7, 1138, in presence of the papal legate. Crowned at Aix-la-Chapelle six days later, he was acknowledged at Bamberg by several of the South German princes; but his position could not be strong while Henry the Proud, the powerful duke of Bavaria and Saxony, refused his allegiance. Attempts at a peaceful settlement of this rivalry failed, and Henry was placed under the ban in July 1138, when war broke out in Bavaria and Saxony. The king was unable to make much headway, in spite of the death of Duke Henry, which occurred in Oct. 1139; and his half-brother Leopold IV., margrave of Austria, to whom Bavaria had been entrusted, was defeated by Henry's brother Welf, afterwards duke of Spoleto and margrave of Tuscany. Conrad captured the fortress of Weinsberg from Welf in Dec. 1140, and is said to have allowed the women to leave the town, each with as much of her property as she could carry on her back. To his surprise, so the story runs, each woman came out bearing on her back a husband, a father or brother who thus escaped the conquerors. Peace was made at Frankfort in May 1142, when Henry the Lion, son of Henry the Proud, was confirmed in the duchy of Saxony, while Bavaria was given to Conrad's stepbrother Henry Jasomirgott, margrave of Austria, who married Gertrude, the widow of Henry the Proud.

Affairs in Italy demanded the attention of the king, as Roger I., king of Sicily, had won considerable authority on the mainland and refused to recognize the German king, whose help Pope Lucius II. implored against the rebellious Romans. This state of affairs drove Conrad into alliance with the East Roman emperor, Manuel Comnenus, who in 1146 married his stepsister; but the condition of Germany prevented the contemplated campaign against Roger. The solitary success amid the general disorder in the empire was the expedition undertaken in 1142 by Conrad into Bohemia, where he restored his brother-in-law Ladislaus to this throne. An attempt, however, to perform the same service for another brother-in-law, also called Ladislaus, who had been driven from his Polish dukedom, ended in failure. Disorder was rampant in Saxony, Bavaria and Burgundy; and in 1146 war broke out between the Bavarians and the Hungarians. A term was placed to this condition of affairs by the preaching of Bernard of Clairvaux, and the consequent departure of many turbulent nobles on crusade. In Dec. 1146 the king himself took the cross, secured the election and coronation of his young son Henry as his successor, appointed Henry I., archbishop of Mainz, as his guardian, and set out for Palestine in the autumn of 1147. Marching with a large and splendid army through Hungary, he reached Asia Minor, where his forces were decimated by disease and by the sword. Stricken by illness, Conrad returned to Constantinople at Christmas 1147, but in March 1148 set out to rejoin his troops. Having shared in the fruitless attack on Damascus, he left Palestine in Sept. 1148 and passed the ensuing winter at Constantinople, where he made fresh plans for an attack on Roger of Sicily. He reached Italy by sea; but the news that Roger had allied himself with Louis VII., king of France, and his old opponent Welf of Bavaria, compelled him to return hastily to Germany. He was obliged to neglect repeated invitations from the Romans, who sent him a specially urgent letter in 1149, and consequently never received the imperial crown.

Conrad died on Feb. 15, 1152, at Bamberg, where he was buried. By his wife, Gertrude, daughter of Berenger, count of Sulzbach, he had two sons, the elder of whom, Henry, died in 1150. Passing over his younger son Frederick on account of his youth, he appointed as his successor his nephew Frederick III., duke of Swabia, afterwards the emperor Frederick I.

See Otto of Freising, "Chronicon," in the *Monumenta Germaniae historica. Scriptores,* Band xx. (Hanover and Berlin, 1826–92). The best modern authorities are O. von Heinemann, *Lothar der Sachse und Konrad III.* (Halle, 1869); W. von Giesebrecht, *Geschichte der deutschen Kaiserzeit,* Band iv. (Brunswick, 1877); L. von Ranke, *Weltgeschichte, achter Teil* (Leipzig, 1887–88); W. Bernhardi, *Konrad III.* (Leipzig, 1883); J. Jastrow, *Deutsche Geschichte im Zeitalter der Hohenstaufen* (Berlin, 1893).

CONRAD IV. (1228–1254), German king, son of the emperor Frederick II. and Isabella of Brienne, was born at Andria in Apulia on April 26, 1228. In 1235 he was made duke of Swabia and in 1237 was chosen king of the Romans, or German king, at Vienna, in place of his half-brother Henry, an election which was subsequently confirmed by the diet at Spires. In 1240 he called an assembly to Eger, where many of the princes declared openly against the pope, and was soon in arms against Siegfried, archbishop of Mainz, the leader of the papal party in Germany. Although defeated near Frankfürt in Aug. 1246 by the anti-king, Henry Raspe, landgrave of Thuringia, he obtained help from the towns and from his father-in-law, Otto II., duke of Bavaria, and drove Henry Raspe to Thuringia. He was carrying on the struggle against Henry Raspe's successor, William II., count of Holland, when the emperor died in Dec. 1250, and a few days later Conrad narrowly escaped assassination at Regensburg. He raised an army by pledging his Swabian estates and marched to Italy in 1251, where with the help of his illegitimate half-brother, Manfred, he overran Apulia and took Capua and Naples. He died at Lavello on May 21, 1254. He left a son named Conradin.

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CONRAD (d. 955), surnamed the "Red," duke of Lorraine, was a son of a Franconian count named Werner. He rendered valuable assistance to the German king Otto, afterwards the emperor Otto the Great, and in 944 was made duke of Lorraine. In 947 he married Otto's daughter Liutgard (d. 953), and afterwards took a prominent part in the struggle between Louis IV., king of France, and Hugh the Great, duke of Paris. He accompanied his father-in-law to Italy in 951, and when Otto returned to Germany in 952, Conrad remained behind as his representative, and signed a treaty with Berengar II., king of Italy, which brought about an estrangement between the German king and himself. He entered into alliance with his brother-in-law Ludolf, and taking up arms against Otto, seized the person of the king, afterwards resisting successfully an attack on Mainz. He then ravaged the lands of his enemies in Lorraine; treated with the Magyars for support, but submitted to Otto in June 954, when he was deprived of his duchy, though permitted to retain his hereditary possessions. He was killed on the Lechfeld on Aug. 10, 955, while fighting for Otto against the Magyars, and was buried at Worms. He left a son Otto, who was the grandfather of the emperor Conrad II.

See Widukind, "Res gestae Saxonicae," in the *Monumenta Germaniae historica. Scriptores,* Band iii. (Hanover and Berlin, 1826–92); W. von Giesebrecht, *Geschichte der deutschen Kaiserzeit* (Leipzig, 1881); R. Köpke and E. Dümmler, *Jahrbücher des deutschen Reichs unter Kaiser Otto I.* (Leipzig, 1876); K. Köstler, *Die Ungarnschlacht auf dem Lechfelde* (Augsburg, 1884).

CONRAD, JOSEPH (1857–1924), English novelist, was born on Dec. 6, 1857, in the Ukraine, of a Polish family of the name of Korzeniowski; his father, a man of letters, became involved in the Polish insurrection of 1863 and was banished to Vologda, whence he returned to Cracow before his death. In Cracow, the son, Joseph, passed his boyhood. He learned to speak and write French with fluency as a youth. His first acquaintance with English literature was made through Polish translations of Shakespeare and Dickens; later on Hugo's *Travailleurs de la mer* and the novels of Marryat and Fenimore Cooper—particularly Cooper's *The Pilot*—inspired him with romantic ideas of the seaman's life.

At the age of 17 he found his way to Marseilles, and for two years served in French ships in the Mediterranean and on the South American coast. With hardly a word of English speech at his command, he came to Lowestoft in 1878, qualified as able seaman on a coasting vessel, and in Aug. 1880 sailed as third mate to Sydney in the Clyde-built, Clyde-owned sailing ship "Loch Etive," commanded by a famous clipper captain, William Stuart of Peterhead. Four years later he had become a master in the British merchant service and a British subject, and for a number of years his calling sent him to many parts of the world and through a constant succession of adventures, all contributory to the cosmopolitan spirit and the range of incident in his subsequent stories.

"My first English reading was the *Standard* newspaper," he wrote to a friend as late as 1911; "and my first acquaintance by the ear with it was in the speech of fishermen, shipwrights and sailors of the East Coast. But in 1880 I had mastered the language sufficiently to pass the first examination for officers in the merchant service, including a *viva voce* of more than two hours. But 'mastered' is not the right word; I should have said 'acquired.' I've never opened an English grammar in my life."

A Sequence of Novels.—During a period of ill-health (the result of Congo fever), he started his first novel, *Almayer's Folly,* the writing of which engaged him, with frequent and protracted intermissions, from 1889 till 1894. Into its composition went many personal experiences of his own as first officer of a ship in which he had sailed between Singapore, Borneo, Celebes and Sumatra. When published in 1895 it was recognized, by acutely discerning readers, as a portent of something new in English fiction, the product of a rare temperament and of unusual experiences, expressed in a fastidious choice of phrase, in a studied cadence whenever that would carry an emotional effect, or best suggest half-lyrical moods evoked by natural scenes or moments of human crisis. His style in general had dignity, clarity and idiomatic vigour, with an elusive quality of charm which few readers probably suspected might be due to the writer being a foreigner, with at least three languages at his command wherefrom to choose and adapt the colours and harmonies of his verbal palette.

This first novel was enough to establish a small though devoted band of permanent Conradians, but neither it, nor its immediate successors—*An Outcast of the Islands* (1896), *The Nigger of the Narcissus* (1897), *Lord Jim* (1900), *Youth* (1902) and *Typhoon* (1903)—found any large body of the reading public to share the enthusiasm of the critics till many years after. Of *The Nigger of the Narcissus,* Conrad, in the year before he died, declared it was "the story by which as a creative artist I stand or fall; at any rate, no one else could have written it." It and *Youth* and *Typhoon* brought out hitherto unexploited aspects of life at sea with amazing effect, and gave ocean storms and the trials and endurance of the mariner an epic grandeur. The scene of *An Outcast of the Islands* and of *Lord Jim* was laid on the same coasts as *Almayer's Folly.*

Soon after his emergence as a writer, he gave up the sea, and went to live in Kent. But the public apathy regarding his work, and the stress of pecuniary cares paralysed his pen for a while; ever a slow writer, he began to find a whole day at the desk produced no more than a few sentences, and thoroughly disheartened, decided to go to sea again. Fortunately for himself and English letters, his efforts to get a command on a Clyde ship, four years after giving up the sea, failed. A modest Civil List pension was secured for him, and relinquished as soon as the sales of his books made his circumstances easier. Still in the prime of life, he wrought industriously and could yet call up reserves of zest, passion, poetic and romantic mood to vivify the recollections of his earlier strange experiences. In the following 25 years he produced a score of volumes of fiction; complete novels for the most part, others, collections of his short stories; as well as several volumes of his own reminiscent experiences.

Conrad's "first period" is generally classified as ending with *Nostromo* (1904), a tale of an imaginary state in South America, with its atmosphere created from an old book of South American travels. *The Mirror of the Sea* which followed, a blend of reminiscence, fable and reflection, may be looked upon as commentatory on a chapter closed.

The Second Period.—It was, in many respects, a new Conrad who produced in 1907 *The Secret Agent,* a fantastic tale of the anarchist and criminal underworld, which 15 years later, he dramatised. *Chance* (1914) first brought him a large public and adequate financial rewards. *Within the Tides* (1915)—a series of short tales—was followed by *Victory* (1915) (with the old Celebes and Java background), *The Arrow of Gold* (1919), *The Rescue* (1920) and *The Rover* (1923). For many of Conrad's earliest admirers those novels, though delightful, missed something of his first creative ecstasy, but by them he secured a great vogue for all his works in Britain and America, and on his death he was recognized and honoured on both sides of the Atlantic.

The Rover—an historical tale with its scene laid in the peninsula between Toulon and Hyères—was, in a sense, the residual product of a much greater Mediterranean story he had been brooding on since 1907, dealing with French intrigue at Napoleon's Elba period. This latter work, begun only in June 1920, was but half or two-thirds done when he died, and it was published in its fragmentary state in 1925, with the title of *Suspense.*

An Estimate.—Conrad, as has been said, brought to his first essays in English writing at least tri-lingual knowledge, and although he never contemplated writing in French, he found in the best French writers inspirational effects of balance, light and shade, a delight in words for their own sake, as well as more subtle psychological results arising from the indulgence of personal mood even at the cost of action, held momentarily in suspense. This French influence was rarely absent from his work, and wonderfully enriched it.

He came to the study and practice of English in his maturity, with an instinctive sense of verbal beauty, a respect for good technique, a cultivated mind and high ideals as an artist. In all his books is manifest a scrupulous avoidance of *cliché* either of thought or phrase, and a philosophy that forbade surrender to romantic sentimentalism on the one hand or "realistic" squalor on the other. It was his conviction that only through an unremitting care for the shape and ring of sentences, an approach could be made to plasticity, to colour, and the light of magic suggestiveness could be brought to play for an evanescent instant over the commonplace surface of words worn thin by ages of careless usage. "The sincere endeavour to accomplish that creative task, to go as far on the road as his strength will carry him, to be undeterred by falterings, weariness or reproach, was," he said, "the only justification of the worker in prose."

There was no deliberate ethical purpose in his books. "I suspect," he said, "that the aim of creation cannot be ethical at all. I would fondly believe that its object is purely spectacular—a spectacle for awe, love, adoration or hate, if you like, but in this view—never for despair. These visions, delicious or poignant, are a moral end in themselves." For the most renowned Russian novelists he had neither respect nor admiration, which perhaps is not to be wondered at in a Pole. Though he disliked the appellation of "romantic novelist" and preferred to be known as a "creative artist," he greatly vindicated romance in a period of "realistic" reaction. He died at Bishopsbourne, near Canterbury, on Aug. 3, 1924. A volume, *Last Essays,* was published in 1926.

See Ford Madox Ford, *Joseph Conrad* (1924); A. Symons, *Notes on Joseph Conrad: With some unpublished letters* (1926); G. Jean-Aubry, *Joseph Conrad, Life and Letters* (1927). (N. M.)

CONRADIN or **CONRAD THE YOUNGER** (1252–1268), king of Jerusalem and Sicily, son of the German king, Conrad IV., was born at Wolfstein, Bavaria, on March 25, 1252. Although he had been entrusted by his father to the guardianship of the Church, pope Innocent IV. sought to bestow the kingdom of Sicily on a foreign prince. Innocent's successor, Alexander IV., continued this policy, offered the Hohenstaufen lands in Germany to Alphonso X. king of Castile, and forbade Conradin's election as king of the Romans. Having assumed the title of king of Jerusalem and Sicily, Conradin took possession of the duchy of Swabia in 1262. Conradin's first invitation to Italy came from the Guelphs of Florence, by whom he was asked to take arms against Manfred, who had been crowned king of Sicily in 1258. This invitation was refused, but after Manfred's fall in 1266 envoys came again to Bavaria. Conradin crossed the Alps and issued a manifesto at Verona setting forth his claim on Sicily. His partisans both in the north and south of Italy took up arms; his envoy was received with enthusiasm in Rome; and the young king himself was welcomed at Pavia and Pisa. In Nov. 1267 he was excommunicated; but his fleet was victorious over that of Charles, duke of Anjou, who had taken possession of Sicily on Manfred's death; and in July 1268 he was himself greeted with immense enthusiasm at Rome. In Aug. 1268 he unsuccessfully encountered the troops of Charles at Tagliacozzo. He was seized at Astura and handed over to Charles. Tried as a traitor, he was beheaded with his friend Frederick of Baden, titular duke of Austria. With his death the Hohenstaufen race became extinct. In the great 14th century "Manesse" ms. (*c*) collection of mediaeval German lyrics, preserved at Heidelberg, there are two songs by Conradin, and his fate has formed the subject of several dramas.

See F. W. Schirrmacher, *Die letzten Hohenstaufen* (Göttingen, 1871); del Giudice, *Il Giudizio e la condanna di Corradino* (Naples, 1876); K. Hampe, *Geschichte Konradins von Hohenstaufen* (Berlin, 1893); E. Miller, *Konradin von Hohenstaufen* (Berlin, 1897).

CONRAD OF MARBURG (*c.* 1180–1233), German inquisitor, born probably at Marburg, and educated at the university of Bologna. It is not certain that he belonged to any order, although he has been claimed both by the Franciscans and the Dominicans. In 1214 he was commissioned by Innocent III. to arouse interest in the proposed crusade, and during his mission of reforming convents he came to occupy, in 1226, a position of influence at the court of Louis IV., landgrave of Thuringia. He became confessor to the landgrave's wife, St. Elizabeth of Hungary (*q.v.*), and exercised the landgrave's rights of clerical patronage during his absence on crusade. In 1227 he was employed by Pope Gregory IX. to extirpate heresy in Germany, to denounce the marriage of the clergy, and to visit the monasteries. In 1233 he accused Henry II., count of Sayn, of heresy. An assembly at Mainz of bishops and princes declared Henry innocent, but Conrad demanded that this sentence should be reversed. As he rode from Mainz he was murdered near Marburg, on July 30, 1233. His *Epistola ad papam de miraculis Sanctae Elisabethae* was published at Cologne in 1653. Conrad is known to English readers through Kingsley's *Saint's Tragedy,* in which he is a prominent character.

See E. L. T. Henke, *Konrad von Marburg* (Marburg, 1861); B. Kalter, *Konrad von Marburg und die Inquisition in Deutschland* (Prague, 1882); A. Hausrath, *Der Ketzermeister Konrad von Marburg* (Leipzig, 1883); Michael, *Gesch. des deutschen Volkes,* vol. ii. (Freiburg, 1899).

CONRAD OF WÜRZBURG (d. 1287), the chief German poet of the second half of the 13th century. By birth probably a native of Würzburg, he seems to have spent part of his life in Strasbourg and his later years in Basle, where he died on Aug. 31, 1287. Like his master, Gottfried of Strasbourg, Conrad did not belong to the nobility. His style is dignified in tone; his metre is clearly influenced by Gottfried's tendency to relieve the monotony of the epic-metre with ingenious variations, but it is always correct; his narratives—if we except *Die halbe Birn,* of which the authorship is doubtful—are free from coarseness, and, although mysticism and allegory bulk largely in his works, they were not allowed to usurp the place of poetry. Conrad's powers are to be seen to best advantage in his shorter verse romances, such as *Engelhart und Engeltrut, Kaiser Otto* and *Die Herzemaere;* the last mentioned is one of the best poems of its kind in Middle High German literature.

Bibliography.—There is no uniform edition of Conrad's works. *Der trojanische Krieg* was edited by A. von Keller for the Stuttgart *Literarische Verein* (1858); *Partenopier und Meliur,* by K. Bartsch (1871); *Die goldene Schmiede* and *Silvester,* by W. Grimm (1840 and 1841); *Alexius,* by H. F. Massmann (1843) and R. Henczynski (1898); *Der Welt Lohn,* by F. Roth (1843); *Engelhart und Engeltrut,* by M. Haupt (1844, 2nd ed., 1890); *Klage der Kunst,* by E. Joseph (1885). The shorter poems, *Otto* and *Herzemaere,* will be found most conveniently in *Erzählungen und Schwänke des Mittelalters,* edited by H. Lambel (2nd ed., 1883). Modern German translations of Conrad's most popular poems have been published by K. Pannier and H. Krüger in Reclam's *Universalbibliothek* (1879–91). On Conrad *see* F. Pfeiffer in *Germania,* iii. (1867), and W. Golther in the *Allgemeine deutsche Biographie,* vol. xliv. (1898), *s.v.* "Würzburg, Konrad von." Paul Genke has edited *Die Legenden* (Halle, 1925–27).

CONRAD VON HÖTZENDORF, FRANZ (1852–1925), Austro-Hungarian soldier, was born in Vienna Nov. 11, 1852. Conrad was the leading military figure of the old Dual Monarchy, and also one of its most influential politicians. In 1899, as a brigadier in Trieste, his observations on Italian Irredentist propaganda inspired him with a lasting mistrust of the third member of the Triple Alliance. Here he made the acquaintance of the heir to the throne, the Archduke Francis Ferdinand, whose ideas coincided with his own in many respects. Francis Ferdinand's influence elevated Conrad to the post of chief of staff in 1906. His predecessor, Gen. Beck, had held this post for some 20 years, in the course of which Beck, who shared the emperor Francis Joseph's optimism, had allowed the army to lag far behind modern progress, in technical matters and had paid little attention to the national problems.

Conrad at once began to reorganize the army, especially the artillery. His activities earned him the hatred not only of the German Liberals but also of the Slavs and the Magyars, all of whom, if for different reasons, were opposed to an aggressive army policy. His most serious conflict, however, came with the emperor himself and the minister of foreign affairs, Count Aehrenthal. Conrad was convinced that the Monarchy could not avoid a conflict with Serbia; and further that Italy must be considered not as an ally but an enemy. He believed the only salvation to be in aggressive "preventive" measures. Both before and after the annexation of Bosnia and Hercegovina he urged that the only solution of the Southern Slav question would be the "preventive" annexation of Serbia. When Italy became engaged in war with Turkey in 1911, he again advocated a "preventive" war against the Monarchy's ally. This last suggestion led to such a conflict of views with Aehrenthal, who believed that peace could be maintained, that Conrad was forced to resign. He was reappointed, however, a few months later, when events in the Balkans again grew critical. Conrad did not overestimate the strength of his army, and, therefore, when war broke out and the attitude of Italy and Rumania grew critical, he urged—vainly—that these former Allies be appeased by territorial concessions. Meanwhile he conducted the operations of the Austro-Hungarian troops in Galicia with skill and boldness, and later, when they entered the World War, also saved his country from much devastation by his bold strategy. When, however, the young emperor Charles himself took over the command of his army in place of the previous nominal commander, the Archduke Frederick, he took offence at Conrad's assured manner and dismissed him from his post. From March 1917 on Conrad commanded an army group on Austria's Italian Front. No further successes crowned his efforts, and finally the troops under his command disintegrated with the collapse of the Monarchy.

Conrad's political views aroused much controversy. From his own point of view—the maintenance at all costs of the dynastic power of the Habsburgs—they were undoubtedly correct; he took too little account however of the stronger but more remote influence of world politics. As a strategist he was bold and skilful but unlucky. As a personality he was simple and deeply respected; his chief failing was his often faulty judgment of human character. After the downfall of the Monarchy Conrad withdrew entirely into private life and occupied himself with the preparation of his monumental memoirs, *Aus Meiner Dienstzeit,* the fifth volume of which appeared in 1925. He died at Mergentheim Aug. 26, 1925.

(C. A. M.)

CONRADY, AUGUST (1864–1926), German orientalist, was born at Wiesbaden on April 28, 1864. In 1897 he was appointed a professor at the University of Leipzig, where he eventually became director of the school of oriental studies. He became an authority on Chinese languages and literature and on Indo-Chinese philology, the study of which he originated.

Among his works are *Eine indochinesische Kausativ-Denominativbildung* (1896); the section on "China" in J. von Pflugk-Harttung's *Weltgeschichte* (1910); *Die chinesischen Handschriftenkunde Sven Hedins in Lou-lan* (1920).

CONRART or **CONRARD, VALENTIN** (1603–1675), one of the founders of the French academy, was born in Paris of Calvinist parents. He was made councillor and secretary to the king; and in the year 1629 his house became the resort of men of letters. Cardinal Richelieu offered to give the society his protection, and in this way (1635) the French academy was created. Its first meetings were held in the house of Conrart, who was unanimously elected secretary, and discharged the duties of his post for 43 years, till his death on Sept. 23, 1675. The most important of Conrart's works is his *Mémoires sur l'histoire de son temps,* published by L. J. N. de Monmerqué in 1825.

See also R. Kerviler and Édouard de Barthélemy, *Conrart, sa vie et sa correspondance* (1881); C. B. Petitot, *Mémoires relatifs à l'histoire de France,* vol. xlviii.; and Sainte-Beuve, *Causeries du lundi* (July 19, 1858).

CONS, EMMA (1838–1912), English philanthropist, was born in London on March 4, 1838. Through an acquaintance with Miss Octavia Hill she became interested in social work, and in particular in housing questions. She became known for her work in connection with Morley College and the Royal Victoria Hall, Waterloo Road, which is generally known as the "Old Vic." Miss Cons, whose social work in Lambeth had shown her the difficulty of providing decent amusement at a cheap rate, obtained an interest in the Royal Victoria Hall in 1880. At one time a well-known theatre, it later degenerated into a disreputable haunt where only the lowest melodramas were played. It was then enlarged and improved, the sale of drink was forbidden, and programmes of music, drama and lectures were undertaken. In 1882 the wealthy manufacturer and philanthropist Samuel Morley began to take an interest in the Hall, and in 1884 joined the executive committee, contributing not only money but sympathy and practical business advice. The "Old Vic" attained high repute, and in 1889 concert performances of grand opera were started, a chorus being formed in 1896. Symphony concerts were given in 1905 and for several seasons. Emma Cons was elected to the first London County Council (1888) and was chosen an alderman, but retired owing to difficulties raised as to the right of women to sit. She died at Hever, Kent, on July 24, 1912.

Her sister, Ellen Cons (1840–1920), was also closely associated with many philanthropic schemes, and was one of the governors of the "Old Vic." She died in London on June 25, 1920.

CONSALVI, ERCOLE (1757–1824), Italian cardinal and statesman, was born at Rome on June 8, 1757. In 1776 he entered the Academia Ecclesiastica at Rome, in which Pope Pius VI. took a strong personal interest. This led to his being appointed in 1783 *camariere segreto* to the pope, then a domestic prelate, a member of the Congregation *del buon governo,* and, on the first vacancy, auditor of the Rota for Rome.

In 1798, when the French occupied Rome (dethroning the pope and dispersing the cardinals), Consalvi was imprisoned in the castle of St. Angelo, but on being deported to Naples he managed with difficulty to reach Pius VI., who had sought refuge in the Certosa of the Val d' Ema, and was present at his death-bed.

As secretary to the conclave of November 1799, Consalvi helped secure Cardinal Chiaramonti's election as Pius VII. (March 14, 1800). On Aug. 11, Consalvi was appointed cardinal-deacon and secretary of state, or prime minister, an appointment for which he was admirably fitted. He recognized the urgent need for reform in the system of papal government. He permitted laymen to hold certain public offices, under surveillance of prelates, organized a guard from the Roman nobility, decreed a plan for redeeming the base coinage, permitted the communes a certain municipal liberty, and promised the liquidation of the public debt. In the long debates between Rome and France about the Concordat, Consalvi took the leading part, and it was largely owing to his firmness and tact that the Concordat as ultimately signed was free from the objectionable clauses on which the first consul had at first insisted. Owing to continuous friction with Napoleon, Consalvi resigned in June 1807, and when in 1808 Gen. Miollis entered Rome, and the temporal power of the pope was formally abolished, he broke off all relations with the French. In 1809 he was at Paris, where he received from Napoleon an apology for the treatment he had received. With unbending dignity, however, he retained his antagonism; and shortly afterwards he was one of the 13 cardinals who refused to attend the emperor's marriage with Marie Louise. For this he was banished to Reims, and not released till some three years later, when Napoleon had extorted terms from the captive pope at Fontainebleau. Consalvi was soon after allowed to resume his functions under the restored pontificate.

In 1814 Consalvi was sent as papal plenipotentiary to the congress of Vienna. Here he obtained for the pope the restitution of the marches (Ancona, Treviso and Fermo) and legations (Bologna, Ferrara and Ravenna), but he failed to prevent Austria from annexing the possessions on the left bank of the Po and obtaining the right to garrison Ferrara and Comacchio. This led to his presenting at the close of the congress a formal *protestatio,* in which he denounced the failure of the Powers to do justice to the Church, and their refusal to re-establish that "centre of political unity," the Holy Roman empire.

Consalvi was now practically governor of Rome, and his rule, in times of singular difficulty and unrest, was characterized by wisdom and moderation. His foreign policy was guided by the traditional antagonism of the papacy to German domination in Italy, and by a desire to free the Holy See from the political entanglements of the age. Thus he resisted all Metternich's efforts to draw him into his "system," and stoutly maintained the doctrine of non-intervention against the majority of the Powers of the Continental alliance.

On the death of Pius VII. (Aug. 21, 1823), Consalvi retired to his villa of Porto d' Anzio; and, though he accepted from the new pope the honorary office of prefect of the college *De propaganda fide,* his political career was closed. He died on Jan. 24, 1824. He was a notable patron of the arts and sciences, music being his main passion. For the city of Rome he did much; ancient buildings were excavated and preserved by his direction; chairs of natural science and archaeology were founded in the university; and extensive purchases were made for the Vatican museum, which was augmented by the beautiful Braccio Nuovo.

See C. von Duerm, *Correspondance du Cardinal Consalvi avec le Prince C. de Metternich, 1815–23* (1899); I. Rinieri, *Correspondenza inedita dei Cardinali Consalvi e Pacca, 1814–15* (Turin, 1903); J. Crétineau-Joly, *Mémoires du Cardinal Consalvi,* 2 vols. (1864); J. L. Bartholdy, *Züge aus dem Leben des Cardinal Consalvi* (Stuttgart, 1824); Cardinal Wiseman, *The Last Four Popes* (1858); Ernest Daudet, *Le Cardinal Consalvi* (Paris, 1866); E. L. Fischer, *Cardinal Consalvi* (Mainz, 1899); F. Nielsen, *Hist. of the Papacy in the 19th Century* (2 vols., Eng. trans. by A. J. Mason, 1906).

CONSANGUINITY or **KINDRED,** in law, the connection or relation of persons descended from the same stock or common ancestor (*vinculum personarum ab eodem stipite descendentium*). This consanguinity is either lineal or collateral. Lineal consanguinity is that which subsists between persons of whom one is descended in a direct line from the other, while collateral relations descend from the same stock or ancestor, but do not descend the one from the other. Collateral kinsmen, then, are such as lineally spring from one and the same ancestor, who is the *stirps,* or root, as well as the *stipes,* trunk or common stock, whence these relations branch out. It will be seen that the modern idea of consanguinity is larger than that of *agnatio* in the civil law, which was limited to connection through males, and was modified by the ceremonies of adoption and emancipation, and also than that of *cognatio,* which did not go beyond the sixth generation, and was made the basis of Justinian's law of succession. The degrees of collateral consanguinity were differently reckoned in the civil and in the canon law. "The civil law reckons the number of descents between the persons on both sides from the common ancestor. The canon law counts the number of descents between the common ancestor and the two persons on one side only," and always on the side of the person who is more distant from the common ancestor. English law follows the canon law in beginning at the common ancestor and reckoning downwards. The question of consanguinity owes its great importance to the relationship it bears to the laws of marriage and inheritance. The laws of inheritance and descent are regulated in a great measure according to consanguinity, however much they may vary in different jurisdictions.

Apart from those countries which have made either the civil or the canon law the basis of reckoning degrees of consanguinity (and practically all civilized countries adopt one or other), it is impossible to describe any method or system, for they are as various as the countries and tribes. *See,* however, the article INDIAN LAW; and consult J. F. McLennan, *On Primitive Marriage* (1865); L. H. Morgan, *Systems of Consanguinity and Affinity of the Human Family* (1870); E. A. Westermarck, *History of Human Marriage* (2nd ed., 1894); E. Crawley, *The Mystic Rose* (1902); A. Lang and J. J. Atkinson, *Social Origins and Primal Law* (1903); E. B. Tylor, *Primitive Culture* (4th ed., 1903). *See* also AFFINITY; MARRIAGE; INHERITANCE; MATRIARCHY.

CONSCIENCE, HENDRIK (1812–1883), Flemish writer, of mixed French and Flemish parentage, was born at Antwerp on Dec. 3, 1812. His father, Pierre Conscience, from Besançon, had been *chef de timonerie* in the navy of Napoleon, and was appointed under-harbourmaster at Antwerp in 1811, when that city formed part of France. About 1826 he retired to that Kempen or Campine which Hendrik Conscience so often describes in his books—the desolate flat land that stretches between Antwerp and Venloo. At the age of 17 Hendrik left Kempen to be a tutor in Antwerp, and to prosecute his studies. He volunteered as a private in the new Belgian army at the revolution of 1830, and served in barracks at Venloo, and afterwards at Dendermonde, until 1837, when he retired with the grade of sergeant-major. Thrown in this way with Flemings of every class, the young man formed the idea of writing in the despised idiom of the country—an idiom which was then considered too vulgar to be spoken, much less written in, by educated Belgians. His poems, however, written while he was a soldier, were all in French. He received no pension when he was discharged, and going back idle to his father's house, he determined to write a Flemish book. A passage in Guicciardini fired his fancy, and straightway he wrote the wonderful series of sketches of the War of Dutch Independence entitled *In't Wonderjaar 1566* (Ghent, 1837).

His father thought it so vulgar to write a book in Flemish that he turned his son out of doors, and Hendrik started for Antwerp, with two francs and a bundle of clothes. An old schoolfellow gave him shelter, and soon various people, amongst them the painter Wappers, interested themselves in the young man. Wappers presented him to the king, who expressed a wish that the *Wonderjaar* should be added to the library of every Belgian school. It was under the patronage of Leopold I. that Conscience published his second work, *Fantasy,* in the same year, 1837. A small appointment in the provincial archives relieved him from want, and in 1838 he wrote the historical romance called *The Lion of Flanders,* which was followed by *How to become a Painter* (1843), *What a Mother can Suffer* (1843), *Siska van Roosemael* (1844), *Lambrecht Hensmans* (1847), *Jacob van Artevelde* (1849), and *The Conscript* (1850). It was long before the sale of his books, greatly praised but seldom bought, made him in any degree independent. His ideas, however, began to be generally accepted.

At a Flemish congress which met at Ghent so early as 1841, the writings of Conscience were mentioned as the seed of a really national literature. In 1845 was published his *History of Belgium,* but he was well advised to return to those exquisite pictures of Flemish home life which form his best work. He was now at the height of his genius, and *Blind Rosa* (1850), *Rikketikketak* (1851), *The Decayed Gentleman* (1851), and *The Miser* (1853) rank among the most important of the long list of his novels. These had an instant effect upon contemporary fiction, and Conscience had many imitators. In 1855 the earliest translations of his tales began to appear in English, French, German and Italian. In 1867 the sinecure of keeper of the Royal Belgian museums was created for him. He died in Antwerp on Sept. 10, 1883, and was awarded a public funeral.

The portraits of Conscience present to us a countenance rather French than Flemish in type, with long smooth hair, contemplative dark eyes under heavy brows, a pointed nose, and a humorous broad mouth; in late life he wore the ornament of a long white beard. In spite of too rhetorical a use of soliloquizing, and of a key of sentiment often pitched too high for modern taste, the stories of Conscience are animated by a real spirit of genius, mildly lustrous, perhaps, rather than startlingly brilliant. Whatever glories may be in store for the literature of Flanders, Conscience is always sure of a distinguished place as its forerunner and its earliest classic.

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CONSCIENCE, a philosophical term used both popularly and technically in many different senses for that mental faculty which decides between right and wrong. In popular usage "conscience" is generally understood to give intuitively authoritative decisions as regards the moral quality of single actions; this usage implicitly assumes that every action has an objective or intrinsic goodness or badness, which "conscience" may be said to discern much in the same way as the eye sees or the ear hears. Moralists generally, however, are agreed that in all moral judgments of this character there is an implied reference to moral laws, the validity of which is in some ethical systems the true subject-matter of conscience. The part played by conscience in relation to general moral laws and particular cases will vary according to the view taken of the character of the general laws. If, on what is called the "jural" theory, these laws are regarded as deriving their authority from an external source, the operation of conscience is so far limited. It may be held to recognize the validity of divine laws, for example; or it may be confined to the deductive process of applying those laws to particular cases, known as "cases of conscience" (*see* CASUISTRY). If, on the other hand, the general laws are regarded as intuitive, then the discernment of them may be taken as the true function of conscience. In either theory, conscience may be understood as the active principle in the soul which, in face of two alternatives, tells a man that he ought to select the one which is in conformity with the moral law. Apart from the two functions of discerning between right and wrong, and actively predisposing the agent to moral action, conscience has further a retrospective action whereby remorse falls upon the man who recognizes that he has broken a moral law. *See* ETHICS; CHARACTER; also BUTLER, JOSEPH; and compare the "moral sense" doctrine of Shaftesbury.

There are certain special uses of the word "conscience." A *Conscience clause* is the term given to a special provision often inserted in an English act of parliament to enable persons having religious scruples to absent themselves from certain services or to abstain from certain duties, such as war service as a combatant, otherwise prescribed by the act. *Conscience money* is the name given to a payment voluntarily made by a person who has evaded his obligations, especially in respect of taxes and the like. This usage derives from the last function of conscience mentioned above. *Conscience Courts* were local courts, established by acts of parliament in London and various provincial towns, for the recovery of small debts, usually sums under £5. They were superseded by county courts (*q.v.*).

CONSCIENTIOUS OBJECTOR, one who on moral or religious grounds declines to serve as a combatant, or who refuses obedience to military service acts on the ground that the State has no right to force the individual to perform military service of any kind. In Great Britain the Military Service Act of 1916 raised the issue of the conscientious objectors on a large scale; tribunals were set up to deal with them, many were sent into non-combatant units or put to agricultural or other necessary work, while of the large numbers not granted exemption many suffered imprisonment for disobedience to army orders. The Representation of the People Act, 1918, disfranchised for five years after the war any conscientious objector who had refused to undertake the work of national importance allotted him.

The United States.—Conscientious objection among drafted men in the United States was of various sorts: objection to all wars on religious or humanitarian grounds; to the World War on economic and political grounds; to combatant service; to all service in the army or under military orders; to alternative service under conscription and for the avowed purpose of helping the war. This last class of objectors in the United States as in Great Britain were called absolutists.

The United States by reason of its geographical position had never found necessary the European system of universal military training and service. Save for a limited use of the draft in the latter part of the Civil War it had fought its wars with volunteers. This fact and the avowed intention of certain young men to imitate British conscientious objectors, early impressed the Government. In the conscription bill, exemption, but only from combatant service, was granted to members of recognized religious sects or organizations in existence at the time of the passage of the law, whose creed or principles opposed participation in war. The President found it necessary considerably to enlarge the measure of exemption for objectors. "Sincere" objectors were offered alternative service, in some cases with the Friends' Red Cross unit in France, more often in agricultural work. "Insincere" objectors and absolutists who refused all service were court martialled not as objectors but for refusal to obey some specific military order. The last objectors, 31 in number, were released in Nov. 1920. It should be explained that "sincere" objectors as interpreted meant objectors to all war; "insincere" objectors meant objectors to this particular war. In practice the distinction was hard to maintain.

The number of objectors was surprisingly small. According to the Government report, of 3,989 objectors in camps 1,300 "accepted or were assigned to non-combatant service," 1,299 were furloughed for alternative service, 450 were sent to prison by courts-martial and the remainder were still in camp when the Armistice was signed. (N. M. T.)

CONSCIOUSNESS in its widest sense denotes mental experience of every kind. In this sense of the term consciousness may be described as the subject matter of psychology (*q.v.*), and psychology might be defined as the science of consciousness. Very frequently, however, the term is used in the sense of self-consciousness, or of what is in the focus of consciousness, or at least in the margin of consciousness. It is then contrasted with the sub-conscious and the unconscious, etc. (*See* ABNORMAL PSYCHOLOGY, and PSYCHOANALYSIS.)

Physiology of Consciousness.—Physiologists and most psychologists assume that physical awareness is wholly dependent upon some definite bodily structure or structures. Various theories exist as to the identity of this bodily organ of consciousness. One theory holds that each atom of the physical body possesses an inherent attribute of consciousness. If each atom, or, in later forms of this theory, each cell of the body emanates its own consciousness, then the "self" must actually consist of an amalgamation of all these tiny units of awareness. Experimental evidence is against this theory, since physical consciousness seems to disappear from any part of the body disconnected from the central nervous system.

A second theory assumes that there exist, in the brain, special nerve cells capable of producing consciousness whenever activated. There is no physical evidence for the existence of such special consciousness cells.

A third theory seeks to identify consciousness with some aspect of the simple nerve impulse. There are two lines of evidence against this theory. First, the physical phenomena most closely corresponding with consciousness do not occur *within* individual nerve cells, but rather *between* the individual cells joined together in any reflex-arc system. Some of these phenomena are inhibition, irreversability of direction of propagated disturbances, fatigue, marked susceptibility to drugs, conflict and mutual facilitation of impulses, marked delay of reflex conduction, after discharge and summation of impulses. Second, identical nerve cells are activated in producing very dissimilar states of consciousness; and different nerve cells are stimulated to produce identical elements of consciousness.

The psychonic theory, based on the correspondences between consciousness and inter-neuronic phenomena, suggests that consciousness occurs each time any unit of junctional tissue between individual neurones is energized. Units of junctional tissue are termed *psychons,* and each *psychonic impulse* is regarded as a single unit of physical consciousness. This theory is now under experimental investigation.

See W. M. Marston, "The Psychonic Theory of Consciousness," *Journal of Abnormal and Social Psychology* (July 1926).

(W. M. M.)

CONSCRIPTION. Compulsion as applied to military recruitment should not be confused with conscription, which entails not only the natural obligation of every able-bodied man to defend his hearth, home and country against foreign aggression, but the establishment of a standing army of short service men entirely at the call of the government of the land. Whilst in all such military organizations as the Greek and Roman city militias and the

Saxon fyrd compulsion was by natural right and tradition, in most of the great modern armies it is by law, and in such as do not enforce conscription by the inducement of pay, or the avoidance of starvation. We thus obtain two main systems of recruitment, the compulsory and the voluntary; both are professional, the latter in that its men undergo a prolonged training, and the former in that its instructional cadre and its corps of officers are permanent, whilst the bulk of its men serve but for one, two, or three years. Conscription in its modern sense dates from the French Revolution, and was exactly adapted to the environment of its times, namely equality of service, liberty of popular opinion backed by force, and the fraternity of all classes of society; such were theoretically the governing ideals of this period. To understand its influence on the history of the 19th and 20th centuries, and to trace its future demands a brief survey of military development preceding the date of its initiation, namely 1798.

Early History of Military Development.—The principle that every able-bodied man should assist in the defence of the community to which he belongs held good in fact as long as agricultural instruments could be effectively used as military weapons, though naturally weapons of the chase—bow, spear and long knife—were preferred. It was the manufacture of armour, a purely military invention, which introduced the professional soldier, and since that early date, lost in the dawn of human history, each purely military invention has had a marked influence on the militarization of civil life. If the invention was costly, or difficult to come by, armies became small and aristocratic, as was the case during the middle ages when armour was of predominant military importance; if cheap and easy, then large and democratic, as after the advent of gunpowder. When trade began to become more profitable than plunder, that is after the crusades, occupations began to become specialized, wealth was accumulated and fortifications became a necessary safeguard to wealth, trade and commerce. Fortifications demanded permanent garrisons, and as it was uncongenial and beneath the dignity of a military aristocracy, or a rich burgher community, to man and protect castle or city walls, hired soldiery came into existence, and in time specialized into two classes: the defenders and attackers of fortresses. It is in these troops, rather than in the feudal levy, that the origin of present day standing armies must be sought. As fire arms were introduced, organization and training became more complicated, and in the 16th century we find Machiavelli and Maurice of Nassau suggesting the idea of universal service. At this period it was reckoned that 5,000 disciplined Spanish troops were more than a match for four times their number of Burghers, but except for Spain, enriched by the gold and silver of the New World, nations were too poor to maintain large professional armies, and continued to depend on citizen militia forces and the hire of mercenaries.

With the close of the Wars of Religion in 1648, conflicts between nations centred more and more round dynastic questions, the object being territorial acquisition, and as such was useless without revenue and inhabitants to pay it, as Clausewitz says: "The principle of moderation was introduced into the conduct of hostilities altogether foreign to their nature." Plunder and pillage were forbidden, with the result that the profession of the soldier became less and less remunerative, and armies more and more dependent on the lower strata of society—those men who were lacking in spirit and intelligence, and unsuited to earn a livelihood in civil employment. Thus it happened that immediately preceding the outbreak of the French Revolution, except for a few *corps d'elites,* the human quality of all armies throughout Europe "reached the very nadir of degradation." It was time for something new.

The Birth of Conscription.—The general upheaval which followed the outbreak of the Revolution in 1789 swept away the old royal army of France, and simultaneously initiated the problem of national defence. The theory of equality logically led to the demand for universal service, and as the majority of the people are naturally adverse to risking their skins, universal service was tantamount to compulsory enlistment. The proposal accepted was a threefold one, namely, voluntary enlistment for the line, all unmarried citizens between 18 and 40 years of age to constitute the militia, and the rest of the male population to form the National Guards for home defence. The last mentioned category proved popular, and 2,571,000 names were inscribed, but only 60 out of the 169 battalions of volunteers it was hoped to raise were obtained. The result was so disappointing that on July 11, 1792 a decree was passed according to which every able-bodied man was to consider himself liable for active service, it being left to the communes to select those who were to proceed to the front. The means of enforcing this law were so imperfect that not more than 30,000 men reached the field armies, and only remained with them for a few months. To fill the ever increasing gaps in the ranks, on Feb. 20, 1793 the Convention decreed a compulsory levy of 500,000 men, which was so unpopular that thousands deserted their homes, and Vendée rose in revolt. At length in August Carnot succeeded in introducing a workable scheme which limited liability to service to men between 18 and 25. This was accepted by the people, because the class called upon was not politically strong enough to resist coercion, and by Jan. 1, 1794 no less than 770,000 men were under arms.

The successes of Bonaparte in Italy, which brought wealth and glory to France, as well as the consolidation of political power and the revival of trade, brought to the notice of political economists the loss of productive energy in compelling highly skilled civil workers to enlist whilst those in the ranks were willing to renew their contract. This consideration coupled with the fact that by the summer of 1798 a renewal of the war with Austria was inevitable, General Jourdan proposed a system of conscription which became law on the 19th Fructidor (Sept. 4) that year. "The young men in each Department were to be registered in five classes, the first consisting of those between twenty and twenty-one, and so on in an ascending scale of age to the last class, those between twenty-four and twenty-five. The conscripts each year were to be drawn from the first class, each subsequent class to be called out only in case the first did not furnish a sufficient number." Such were the main clauses of this law which not only rendered the Napoleonic conquests possible, but which were destined to influence the subsequent course of European history in a manner quite unrealized by its initiators.

Conscription Under Napoleon.—Though under the Directory this law proved worse than a failure, only 37,000 conscripts being obtained out of the required 200,000, when once Bonaparte seized the reins of power he forged out of it his tremendous armies. At Schönbrunn, in 1805, he said to Metternich: "I can use up 25,000 men a month"—such was the pivotal argument in his theory and practice of "absolute warfare"—the nation was but a vast manufactory of cannon-fodder. In 1800, France provided him with 30,000 men; 60,000 in 1801; 60,000 in 1802; 60,000 in 1803; 60,000 in 1804; 210,000 in 1805; 80,000 in 1806; 80,000 in 1807; 240,000 in 1808; 76,000 in 1809; 160,000 in 1810; 120,000 in 1811; 237,000 in 1812; and 1,140,000 in 1813—a total of 2,613,000. These figures are not only interesting in themselves, but are indicative of the whole course of European warfare, and its nature, from 1800 to the present day. The cheapness of the musket as a weapon coupled with the democratic spirit of the age threw nations back to the primitive idea of military power, namely, the nation in arms. The theory that "God marches with the biggest battalions" coloured the entire strategy and tactics of the wars of the 19th century, whether in Europe, Asia or America, and formed the crucial military problem of the Russo-Japanese war of 1904–05, and the World War of 1914–18. This theory sprang full-armed from out the head of the French Revolution, and it is of interest to trace its influence on the national life and military art of its greatest exponent during the last 130 years of its existence.

The Influence of Conscription on Prussia.—Napoleon's conquests brought with them the French law of conscription which was immediately enforced. Prussia pursued this idea to its logical conclusion, and in 1808 "definitely affirmed the principle of universal service without distinction of class, or right of exemption by purchase." After Tilsit her enthusiasm was checked by the Emperor, but only temporarily so, for she returned to it in full force once her adversary was crushed. From 1815 onwards, as one writer aptly expresses it: "Army expenditure became the fly-wheel which steadied her disorganized finance." The nationalization of the Prussian army not only stimulated trade, for it had to be fed, clothed and equipped, but consolidated the nation which, since the peace of Westphalia, had been groping in the dark toward the realization of Wallenstein's dream of a united Germanic Empire. Compulsory service brought all classes and ranks into close intercourse. The army became the national university in which was cultivated a common spirit. The better class recruits, consciously, or unconsciously, instructed their social inferiors, and in the exercise of these functions mutually added to each other's character and sympathies. The intelligence of the men reacted on their officers who were compelled to keep pace with the general intellectual movement. As the duration of service was limited to three years, the regimental officers had to become in every way instructors of their men, with the result that a magnificent corps of officers was created. During the 50 years following Napoleon's defeat at Waterloo, the Prussian military machine separated the wheat from the chaff, yearly turning out as it did an increasing number of men whose physical and moral training were vastly superior to the unconscripted man of the classes from whom they had sprung. This system of national reconstruction through universal service reached the apex of its perfection in the sixties and swept all before it in the victories of 1866 and 1870.

The Causes of Decline.—Perfection in war as in peace is the herald of death. Prussia's greatness grew out of Jourdan's law of conscription, and the results of this law reached their zenith at Sedan. Since 1870 a new social environment has been created which has vastly influenced the organisation of armies. First, the general introduction of compulsory education, has largely replaced the educative value of compulsory service. Secondly, the enormous advances in science and industrial production, with their consequents—luxury, wealth and intellectual pursuits—have changed the character of nations, and have replaced agriculture by manufacture as the key industry of civilised countries. Thirdly, a still more important consequent was and still is the change in the power and nature of weapons themselves.

From 1870 onwards the value of conscription, both as a national stimulant and a means of military recruitment, began to sag. The pay of the conscript was negligible, and, as luxuries increased, it had to be supplemented by small paternal and maternal allowances, unless the soldier was of the type who could cheerfully tolerate acute discomfort and the normal lack of art in military cooking. The best men refused to re-engage and returned to civil life, consequently inferior soldiers had to be promoted to non-commissioned rank, and when invested with authority frequently abused it; this tended by degrees to make conscription unpopular. Industrialization was at first followed by a vast increase in the population, and as years followed, more and more did it become impossible to absorb the ever-increasing numbers of men of military age. In all conscript armies this led to a host of exemptions, which though in theory strictly regulated, in practice resulted in many abuses, the richer classes of men of military age normally being able to avoid service, or if conscripted to carry out their duties on easier terms. In spite of these disabilities, which became apparent before the 19th century reached its close, all great nations, other than Great Britain and America, placed their faith in conscription, and still fervently believed with Napoleon and Clausewitz that God marches with the biggest battalions, and that, consequently, numbers of men are the deciding factor in war.

The World War of 1914–1918.—The World War of 1914–1918 was fought out on this assumption at terrific cost. Amongst the combatants conscription became universal, Great Britain and America being compelled to adopt it. In all some 50 millions of men were conscripted, and the total casualties in killed alone has been reckoned at more than 10 millions. What the war cost directly and indirectly it is impossible to calculate. Throughout its entire duration the Central Powers were outnumbered, yet it was only after over four years' incessant struggle that the Allies were able to enforce an armistice on Germany. The "big battalions" had grotesquely failed as an instrument whereby economical victory could be gained. There was no Sadowa and no Sedan, in place battles such as Verdun, the Somme and Ypres (1917) were fought to mutual destruction. As the war proceeded it became more and more apparent that, as in 1798, it was nothing less than a national, let alone military crime to conscript all classes of men as if they were one class and of equal value, and to fill the trenches, which were little more than altars of human sacrifice to a discredited god, with highly skilled mechanics, miners and professional men. Throughout the war it was scarcely realised by any of the General Staffs that the one great tactical problem was not to increase fighting man power, but as far as it was possible to eliminate the fighting man, the human slop-butt, and replace him by a mechanic. In spite of tank attacks, air attacks, naval attrition and chemical attacks, it was not realised that weapons give blows and men receive them, and that the main problem in tactics is how to give blows without receiving them, and not a mere mathematical question of human tonnage. It was not grasped that quality and not quantity was the problem, and so little was this realised that, in 1919, Germany was denied the power to maintain a conscript army, and was compelled to establish a voluntary one, that is to rely on quality, whilst her most powerful land enemy—France—adhered to bulk numbers.

The Future.—To those who can read the past and follow present tendencies, the future development of recruitment is clear and certain. Conscription is the military expression of an agricultural democracy, and when nations cease to depend on agriculture as their staple industry it rapidly becomes a burden. An industrial democracy lives in a totally different world. As military power was once based on the numbers of sturdy yeomen and peasants who could be impressed or enlisted, to-day it depends on the numbers of skilled mechanics, not only to manufacture war machines but to fight them. The advent of the motor-driven battle vehicle has reintroduced armour as an essential in tactical organisation. Another armoured age faces the great armies of the world, an age of costly machines in place of cheap muskets, and the tendency is, consequently, one towards small armies in which quality will replace the quantity theory of the present cannon fodder masses. None but industrial powers are likely to wage great wars with any hope of success, for in spite of all opposition, petrol-power is transforming armies as surely as steam-power transformed navies from 1860 onwards; the result must be the same. Whilst 100 years ago any merchantman could be converted into a warship at a few days' notice, to-day not all the merchantmen in the world could fight, on equal terms, a single Dreadnought.

The theory of conscription, as some military men believe, is growing out of date. In their opinion no conscript army will be able to face an organised attack by armed motor cars, let alone by tanks and kindred weapons. It will have its use solely as an army of occupation, a force of men which will occupy a conquered area but not conquer it. The fighting armies of the future will be voluntary, highly professional and highly paid, consequently, comparatively small; this is the whole tendency of present day military evolution.

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THE UNITED STATES

Revolution and War of 1812.—During the Revolution and the War of 1812 the volunteer system failed to procure the men required for military purposes. To stimulate voluntary enlistments bounties, consisting of gifts of money, land, and clothing, were granted to recruits. Massachusetts and Virginia resorted to conscription in 1777. On February 6, 1778, two-thirds of the authorized Continental Army being unrecruited, Congress recommended that the other colonies follow the example set by Massachusetts and Virginia. Washington, himself, wrote to the president of the Continental Congress in 1778, "I believe our greatest and only aid will be derived from drafting, which I trust may be done by the United States." The aid extended by France averted the necessity for conscription. During the latter part of the War of 1812, when volunteers failed to fill the depleted ranks of the Army, Congress considered several methods of conscription, but peace prevented definite action.

Civil War.—The volunteer system which enthusiastically filled the Union ranks in 1861 practically collapsed in 1862 after the president had issued a call for 300,000 additional volunteers. In the summer of 1862, the States attempted conscription, but without success. The Federal Government was then forced to accept the necessity of a Federal draft, an obligation the Confederacy had already been driven to assume nearly one year before. On March 3, 1863, the Enrollment Act was passed, boldly declaring the liability to military service in the national forces of all males, except certain exempted persons, between the ages of 20 and 45. The law imposed upon the citizen a direct and personal obligation to the nation.

Unfortunately, the principle of universal liability of all citizens to perform military service was not carried to its logical conclusion; the law was weakened by provisions authorizing the payment of bounties and the hiring of substitutes. The calls for men were apportioned among the States. If not filled by volunteers before a certain date, the deficit had to be supplied by conscription. In order to avoid conscription, each State, and the subdivisions thereof, entered upon a race for volunteers. Larger and larger became the bounties. Wealthy communities reached into the poorer districts and bought up the necessary manpower. The result was inevitable. Riots broke out especially in New York city and order was restored only by the arrival of troops withdrawn from the front.

The Confederate conscription law was enacted in April, 1862. Its purpose was to insure the retention of the men already in the service as well as to obtain others. In its administration emerged the modern theory that the industrial organization behind the line was quite as important as the military organization. This theory was not successfully applied because the army officers by whom the act was administered lost sight of every consideration except the single one of procuring soldiers.

World War.—In 1917 the Administration decided to rely upon conscription for the recruitment of the army. In urging the passage of the bill, known as the Selective Service Act, the secretary of war stated "This is no time to tolerate uncertainty in the raising and the maintenance of the large numbers of men which the present emergency is likely to require nor uncertainty in the methods to be adopted for the establishment of an adequate efficient military service. The bill makes certain the raising and maintenance of the required forces with the utmost expedition. It establishes the principle that all arms-bearing citizens owe to the nation the duty of defending it. It selects only those who, by reason of their age and physical capacity, are best fitted to receive the training and withstand the actual hardship of campaign, and who, happily, can be taken with least disturbance of normal economic and industrial conditions." The law was unequivocal in its terms. It vested the president with plenary power of prescribing regulations which should strike a balance between industrial, agricultural, and economic need of the nation on the one hand and the military need on the other, and which should summon men for service in the place in which it should best suit the common good to call them. The regulations for the Administration of the law were written so as to avoid the mistakes made in the execution of conscription in the Civil War.

The governors of States, the mayors of cities, and the officials of counties were called upon to lend their aid in the accomplishment of registration which began on June 5, 1917. Over 10,000,000 men, between the ages of 21 and 30 years, were enrolled in a single day. Later the age limits were changed to 18 to 45 years, and the number enrolled was increased to 24,000,000. With the registration completed, it became necessary to provide a system of local selection boards and to prescribe their procedure in hearing and resolving claims for exemption. The life histories and the most intimate relations of the enrolled men were carefully examined and their future status fixed. Questionnaires, which elicited detailed information, and physical examinations formed the basis of classification. The available manpower was grouped into four classes in the inverse order of its industrial importance; a fifth group contained those exempted from all liability under the terms of the Selective Service Law. The first class constituted the reservoir of manpower, the drain of which for military duty would least disturb the domestic and economic life of the nation. The other classes contained the men whose domestic and industrial relations were such that their call to the colours should be deferred as long as the exigencies of the military situation would permit. In order to determine the order in which men were to be called to the colours, a great central lottery was established in Washington. 2,810,296 men were inducted into the service through selective service, while approximately 2,000,000 additional men, anticipating their call, voluntarily enlisted in the Army and Navy.

The task of selective service did not stop with the raising of armies; rather it became more intricate and more highly difficult. The classification scheme sorted out from the 24,000,000 registrants and placed in the Army those whose withdrawal from domestic and industrial connections would create the least disturbing effect upon the current of national life. But the remainder far outnumbered those who went to the fighting forces. The efforts of the residue, the deferred classes, which formed the great army behind the lines, had to be directed so that they could contribute most effectively to the fighting forces. How to mould this vast group of manpower, how to weave its energies into the general pattern of national effectiveness, attaining a maximum of war-time production and a minimum of peace-time disturbance—these were the problems, herculean in magnitude, yet susceptible of only the most delicate treatment, to which the selective service organization had to address itself. From the war-time standpoint, occupations may be roughly placed in three groups: (1) Those enterprises such as shipbuilding and the manufacture of munitions; (2) Those enterprises contributing to the general good, without which the normal life of the nation would be seriously affected and the continuance of which must be fostered to render a return to peace-time conditions easy; (3) The non-productive employments. The ultimate aim of the system was to eliminate useful manpower in the third group, to comb the second to the minimum consistent with the preservation of the framework of normality and to fill the first to the utmost possible limits. The whole scheme may be envisioned as an instantaneous destruction of the third group, a gradual compression of the second and a constant expansion of the first.

The Future.—The value of the conscription method over the volunteer method was so clearly demonstrated in the World War that there can never be a question as to the choice, provided large armies are required. The volunteer system always constitutes a serious drain upon essential war industries; large numbers of men whose energies may be of infinitely more value in the industrial world than on the battlefield will abandon their productive labours. The modern conscription method inventories the nation's manpower. By means of it, the most available men may be drawn at such times and in such numbers as required for use in the fighting forces with the least possible disturbance of the economic structure of the country.

In war, as in the industrial world, a modern machine, operated by a few men under favourable conditions, may be capable of greater execution than a much larger number of men unaided by the machine. However, war machines now have physical, tactical and strategical limitations which prevent universal use of them. Mechanical fighting elements of this kind must always manoeuvre above ground. A gun can always be found to destroy the heaviest armour. Immobilized, such elements are quite vulnerable. Replacement is slow and costly. Above all, they alone cannot hold conquered ground. This can be done only by men, usually in large numbers. A completely mechanized fighting force, therefore, has distinct limitations as to the terrain on which it can be employed and as to time and manner of its employment. It is essentially an element of offense. The use of modern war machines will not materially reduce the size of armies in future wars of great magnitude and conscription will be as necessary as it has been in the past. (E. H. Cr.; X.)

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CONSECRATION, the act by which a person or thing is separated from common use and permanently dedicated to the service of God. In the primitive forms of religion, natural objects, such as rivers and springs, rocks and trees, were often considered as consecrated because they were regarded as the haunts of gods or spirits. Other things were made holy by some ritual form of consecration, as in tabus and fetishes. In Graeco-Roman times, the augurs hallowed sites for the erection of temples which were then dedicated by the priests. The Vestal virgins were set apart by a ceremony of inauguration. In the Old Testament, Aaron and his sons were consecrated as priests by a special ritual and there was also a priestly consecration of the Levites (Num. iii) and of the Nazarites (Num. vi). Similarly, the Hebrews dedicated temples, altars, first fruits and other objects to the service of God.

In the Roman Catholic Church, consecration is distinguished from simple blessing by reason of its greater solemnity and its more permanent character. The highest form of consecration is that act during the celebration of Mass, when the bread and wine are changed into the body and blood of Jesus Christ, repeating what He Himself did at the Last Supper and what He bade the apostles perform in commemoration of Him. This consecration is known to theologians as transubstantiation, the changing of the substance of bread and wine into the substance of the body and blood of Christ, while the outward appearances of bread and wine remain as before.

Aside from transubstantiation in the Mass, consecration is either of a person, as a bishop, or of a place or thing, as a church or an altar. A feature of all consecrations is unction with blessed oil, though there is anointing in other ceremonies which are not regarded as consecrations; for example, in the rituals of baptism and of confirmation and in the ordination of priests. On the other hand, the ceremony for the solemn profession of virgins, in which no sacred oil is used, is officially designated as the blessing *and* consecration of virgins. Non-Catholic rites have retained the term consecration for a more solemn form of dedication, so the Book of Common Prayer has the ceremony for "The Consecration of Bishops" and the form for "The Consecration of a Church or Chapel."

The consecration of a Roman Catholic bishop centres about the laying-on of hands by the three officiating bishops and the placing of the book of the Gospels on the head and shoulders of the bishop-elect. There is an unction of the crown of his head and the palms of his hands. The pastoral staff is handed the new bishop, the episcopal ring is placed on his finger, and the book of the Gospels taken from his head and delivered to him. Then the newly consecrated bishop celebrates Mass together with the consecrating prelate, receiving Holy Communion both under the form of bread and under that of wine. Near the conclusion of the ceremony, the new bishop is invested with the episcopal mitre and the pontifical gloves and is solemnly enthroned.

The consecration of a Christian church may be said to be a development of the Jewish rite employed for the dedication of Solomon's temple. Under Roman Catholic law, no building may be regularly used for the celebration of Mass until it has been either solemnly consecrated or at least blessed. Blessing is a more simple ceremony, which though properly performed by a bishop, may also be done by a priest delegated for the purpose. The essential rite of consecration is the unction of twelve crosses on the interior walls of the church. Twelve stones surrounded the altar which Moses erected when he descended from Mount Sinai. (Ex. xxiv, 4). The preliminary ceremonies include the sprinkling of the outer walls of the building with holy water and of the interior walls with specially blessed water, to which salt, ashes and wine have been added. Ashes are strewn on the floor of the church and the alphabet, first in Greek and then in Latin, is traced by the officiant along two diagonal lines, which intersect in the middle of the nave. The altar, or altars, of the church are consecrated together with the building, though an altar may be the subject of consecration apart from that of the church. Relics of martyrs are enclosed in a cavity in the altar, after the cavity and its cover have been anointed with sacred oil. Previous to this ceremony, the altar is repeatedly sprinkled and signed with the specially blessed water mentioned above. After the relics have been enclosed in it, the altar is incensed many times by the bishop and then there is a continuous incensing by a priest who circles about the altar with a smoking censer until the conclusion of the function. The altar table is anointed several times at the four corners and in the centre, two varieties of blessed oil being used, and finally both oils are poured out and spread over the surface of the table. All these ceremonies are performed with the recitation of prayers and the chanting of psalms and anthems. The burning of wax crosses, together with incense, at the four corners and in the centre of the altar, is a spectacular rite, near the end of the ceremony, which concludes with a final unction of the altar, this time on the front and at the four places where the table is joined to its supports. A slightly condensed version of the same ritual is used when an altar stone, a more or less portable slab, often employed for Mass in place of a permanently erected altar, is consecrated.

Of all the paraphernalia set apart for public worship in the Catholic Church, only the chalice and paten, the cup and plate used at Mass, receive solemn consecration. The vestments and other appurtenances are merely blessed. The ceremony of the consecration of a chalice and paten consists of the unction of the upper surface of the plate and of the inside of the cup, to the accompaniment of appropriate prayers, and a final sprinkling with holy water.

In a more generic sense, consecration is used, outside of its technical, ecclesiastical significance, to designate any kind of solemn dedication from religious, patriotic or romantic motives.

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CONSEIL DE FAMILLE ("family council"), in France, an institution for the protection of the interests of minors. By the Code Civil (art. 407–410) it is composed of seven members; the local justice of the peace is the presiding officer. The other six members must be relations of the minor, chosen from the mother's and father's side of the family respectively (three on each side). Five members make a quorum. The council has power to appoint a guardian to the minor; to authorize marriage or oppose it; to audit the accounts and decide questions concerning the minor's estate. The French family council is founded on the Roman Law of Tutelage.

CONSEQUENS is the Latin form of "consequent," and means "that which follows." Its correlative term is "antecedent," that which precedes. In logic both terms are used with special reference to the hypothetical or conditional judgment or proposition. Such a proposition usually expresses a connection between a condition and a result. The condition is commonly expressed first, the consequent last. The general form is *If A, then C,* where *A* stands for the condition or *antecedent,* and *C* for the result or *consequent, e.g., If it rains the streets are wet; If a triangle is equilateral, then it is equiangular.* Now if a given hypothetical proposition is true, its consequent must be realized whenever its antecedent is. On the other hand, the consequent may in some cases be realized or brought about in other ways than that indicated by the antecedent. Streets, *e.g.,* may be sprinkled by water carts instead of by rain. It is therefore not legitimate to argue from the truth of the consequent (say, *the streets are wet*) to the truth of the antecedent (say, *it is, or has been, raining*). Such an inconclusive inference is known as the *Fallacy of consequens,* or simply *Consequens.*

CONSERVATIVE PARTY. In Great Britain, the name of the successors of the Tories (*see* WHIG AND TORY). J. W. Croker popularized the term in an article in the *Quarterly Review,* Jan. 1830, but the name had already been used by Canning at a city dinner as early as 1824, and Greville had written in his diary on March 14, 1829, "Herries told Hyde Villiers that their policy was conservative, that of the Whigs subversive." For some time it was only used sporadically, and many of the old Tory régime disliked it. The term "Tory" has, in fact, never quite fallen out of use, and has been commonly retained by many modern Conservatives who wish to emphasize that theirs is a constructive and positive policy of constitutional as opposed to radical reform, and not merely one of letting things remain simply "as they are." After the Reform act of 1832 associations known as "Constitutional" or "Conservative" multiplied throughout the country; and a "National Union of Conservative and Constitutional Associations" formed a confederation in 1867, in alliance with the work of the central Conservative office under the Party whips. It was, however, unlike the similar Liberal "National Liberal Federation," under the control of influential people who were loyal to the central office. In this respect the Conservative Party, as an internally loyal party, had some advantage in organization; and such independent outbreaks as that of the "Fourth Party" (in the Parliament of 1880), while stimulating to the central office, may be said to have applied a useful *massage* rather than to have led to any breaking of bones; while the Primrose League and any similar new bodies, acted as cooperating agencies. Gladstone's proposal of home rule for Ireland in 1886 resulted in a great accession of strength to the party, owing to the splitting off of the Liberal Unionists from the Liberal Party. From this time the term "Unionists" began to come into use, to signify both the Conservative and the Liberal Unionist Parties; and, as the distinction between the two wings gradually grew smaller, to signify the whole party.

For ten years prior to 1906 the Conservatives, in close alliance with the Liberal Unionists, were continuously in power. In 1903, however, Joseph Chamberlain raised a new issue by promulgating his policy of tariff reform. Tariff reform split the Unionist Party, as home rule, 20 years before, had split the Liberal Party, though neither so fundamentally nor so permanently. Nevertheless at the general election of 1906 the Unionists suffered a crushing reverse, and the Liberals came into power, fettered only by the still coordinate authority of the House of Lords. To curb the Lords they introduced (April 1910) the Parliament bill, which the Unionists stoutly but unavailingly opposed. In November 1911 the Conservative Party was compelled, by the resignation of Mr. Balfour, to elect a new leader. The industrialists and protectionists urged the claims of Mr. (now Sir) Austen Chamberlain; the old Tories, the churchmen, and the country folk, preferred Mr. Walter Long. Ultimately both stood aside in order to secure unanimity, and the choice of the party fell on Mr. Bonar Law.

Leadership of Bonar Law.—The choice proved a happy one, though the new leader's powers were displayed to much greater advantage in the House of Commons than on the platform. His leadership continued until his resignation of the premiership, after only a few months' tenure, in 1923. After the passage of the Parliament act in April 1912, Mr. Asquith introduced and ultimately, by the aid of the Parliament act, carried a home rule bill. Meanwhile Ulster was preparing to resist forcible disjunction from the United Kingdom, and behind Ulster stood the bulk of the Unionist Party. But by that time the issues of European peace and war were hanging in the balance. Party controversies were instantly put aside, and the Conservative leaders promised, in the event of war, the whole-hearted support of the party to the Government.

The War Period.—That promise was fulfilled in the letter and the spirit. In May 1915 Mr. Bonar Law and other Conservative leaders joined forces with the Liberals and Socialists in an administration formed to conduct the War to a successful issue. But the issue was not yet; victory tarried; public dissatisfaction grew; in Dec. 1916 a political crisis supervened and Mr. Asquith resigned. Mr. Bonar Law was invited to form a government but declined, and chose instead to serve as chancellor of the Exchequer and leader of the House of Commons under Mr. Lloyd George as premier. A new coalition of the three parties ensued, and was maintained until the conclusion of the Armistice (Nov. 11 1918).

Post-War Changes.—The long parliament was at last dissolved (Nov. 1918) and Mr. Lloyd George and Mr. Bonar Law jointly appealed, as leaders of the Coalition, to the new and vast electorate created by the Reform act of 1918. The country gave them an overwhelming majority and, as spokesmen for the nation, they attended the Peace Conference at Paris. After the conclusion of peace the cohesion between the two wings of the Coalition manifestly weakened. A considerable section of the Conservative Party became increasingly restless under Mr. Lloyd George's leadership, and after the concession of dominion home rule to southern Ireland (1921), the "die-hards," as they were termed, decided that when the inevitable appeal to the country came, they would make it as Conservatives, *sans phrase* and under their own leaders. Matters reached a crisis on Oct. 19, when a meeting of Conservative M.P.'s held at the Carlton Club, decided by 187 to 87 votes, "that the Conservative Party, while willing to co-operate with the Liberals, should fight the election as an independent party, with its own leader and with its own programme."

To this result two speeches largely contributed. One was a singularly direct, manly, and courageous speech by Mr. Stanley Baldwin; the other was a firm declaration by Mr. Bonar Law, who had been reluctantly persuaded to emerge from retirement and head the revolt against the Coalition. But it was a soldiers' battle; the victory was that of the rank and file, who for the last two years had been increasingly suspicious of Mr. Lloyd George's policy.

The die was now cast. The Coalition was smashed; Mr. Lloyd George resigned and Mr. Bonar Law became prime minister and the head of a purely Conservative ministry—the first since 1905. The electorate showed its confidence in the new administration by returning (Nov. 1922) 344 Conservatives as against 53 Asquithian Liberals and 61 National (or Lloyd George) Liberals, and 142 Labour-Socialist members. The parliament elected in Nov. 1922, on the cry of rest and recuperation, was short-lived. Mr. Bonar Law was compelled by illness to resign in May 1923. Who was to succeed him? Length and distinction of service, great experience, intellectual endowments—all pointed to Lord Curzon of Kedleston. The King, however, decided that a peer premier was, under the circumstances, impracticable, and his choice fell on Mr. Stanley Baldwin.

The new Government did not last long. Mr. Baldwin, convinced that only protection could provide a positive cure for unemployment, asked the country (Nov. 1923) to endorse that conviction. At the ensuing general election the country declined. The Liberals and Socialists combined to turn out Mr. Baldwin's Government; the Labour Party took office on Liberal sufferance, but in the early autumn of 1924 became involved in irretrievable difficulties and appealed to the country. The country showed even less liking for Socialism than for protection, and Mr. Baldwin achieved a victory almost national in dimensions. The new parliament contained nearly 420 Conservatives and 151 Socialists, while the Liberal Parties were in the aggregate reduced to 40. Mr. Baldwin, rightly interpreting the verdict of the country as a call to the union of all constitutionalists, included in his new ministry not only those Unionists who, like Sir Austen Chamberlain and Lord Birkenhead, had gone into temporary exile with Mr. Lloyd George, but Mr. Winston Churchill, who for nearly 20 years had been a member of the Liberal Party and now took office as chancellor of the Exchequer. Though defeated in the 1929 election, the Conservatives and the National Government won a decisive majority in that of 1931 and again in 1935. (*See* ENGLISH HISTORY.) (J.A.R.M.)

CONSERVATOIRE, a public institution for instruction in music and declamation. The name conservatoire has come to be used not only of the French institutions to which it properly applies, but also of similar establishments in other countries. In the United States, however, the anglicized form "conservatory" is employed, a form far more satisfactory from the point of view of linguistic purity, but difficult to adopt in England, where the word has long since meant something quite different, to wit, a particular kind of greenhouse. The Italian conservatorios were the earliest, and originated in hospitals for the rearing of foundlings and orphans in which a musical education was given. The first to which a definite date can be assigned is the Conservatorio di Santa Maria di Loretto, at Naples, founded by Giovanni di Tappia in 1537. Three other similar schools were afterwards established in the city, of which the Conservatorio di Sant' Onofrio deserves special mention on account of the fame of its teachers, such as Alessandro Scarlatti, Leo, Durante and Porpora.

The celebrated conservatoire of Paris owes its origin to the École Royale de Chant et de Declamation founded by Baron de Breteuil in 1784, for the purpose of training singers for the opera. Suspended during the stormy period of the Revolution, its place was taken by the Conservatoire de Musique, established in 1795. The plan and scale on which it was founded had to be modified more than once in succeeding years, but under the successive direction of eminent musicians, including Cherubini, Auber, Ambroise Thomas, Gabriel Fauré, it thereafter occupied, as it continues to do (1939), a foremost place among institutions of its kind. Of other European conservatoires of the first rank may be named those of Berlin, the famous Hochschule für Musik, founded in 1869, and long directed by Joachim; of Vienna, founded in 1817; of Leipzig, which assumed such importance in the days of Mendelssohn, by whom it was founded in 1843; of Brussels, founded in 1833 and long presided over by the celebrated Fétis; and of Cologne, founded in 1849; to mention but a few.

In England the functions of a conservatoire have been discharged by the Royal Academy of Music, of London, founded in 1822, the Royal College of Music (1882), the Guildhall School of Music and similar institutions.

In the United States the leading teaching institutions include the National Conservatory of Music of America, founded in New York in 1885, of which Dvořák was director for a time, the Institute of Musical Art and the American Institute of Applied Music, both also in New York. Other well-known American establishments are the Peabody Conservatory in Baltimore (1868), the American Conservatory of Music (1886) and the Conservatory of Dramatic and Musical Art (1885) in Chicago, the Cincinnati Conservatory of Music (1867), and the New England Conservatory of Music in Boston (1867).

CONSERVATOR, a title given in the middle ages to various officers, such as those appointed by the council of Würzburg in 1287 to protect the privileges of certain religious persons, the guardians of academic rights in the University of Paris, certain Roman magistrates as late as the 16th century, or the *conservator Judaeorum,* who was enjoined to look after the Jews of the county of Provence in 1424. By the statute 2 Henry V. there was appointed a conservator of truce and safe conducts in each English seaport "to enquire of all offences done against the king's truce and safe conducts, upon the main sea, out of the liberties of the cinque ports." In Scotland the conservator of the realm (*c.* 1503) had jurisdiction to settle the disputes and protect the rights of Scottish merchants in foreign ports or places of trade. In England the conservators of the peace (*custodes pacis*) were the precursors of the modern justices of the peace. Stubbs traces their origin to the assignment of knights, in 1195, to enforce the oath to preserve the peace which Richard I. ordered to be taken by all persons above the age of 15. By the statute 1 Edward III. conservators of the peace were appointed for each county to guard the peace and to hear and determine felonies. The office was reconstituted by the parliament of 1327, and its powers were extended in 1360. From the sovereign and the lord chancellor down to the justice and the village constable, all who have to do with the repression of crime are included within the general term of conservators of the peace. As commonly used nowadays in England the term conservator is applied only to the guardian of a museum or of a river (*see* THAMES).

In some countries the registrar of land transfers, etc., is called conservator.

CONSETT, an urban district of Durham, England, 12 mi. S.W. of Newcastle-upon-Tyne by a branch of the L.N.E.R. Pop. (1938) 37,340. Area 2.5 sq.mi. At Shotley Bridge a colony of German metalworkers, making swords and knives, was established in the 17th century. Metalworking, iron smelting, furnace building and the production of coke are important. There was unemployment in these industries during the depression of the 1930s.

CONSHOHOCKEN, a borough of Montgomery county, Pennsylvania, U.S.A., on the Schuylkill river, 12m. N.W. of Philadelphia; served by the Pennsylvania and the Reading railways. Pop. (1940) 10,776. Industries include the manufacture of fire trucks and pumps, steel sheets and plates, water heaters, tanks, steel containers, rubber tires, rubber mechanical goods, glass bottles and scientific glassware; textiles, caps and uniforms, paper fibre, steel conduits for electrical insulation. Across the river is the borough of West Conshohocken (pop. 1940, 2,464) which has woolen yarn mills, stone quarries, and manufactures cement and chemicals. Conshohocken is an Indian word meaning "pleasant valley." The borough was settled about 1820 and incorporated in 1850. Until 1830 it was called Matson's Ford.

CONSIDÉRANT, VICTOR PROSPER (1808–1893), French socialist, was born at Salins (Jura) on Oct. 12, 1808. Educated at the École Polytechnique in Paris, he entered the French army as an engineer, rising to the rank of captain. He resigned his commission in 1831, in order to devote himself to advancing the doctrines of François Fourier (*q.v.*). On the death of Fourier in 1837 he became the acknowledged head of the movement, and took charge of *La Phalange,* the organ of Fourierism. He also established *phalanges* at Condé-sur-Vesgres and elsewhere. During this period he published his *Destinée sociale* (1834–38), undoubtedly the most able and most important work of the Fourierist school. After the revolution of 1848 he was elected to the Constituent Assembly for the department of Loiret, and in 1849 to the Legislative Assembly for the department of the Seine. Considérant's share in the "demonstration" under the leadership of Alexandre Ledru-Rollin (*q.v.*) on June 13, 1849, made it necessary for him to leave France. He made Brussels his headquarters and from there made his visits to America. On the second of these visits he founded at San Antonio, Texas, the short-lived communistic colony of La Réunion. He returned to Paris in 1869, and died there on Dec. 27, 1893. The most important of Considérant's other writings were *Exposition du système de Fourier* (1845), *Principes du socialisme* (1847), *Théorie du droit de propriété et du droit au travail* (1848).

See Mme. Coignet, *Victor Considérant, sa vie, son oeuvre* (1895); P. Collard, *Victor Considérant, sa vie, ses idées* (Dijon, 1910).

CONSIDERATION, in the law of contract, an act or forbearance, or the promise thereof, offered by one party to an agreement, and accepted by the other as an inducement to that other's act or promise (Pollock on *Contract*). Consideration in the legal sense is essential to the validity of every contract unless it is made in writing under seal. The meaning of the word is quite accurately expressed by a phrase used in one of the earliest cases on the subject—it is strictly a *quid pro quo.* Something, whether it be in the nature of an act or a forbearance, must move from one of the parties in order to support a promise made by the other. A mere promise by A to give something to B cannot be enforced unless there is some consideration "moving from B." While every contract requires a consideration, it is held that the court will not inquire into the adequacy thereof, but it must be of some value in the eye of the law. It must also be legal, and it must be either present or future, not past. "Valuable consideration" differs from *causa,* which was required in the Roman law of contracts, since this, *i.e.,* the reason, such as affection or moral duty, was sufficient to make a contract sustainable. In Scots law a mere promise without consideration is enforceable. *See* CONTRACT.

CONSIDERATION MONEY. In the transfer of stocks and shares, this is the amount of money stated on the deed of transfer as being paid by the buyer to the seller. If shares are sold on the Stock Exchange, however, it by no means follows that the seller will find named on the transfer the sum for which his stockbroker sold the shares, and which was stated on the stockbroker's contract note. That is because shares may change hands several times during a stock exchange settlement period, and, under the Stamp act, it is the amount paid by the sub-purchaser which has to be stated on the transfer for the purpose of assessment of the transaction to *ad valorem* stamp duty.

CONSIGNMENT, generally, the delivery or transmission of any person or thing for safe custody, *e.g.*, of a malefactor to prison, or of a horse to the care of a groom. In law, consignment is used for the sending or transmitting of goods to a merchant or factor for sale. The person who consigns the goods is called the consignor, and the person residing at the port of delivery or elsewhere to whom the goods are to be delivered when they arrive there is called the consignee. Consignation as used in the Code Napoléon and similar systems means payment into court. (*See* AFFREIGHTMENT.)

CONSISTORY, a term which, like many other expressions, has undergone a regular evolution in the course of centuries. It was first applied (from Lat. *consistorium,* literally, a standing place, hence meeting place) to the audience-chamber in which the emperors received petitions and gave judgment; it soon came to mean also the persons who took part in the deliberation, and, by an extension of meaning, a tribunal or jurisdiction (*see* Du Cange, *Glossarium, s.v.*). But the expression has now long been exclusively applied to gatherings of ecclesiastical persons for the purpose of administering justice or transacting business.

In the Western Church the episcopal consistory was simply the bishops' tribunal, the proceedings of which took a more or less strictly judicial form. But the name has disappeared almost everywhere; the only episcopal consistories outside England (*see* CONSISTORY COURTS) which survive are in Austria and in certain dioceses of Bavaria and Germany (*see* Vering, *Kirchenrecht,* § 149). Thus the name has come to be applied almost exclusively to meetings of the college of cardinals with the pope as president, formerly for deliberative purposes, but nowadays purely formal and ceremonial, the business upon which they are supposed to meet being discussed and decided previously; they are now merely a kind of solemn promulgation.

There are three kinds of consistory: the secret consistory, in which only the cardinals take part; the public consistory, to which are admitted persons from outside and a fairly large audience; and finally, the semi-public consistory, in which the bishops present in Rome take part with the cardinals, and are allowed to state their opinion. The last form is only used in the case of the consistory preceding a canonization. The public consistory is now only held for the ceremony of conferring the hat on newly created cardinals; formerly the popes used to receive in public consistory sovereigns and certain other great persons, but in this case the consistory was not deliberative in form.

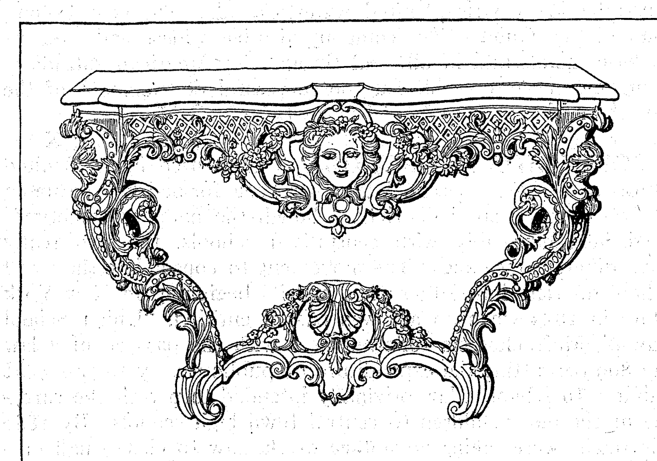
Finally, in secret consistories were discussed matters of general interest, such as the creation of cardinals, the provision of cathedral churches and other higher benefices,—hence called consistorial,—the creation, union or division of dioceses, the conferring of the pallium (*q.v.*), and other matters of importance. The custom is for the pope to open the meeting by a discourse, or "consistorial allocution." Such, for example, were the allocutions of Pius IX. against the successive invasions of his temporal domain, or that of Pius X. against the breaking of the Concordat by the French government.

See the *Catholic Encyclopaedia,* art. "Consistory," and for full historical information, Bouix, *De Curia romana,* pt. ii. c. 1. (Paris, 1850); Plattenberg, *Notitia congregationum,* cap. 3 (Hildesheim, 1693); Cardinal de Luca, *Theatrum veritatis,* lib. xv. p. 2 (Rome, 1671).

CONSISTORY COURTS, those ecclesiastical courts wherein the ordinary jurisdiction of the bishop is exercised (*see* CONSISTORY). They exist in every diocese of England. Consistory courts were established by a charter of William I., which appointed the cognizance of ecclesiastical causes in a distinct place or court from the temporal. The officer who exercises jurisdiction in a consistory court is known as the chancellor (*q.v.*), and he is appointed by patent from the bishop or archbishop. All jurisdiction, both contentious and voluntary, is committed to him under two separate offices, those of official principal and vicar-general; the distinction between the two offices is that the official principal usually exercises contentious jurisdiction and the vicar-general voluntary jurisdiction. (In the province of York there is an official principal of the chancery court and a vicar-general of the diocese.) Since about the middle of the 19th century consistory courts have been shorn of much of their importance. Before the year 1858 consistory courts exercised concurrently with the courts of their respective provinces jurisdiction over matrimonial and testamentary matters. This jurisdiction was taken away by the Court of Probate Act 1857 and the Matrimonial Causes Act 1857. They had also corrective jurisdiction over criminous clerks, but this was abrogated by the Church Discipline Act 1840. The principal business of consistory courts is now the dispensing of faculties. The procedure in such is strictly forensic, for all applications for faculties, though they may be unopposed, are commenced by citation, calling on all who may have an interest to oppose. From the consistory courts an appeal lies to the provincial courts, *i.e.* the arches court of Canterbury and the chancery court of York. Also, by the Clergy Discipline Act 1892, a clergyman may be prosecuted and tried in a consistory court for immoral acts or conduct. Under this act, either party may appeal either to the provincial court or to the king in council against any judgment of a consistory court.

CONSOLATION, in general the soothing of disappointment or grief. In the sense of compensation for loss the word "consolation" has had a variety of adaptations; *consolatio* was the name for the evening meal given to monks after a regular collation "by way of consolation," and to certain payments made to members of chapters over and above the revenues of their benefices. In an analogous sense we use the word in such combinations as "consolation prize," "consolation race," "consolation stakes," meaning such as are open only to competitors who have not won in any preceding "event."

CONSOLE, in architecture, a corbel (*q.v.*) or built-in bracket whose height is greater than its projection. Decorative consoles were used by the Greeks and Romans of the classic period to support the projecting cornice over a door, as in the door of the Erechtheum (*q.v.*) at Athens (completed 408 B.C.), and the temple of Vesta at Tivoli (early first century). The type of console decoration thus set, consisting of "S" scrolls on the sides, a moulded edge with, occasionally, an applied leaf, was widely used throughout the Renaissance styles (*see* RENAISSANCE ARCHITECTURE), not only for door and window cornices, but also as a decoration under window sills and sometimes in cornices or other



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

CONSOLE TABLE OF THE FIRST QUARTER OF THE EIGHTEENTH CENTURY

This example is of gilded wood and topped with a royal red marble slab

positions, such as the reversed consoles used as buttresses in the dome of S. Maria della Salute in Venice, begun 1631. It was a favourite form of the baroque period (*see* BAROQUE ARCHITECTURE), which treated it with the utmost fantasy.

In furniture, the word console, or console table, is used to describe a type of table supported either upon brackets, like consoles, or by legs of similar form, and always designed to be placed against the wall. This type of table was particularly important in France from the time of Louis XIV. to the fall of Napoleon. In almost all cases French console tables are richly decorated with carved scrolls, shells, flowers, wreaths and even masks. During the Louis XVI. and empire periods the design is much more restrained. These console tables were frequently of bronze or brass, with marble tops, and when of wood usually gilded or painted, except under the empire, when they were of natural wood with brass mountings. A console mirror is a long narrow mirror designed to occupy the space above a console table.

CONSOLIDATED GOLD FIELDS OF SOUTH AFRICA, LTD. The Gold Fields of South Africa, Ltd. was formed in 1887 by Cecil Rhodes and Charles Rudd with the principal object of exploiting gold mines on the newly discovered Witwatersrand.

Together with other companies it was absorbed in 1892 by the Consolidated Gold Fields of South Africa, Ltd. The objects of this company being limited by its memorandum of association, an operating company, New Consolidated Gold Fields, Ltd., was formed in 1919 in order to enlarge the scope of the business. All the shares in the operating company are held by the parent company. The capital of the company has been increased from time to time from the original £250,000 to a figure of £6,500,000 in 1939. The capital has never been written down and is exceeded by the book value of the investments which "show a further unrealized profit". The average return on the ordinary share capital over the life of the company is over $17\frac{1}{2}\%$.

A subordinate company, the Gold Fields Rhodesian Development Co., Ltd., was formed in 1911 to undertake business in this field, followed by others of similar objects and title for America (1911) and Australia (1932). The central administration is in London and offices are maintained in Johannesburg, New York, Bulawayo, and Kalgoorlie.

The company's main field of activity has always been the Witwatersrand where it has taken a prominent part in technical progress and has, in recent years, been responsible for the development of the western extension of the field (West Witwatersrand Areas, Ltd.) over a distance of 40 miles. Since, however, further extensions of the gold fields became limited, the management considered it essential to extend its field and scope of investment to other parts of the world. As a result of such developments other interests held directly or through associated companies are world wide and include gold mining in Western Australia, West Africa, United States, Canada, Venezuela, Colombia and New Guinea. The company also has widespread interests in base metals and in oil, and through its American subsidiary company was responsible for the successful development of the potash and borax deposits at Searles Lake in California.

(L. C. M.; X.)

CONSOLIDATED SCHOOL, a term used in the United States to designate a school that has been formed by the union of two or more rural districts. Though the name is sometimes used interchangeably with centralized schools, the two really have different meanings. The movement to consolidate the small school districts into larger ones had its beginning in New York State in 1853 when an act was passed entitled, "Union School Laws." Massachusetts followed next with the passage of a law in 1869 permitting the expenditure of public money to transport children to school, a law originally intended to permit the carrying of the older children to central town high schools. By 1880 the towns were taking advantage of the law to close small outlying schools and transport the children to a central town school. This movement was accelerated in Massachusetts when in 1882 the district system was abolished and the township system restored in its place. The consolidation movement had spread to all the New England States by 1890. By this time New Jersey and Nebraska had passed legislative acts that made consolidation possible; and Indiana had started the movement without waiting for legislative provisions. In 1894 Ohio passed a law permitting the expenditure of public money for the transportation of pupils. By 1910 38 States had enacted permissive legislation, and by 1927 there were in the United States about 15,000 consolidated schools. The consolidated schools vary in size from the small two-room school to the large modern school of 600 or more pupils equal in physical equipment, curriculum, teaching force and financial support to the better town and city schools.

Advantages.—The advantages of the consolidated school may be summarized as follows: (1) Better classification and gradation of pupils is made possible, and classes large enough to stimulate rivalry and enthusiasm in the work of the school. (2) The number of grades a teacher must handle and the number of recitations are materially reduced, while the length of the recitations are materially increased. (3) The curriculum can be enriched by the introduction of instruction in agriculture, home economics, manual training, music, art and nature study. (4) The larger school unit makes possible buildings with better equipment in heating, ventilation, lighting and sanitary conveniences; professionally trained teachers, and modern teaching equipment and supplies. (5) Consolidation makes possible longer terms of school than the small districts usually can afford; provides supervision of instruction; and higher salaries for teachers which lengthens the tenure of office. (6) Transportation, which is an essential feature of consolidation, provides for the placing of the children under the care of a responsible person in travelling to and from the school. (7) Enrolment in the school is increased and absences and tardiness are reduced to the minimum. (8) It brings together at one place enough pupils to permit of organized plays and games, making it possible to utilize the educative value of play which is largely lost to the small district school. (9) It offers to rural children and rural communities all the desirable educational advantages which the city children now enjoy.

(W. D. A.; W. H. Ha.)

CONSOLIDATION. In military language, the act of making secure, against enemy counter-attack, ground or trenches that have been captured. Consolidation is effected in two ways—by the reorganization and suitable distribution of the occupying troops and by the rapid provision of entrenchments. For Consolidation in Industry and Commerce, *see* Merger.

CONSOLIDATION ACTS. Where opportunity offers, the law expressed in many statutes is sometimes recast in a single statute, called a Consolidation Act. In settling private acts, such as those relating to public undertakings, common clauses were embodied in separate statutes, and their provisions are ordered to be incorporated in any private act of the description mentioned therein.

CONSOLS. An abbreviation of Consolidated Annuities, a form of British government stock which originated in 1751. Previous to World War I Consols formed the larger part of Britain's "funded debt"—*i.e.,* that portion of the national debt the redemption of which is at the option of the government. During the 19th century the practice of the government was not to borrow at various rates of interest, but to keep the rate of interest constant while offering principal in various amounts. Thus subscribers of £100 might be offered £150 in 3% stock. In 1815, at the close of the French wars, a large loan was raised at as much as £174 of 3% stock for £100 cash. This practice dated from the reign of George II. In 1888 a great conversion operation took place. All outstanding Consols together with certain 3% annuities were consolidated into one stock, the rate of interest being reduced to $2\frac{3}{4}\%$ for the first 14 years and to $2\frac{1}{2}\%$ thereafter. Following this operation, at one time $2\frac{3}{4}\%$ Consols touched 114, but in the early years of the 20th century $2\frac{1}{2}\%$ Consols fell below par.

The huge increase in the national debt during World War I meant that Consols became only one of many government stocks. Funding operations culminating in the war loan conversion of 1933, when nearly £2,000,000,000 of 5% stock was successfully replaced by a corresponding amount of $3\frac{1}{2}\%$ stock, placed the national debt on a simpler footing, but expenditure upon rearmament prior to Sept. 3, 1939, led to the issue of fresh government loans for defense purposes.

At the outbreak of World War II in Sept. 1939 the British national debt totalled £8,163,000,000, of which only £276,100,000 was represented by $2\frac{1}{2}\%$ Consols. Other forms of funded debt outstanding were £1,911,000,000 of $3\frac{1}{2}\%$ war loan, repayable in or after 1952; £739,000,000 of $3\frac{1}{2}\%$ conversion loan, repayable in or after 1961; and £400,000,000 of 4% Consols, repayable in or after 1957. The total funded debt was then £3,365,000,000. Unfunded debt included loans repayable at specific dates and also national savings certificates. It totalled nearly £3,000,000,000. The floating debt was about £900,000,000.

World War II raised the national debt to £22,398,000,000 by March 31, 1945. The chief new issues consisted of national savings certificates, 2½% national war bonds, and 3% savings bonds. All debt raised during the war consisted of unfunded or floating debt.

As a result 2½% Consols in 1945 represented only a minute fraction of the British national debt. Yet they are not without their importance. They are the only government loan in which no specific year is mentioned as even a possible date of repayment. This means that the yield obtainable from them is the best available measurement of the long-term rate of interest, because no element of amortization enters therein. Here is the actual record:

		Price	Yield
1939	Aug. 31	64¾	3.86%
	Sept. 7	62¼	4.02%
1940	June 22	71⅝	3.49%
1941	Dec. 8	82⅛	3.04%
1945	May 7	83⅛	3.00%

In round figures, despite a war increase in the national debt from about £8,000,000,000 to over £22,000,000,000, the long-term rate of interest was brought down from 4% to 3%. This is a measure of the success of the British government's cheap money policy. (N. E. C.)

CONSORT, in general, a partner or associate, but more particularly a husband or wife. The word is also used in conjunction with some titles, as "queen consort," "prince consort." Under the law of Great Britain, the queen consort is a subject, but has certain privileges. By the Treason Act 1351, the compassing and imagining her death is high treason, as is also the commission of adultery with her. With regard to the acquisition and disposal of property, the incurring of rights and liabilities under contract, suing and being sued, a queen consort is regarded as a *feme sole* (32 Henry VIII. c. 51, 1540; Private Property of the Sovereign Act 1800). In other words she may sue and be sued as a private subject. The queen consort has her own ceremonial officers and appears in the courts by her attorney- and solicitor-general. At one time she had a revenue out of the demesne lands of the Crown and a portion of any sum paid by a subject to the king in return for a grant of any office or franchise; this was termed *aurum reginae* or queen-gold. Provision is now made for the queen consort by statute. When the husband of a queen consort dies she becomes a queen dowager. A queen regnant, holding the crown in her own right, has all the prerogatives of a sovereign. In the four cases of queens regnant in English history, the husbands' positions have each been different. When Mary I. married Philip of Spain it was provided by every safeguard that words could suggest that the queen alone should exercise all the powers of the Crown; official documents, however, were to issue in their joint names. William III. occupied the throne jointly with his wife, Mary II. The husband of Queen Anne, George of Denmark, who was naturalized by act of parliament in 1689, occupied no definite position, and differed only from other subjects of the queen in the conditions of his naturalization. The position of Prince Albert of Saxe-Coburg-Gotha, the husband of Queen Victoria, was somewhat like that of Prince George of Denmark. A few days before his marriage he had been naturalized as a British subject, and immediately after his marriage letters patent were issued, giving him precedence next to the queen. He had, however, no distinctive title, and the privileges and precedence he received were only by courtesy. As the patent which gave him precedence was inoperative outside Great Britain, certain difficulties occurred at foreign courts, and in order to settle these, the formal title of "Prince Consort" was conferred upon him by letters patent in 1857.

CONSPIRACY, in English law, an agreement between two or more persons to do an unlawful act, or to do a lawful act by unlawful means. It is not necessary that the unlawful act or the unlawful means should be criminal; they need be only wrongful, *i.e.,* tortious. At common law conspiracy is an indictable misdemeanour, but by s. 4 of the Offences against the Person Act 1861 conspiracy to murder, whether the victim be a subject of the king or not, and whether he is within the king's dominions or not, is declared also a misdemeanour and is punishable by penal servitude not exceeding ten years. Conspiracy to commit treason is treason. It is also interesting to note that the legislature has interfered in the case of illegal agreements as to bidding at auctions, and has made it an offence for a dealer to abstain from bidding for a consideration (Auctions Bidding Agreements Act 1927).

Criminal conspiracy may be classified as follows:—(1) To cheat and defraud; (2) to injure by wrongful acts other than fraudulent acts; (3) to commit any offence punishable by law; (4) to do any act with intent to pervert the course of justice; (5) conspiracies or combinations in relation to trade and employments. A husband and a wife cannot commit the offence as they are in law one person, but they can conspire with a third person.

Individuals Acting in Concert.—The most important question in the law of conspiracy, apart from the statute law affecting labourers, is how far things which may be lawfully done by individuals can become criminal when done by individuals acting in concert, and some light may be thrown on it by a short statement of the history of the law. In the early period of the law down to the 17th century, conspiracy was defined by the Ordinance of Conspirators of 1305:—"Conspirators be they that do confedre or bind themselves by oath, covenant, or other alliance, that every of them shall aid the other falsely and maliciously to indite, or cause to indite, or falsely to move or maintain pleas, and also such as cause children within age to appeal men of felony, whereby they are imprisoned and sore grieved, and such as retain men in the country with liveries or fees to maintain their malicious enterprizes, and this extendeth as well to the takers as to the givers." The offence aimed at here is conspiracy to indict or to maintain suits falsely; and it was held that a conspiracy under the act was not complete, unless some suit had been maintained or some person had been falsely indicted and acquitted. A doctrine, however, grew up that the agreement was in itself criminal, although the conspiracy was not actually completed (Poulterer's case, 1611). This developed into the rule that any agreement to commit a crime might be prosecuted as a conspiracy.

A still further development of this doctrine is that a combination might be criminal, although the object apart from combination would not be criminal. A dictum of Lord Denman's is often quoted as supplying a definition of conspiracy. It is, he says, either a combination to procure an unlawful object, or to procure a lawful object by unlawful means; but the exact meaning to be given to the word "lawful" in this antithesis has nowhere been precisely stated. A thing may be unlawful in the sense that the law will not aid it, although it may not expressly punish it. The extreme limit of the doctrine is reached in the suggestion of Lord Mansfield, C.J., in 1809 (2 Camp. 369) that a combination to hiss an actor at a theatre is a punishable conspiracy.

The application of the wide conception of conspiracy to trade disputes and to civil questions arising out of contracts for service is dealt with under the headings LABOUR LAW, STRIKES AND LOCKOUTS, and TRADE UNIONS.

The Conspiracy and Protection of Property Act.—The criminal side is regulated by the Conspiracy and Protection of Property Act, 1875, which enacted by s. 3 that "an agreement or combination by two or more persons to do, or procure to be done, any act in contemplation or furtherance of a trade dispute between employers and workmen shall not be indictable as a conspiracy, if such act committed by one person would not be punishable as a crime. By s. 4 of that statute a person employed on the supply of gas and water, breaking his contract with his employer, and knowing or having reasonable cause to believe, that the consequence of his doing so, either alone or in combination with others, will be to deprive the inhabitants of the place wholly or to a great extent of their supply of gas or water, shall be liable on conviction to a penalty not exceeding £20, or a term of imprisonment not exceeding three months. And by s. 5 any person wilfully and maliciously breaking a contract of service or hiring, knowing or having reasonable cause to believe that the probable consequences of his so doing either alone or in combination with others will be to endanger human life or cause serious bodily injury, or to expose valuable property whether real or personal to destruction or serious injury, shall be liable to the same penalty. By s. 7 every person who, with a view to compel any other person to abstain from doing or to do any act which such other person has a legal right to do or abstain from doing, wrongfully and without legal authority, (1) uses violence to or intimidates such other person, or his wife and children, or injures his property; or (2) persistently follows such other person about from place to place; or (3) hides any tools, clothes or other property owned or used by such other person, or deprives him of or hinders him in the use thereof; or (4) watches or besets the house or other place where such other person resides or works, or carries on business, or happens to be, or the approach to such house or place; or (5) follows such other person with two or more other persons, in a disorderly manner, in or through any street or road, shall be liable to the before-mentioned penalties."

The Trade Disputes and Trade Unions Act, 1927, prescribes that: "3. (1) It is hereby declared that it is unlawful for one or more persons (whether acting on their own behalf or on behalf of a trade union or of an individual employer or firm, and notwithstanding that they may be acting in contemplation or furtherance of a trade dispute) to attend at or near a house or place where a person resides or works or carries on business or happens to be, for the purpose of obtaining or communicating information or of persuading or inducing any person to work or to abstain from working, if they so attend in such numbers or otherwise in such manner as to be calculated to intimidate any person in that house or place, or to obstruct the approach thereto or egress therefrom, or to lead to a breach of the peace; and attending at or near any house or place in such numbers or in such manner as is by this subsection declared to be unlawful shall be deemed to be a watching or besetting of that house or place within the meaning of section seven of the Conspiracy, and Protection of Property Act, 1875. (2) In this section the expression 'to intimidate' means to cause in the mind of a person a reasonable apprehension of injury to him or to any member of his family or to any of his dependents or of violence or damage to any person or property, and the expression 'injury' includes injury to a person in respect of his business, occupation, employment or other source of income, and includes any actionable wrong. (3) In section seven of the Conspiracy, and Protection of Property Act, 1875, the expression 'intimidate' shall be construed as having the same meaning as in this section. (4) Notwithstanding anything in any Act, it shall not be lawful for one or more persons, for the purpose of inducing any person to work or to abstain from working, to watch or beset a house or place where a person resides or the approach to such a house or place, and any person who acts in contravention of this subsection shall be liable on summary conviction to a fine not exceeding 20 pounds or to imprisonment for a term not exceeding three months." It was further provided by s. 6: "(4) There shall be added to section five of the Conspiracy, and Protection of Property Act, 1875, the following provision, that is to say:—

'If any person employed by a local or other public authority wilfully breaks a contract of service with that authority, knowing or having reasonable cause to believe that the probable consequence of his so doing, either alone or in combination with others, will be to cause injury or danger or grave inconvenience to the community, he shall be liable, on summary conviction, to a fine not exceeding ten pounds or to imprisonment for a term not exceeding three months.' " A combination of two or more persons, even where not expressly provided for, would be punishable as a conspiracy, as provided in s. 3 of the act of 1875. (X.)

UNITED STATES

The American law of conspiracy is rooted firmly in the English common law, the influence of which is plainly discernible in most American decisions. In the United States the most important field to which the law of conspiracy has been applied is that of combinations in restraint of trade, whether these combinations are of labour with a view to securing concessions by employers or of industrial enterprises with a view to price fixing through control of production.

The Sherman Act.—In this connection a large body of law centres around the Sherman Anti-trust Act of 1890 and the Clayton Anti-trust Act of 1914. The first section of the Sherman Law makes every "conspiracy in restraint of trade and commerce among the states or with foreign nations illegal." Again in the third section it is made an offence "to combine or conspire with any other person or persons to monopolize any part" of such trade or commerce. The decisions interpreting the scope of the word "conspiracy" as used in the Sherman Law are very broad. A mere tacit understanding between persons to work to a common purpose will be a conspiracy. The exchange of trade information through organized channels with a view to influencing prices through control of production may be a violation. Always a criminal intent, that is, the intent to do something forbidden by the act, must be present, but the result intended is the criterion, and there need be no deliberate intention to violate the act. A series of acts in themselves innocent when taken together may give rise to the charge of conspiracy, when the collective effect is to limit commerce or to restrain trade. Furthermore a person who joins the combination or conspiracy after its inception will be equally guilty with the originators. Corporations, though artificial, may be guilty of conspiracy. Necessarily they act through agents and these agents together with the corporation are responsible.

The Sherman Law, being enacted in pursuance of Federal authority, is limited to interstate commerce or commerce between the nations. But it has been held that even though various defendants may be engaged exclusively in intrastate commerce, if they conspire to restrain the trade of other persons who are engaged in interstate commerce they will be guilty under the act.

The Clayton Act undertakes to define with greater precision certain types of conspiracy or combination in restraint of trade which are punishable. One of its principal purposes was to eliminate as a crime under the Sherman Law combinations among labourers for the purpose of achieving legitimate trade-union purposes. To that end certain trade-union practices were specifically permitted. In some instances, however, these practices were lawful at common law and therefore also under the Sherman Law. Thus the Clayton Act to a considerable degree is simply a legislative pronouncement of what was already the law. (R. P. B.)

CON SPIRITO (It.), "with spirit," a common direction in music, *spiritoso* having the same meaning.

CONSTABLE, ARCHIBALD (1774–1827), Scottish publisher, was born on Feb. 24, 1774, at Carnbee, Fife. In 1795 he started in business as a dealer in rare books. He bought the *Scots Magazine* in 1801, and John Leyden, the orientalist, became its editor; in Nov. 1802 he issued the first number of the *Edinburgh Review,* to which Lord Jeffrey, Sir Walter Scott, Henry Hallam, and afterwards Macaulay were the leading contributors. In 1805, jointly with Longman and Co., Constable published Scott's *Lay of the Last Minstrel,* and in 1807, *Marmion;* but in 1808 there was a split between Constable and Scott, who transferred his business to John Ballantyne and Co., until 1813, when that firm was in difficulties and Constable again became Scott's publisher. In 1812 Constable purchased the copyright of the *Encyclopædia Britannica,* adding the supplement (6 vols., 1816–24) to the 4th, 5th and 6th editions (*see* ENCYCLOPÆDIA); and in 1814 he bought the copyright of *Waverley.* The firm also published the *Annual Register.* In 1826 Constable failed for over £250,000, through over-speculation, while James Ballantyne and Co. also went bankrupt; Sir Walter Scott was involved in the failure of both firms; but Constable started business afresh, and began in 1827 *Constable's Miscellany of original and selected works,* a series of original works and of standard books republished in cheap form. He died on July 21, 1827. Archibald Constable's son, Thomas (1812–81), was appointed, in 1839, printer and publisher in Edinburgh to Queen Victoria.

See T. Constable, *Archibald Constable and his literary Correspondents* (3 vols. 1873).

CONSTABLE, HENRY (1562–1613), English poet, graduated from St. John's college, Cambridge, in 1580. He became a Roman Catholic, but nevertheless appears to have been in the secret service of the English Government in Paris in 1584 to 1585. In 1598 he was sent by the pope to Scotland to indicate the terms on which James VI. would be supported in his claim to the English throne, and later he was in the service of the king of France. Most of his adult life was spent abroad, and when he ventured to visit England in 1604 he was arrested. He died at Liége on Oct. 9, 1613. Constable has an early place in the development of the English sonnet. His *Diana, the praises of his Mistress in certain sweet sonnets, by H. C.*, which owes something to the *Diane* of Desportes, contained 23 poems, and was printed in 1592. The reprint of 1594 contains 76 pieces, many of them by other hands. Constable contributed four sonnets to Sidney's *Apologie of Poetry*, and four pastoral poems to *England's Helicon* (1600), one of which, the *Shepheardes Song of Venus and Adonis*, was certainly known to Shakespeare.

The second edition of *Diana* was reprinted by Arber in the *English Garner*, vol. ii. (1877). Sixteen *Spirituall Sonnettes* attributed to Constable were found in ms. and printed by Thomas Park in *Heliconia* (1815), and another small collection found in Canterbury by H. J. Todd was printed in the *Harleian Miscellany* (1813). Constable's works were edited by W. C. Hazlitt in 1859.

CONSTABLE, JOHN (1776–1837), English landscape painter, was born at East Bergholt in Suffolk on June 11, 1776. His father was a man of some property, including water-mills at Dedham and Flatford, and two windmills, in which John, the second son, was set to work at the age of 17, after leaving Dedham grammar school. From boyhood he was devoted to painting, which he studied in his spare time in company with John Dunthorne, a local plumber and glazier. While working thus he made the acquaintance of Sir George Beaumont, a mediocre painter but a keen patron of the arts, and was inspired by the sight of Claude's "Hagar and Ishmael" and by some drawings of Girtin which Sir George possessed. His passion for art increasing, he was allowed by his father to visit London in 1795 to consult the landscape-painter Joseph Farington, R.A. (1747–1821), who recognized his originality and gave him some technical hints. He also made the acquaintance of the engraver J. T. Smith, who taught him etching, and corresponded with him during the next few years, which were spent partly in London and partly in Suffolk. In 1797 he was recalled to work in his father's counting-house at Bergholt, and it was not till Feb. 1799 that he definitely adopted the profession of painting, and became a student at the Royal Academy. The few existing works of this period are heavy, clumsy and amateurish. Recognizing their faults, Constable worked hard at copying old masters "to acquire execution." In 1802 he exhibited at the Royal Academy, and was much helped and encouraged by the president, Benjamin West, who did him a further service by preventing him from accepting a drawing-mastership (offered by Archdeacon Fisher, of Salisbury), and thereby greatly stimulating his efforts. The manner of West appears strongly in the altar-piece painted by Constable for Brantham church in 1804, but Gainsborough, the Dutch masters and Girtin are the predominant influences upon his landscape, especially Girtin in the year 1805, and in 1806, when he visited the Lake District. From 1806 to 1809 Constable was frequently engaged in painting portraits or in copying portraits by Reynolds and Hoppner. The effect on his landscape was great. He learned how to construct an oil painting, and the efforts of the next few years were devoted to combining this knowledge with his innate love of the fresh colour of nature.

With the year 1811 began a critical period. He exhibited a large view of Dedham Vale, in which the characteristic features of his art appear for the first time almost fully developed, and he became attached to Miss Maria Bicknell. His suit was opposed by the lady's relatives, and Constable's apparently hopeless prospects drove him again to portrait-painting, in which he acquired considerable skill. Not until the death of his father in 1816 was he able to marry and settle in No. 1 Keppel street, Russell square, London, where a succession of works now well known was painted: "Flatford Mill" (1817), "A Cottage in a Cornfield," and in 1819 "The White Horse," which was bought by his great friend Archdeacon Fisher for £105, as was the "Stratford Mill" of 1820. In 1819 two legacies each of £4,000 diminished his domestic anxieties, and his talent was recognized by his election in November to the associateship of the Royal Academy. The series of important works was continued by "The Haywain" (1821), "A View on the Stour" (1822), "Salisbury Cathedral from the Bishop's Garden" (1823), and "The Lock" (1824). This last year was a memorable one. "The Haywain" was sold to a Frenchman, was exhibited at the Louvre, and, after creating a profound sensation among French artists, was awarded a gold medal. In the following year "The White Horse" won a similar distinction at Lille. In 1825 he exhibited "The Leaping Horse" (perhaps his masterpiece), in 1826 "The Cornfield," in 1827 "The Marine Parade and Chain Pier, Brighton," and in 1828 "Dedham Vale."

In 1822 Constable had taken Farington's house, 35 Charlotte street, Fitzroy square, London, but his wife's health failing he turned his attention to Hampstead. After temporary occupation first of 2 Lower terrace and then of a house on Downshire hill, he took No. 6 Well walk in 1827, letting the greater part of his London house. In 1828 his financial position was made secure by a legacy of £20,000 from Mr. Bicknell, but the death of his wife towards the end of the year was a shock from which he never wholly recovered. His election to membership of the Academy in the following year did not lessen his distress: he felt that the honour had been delayed too long. His chief exhibit in 1829 was "Hadleigh Castle," and this was succeeded by the great "Salisbury Cathedral from the Meadows" (1831), "The Opening of Waterloo Bridge" (1832), which had been begun in 1817, "Englefield House" (1833), "The Valley Farm" (1835), "The Cenotaph" (1836) and "Arundel Mill and Castle" (1837). Constable had long suffered from rheumatism and nervous depression but his sudden death on March 31, 1837, could be traced to no definite disease. He was buried in Hampstead churchyard, where his tomb may still be seen.

In May 1838 his remaining works were sold at auction, but fetched very small prices. Many were bought in by his children, and through their generosity have passed to the English nation, as the various national collections testify. Nowhere else can Constable's art be studied completely or safely, since forgeries and imitations are common and have crept into the Louvre and other famous galleries. Much of the power of his work survives in the noble series of mezzotints made after his sketches by David Lucas, and first issued in 1833. Though a commercial failure at the time of publication, this *English Landscape* series is now deservedly prized, as are the other plates which Lucas engraved after Constable. Constable himself made a few desultory experiments in etching, but they are of no importance.

As already indicated, the mature art of Constable did not develop till after the year 1811, when he began to combine the fresh colour of nature, which he had learned to depict by working in the open air, with the art of making a picture, which he had learned from painting portraits and copying those of other masters. His development was unusually slow, and his finest work, with but few exceptions, was done between his 40th and 50th years (1816–26). During the last 12 years of his life his manner became more free, and the palette knife was constantly used to apply spots and splashes of pure colour, so that his technique often suggests that afterwards employed by the Impressionists. Yet his direct influence upon French landscape has sometimes been overrated. When Constable first exhibited at the Salon in 1825 Théodore Rousseau, the pioneer of French naturalism, was only 12 years old, and the movement of 1830 was really originated in France by Gros and Géricault, while in England the water-colour painters led the way. Constable's death in 1837 removed the man and most of his work from the public eye for another generation, and he became a famous shadow rather than a living force. So Monet and the Impressionists, when they sought after the secret of painting air and sunshine, looked to Turner rather than to Constable, and in England the eloquence of Ruskin pointed in the same direction.

Since the British nation came into the possession of a large portion of Constable's pictures and sketches, his work has been better understood. Though limited in range of subject to the scenery of Suffolk, Hampstead, Salisbury and Brighton, his sketches express the tone, colour, movement and atmosphere of the scenes represented with unrivalled force and truthfulness, and modern criticism tends to rate their spontaneity above the deliberate accomplishment of his large finished works. His treatment of skies is specially notable. Here his early experience as a miller told in his favour. No one has painted English cloud effects so truthfully, or used them as a compositional quantity with so much skill. Though in looking at nature he was determined to see with his own eyes and not with those of any former master, he found that the science of his predecessors was necessary to him before his sketches could be translated into large pictures. In these pictures his vivid tones and fresh colour are grafted upon the formulae of Claude and Rubens, and it is a common error to regard Constable as an opponent of the great old masters. His pictures, like his writings and lectures, prove just the reverse. His dislike was reserved for the painters who took their ideas from other painters instead of getting them directly from nature.

(C. J. H.)

Bibliography.—C. R. Leslie, *Memoirs of the Life of John Constable, R.A.* (2nd ed. 1845, 3rd ed. 1896) (the classical work on the subject); *English Landscape Scenery, a Series of Forty Mezzotint Engravings on Steel, by David Lucas, from pictures painted by John Constable, R.A.* (folio, 1855). The large work on *Constable and his Influence on Landscape Painting*, by C. J. Holmes (1902), contains the only chronological catalogue of Constable's paintings and sketches. Leslie's biography has been admirably rendered into French by Léon Bazalgette (1905). *See* also A. B. Chamberlain, *John Constable* (1903); Lord Windsor, *John Constable, R.A.* (1903); Sir J. D. Linton, *Constable's Sketches in Oil and Water-colour* (1905); E. V. Lucas, *John Constable, the Painter* (1924).

CONSTABLE, SIR MARMADUKE (*c.* 1455–1518), English soldier, was descended from a certain Robert (d. 1216), lord of Flamborough, who was related to the Lacys, hereditary constables of Chester, hence the surname of the family. A son of Sir Robert Constable (d. 1488), Marmaduke was in France with Edward IV. in 1475 and with Henry VII. in 1492. After being sheriff of Staffordshire and Yorkshire, he fought at the battle of Flodden in 1513. He died on Nov. 20, 1518.

Sir Marmaduke's eldest son, Sir Robert Constable (*c.* 1478–1537), helped Henry VII. to defeat the Cornish rebels at Blackheath in 1497. In 1536, he took part in the rising known as the Pilgrimage of Grace which broke out in the north of England. He was tried for treason and hanged in 1537.

Sir Marmaduke's second son, Sir Marmaduke (*c.* 1480–1545), was knighted after the battle of Flodden, and was at the Field of the Cloth of Gold in 1520. He was a knight of the shire for Yorkshire and then for Warwickshire, and was a member of the Council of the North from 1537 until his death.

Another noteworthy member of this family was the regicide, Sir William Constable (d. 1655), created a baronet in 1611. He fought with the parliamentarians at Edgehill and in 1644 in north Yorkshire. In 1648, he became governor of Gloucester. He was one of the king's judges, was a member of the council of state under Cromwell, and died on June 15, 1655.

CONSTABLE, a title now confined to the lord high constable of England, the lord constable of Scotland, the constables of some royal castles in England, and to certain executive legal officials of inferior rank in Great Britain and the United States.

The Byzantine *comes stabuli* (κόμης τοῦ σταβλοῦ) was in his origin simply the imperial master of the horse, the head of the imperial stables, and a great officer of state. From the East the title was borrowed by the Frankish kings, and during the Carolingian epoch a *comes stabuli* was at the head of the royal stud, the marshals (*marescalci*) being under his orders. The office survived and expanded in France under the Capetian dynasty; in the 11th century the constable has not only the general superintendence of the royal stud, but an important command in the army—though still under the orders of the seneschal—and certain limited powers of jurisdiction. From this time onward the office of constable tended, in France, continually to increase in importance. In the 14th century, owing to the confusion of his prerogatives as the royal lieutenant with his functions as constable, the constable was recognized as commander-in-chief of the army. The French kings never allowed the office of constable to become hereditary, and in Jan. 1627, after the death of François de Bonne, duc de Lesdiguières, the office was suppressed by royal edict.

The jurisdiction of the constable, known as the *connétablie et maréchaussée de France,* was held in fee until the abolition of the office of constable, when it became a royal court, presided over by the *lieutenant général* with the *lieutenant particulier* and the *procureur du roi* as assessors. Its seat was ultimately fixed at Paris, as part of the organization of the parlement. Its jurisdiction, which included all military persons and causes, was somewhat vaguely extended to embrace all crimes of violence, etc., committed outside the jurisdiction of the towns; it thus came often into conflict with that of the other royal courts.

The Gothic kings of Spain and, later on, the kings of Naples also, had their *comites stabuli* with similar functions.

In England the title of constable was unknown before the Conquest, though the functions of the office were practically those of the English *staller*. In the laws of Edward the Confessor the title constable is mentioned as the French equivalent for the English *heretoga*. After the Conquest the constable duly makes his appearance as "quartermaster general of the court and of the army." From the first, however, the title of constable was not confined to the constable proper, whose office in the reign of Stephen was made hereditary under the style of high constable (*see* Lord High Constable); for under the Norman and Angevin kings, the title soon came to be loosely applied to any high military command. Its extension to officials exercising civil jurisdiction is not difficult to account for. In feudal society, based as this was on a military organization, it is easy to see how the military jurisdiction of the constables would tend to encroach on that of the civil magistrates. The origin of the modern chief and petty constables, however, is to be traced to the Statute of Winchester of 1285, by which the national militia was organized by a blending of the military system with the constitution of the shires. Under this act a chief or high constable was appointed in every hundred; while in the old tithings and *villatae* the village bailiff was generally appointed a petty constable. The high and petty constables remained the executive legal officers in the counties until the County Police Acts of 1839 and 1840 reorganized the county police. In 1842 an important statute was passed enacting that for the future no appointment of a petty constable, headborough, borsholder, tithing-man or peace officer of the like description should be made for any parish at any court leet, except for purposes unconnected with the preservation of the peace, and providing, as a means of increasing the security of persons and property, for the appointment by justices of the peace in divisional petty sessions of fit persons or their substitutes to act as constables in the several parishes of England, and giving vestries an optional power of providing paid constables. Under the Acts of 1839 and 1840 the establishment of a paid county police force was optional with the justices. With the Police Act of 1856 this optional power became compulsory, and thenceforth the history of the petty constable in England is that of the police. By the High Constables Act, 1869, the office of high constable was abolished, and, as the establishment of an efficient police force rendered the general appointment of parish constables unnecessary, the appointment ceased, subject to the appointment by vestries of paid constables under the chief constable of the county (Parish Constables Act 1872). *See* further, Police.

"Special constables" are peace officers appointed to act on occasional emergencies when the ordinary police force is thought to be deficient.

In the United States, outside the larger towns, the petty constable retains much the same status as in England before the Act of 1842. He still has a limited judicial power as conservator of the peace, and often exercises various additional functions, such as that of tax-collector or overseer of the roads or other duties, as may be decided for him by the community which appoints him. In the old colonial days the office, borrowed from England, was of much importance. The office of high constable existed also in Philadelphia and New York, in the latter city until 1830, and in some towns the title has been retained for the chief of the police force.

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CONSTANCE or **KONSTANZ,** a town in the *Land* of Baden, Germany, on the south or left bank of the Rhine, as it flows from the Lake of Constance to form the Untersee. Pop. (1939) 38,469. It is some 30 mi. by rail from Schaffhausen (on the west) and 22½ mi. along the south-west shore of the lake from Rorschach. A fine bridge leads north over the Rhine to one suburb, Petershausen, while to the south the town gradually merges into the Swiss suburb of Kreuzlingen. Constance, originally a Roman station, was a bishop's see from the 6th century (transferred hither from Vindonissa, near Brugg, in the Aargau) till its suppression in 1821. To this it owes its importance. The bishop was a prince of the Holy Roman empire, while his diocese included at one time most of Baden and Württemberg and a large portion of Switzerland. Towards the end of the 12th century the city became an imperial free city, but the bishop practically ruled it till the time of the Reformation. The former cathedral church was erected 1069–89, but was later rebuilt in Gothic style. The Dominican convent, on an island east of the town, is now a hotel, but the buildings (especially the cloisters) are well preserved. The *Kaufhaus* (warehouse for goods) is 14th century, while the town hall dates from 1592. In the market-place are the *Gasthaus zum Barbarossa,* where Frederick Barbarossa is said to have signed the peace of Constance (1183), while in the house named *zum Hohen Hafen* the emperor Sigismund is said to have invested Frederick of Hohenzollern with the mark of Brandenburg (1417). A great Reforming Church council was held in Constance from 1414–18. It condemned and burned John Huss in 1415 and Jerome of Prague in 1416. Constance is the natural capital of the Thurgau, so that when in 1460 the Swiss wrested that region from the Austrians, the town and the Swiss Confederation should have been naturally drawn together. But Constance refused to give up to the Swiss the right of exercising criminal jurisdiction in the Thurgau, which it had obtained from the emperor in 1417, while the Austrians, having bought Bregenz, were also desirous of securing the city. In 1530 Constance (whose bishop had been forced to flee in 1527 to Meersburg) joined, with Strasbourg, Memmingen and Lindau, the Schmalkalden League. But after the defeat of the Protestants in 1547 at Mühlberg the city found itself isolated in southern Germany. The Austrians had long tried to obtain influence in the town, especially when its support of the Protestant cause attracted the sympathy of the Swiss. Hence Charles V. in 1548 forced it to surrender to the imperial authority and to receive the bishop again and consent to annexation to the Austrian dominions. Protestantism was then vigorously stamped out. In 1633 Constance resisted successfully an attempt of the Swedes to take it, and in 1805, by the treaty of Pressburg, was handed over by Austria to Baden. Constance trades in textiles and iron goods and is a tourist centre.

CONSTANCE, COUNCIL OF. This council, convoked at the instance of the emperor Sigismund by Pope John XXIII.—one of the three popes among whom Christendom was at the time divided—with the object of putting an end to the Great Schism of the West and reforming the church, was opened on Nov. 5, 1414, and did not close until April 22, 1418. In spite of his reluctance to go to Constance, John XXIII., who succeeded Alexander V. (the pope elected by the council of Pisa), hoped that the new council, while confirming the work of the council of Pisa, would proclaim him sole legitimate pope and definitely condemn his two rivals, Gregory XII. and Benedict XIII. But he was soon forced to renounce this hope. So urgent was the need of restoring union at any cost that even prelates who had taken an active part in the work of the council of Pisa, *e.g.,* Pierre d'Ailly, cardinal bishop of Cambrai, were forced to admit, in view of the fact that the decisions of that council had been and were still contested, that the only possible course was to reconsider the question of the union *de novo,* entirely disregarding all previous deliberations on the subject, and treating the claims of John and his two competitors with the strictest impartiality. Feebly supported by the Italians, by the majority of the cardinals, and by the representatives of the king of France, John soon found himself in danger of being driven to abdicate and fled into Austria.

The fathers, determined to have their will carried out, drew up in their 4th and 5th sessions (March 30 and April 6, 1415) a set of decrees with the intention of justifying their attitude and putting the fugitive pope at their mercy. Interpreted in the most general sense, these decrees, which enacted that the council of Constance derived its power immediately from Christ, and that everyone, even the pope, was bound to obey it and every legitimately assembled general council in all that concerned faith, reform, union, etc., were tantamount to the overturning of the constitution of the church by establishing the superiority of the council over the pope. The validity of the decrees was especially contested on the ground that the council was not ecumenical, since it represented at that date the obedience of only one of three rival popes. Nevertheless, John, who had been abandoned by the duke of Austria and imprisoned in the castle of Radolfzell, near Constance, was arraigned, suspended and deposed (May 29), and himself ratified the sentence of the council. Gregory XII. was next required to renounce his rights, and this he did, with as much independence as dignity, through a legate, who previously convoked the council in the name of his master, and thus in some sort gave it the necessary confirmed authority. This was the regular extinction of the line of pontiffs who, if the validity of the election of Urban VI. on April 8, 1378, be admitted, had held the legitimate papacy for thirty-seven years. All that remained was to obtain the abdication of Benedict XIII., the successor of the Avignon pope, Clement VII, but the combined efforts of the council and the emperor were powerless to overcome the obstinacy of the Aragonese pope. Abandoned by almost all his adherents Benedict found refuge in the impregnable castle of Peñiscola, overlooking the Mediterranean, and remained intractable. At the council proceedings were instituted against him, which ended at last on July 26, 1417, in his deposition.

The action of the council of Constance in renewing the condemnation of the doctrines of Wycliffe pronounced at Rome in 1413, and in condemning and executing John Huss and Jerome of Prague (*qq.v.*), is dealt with elsewhere; nor is it possible to mention here all the intrigues and quarrels that arose during three and a half years among the crowd of prelates, monks, doctors, simple clerks, princes and ambassadors composing this tumultuous assembly. From the outset, voting by count of heads had been superseded by voting according to nations, *i.e.,* all questions were deliberated and settled in four distinct assemblies—the Italian, the French, the German and the English,—the decisions of the nations receiving a formal ratification afterwards by the council in general congregation, and also, if occasion arose, in public session (it is noteworthy that the English, who had hitherto been considered to form part of the German "nation," were recognized as a separate nation at this council for the first time). These four groups, however, were of unequal importance, and thanks to this arrangement the English, although weakest in point of numbers, were able to exercise the same influence in the council as if they had formed a fourth of the voters.

The reform which the council had set itself to effect was a subject the fathers could not broach without stirring up dissension: some stood out obstinately for preserving the *status quo,* while others contemplated nothing less than the transformation of the monarchical administration of the church into a parliamentary democracy, the subordination of the sovereign pontiff, and the annihilation of the Sacred College. In view of these difficulties, the opinion which tended to assure the success of one at least of the great tasks before the council, viz., the re-establishment of unity by the election of a single pope, finally prevailed. The general reform on which the council had failed to come to an understanding had to be adjourned, and the council contented itself with promulgating, on Oct. 9, 1417, certain reforming decrees on which an agreement could be reached; *e.g.,* the principle of the periodicity of the councils (the first was to assemble after the lapse of five years, the second within the next seven years, and subsequent councils were to meet decennially). In the event of a fresh schism, the council, which bound itself to assemble immediately, even without formal convocation, was to remain sole judge of the conflict. The execution of the general reform of the church in its head and members was left in the hands of the future pope, who had to proceed conjointly with the council, or rather with a commission appointed by the nations—in other words, once the new pope was elected, the fathers, conscious of their impotence, were disinclined to postpone their dispersion until the laborious achievement of the reform. On March 21, 1418, however, seven additional points were agreed on.

In order to rebuild the see of St. Peter on a basis now cleared of obstacles, an attempt was made to surround the election of the future pope with all the necessary guarantees. The authority of the cardinals, who were the only persons judicially invested with the right of electing the pope, emerged from the crisis through which the church had just passed in far too feeble and contested a condition to carry by its own weight the general assent. It was therefore decided that with the cardinals each nation should associate six delegates, and that the successful candidate should be required to poll two-thirds of the suffrages, not only in the Sacred College, but also in each of these five groups. The advantage of this arrangement was that the choice of the future pope would depend, not only on the vote of the cardinals, thus safeguarding tradition, but at the same time on the unanimous consent of the various nations, by which the adhesion of the whole Catholic world to the election would be guaranteed. There was, indeed, a danger lest the rivalries in the assembly might render it exceedingly difficult, not to say impossible, to obtain such unanimity. But at the end of three days the conclave resulted in the election of Cardinal Otto Colonna, who took the name of Martin V. (Nov. 11, 1417), and the Great Schism of the West was at an end.

To all seeming the pope had admitted the canonicity of several of the decrees of Constance—for instance, he had submitted to the necessity of the periodical convocation of other councils; but from his reticence on some points, as well as from his general attitude and some of his constitutions, it appeared that the whole of the decrees of Constance did not receive his unqualified approval, and without any definite pronouncement he made some reservations in the case of decrees which were detrimental to the rights and pre-eminence of the Holy See.

See Hefele-Leclercq, *Histoire des conciles,* VII, 108–584 (1916); art. "Constance" in the *Catholic Encyclopaedia;* M. Creighton, *History of the Papacy from the Great Schism,* vols. i., ii. (1897); N. Valois, *La France et le grand schisme de l'Occident* (1896 ff.); H. Finke, *Forschungen u. Quellen zur Geschichte des Konstanzer Konzils* (1889).

CONSTANCE, LAKE OF (Bodensee), after Lake Geneva the largest lake in the Alpine region, is on the north-east frontier of Switzerland, and is formed by the Rhine. Its north-west end divides into two arms, the *Untersee* (from Constance to Stein-am-Rhein) and the *Überlingersee* (running up to Ludwigshafen). From Bregenz to Stein-am-Rhein it is 46½ mi. long and from Bregenz to Ludwigshafen 40 miles. Its surface is 1,309 ft. above sea-level, greatest width 10½ mi., and greatest depth 827 feet. The area of the lake is 204¾ sq.mi., part being in Switzerland (cantons of Thurgau and St. Gall), part in Austria, and portions in Baden, Württemberg and Bavaria. For accounts of ancient lake dwellings *see* H. Reinerth, *Die jungere Steinzeit der Schweiz* (1927).

CONSTANS I, FLAVIUS JULIUS (d. 350), emperor of the west, was the son of Constantine the Great and Fausta. Under his father he governed western Illyricum, Italy and Africa, and at the division of the empire in 337 he received this share as emperor. His brother Constantine II invaded him in 340, but was defeated and killed. He was killed in the rebellion of Magnentius, in the Pyrenees, in 350.

See Aurel, Vict., *de Caes.* xli; *Cambridge Mediaeval History,* vol. i.

CONSTANS II (FLAVIUS HERACLIUS) (630–668), emperor of the east from 641 to 668, was the son of Constantine III and Gregoria and was born on Nov. 7, 630. He succeeded, after an interval due to the usurpation of Heracleonas, in 641, with Valentine as regent. His reign is notable for disasters at the hands of the Arabs and the Lombards. He fitted out an expedition to recover Egypt then occupied by the Arabs and tried to get assistance from China. The only result was that the Arabs attacked Greek North Africa, and while he was engaged there, Mu-Awijah took Syria and Cyprus and ravaged Cilicia. In 651 the Arabs extended their hold on Sicily and captured Rhodes. In 655, the loss of the sea fight off Lycia endangered Constantinople itself, but Constans profited by the internal dissensions of the Arabs and won some successes on the Danube. The Lombards invaded north Italy at the beginning of his reign. Constans decided to turn them out, and made the last recorded attempt to re-establish Rome as the centre of the united empire. He left for Italy in 662 and at first was successful, but then failed and went to live in Syracuse. Africa then revolted under a new tribute and was lost, and the reign closed with further losses in Italy and the Greek provinces. Constans died mysteriously in his bath at Syracuse on July 15, 668. The reign is also notable for heretical disturbances, and an edict of Constans, the *Typus,* prohibits all religious discussion. In 653 the exarch Calliopas captured the pope.

See Zonaras ii, 87.

CONSTANS, JEAN ANTOINE (1833–1913), French statesman, was born at Béziers on May 3, 1833, and died in Paris on April 7, 1913. He was professor of law at Douai and then at Toulouse until he was elected deputy for the latter city in 1876. He was minister of the interior in the Freycinet cabinet of 1880, and again, during the Boulangist agitation, in the Tirard and Freycinet cabinets (1889–92). He took strong measures against the Boulangists and against the Ligue des Patriotes, and was violently attacked for his action in the press. Constans was ambassador at Constantinople from 1898 to 1907.

CONSTANT, BENJAMIN JEAN JOSEPH (1845–1902), French painter, was born in Paris, and studied under Cabanel. His first Salon picture, "Hamlet et le Roi," was hung in 1869, and he became at once one of the recognized modern masters in France. In addition to a number of subject-pictures, such as "Trop Tard" (1870), "Samson et Délilah" (1871), and others taken from Moroccan studies, he was an eminent painter of portraits of some of the most prominent men and women of the day, one of his last being that of Queen Victoria (1900).

See G. Haller, *Le Salon: Dix ans ae Peinture* (1902).

CONSTANT, a quantity which does not vary. In mathematics and physics a quantity may be constant with respect to one variable but not with respect to another. Many so-called physical constants are constant under certain conditions only; *e.g.,* the boiling point of a pure substance is constant only if the atmospheric pressure is constant (*see* VAPORIZATION). On the other hand there are constants which express invariable ratios, such as the *gas constant R* (*see* THERMODYNAMICS), the *gravitational constant* (*see* GRAVITATION), and *Avogadro's constant* (*q.v.*) *N.* The elementary electric charge *e* (*see* ELECTRON) is an example of the invariable measure of a physical property. Another type of physical constant is the *universal constant, e.g.,* Plank's constant *h,* the element of action (*see* QUANTUM MECHANICS). A famous physical constant is the *velocity of light* (*see* LIGHT), approximately 3×10^{10} cm. per second.

CONSTANȚA, a seaport on the Black Sea, and capital of the department of Constanța, Rumania; 149 mi. east by south from Bucharest by rail. Pop. (1939) 61,412. Constanța was founded as Constantiana by Constantine the Great (A.D. 274–337) in honour of his sister Constantia. Tomi, where Ovid spent eight years of exile, is near by. The bulk of the town was rebuilt after its cession to Rumania in 1878. It was severely damaged in World War I, but afterwards recovered very rapidly, especially owing to the absence of competition from Odessa. It likewise developed as a bathing station, and there are mineral springs in the neighbourhood. There are hotels, a casino, broad streets and numerous mosques, churches and synagogues for the mixed population; it has a small local industry, but Constanța's principal importance is as Rumania's chief outlet to the Black sea, and it does a large transit trade, the main exports being oil and cereals, and imports coal, coke, machinery, iron goods and textiles. A pipe line runs to the Rumanian oil fields; there are many oil storage tanks, and a special basin for vessels loading with petroleum. The harbour is protected by two breakwaters; it requires constant dredging, but has a depth of 20 ft. beside the quays, and 24 ft. in the eastern portion. There are nearly 3 mi. of quays, with coal and timber wharfs, warehouses and grain elevators, and the railway alongside. The harbour accommodates 30 large steamers, with further space on the western side. There are steamship services to Constantinople-Peiraeeus-Naples, Constantinople and Alexandria, and two runs monthly are made to Jaffa and Haifa. Constanța was used by the Germans in World War II as a supply base for their armies in the U.S.S.R.

CONSTANT DE REBECQUE, HENRI BENJAMIN (1767–1830), French writer and politician, was born in Lausanne on Oct. 25, 1767, the son of Juste Arnold de Constant, who commanded a regiment in the Dutch service. After a good private education at Brussels he was sent to Oxford, Erlangen and then to Edinburgh, where he came into contact with prominent Whigs. He returned to Switzerland in 1786, and in the next year visited Paris, where he met Madame de Charrière, who, although 27 years older than Constant, became his mistress, and the *liaison,* an affair possibly more of the intellect than of the heart, lasted until 1796, when Constant became intimate with Madame de Staël. He became chamberlain at the court of Charles William, duke of Brunswick, and in 1789 he married one of the ladies-in-waiting, Wilhelmina, Baroness Chramm. On the dissolution of his marriage in 1794 he resigned a post which his republican opinions made distasteful.

Constant, who had met Madame de Staël at Lausanne in 1794, followed her in the next year to Paris; by 1796 he had established with her intimate relations, which, in spite of many storms, endured for ten years. In 1796 he published two pamphlets in defence of the Directory and against the counter-revolution, and he supported Barras in 1797 and 1799 in the *coups d'état* of 18 Fructidor, and of 18 Brumaire. In Dec. 1799 he was nominated a member of the Tribunate, where he showed from the outset an independence quite unacceptable to Napoleon, by whom he was removed in the "creaming" of that assembly in 1802. The salon of Madame de Staël was a centre for those disaffected from the Napoleonic régime, and in 1803 he followed her into exile. Much of Constant's time was spent with her at Coppet; but he also made long sojourns at Weimar, where he mixed in the Goethe-Schiller circle, and accumulated material for the work on religion which he had begun, so far back as 1787, at Colombier. His relations with Madame de Staël became more and more difficult, and in 1808 he secretly married Charlotte von Hardenberg, whom he had known at Brunswick, and whose divorce from her second husband, General Dutertre, he had secured.

The Napoleonic reverses of 1813 brought him back to politics, and in November he published at Hanover his *De l'esprit de conquête et de l'usurpation dans leurs rapports avec la civilisation européenne,* directed against Napoleon. He also entered into relations with the crown prince of Sweden (Bernadotte). On his return to Paris, during its occupation by the allied sovereigns, he was well received by the emperor Alexander I. of Russia, and resumed his old place in the Liberal salon of Madame de Staël. In a series of pamphlets he advocated the principles of a Liberal monarchy and the freedom of the press. At this point began the second great attachment of his life, his infatuation for Madame Récamier, under whose influence he committed the worst blunder of his political career, for, after an interview with Napoleon on April 10, he became a supporter of his Government and drew up the *Acte constitutionnel.* The return of Louis XVIII. drove him into exile.

In London in 1815 he published *Adolphe,* one of the earlier examples of the psychological, autobiographical novel. In 1816 he was again in Paris, advocating Liberal constitutional principles. He founded in 1818 with other Liberal journalists the *Minerve française* and in 1820 *La Renommée.* In 1819 he was returned to the Chamber of Deputies. Perhaps the greatest service he rendered to his party was his consistent advocacy of the freedom of the press. At the outbreak of the revolution of 1830 he was absent from Paris, but he returned at the request of Lafayette to take his share in the elevation of Louis Philippe to the throne. On Aug. 27 he was made president of the council of State. He died on Dec. 8 of the same year. During his later years he had been a cripple in consequence of a fall in the Chamber of Deputies, and he fought the last of his many duels sitting in a chair. After the death, in 1817, of Madame de Staël, whom he continued to visit daily until the end, he had ceased to go into society, giving himself up to his passion for play.

In the most important of his writings, *De la religion considérée dans sa source, ses formes, et ses développements* (5 vols., 1825–31), Constant traces the successive transformations of the religious sentiment imperishable under its varying forms. Besides *Adolphe,* in its way as important as Chateaubriand's *René,* he left two other sketches of novels in ms., which are apparently lost. His political tracts were collected by himself as, *Collection complète des ouvrages publiés sur . . . la France, formant une espèce de cours de politique constitutionnelle* (4 vols., 1818–20), as were his *Discours à la Chambre des Députés* (2 vols., 1827).

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CONSTANTIA, a district of Cape Colony, in the Cape peninsula, noted for the excellent quality of its wines, the best produced in South Africa. The Government wine farm, Groot Constantia, 10 mi. S. of Capetown, contains over 150,000 vines. This and the adjacent farm of High Constantia are the only farms on which the vines yielding the finest wines flourish. The district is also celebrated for the excellence of the fruit it yields. Groot Constantia House is a good example of the Dutch colonial dwelling-houses of the 17th century. It was built (*c.* 1684) by the governor Simon van der Stell, and named in honour of his wife Constance. Van der Stell also laid out the vineyard, which soon attained a wide reputation. *Old Cape Colony,* by Mrs. A. F. Trotter (1903) contains a plan and sketches of Groot Constantia.

CONSTANTINE VI. (1861–1930), Patriarch of the Greek Orthodox Church, whose family name was Araboghlou, was born at Sigmi, Anatolia, became metropolitan of Derkos, and succeeded Gregory VII. as Oecumenical Patriarch on Dec. 17, 1924, but was expelled from Constantinople on Jan. 30, 1925, on the ground that he was not "domiciled" in the sense of the terms of the treaty of Lausanne. He retired to Salonika, and resigned in order to avoid friction. He was succeeded in the patriarchate by Basil Georgiades, metropolitan of Nicaea.

For a full account of the dispute over the expulsion of Constantine see *Survey of Internat. Aff. 1925,* vol. ii., pp. 266 *et seq.* (1927).

CONSTANTINE, the name of several Roman emperors.

CONSTANTINE I., known as "The Great" (288?–337), Roman emperor, was born on Feb. 27, probably A.D. 288, at Naissus (the modern Nish) in upper Moesia (Serbia). He was the illegitimate son of Constantius I. and Flavia Helena (described by St. Ambrose as an innkeeper). While still a boy, Constantine was sent—practically as a hostage—to the Eastern court. He accompanied Diocletian to the East in 302, was invested with the rank of *tribunus primi ordinis* and served under Galerius on the Danube. In 305 Diocletian and Maximianus abdicated, and Constantius and Galerius became Augusti, while Severus and Maximin Daia attained the rank of Caesars. Constantius now demanded from Galerius the restoration of his son, which was unwillingly granted; indeed, we are told that Constantine only escaped from the court of Galerius by flight, and evaded pursuit by carrying off all the post-horses! He found his father at Bononia (Boulogne), on the point of crossing to Britain to repel an invasion of Picts and Scots. After gaining a victory, Constantius died at Eboracum (York) and on July 25, 306, the army acclaimed his son as

Augustus. Constantine, however, accepted the nomination of the army with feigned reluctance and wrote a carefully worded letter to Galerius, disclaiming responsibility for the action of the troops, but requesting recognition as Caesar. Galerius was not in a position to refuse the request, in view of the temper of the western army, and for a year Constantine bore the title of Caesar not only in his own provinces, but in those of the East as well. He fought with success against the Franks and Alamanni, and reorganized the defenses of the Rhine. The rising of Maxentius (*q.v.*) at Rome (Oct. 28), supported by his father Maximianus (*q.v.*), led to the defeat, capture and death of the western Augustus, Severus. Maximianus thereupon recognized Constantine as Augustus (A.D. 307); their alliance was confirmed by the marriage of Constantine with Fausta, the daughter of Maximianus, and the father and son-in-law held the consulship, which, however, was not recognized in the East. Galerius now invaded Italy, but was forced by a mutiny of his troops to retire from the gates of Rome. Maximianus urged Constantine to fall upon the flank of his retreating army, but he once more showed his determination to tread the strict path of legitimacy. In 308 Diocletian and Galerius held a conference at Carnuntum and determined to annul the actions of the Western rulers. Maximianus was set aside, Licinius invested with the purple as Augustus of the West (Nov. 11), while the title *filius Augustorum* was conferred upon Constantine and Maximin Daia. Constantine tacitly ignored this arrangement; he continued to bear the title of Augustus, and in 309, when he himself was proclaimed consul (with Licinius) in the East, no consuls were recognized in his dominions. In 310, while Constantine was engaged in repelling an inroad of the Franks, Maximianus endeavoured to resume the purple at Arelate (Arles). Constantine returned in haste from the Rhine, and pursued Maximianus to Massilia, where he was captured and put to death. Since Constantine's legal title to the Empire of the West rested on his recognition by Maximianus, he had now to seek for a new ground of legitimacy, and found it in the assertion of his descent from Claudius Gothicus (*q.v.*), who was represented as the father of Constantius Chlorus.

Constantine's patience was soon rewarded. In 311 Galerius died, and Maximin Daia (who had assumed the style of Augustus in 310) at once marched to the shores of the Bosporus and at the same time entered into negotiations with Maxentius. This threw Licinius into the arms of Constantine, who entered into alliance with him and betrothed his half-sister Constantia to him. In the spring of 312 Constantine crossed the Alps, before Maxentius had completed his preparations. The force he commanded was of uncertain strength; according to his panegyrist (who may have underrated it) it consisted of about 25,000, according to Zonaras of nearly 100,000 men. He stormed Susa, defeated Maxentius's generals at Turin and Verona, and marched straight for Rome. This bold move, which contrasted strongly with Constantine's usual caution, was, it would seem, the result of an event which, as told in Eusebius's *Life of Constantine,* takes the form of a conspicuous miracle—the Vision of the Flaming Cross which appeared in the sky at noonday with the legend Ἐν τούτῳ νίκα ("By this conquer"), and led to Constantine's conversion to Christianity. Eusebius professes to have heard the story from the lips of Constantine; but he wrote after the emperor's death, and it was evidently unknown to him in the shape given above when he wrote the *Ecclesiastical History.* The author of the *De mortibus persecutorum* was a well-informed contemporary, and he tells us that the sign was seen by Constantine in a dream; and even Eusebius supplements the vision by day with a dream in the following night. In any case, Constantine adopted the monogram ☧ (borne on the *labarum* [*q.v.*]) as his device.

Maxentius, trusting in superiority of numbers, marched out of Rome and prepared to dispute the passage of the Tiber at the Pons Mulvius (Ponte Molle), beside which a bridge of boats was constructed (*see* SAXA RUBRA). The army which Constantine had been training for six years at once proved its superiority. The Gallic cavalry swept the left wing of the enemy into the Tiber, and with it perished Maxentius, owing, as was said, to the collapse of the bridge of boats (Oct. 28, 312). The remainder of his troops surrendered at discretion and were incorporated by Constantine in the ranks of his army, with the exception of the praetorian guard, which was finally disbanded.

Thus Constantine became undisputed master of Rome and the West, and Christianity, although not as yet adopted as the official religion, secured by the edict of Milan toleration throughout the empire. This edict was the result of a conference between Constantine and Licinius in 313 at Milan, where the marriage of the latter with Constantia took place. In 314 war broke out between the two Augusti, owing, as we are told, to the treachery of Bassianus, the husband of Constantine's sister Anastasia, for whom he had claimed the rank of Caesar. After two hard-won victories Constantine made peace, Illyricum and Greece being added to his dominions. Constantine and Licinius held the consulship in 315.

Peace was preserved for nearly nine years, during which the wise government of Constantine strengthened his position, while Licinius (who resumed the persecution of the Christians in 321) steadily lost ground. Great armaments were called into being by both emperors, and in the spring of 324 Licinius (whose forces are said to have been superior in numbers) declared war. He was twice defeated, first at Adrianople (July 1) and afterwards at Chrysopolis (Sept. 18), when endeavouring to raise the siege of Byzantium, and was finally captured at Nicomedia. His life was spared on the intercession of Constantia and he was interned at Thessalonica, where he was executed in the following year on the charge of treasonable correspondence with the barbarians.

Constantine now reigned as sole emperor in East and West, presiding at the council of Nicaea (*see* under NICAEA, COUNCIL OF and COUNCIL) in 325. In the following year his eldest son, Crispus, was banished to Pola and there put to death on a charge brought against him by Fausta. Shortly afterwards, as it would seem, Constantine became convinced of his innocence, and ordered Fausta to be executed. The precise nature of the circumstances remains a mystery.

In 326 Constantine determined to remove the seat of empire from Rome to the East, and before the close of the year the foundation-stone of Constantinople was laid. At least two other sites—Sardica and Troy—were considered before the emperor's choice fell on Byzantium. It is probable that this step was connected with Constantine's decision to make Christianity the official religion of the empire. Rome was naturally the stronghold of paganism, to which the great majority of the senate clung with fervent devotion. Constantine did not wish to do open violence to this sentiment, and therefore resolved to found a new capital for the new empire of his creation. He announced that the site had been revealed to him in a dream; the ceremony of inauguration was performed by Christian ecclesiastics on May 11, 330, when the city was dedicated to the Blessed Virgin.

In 332 Constantine was called in to aid the Sarmatians against the Goths, over whom his son gained a great victory. Two years later there was again fighting on the Danube, when 300,000 Sarmatians were settled in Roman territory. In 335 a rebellion in Cyprus gave Constantine an excuse for executing the younger Licinius. In the same year he carried out a partition of the empire between his three sons and his two nephews, Delmatius and Hannibalianus. The last named received the vassal-kingdom of Pontus with the title of *rex regum,* while the others ruled as Caesars in their several provinces. Constantine, however, retained the supreme government. Finally, in 337, Shapur (Sapor) II. of Persia asserted his claim to the provinces conquered by Diocletian, and war broke out. Constantine was preparing to lead his army in person, when he was taken ill and after a vain trial of the baths at Helenopolis, died at Ancyrona, a suburb of Nicomedia, on May 22, having received Christian baptism shortly before at the hands of Eusebius. He was buried in the church of the Apostles at Constantinople.

It has been said by Stanley that Constantine was entitled to be called "Great" in virtue rather of what he did than of what he was; and it is true that neither his intellectual nor his moral qualities were such as to earn the title. His claim to greatness rests mainly on the fact that he divined the future which lay before Christianity, and determined to enlist it in the service of his empire, and also on his achievement in completing the work begun by Aurelian and Diocletian, by which the quasi-constitutional monarchy or "principate" of Augustus was transformed into the naked absolutism sometimes called the "dominate." There is no reason to doubt the sincerity of Constantine's conversion to Christianity, although we may not attribute to him the fervent piety which Eusebius ascribes to him, nor accept as genuine the discourses which pass under his name. The moral precepts of the new religion were not without influence upon his life, and he caused his sons to receive a Christian education. Motives of political expediency, however, caused him to delay the full recognition of Christianity as the religion of the state until he became sole ruler of the empire, although he not merely secured toleration for it immediately after his victory over Maxentius, but intervened in the Donatist controversy as early as 313, and presided at the council of Arles in the following year. By a series of enactments, immunities and privileges of various kinds were conferred on the Catholic Church and clergy—heretics being specifically excluded—and the emperor's attitude towards paganism gradually revealed itself as one of contemptuous toleration. From being the established religion of the state it sank into a mere *superstitio.* At the same time its rites were allowed to subsist except where they were held to be subversive of morality, and even in the closing years of Constantine's reign we find legislation in favour of the municipal *flamines* and *collegia.* In 333, or later, a cult of the *Gens Flavia,* as the Imperial family was called, was established at Hispellum (Spello); the offering of sacrifices in the new temple was, however, strictly prohibited. Nor was it until after Constantine's final triumph over Licinius that pagan symbols disappeared from the coinage and the Christian monogram (which had already been used as a mint mark) became a prominent device. From this time forward the Arian controversy demanded the emperor's constant attention, and by his action in presiding at the council of Nicaea and afterwards pronouncing sentence of banishment against Athanasius he not only identified himself more openly than ever with Christianity, but showed a determination to assert his supremacy in ecclesiastical affairs, holding no doubt that, as the office of *pontifex maximus* gave him the supreme control of religious matters throughout the empire, the regulation of Christianity fell within his province. In this matter his discernment failed him. It had been comparatively easy to apply coercion to the Donatists, whose resistence to the temporal power was not wholly due to spiritual considerations, but was largely the result of less pure motives; but the Arian controversy raised fundamental issues, which to the mind of Constantine appeared capable of compromise, but in reality, as Athanasius rightly discerned, disclosed vital differences of doctrine. The result foreshadowed the process by which the church which Constantine hoped to mould into an instrument of absolutism became its most determined opponent. It is unnecessary to give more than a passing mention to the legend according to which Constantine, smitten with leprosy after the execution of Crispus and Fausta, received absolution and baptism from Silvester I. and by his Donation to the bishop of Rome laid the foundation of the temporal power of the papacy (*see* DONATION OF CONSTANTINE).

The political system of Constantine was the final result of a process which, though it had lasted as long as the empire, had assumed a marked form under Aurelian. It was Aurelian who surrounded the imperial person with oriental pomp, wearing the diadem and the jewelled robe, and assuming the style of *dominus* and even *deus,* who assimilated Italy to the condition of the provinces and gave official furtherance to the economic process by which a régime of status replaced a régime of contract. Diocletian endeavoured to secure the new despotism against military usurpation by an elaborate system of co-regency with two lines of succession, bearing the names of *Jovii* and *Herculii,* but maintained by adoption and not by hereditary succession. This artificial system was destroyed by Constantine, who established dynastic absolutism in favour of his own family, the *Gens Flavia,* evidence of whose cult is found both in Italy and in Africa. To form a court he created a new official aristocracy to replace the senatorial order, which the military emperors of the 3rd century A.D. had reduced to practical insignificance. Upon this aristocracy he showered titles and distinctions, such as the revised patriciate, which carried with them the coveted immunity from fiscal burdens. As the senate was now a *quantité négligeable,* Constantine could afford to readmit its members freely to the career of provincial administration, which had been almost closed to them since the reign of Gallienus, and to accord to it certain empty privileges such as the free election of quaestors and praetors, while on the other hand the right of the senator to be tried by his peers was taken away and he was placed under the jurisdiction of the provincial governor.

In the administration of the empire Constantine completed the work of Diocletian by effecting the separation of civil from military functions. Under him the *praefecti praetorio* ceased entirely to perform military duties and became the heads of the civil administration, more especially in the matter of jurisdiction: in 331 their decisions were made final and no appeal to the emperor was permitted. The civil governors of the provinces (*vicarii* and *praesides*) had no control of the military forces, which were commanded by *duces;* and not content with the security against usurpation which was afforded by this division of power, Constantine employed the *comites* who formed a large element in the official aristocracy to supervise and report upon their conduct of affairs (*see* COUNT), as well as an army of so-called *agentes in rebus* who, under colour of inspecting the Imperial posting service, carried on a wholesale system of espionage. In the organization of the army Constantine was responsible for the creation of the great commands under the *magistri peditum* and *equitum.* He also introduced the practice of placing barbarians, especially Germans, in posts of high responsibility.

The organization of society in strictly hereditary corporations or professions was no doubt partly completed before the accession of Constantine; but his legislation contributed to rivet the fetters which bound each individual to the caste from which he sprang. Such *originales* are mentioned in Constantine's earliest laws, and in 332 the hereditary status of the agricultural *colonus* was recognized and enforced. Above all, the municipal *decuriones* on whom the responsibility for raising taxation rested saw every avenue of escape closed against them. In 326 they were forbidden to acquire immunity by joining the ranks of the Christian clergy. It was the interest of the government by such means to secure the regular payment of the heavy fiscal burdens both in money and in kind which had been laid on the subjects of the empire by Diocletian and were certainly not diminished by Constantine. One of our ancient authorities speaks of him as having been for 10 years an excellent ruler, for 12 a robber and for 10 a spendthrift, and he was constantly forced to make fresh exactions in order to enrich his favourites and to carry out such extravagant projects as the building of a new capital. To him are due the taxes, known as *collatio glebalis,* levied on the estates of senators, and *collatio lustralis,* levied on the profits of trade.

In general legislation the reign of Constantine was a time of feverish activity. Nearly 300 of his enactments are preserved to us in the Codes, especially that of Theodosius. They display a genuine desire for reform and distinct traces of Christian influence; *e.g.,* in their humane provisions as to the treatment of prisoners and slaves and the penalties imposed on offences against morality. Nevertheless, they are often crude in conception as well as turgid in style, and were manifestly drafted by official rhetoricians rather than by trained *legists.* Like Diocletian, Constantine believed that the time had come for society to be remodelled by the fiat of despotic authority, and it is significant that from henceforth we meet with the undisguised assertion that the will of the emperor is the sole fountain of law. Constantine, in fact, embodies the spirit of absolute authority which, both in church and State, was to prevail for many centuries.

BIBLIOGRAPHY.—The principal ancient sources for the life of Constantine are the biography of Eusebius, which is, however, untrustworthy owing to the ecclesiastical bias of its author, the tract *de mortibus persecutorum* ascribed to Lactantius, the orations of the *Panegyrici,* Nos. vi.–x., the second book of the history of Zosimus (written from the pagan standpoint), the so-called *Excerpta Valesiana* and the writings of Aurelius Victor and Eutropius. Among modern books may be mentioned H. Schiller, *Geschichte der römischen Kaiser-*

zeit, ii. 2, 164 ff. (1887); C. H. Firth, *Constantine the Great* (1905); Seeck, *Geschichte des Untergangs der antiken Welt,* vol. i. (1909); and, above all, *Cambridge Mediaeval History,* vol. i. chap. 1 (1911), with useful bibliography. On the religious policy of Constantine, G. Costa, *Religione e politica nel impero romano* (1923) should be consulted. For an examination of the "Constantine Myth," *see* Burch, *Myth and Constantine the Great* (1927). (H. S. J.)

CONSTANTINE II. (317–340), son of Constantine the Great, Roman emperor (337–340), was born at Arelate (Arles) in February 317. On March 1 in the same year he was created Caesar, and was consul in 320, 321, 324 and 329. The fifth anniversary of his Caesarship was celebrated by the panegyrist Nazarius. He gained the credit of the victories of his generals over the Alamanni (331), and over the Goths (332). From 335 he administered the Gallic portion of the empire as Caesar till his father's death, May 22, 337. On Sept. 9 in the same year he assumed the title of Augustus, together with his brothers Constans and Constantius, and in 338 a meeting was held at Viminiacum, on the borders of Pannonia, to arrange the distribution of the empire. In accordance with the arrangements made by his father, Constantine received Britain, Spain, and the Gauls. By virtue of his seniority he claimed a kind of control over his brothers. Constans declined to submit; and Constantine demanded from Constans the cession of Africa and equal authority in Italy. In 340 Constantine invaded Italy, but was killed near Aquileia.

See Zosimus ii., xii.; Aurelius Victor, *Epit.* 41; Eusebius, *Vita Constantini,* iv.; O. Seeck in Pauly-Wissowa's *Realencyclopädie,* iv. pt. I. (1900); Gibbon, *Decline and Fall,* ch. 18.

CONSTANTINE III., son of the emperor Heraclius (d. 641) by his first wife, succeeded as joint-emperor with Heracleonas, the son of Heraclius by his second wife. Court intrigues nearly led to a civil war, which was prevented by the death of Constantine (May 641). He was supposed to have been poisoned by order of his step-mother.

CONSTANTINE IV., *Pogonatus* (the "bearded"), son of Constans II., was emperor from 668 to 685. After his accession he crushed an Armenian usurper in Sicily. For six years (672–77) the Arabs under the caliph Moawiya (*see* CALIPHATE) besieged Constantinople, but were obliged at last to make peace and agree to pay tribute for 30 years. The attacks of the Slavs and Avars upon Thessalonica were repulsed. But Constantine was unable to prevent the Bulgars from crossing the Danube and settling in the district where their name still survives. The Bulgarian kingdom was established under its first king Isperich in 679. The tribute paid by the Arabs was used to purchase the good will of the new settlers. Constantine summoned the sixth ecumenical council at Constantinople, which sat from Nov. 7, 680, to Sept. 16, 681.

CONSTANTINE V., *Copronymus,* son of Leo III. the iconoclast, was emperor 740–75. Immediately after his accession, while he was fighting against the Arabs, his brother-in-law, an Armenian named Artavasdus, a supporter of the image-worshippers, had been proclaimed emperor, and it was not till the end of 743 that Constantine re-entered Constantinople. When he felt his position secure, he determined to settle the religious controversy. In 754 he assembled at the palace of Hiereion 338 bishops, by whom the worship of images was forbidden as opposed to all Christian doctrine. But the resistance to iconoclasm continued, chiefly owing to the influence of the monks. A vigorous campaign against monasticism took place; the monasteries were closed, and monks and nuns were compelled to marry. One of the most important results of the struggle was the defection of the pope, who sought and obtained protection from Pippin, king of the Franks. From this time onward the nominal dependence of Rome and the papacy on emperors at Constantinople ceased. Constantine has been described by the orthodox historians of his time as a monster of iniquity; but it is now generally admitted that he was one of the most capable rulers who ever occupied the Byzantine throne. He restored the aqueduct built by Valens and destroyed by the barbarians in the reign of Heraclius, re-peopled Constantinople (after it had been devastated by a great plague) and some of the cities of Thrace, revived commercial prosperity, and fought with considerable success against the Arabs, Slavs and Bulgarians.

CONSTANTINE VI., grandson of Constantine V., was emperor 780–97. At ten years of age he succeeded his father, Leo IV., under the guardianship of his mother Irene (*q.v.*). In 782 the Arabs under Harun al-Rashid penetrated as far as the Bosporus, and exacted an annual tribute as the price of an inglorious peace. Even when Constantine came of age, Irene practically retained the supreme power. At length Constantine had her arrested, but foolishly pardoned her in 792. In 796 she organized a plot against him and in June 797 he was seized and blinded. According to some, he died on the same day; according to others, he survived for several years. With Constantine VI. the Isaurian dynasty became extinct.

See Theophanes and the biographies of the patriarch Tarasius and Theodore of Studium; also F. C. Schlosser, *Geschichte der bilderstürmenden Kaiser des oströmischen Reichs* (Frankfurt am Main [1812]).

CONSTANTINE VII., *Porphyrogenitus* ("born in the purple") (905–959), East Roman emperor, author and patron of literature, was the son of Leo VI. the Wise. Though nominally emperor from 912–59, he was practically excluded from all real share in the government by ambitious relatives until 945. He was poisoned by his son Romanus in 959. Constantine was a painter and a patron of art and literature. Knowledge of his times is due to the following works written by or directly inspired by him: (1) *De Thematibus,* an account of the military districts (Themata) of the empire during the time of Justinian, chiefly borrowed from Hierocles and Stephanus of Byzantium; (2) *De administrando imperio,* written for the use of his son; (3) *De cerimoniis aulae Byzantinae,* describing the customs of the Eastern Church and court; (4) a life of Basilius I., his grandfather, based on the work of Genesius; also two treatises on military subjects are attributed to him: one on tactics which, as the title shows, was really written by his grandson Constantine VIII., the other a description of the different methods of fighting in fashion amongst different peoples. A speech on the despatch of an image of Christ to Abgar, king of Edessa, is also preserved. Of works undertaken by his instructions the most important were the Encyclopaedic Excerpts from all available treatises on various branches of learning: (1) *Historica,* in 53 sections, of which *De legationibus, De virtutibus et vitiis, De sententiis, De insidiis,* have been wholly or partly preserved; (2) *Basilica,* a compilation from the different parts of the Justinian Corpus Juris; (3) *Geoponica,* agricultural treatises; (4) *Iatrica,* a medical handbook compiled by one Theophanes Nonnus, chiefly from Oribasius; (5) *Hippiatrica,* on veterinary surgery, the connection of which with Constantine is, however, disputed; (6) *Historia animalium,* a compilation from the epitome of Aristotle's work on the subject by Aristophanes of Byzantium, with additions from other writers such as Aelian and Timotheus of Gaza.

See A. Rambaud, *L'Empire grec au dixième siècle* (1870); also Gibbon, *Decline and Fall,* ch. 53, and G. Finlay, *Hist. of Greece,* ii. 294 (1877). Many of Constantine's works will be found in Migne, *Patrologia Graeca,* cix., cxii., cxiii.; for editions of the rest, C. Krumbacher, *Geschichte der byzantinischen Literatur* (1897), and the article by Cohn in Pauly-Wissowa's *Realencyclopädie der classischen Altertumswissenschaft* (1900) should be consulted. The former contains a valuable note on the "Gothic Christmas" described in detail in the *De ceremoniis; see* also Bury in *Eng. Hist. Rev.* xxii. (1907).

CONSTANTINE VIII. This title is given by Gibbon to the son of Romanus I. Lecapenus, one of the colleagues of Constantine VII. Porphyrogenitus, but it is now generally bestowed upon Constantine, the brother and colleague of Basil II. from 976–1025, sole ruler 1025–28. He gave himself up to pleasure and allowed the administration to fall into the hands of six eunuchs.

CONSTANTINE IX. Monomachus, emperor 1042–54, owed his elevation to Zoë, the empress who, in order to secure her position, married Constantine, with whom she shared the throne till her death in 1050. In his old age, Constantine, who had once been a famous warrior, utterly neglected the defences of the empire and reduced his army by disbanding 50,000 of his best troops; on the other hand, he spent extravagant sums on luxuries and the erection of magnificent buildings. Rebellions broke out at home and abroad; the Normans conquered Lombardy, which subsequently (1055) became the duchy of Apulia, and thus Italy was lost to the empire; the Petchenegs (Patzinaks) crossed the Danube and attacked Thrace and Macedonia; and the Seljuk Turks made their appearance on the Armenian frontier.

CONSTANTINE X. *Ducas,* emperor 1059–67, succeeded Isaac I. (*q.v.*) Comnenus. But the choice was not justified, for Constantine, who had shown himself a capable minister, proved incompetent as an emperor. He reduced the army, cut down the soldiers' pay, failed to keep up the supply of war material, and neglected the frontier fortresses at a time when the Seljuk Turks were pressing hard upon the eastern portion of the empire. Alp Arslan overran Armenia in 1064. The Magyars occupied Belgrade, the Petchenegs (Patzinaks) continued their inroads, and in 1065 the Uzes (called by the Greeks Comani), a Turkish tribe from the shores of the Euxine, crossed the Danube in vast numbers, ravaged Thrace and Macedonia, and penetrated as far as Thessalonica. The empire was only saved by an outbreak of plague amongst the invaders and the bravery of the Bulgarian peasants. In the year before Constantine's death the remnant of the Byzantine possessions in Italy was finally lost to the empire, and the chief town, Bari, taken by the Normans. (H. S. J.)

For the later Constantines references to general authorities will be found under ROMAN EMPIRE, LATER; *see* also CALIPHATE and SELJUKS for the wars of the period.

CONSTANTINE, king of the Hellenes (1868–1923), eldest son of George I. and of the Grand Duchess Olga Constantinova of Russia, was born at Athens on Aug. 2, 1868. The prince completed his education in Germany, where he attended the university of Leipzig, served in the Guards and studied at the Prussian Staff college. In 1889 he married the Princess Sophia Dorothea of Hohenzollern, daughter of the Emperor Frederick. This union was popular in Greece because of the superstition that when a Constantine and a Sophia were upon the throne the empire of Byzantium would be restored, and, coupled with the fact that he was appointed a field marshal in the Prussian Army in 1913, it affected the king's attitude during the World War.

On returning to Greece, the crown prince was given various military appointments; in 1897 he took over the command of the army in Thessaly, and he was held largely responsible for the disastrous campaign of that year. In 1909 Constantine and his brothers were once more made scapegoats by the Military league, and were compelled to resign their commissions. Subsequently, on the initiative of Venizelos, the royal princes were recalled from their practical exile. Thenceforward, acting in co-operation with the French military mission, Constantine, now inspector-general of the army, devoted himself to reforms which were markedly apparent during the Balkan wars, and the successes that were then gained completely re-established his prestige. He succeeded his father on the throne of Greece on March 18, 1913.

On Aug. 7, 1914, immediately after the outbreak of the World War, Constantine expressed his personal sympathy for the German emperor and advocated a neutrality which would be useful to him, but took no active steps. But after the entry of Turkey into the war, the king, probably influenced by his military advisers, vetoed Venizelos' proposal to co-operate with the Western Powers in the Dardanelles in exchange for their promises of concessions in Asia Minor. Venizelos resigned (March 1915), but at the subsequent election in June he obtained a large parliamentary majority. (*See* VENIZELOS.)

For some months the struggle between the king and Venizelos continued, but from Oct. 1915 the rupture was complete, and thenceforward Constantine was more occupied by his relations with the Allies than by the internal crisis. The closing months of 1915 and the earlier part of 1916 passed without any overt signs of hostility, but in May of the latter year Fort Rupel, which commanded the Struma pass into eastern Macedonia, was surrendered to the Bulgarians, and the Allies demanded the complete demobilization of the Hellenic army, which menaced them in Macedonia. Five months later (Oct). the Greek fleet (except three vessels) was taken over by the Allies, and in November, the demobilization having proceeded slowly, a further demand was made for the cession of war material. This request was not complied with, and, although it would appear that the king had given personal assurances to the French admiral, an Allied landing at the Peiraeeus was opposed, and the naval contingents, disembarked there on Dec. 1, had to be withdrawn after material losses. A month later a further blockade was declared and the removal of the whole Greek army to the Peloponnesus was insisted on. This was agreed to and a formal apology was made for the events of Dec. 1, but it soon became obvious that the king's attitude constituted a danger to the Allied position at Salonika.

In June 1917 M. Jonnart, the High Commissioner of the protecting Powers, arrived at Athens, where, backed up by strong forces, he demanded better guarantees for the safety of the Allied army in Macedonia, a more loyal adherence to the constitution and the departure of the king. Constantine, accompanied by the queen and the crown prince, sailed from Greece on June 12, leaving his son Alexander upon the throne; but the proclamation then issued by the king was ambiguous, and contained no final renunciation of his rights. Constantine spent the next three years in Switzerland.

As a result of the election of Nov. 1920, and of the subsequent plebiscite, Constantine returned to Athens at the end of December. His position was exceedingly difficult. Never recognized by Great Britain and France, he was compelled either to pursue the Asiatic policy of his predecessors or to make himself unpopular by sacrificing gains promised to Greece under the already signed Treaty of Sèvres. Rightly or wrongly, he adopted the former alternative; he declared himself in favour of a continuation of the Turkish campaign, and he failed to condemn, if he never encouraged, the Greek objections to the several offers of mediation made by the Western Powers. For the disastrous results of the campaign in Asia Minor *see* GREECE: *Modern History*. By the last week in Sept. 1922 an insurrection had broken out in the army, and, at the demand of a revolutionary committee headed by Col. Gonatas, the king abdicated in favour of his son George. On Sept. 30 Constantine left Athens for Palermo, where he died on Jan. 11, 1923, from haemorrhage of the brain.

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CONSTANTINE (FLAVIUS CLAUDIUS CONSTANTINUS), usurper in Britain, Gaul and Spain (A.D. 407–410) during the reign of Honorius, was a common soldier, invested with the purple by his comrades in Britain. He at once crossed over to Gaul and soon made himself master of the country as far as the Alps and Pyrenees, and established his capital at Arelate (Arles). Spain was finally annexed by Constans, the son of Constantine. After the downfall of Stilicho, Honorius, hard pressed by the barbarians, pardoned Constantine, recognized him as joint ruler, and permitted him to confer the title of Caesar upon Constans. This gave Constantine his opportunity. With a large army he marched into Italy, avowedly to assist Honorius, in reality with the intention of making himself ruler of the West. But his plans were upset by the revolt of Gerontius. This capable general set up one of his own adherents as emperor, invaded Gaul, and put Constans to death at Vienna (Vienne). He then besieged Constantine himself in Arelate, but the advance of an Italian army forced him to retire. The generals of Honorius themselves continued the siege. Constantine, seeing that resistance was useless, surrendered the city on condition that his life should be spared. He was, however, executed by order of Honorius.

See Zosimus v. *ad fin.* and vi.; Sozomen, *Ecclesiastical History*, ix. 11 foll.; Gibbon's *Decline and Fall*, ed. J. B. Bury, pp. 272, 340, 502; O. Seeck in Pauly-Wissowa's *Realencyclopädie*, iv. pt. 1. (1900).

CONSTANTINE PAVLOVICH (1779–1831), grand-duke and cesarevich of Russia, was born at Tsarskoye Selo on April 27, 1779, the second son of the tsar Paul and his wife Maria Feodorovna, and was educated under the direction of his grandmother, Catherine II. The only person who really took him in hand was César La Harpe, who was tutor-in-chief from 1783 to May 1795, and educated both the empress's grandsons.

Like Alexander, Constantine was married by Catherine when not yet 17 years of age, and he made his wife, Juliana of Coburg, intensely miserable. After a first separation in the year 1799, she went back permanently to her German home in 1801, the victim of a frivolous intrigue. Constantine's first campaign took place under the leadership of the great Suvorov. The battle of Bassignano was lost by Constantine's fault, but at Novi he distinguished himself by such personal bravery that the emperor Paul bestowed on him the title of cesarevich, which according to the fundamental law of the constitution belonged only to the heir to the throne.

In command of the Guards during the campaign of 1805 Constantine shared the responsibility for the battle of Austerlitz; while in 1807, 1812, 1813 and 1814 he showed courage but not competence as a soldier.

Constantine's importance in political history dates only from the moment when Alexander made him commander-in-chief of the forces of Congress Poland. The command of the Lithuanian troops and of those of the Russian provinces that had formerly belonged to the kingdom of Poland was added in 1819. He organized their army for the Poles, and felt himself more a Pole than a Russian, especially after his marriage (May 27, 1820), with a Polish lady, Johanna Grudzinska. After this marriage he formally renounced any claim to the succession to the tsardom, but the fact was only revealed to two or three persons, and his brother Nicholas was left in ignorance of it. On the death of Alexander (Dec. 1, 1825), there was much confusion and uncertainty. After three weeks hesitation Constantine sent an unconditional renunciation of any claim to Nicholas, whose accession was then announced. On the 26th the Dekabrist rising in Petrograd took place and the mutineers shouted, "Long live Constantine!" The rising was easily suppressed. Constantine had had no part in the plot. But differences soon arose between him and his brother in consequence of the share taken by the Poles in the Dekabrist conspiracy. Constantine held obstinately to the belief that the Polish army and bureaucracy were loyally devoted to the Russian empire. The eastern policy of the tsar and the Turkish War of 1828 and 1829 caused a fresh breach between them. It was owing to the opposition of Constantine that the Polish army took no part in this war.

The insurrection at Warsaw in Nov. 1830 took Constantine completely by surprise. It was owing to his utter failure to grasp the situation that the Polish regiments passed over to the revolutionaries; and during the continuance of the revolution he showed himself as incompetent as he was lacking in judgment. The suppression of the revolution he did not live to see. He died of cholera at Vitebsk on June 27, 1831.

See also Karrnovich, *The Cesarevich Constantine Pavlovich* (1899) (Russian); T. Schiemann, *Geschichte Russlands unter Kaiser Nicolaus I.*, vol. i. (1904); Pusyrevski, *The Russo-Polish War of 1831* (2nd ed., 1890) (Russian).

CONSTANTINE (ancient CIRTA), city of Algeria, capital of the department of the same name, 54 mi. by railway S. by W. of the port of Philippeville, in 36° 22′ N., 6° 36′ E. Constantine is the residence of a general commanding a division, of a prefect and other high officials, is the seat of a bishop, and had a population by the census of 1936 of 106,830. The city occupies a romantic position on a rocky plateau, cut off on all sides save the west from the surrounding country by a beautiful ravine, through which the river Rummel flows. The plateau is 2,130 ft. above sea-level, and from 500 to nearly 1,000 ft. above the river bed. The ravine, formed by the Rummel, through erosion of the limestone, varies greatly in width—at its narrowest part the cliffs are only 15 ft. apart, at its broadest the valley is 400 yd. wide. At the N.E. angle of the city the gorge is spanned by an iron bridge built in 1863, N. and S. by a bridge and a viaduct built in 1912. Along the north-eastern side of the city the Rummel is spanned in all four times by natural stone arches or tunnels.

Walls and Buildings.—Constantine is walled, the extant mediaeval wall having been largely constructed out of Roman material. Through the centre from north to south runs a street (the rue de France) roughly dividing Constantine into two parts. The place du Palais, in which are the palace of the governor and the cathedral, and the kasbah (citadel) are west of the rue de France, as is likewise the place Négrier, containing the law courts. The native town lies chiefly in the south-east part of the city. A striking contrast exists between the Moorish quarter, with its tortuous lanes and Oriental architecture, and the modern quarter, with its rectangular streets and wide open squares, frequently bordered with trees and adorned with fountains. Of the squares the place de Nemours is the centre of the commercial and social life of the city. New quarters have arisen to the S.W. of the town. The palace, built by Ahmed Pasha, the last bey of Constantine, between 1830 and 1836, is a specimen of Moorish architecture of the 19th century. The kasbah, which occupies the northern corner of the city, dates from Roman times, and preserves in its more modern portions numerous remains of other Roman edifices. It is now turned into barracks and a hospital. The fine mosque of Sidi-el-Kattani (or Salah Bey) dates from the close of the 18th century.

The native industry of Constantine is chiefly confined to leather goods and woollen fabrics. A considerable trade is carried on over a large area by means of railway connection with Algiers, Bona, Tunis and Biskra, as well as with Philippeville.

History.—Constantine, or, as it was originally called, Cirta or Kirtha, from the Phoenician word for a city, was in ancient times one of the most important towns of Numidia, and the residence of the kings of the Massyli. Under Micipsa (2nd century B.C.) it reached the height of its prosperity, and was able to furnish an army of 10,000 cavalry and 20,000 infantry. Though it afterwards declined, it still continued an important military post, and is frequently mentioned during successive wars. Caesar having bestowed a part of its territory on his supporter Sittius, the latter introduced a Roman settlement. In the war of Maxentius against Alexander, the Numidian usurper, it was laid in ruins; and on its restoration in A.D. 313 by Constantine it received the name which it still retains. It was not captured during the Vandal invasion of Africa, but on the conquest by the Arabians (7th century) it shared the same fate as the surrounding country. Successive Arab dynasties looted it. During the 12th century it was still a place of considerable prosperity; and its commerce was extensive enough to attract the merchants of Pisa, Genoa and Venice. Frequently taken and retaken by the Turks, Constantine finally became under their dominion the seat of a bey, subordinate to the dey of Algiers. To Salah Bey, who ruled from 1770 to 1792, we owe most of the existing Moslem buildings. In 1826 Constantine asserted its independence of the dey of Algiers, and was governed by Haji Ahmed, the choice of the Kabyles. In 1836 the French under Marshal Clauzel made an unsuccessful attempt to storm the city, which they attacked by night by way of El-Kantara. The French suffered heavy loss. In 1837 Marshal Valée took it by assault. During the Allied campaign against the axis, 1942–43, the city and nearby setif were important bases and centres of command. *See* E. Mercier, *Histoire de Constantine* (Constantine, 1905).

CONSTANTINE THE AFRICAN (*c.* 1020–1087) is one of the few important medical figures of the Middle Ages. He was the initiator of the significant "Arabist" movement, the process of translation into Latin from Arabic. Legends have clustered about his name and his early career is still obscure.

It is said that he was born at Carthage. He was certainly an Arabic-speaking Christian and led a wandering life. Later he claimed that he had studied in many Eastern centres of learning. The legends tell that on his return to his native city his learning brought him under suspicion of witchcraft and he had to flee. We hear of him in the service of the Norman duke, Robert Guiscard (*q.v.*). This was probably about 1071, in Sicily rather than at Salerno, with which Constantine's name is more closely linked. There is in fact some evidence that Constantine was actually a native of Sicily rather than of Carthage, and it must be remembered that some Arabic was still spoken in Sicily in the eleventh century. Moreover, in addition to Arabic he knew some Latin and had a smattering of Greek, and this trilinguality is fully consistent with his birth in the "many-tongued isle" where all three vernaculars were in use. Constantine probably followed Robert Guiscard to Salerno. There he became a monk and ended his days at the Benedictine house of Monte Cassino. He translated at Monte Cassino a number of Arabic works into Latin, and it seems that he had help with the Latin. The character of these works and the knowledge displayed in them suggest that he had neither visited Cairo nor Irak in the way that he claimed. The books themselves are mainly renderings of works by Jewish writers living in North Africa. These works, though wretchedly translated, are yet exceedingly important for the history of culture. They represent the first inflow of a group of new ideas and their appearance marks the end of the "dark ages" and the dawn of the scholastic period.

Among the works which Constantine thus conveyed were two philosophical treatises by Isaac Israeli (855–955) of Kairosuan, known to the West as Isaac the Jew. One of these writings, *On definitions,* contains an account of some of the favourite terms used by the Latin scholastics and later adopted by them from him. Another, *On the Elements,* was an exposition of Aristotelian physics. From the same author he translated a number of medical works which he issued under his own name. He treated similarly the works of Isaac's pupil Ibn Jezzar. The most important medical work that he rendered into Latin he called *Pantechne.* It was in fact an abbreviated version of the *Liber Regius* of the Persian Ali ibn al Abbas (died 994), known as Haly Abbas to the Latins. This was extremely important as the first work which gave the Western world a view of Greek medicine as a whole, though the view was somewhat dimmed by the Arabic cloud that was around it.

Constantine sought to pass off his translations as his original work and it is probable that he never produced any independent writing. Nevertheless his works spread through Europe with extraordinary rapidity and it is difficult to overestimate their influence on the ages which followed. They continued to be read until the sixteenth century and were particularly influential at the important medical school at Salerno (*q.v.*).

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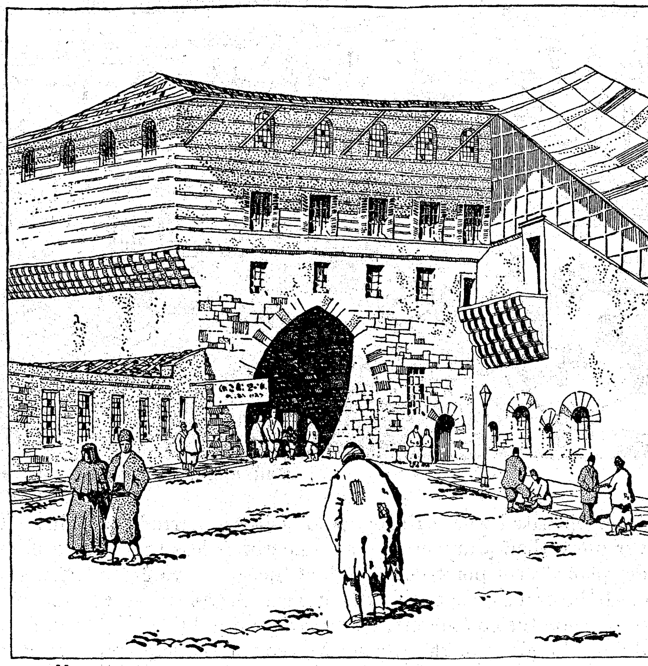
CONSTANTINOPLE, Turkey, now called Istanbul, formerly the capital of the Turkish empire, situated in 41° 0′ 16″ N. and 28° 58′ 14″ E. The city stands at the southern extremity of the Bosporus, upon a hilly promontory that runs out from the European side of the straits towards the Asiatic bank. The sea of Marmora is on the south, and the bay of the Bosporus, forming the magnificent harbour of the Golden Horn, some 4 m. long, on the north. Two streams, the ancient Cydaris and Barbysus, now Ali-Bey-Su and Kiahat-Hanè-Su, enter the bay at its north-western end. A small winter stream, the Lycus, flowing through the promontory west to south-east into the Sea of Marmora, separates a long ridge, divided by cross-valleys into six eminences, overhanging the Golden Horn, from a large isolated hill in the south-west. Hence the claim of Constantinople to be enthroned, like Rome, upon seven hills. The first hill has the Seraglio, St. Sophia and the Hippodrome; the second the column of Constantine and the mosque Nuri-Osmanieh; the third the war office, the Seraskereate tower and the mosque of Sultan Suleiman; the fourth the mosque of Sultan Mohammed II., the Conqueror; the fifth the mosque of Sultan Selim; the sixth Tekfour Serai and the quarter of Egri Kapu; the seventh Avret Tash and the quarter of Psamatia. In Byzantine times the two last hills were named respectively the hill of Blachernae and the Xerolophos or dry hill.

HISTORY

Origin and Site.—Constantinople is famous in history, in the first place as the capital of the Roman empire in the East for more than eleven centuries (330–1453), and in the second as the capital of the Ottoman empire which followed. In respect of influence over the course of human affairs, its only rivals are Athens, Rome and Jerusalem. Yet even the gifts of these rivals to the cause of civilization often bear the image and superscription of Constantinople upon them. Roman law, Greek literature, the theology of the Christian church, for example, are intimately associated with the history of Constantinople.

The city was founded by Constantine the Great, through the enlargement of the old town of Byzantium (*q.v.*) in A.D. 328, and was inaugurated as a new seat of government on May 11, A.D. 330. To indicate its political dignity, it was named New Rome, while to perpetuate the fame of its founder it was styled Constantinople. The chief patriarch of the Greek church still signs himself "archbishop of Constantinople, New Rome." The old name of the place, Byzantium, however, continued in use.

The creation of a new capital by Constantine was not an act of personal caprice or individual judgment. It was the result of causes long in operation, and had been foreshadowed, 40 years



MAIN APPROACH TO THE GRAND BAZAAR IN CONSTANTINOPLE
The arch over the street is adjacent to Mosque Validé Sultane, while at the other end of the vaulted passage is the bridge which leads across the Golden Horn to Pera, the European quarter

before, in the policy of Diocletian. After the senate and people of Rome had ceased to be the sovereigns of the Roman world, and their authority had been vested in the sole person of the emperor, the eternal city could no longer claim to be the rightful throne of the state. That honour could henceforth be conferred upon any place in the Roman world which might suit the convenience of the emperor, or serve more efficiently the interests he had to guard. Furthermore, the empire was now upon its defence. Dreams of conquests and extension had long been abandoned, and the pressing question of the time was how to repel the persistent assaults of Persia and the barbarians upon the frontiers of the realm, and so retain the dominion inherited from the valour of the past. The size of the empire made it difficult, if not impossible, to attend to these assaults, or to control the ambition of successful generals, from one centre. Further, the East had grown in political importance, both as the scene of the most active life in the state and as the portion of the empire most exposed to attack. Hence the famous scheme of Diocletian to divide the burden of government between four colleagues, in order to secure a better administration of civil and of military affairs. It was a scheme, however, that lowered the prestige of Rome, for it involved four distinct seats of government, among which, as the event proved, no place was found for the ancient capital of the Roman world. It also declared the high position of the East, by the selection of Nicomedia in Asia Minor as the residence of Diocletian himself. When Constantine, therefore, established a new seat of government at Byzantium, he adopted a policy inaugurated before his day as essential to the preservation of the Roman dominion. He can claim originality only in his choice of the particular point at which that seat was placed, and in his recognition of the fact that his alliance with the Christian church could be best maintained in a new atmosphere.

But whatever view may be taken of the policy which divided the government of the empire, there can be no dispute as to the wisdom displayed in the selection of the site for a new imperial

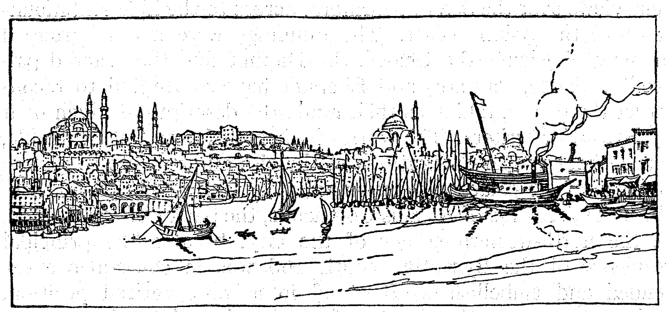
GENERAL VIEW OF CONSTANTINOPLE SHOWING THE GOLDEN HORN

throne. Situated where Europe and Asia are parted by a channel never more than 5 m. across, and sometimes less than half a mile wide, placed at a point commanding the great waterway between the Mediterranean and the Black Sea, the position affords immense scope for commercial enterprise and political action in rich and varied regions of the world. Moreover, the site constituted a natural citadel, difficult to approach or to invest, and an almost impregnable refuge in the hour of defeat, within which broken forces might rally to retrieve disaster. To surround it, an enemy required to be strong upon both land and sea. Foes advancing through Asia Minor would have their march arrested, and their blows kept beyond striking distance, by the moat which the waters of the Bosporus, the Sea of Marmora and the Dardanelles combine to form. The narrow straits in which the waterway connecting the Mediterranean with the Black Sea contracts, both to the north and to the south of the city, could be rendered impassable to hostile fleets approaching from either direction, while on the landward side the line of defence was so short that it could be strongly fortified, and held against large numbers by a comparatively small force. Nature, indeed, cannot relieve men of their duty to be wise and brave, but, in the marvellous configuration of land and sea about Constantinople, nature has done her utmost to enable human skill and courage to establish there the splendid and stable throne of a great empire.

Architecture and Antiquities.—Byzantium, out of which Constantinople sprang, occupied most of the land comprised in the two hills nearest the head of the promontory, and the level ground at their base. The landward wall started from a point near the present Stamboul custom-house, and reached the ridge of the second hill, a little to the east of the point marked by Chemberli Tash (the column of Constantine). There the principal gate of the town opened upon the Egnatian road. From that gate the wall descended towards the Sea of Marmora, touching the water in the neighbourhood of the Seraglio lighthouse. The Acropolis, enclosing venerated temples, crowned the summit of the first hill, where the Seraglio stands. Immediately to the south of the fortress was the principal market-place of the town, surrounded by porticoes on its four sides, and hence named the Tetrastoon. On the southern side of the square stood the baths of Zeuxippus, and beyond them, still farther south, lay the Hippodrome, which Septimius Severus had undertaken to build but failed to complete. Two theatres, on the eastern slope of the Acropolis, faced the bright waters of the Marmora, and a stadium was found on the level tract on the other side of the hill, close to the Golden Horn. The Strategion, devoted to the military exercises of the brave little town, stood close to Sirkedji Iskelessi, and two artificial harbours, the Portus Prosforianus and the Neorion, indented the shore of the Golden Horn. A graceful granite column, still erect on the slope above the head of the promontory, commemorated the victory of Claudius Gothicus over the Goths at Nissa, A.D. 269. All this furniture of Byzantium was appropriated for the use of the new capital.

According to Zosimus, the line of the landward walls erected by Constantine to defend New Rome was drawn at a distance of nearly 2 m. (15 stadia) to the west of the limits of the old town. It therefore ran across the promontory from the vicinity of Un Kapan Kapusi (Porta Platea), at the Stamboul head of the Inner Bridge, to the neighbourhood of Daud Pasha Kapusi (Porta S. Aemiliani), on the Marmora, and thus added the third and fourth hills and portions of the fifth and seventh hills to the territory of Byzantium. We have two indications of the course of these walls on the seventh hill. One is found in the name Isa Kapusi (the gate of Jesus) attached to a mosque, formerly a Christian church, situated above the quarter of Psamatia. It perpetuates the memory of the beautiful gateway which formed the triumphal entrance into the city of Constantine, and which survived the original bounds of the new capital as late as 1508, when it was overthrown by an earthquake. The other indication is the name Alti Mermer (the six columns) given to a quarter in the same neighbourhood. The name is an ignorant translation of Exakionion, the corrupt form of the designation Exokionion, which belonged in Byzantine days to that quarter because marked by a column outside the city limits. Hence the Arians, upon their expulsion from the city by Theodosius I., were allowed to hold their religious services in the Exokionion, seeing that it was an extra-mural district. This explains the fact that Arians are sometimes styled Exokionitae by ecclesiastical historians. The Constantinian line of fortifications, therefore, ran a little to the east of the quarter of Alti Mermer. In addition to the territory enclosed within the limits just described, the suburb of Sycae or Galata, on the opposite side of the Golden Horn, and the suburb of Blachernae, on the sixth hill, were regarded as parts of the city, but stood within their own fortifications. It was to the ramparts of Constantine that the city owed its deliverance when attacked by the Goths, after the terrible defeat of Valens at Adrianople, A.D. 378.

Fortifications Against Barbarism.—To his courtiers, the bounds assigned to New Rome by Constantine seemed too wide, but after 80 years they were too narrow for the population that had gathered within the city. The barbarians had meantime also grown more formidable, and this made it necessary to have stronger fortifications for the capital. Accordingly, in 413, in the reign of Theodosius II., Anthemius, then praetorian prefect of the East and regent, enlarged and refortified the city by the erection of the wall which forms the innermost line of defence in



VIEW ACROSS THE GOLDEN HORN TOWARD STAMBOUL

the bulwarks whose picturesque ruins now stretch from the Sea of Marmora, on the south of Yedi Kuléh (the seven towers), northwards to the old Byzantine palace of the Porphyrogenitus (Tekfour Serai), above the quarter of Egri Kapu. There the new works joined the walls of the suburb of Blachernae, and thus protected the city on the west down to the Golden Horn. Somewhat later, in 439, the walls along the Marmora and the Golden Horn were brought, by the prefect Cyrus, up to the extremities of the new landward walls, and thus invested the capital in complete armour. Then also Constantinople attained its final size. For any subsequent extension of the city limits was insignificant, and was due to strategic considerations. In 447 the wall of Anthemius was seriously injured by one of those earthquakes to which the city is liable. The disaster was all the more grave, as the Huns under Attila were carrying everything before them in the Balkan lands. The desperateness of the situation, however, roused the government of Theodosius II., who was still upon the throne, to put forth the most energetic efforts to meet the emergency. If we may trust two contemporary inscriptions, one Latin, the other Greek, still found on the gate Yeni Mevlevi Khanéh Kapusi (Porta Rhegium), the capital was again fully armed, and rendered more secure than ever, by the prefect Constantine, in less than two months. Not only was the wall of Anthemius restored, but, at the distance of 20 yd., another wall was built in front of it, and at the same distance from this second wall a broad moat was constructed with a breastwork along its inner edge. Each wall was flanked by 96 towers. Here was a barricade 190–207 ft. thick, and 100 ft. high, with its several parts rising tier above tier to permit concerted action, and alive with large bodies of troops ready to pour, from every coign of vantage, missiles of death—arrows, stones, Greek fire—upon a foe. It is not strange that these fortifications defied the assaults of barbarism upon the civilized life of the world for more than a thousand years. As might be expected, the walls demanded frequent restoration from time to time in the course of their long history. Inscriptions upon them record repairs, for example, under Justin II., Leo the Isaurian, Basil II., John Palaeologus, and others. Still, the ramparts extending now from the Marmora to Tekfour Serai are to all intents and purposes the ruins of the Theodosian walls of the 5th century.

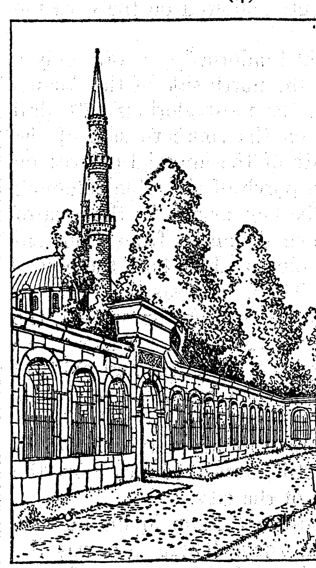
This is not the case in regard to the other parts of the fortifications of the city. The walls along the Marmora and the Golden Horn represent the great restoration of the seaward defences of the capital carried out by the emperor Theophilus in the 9th century; while the walls between Tekfour Serai and the Golden Horn were built long after the reign of Theodosius II., superseding the defences of that quarter of the city in his day, and relegating them, as traces of their course to the rear of the later works indicate, to the secondary office of protecting the palace of Blachernae. In 627 Heraclius built the wall along the west of the quarter of Aivan Serai, in order to bring the level tract at the foot of the sixth hill within the city bounds, and shield the church of Blachernae, which had been exposed to great danger during the siege of the city by the Avars in that year. In 813 Leo V. the Armenian built the wall which stands in front of the wall of Heraclius to strengthen that point in view of an expected attack by the Bulgarians.

The splendid wall, flanked by nine towers, that descends from the court of Tekfour Serai to the level tract below Egri Kapu, was built by Manuel Comnenus (1143–1180) for the greater security of the part of the city in which stood the palace of Blachernae, then the favourite imperial residence. Lastly, the portion of the fortifications between the wall of Manuel and the wall of Heraclius presents too many problems to be discussed here. Enough to say, that in it we find work belonging to the times of the Comneni, Isaac Angelus and the Palaeologi.

If we leave out of account the attacks upon the city in the course of the civil wars between rival parties in the empire, the fortifications of Constantinople were assailed by the Avars in 627; by the Saracens in 673–677, and again in 718; by the Bulgarians in 813 and 913; by the forces of the Fourth Crusade in 1203–04; by the Turks in 1422 and 1453. The city was taken in 1204, and became the seat of a Latin empire until 1261, when it was recovered by the Greeks. On May 29, 1453 Constantinople ceased to be the capital of the Roman empire in the East, and became the capital of the Ottoman dominion.

MONUMENTS AND ART

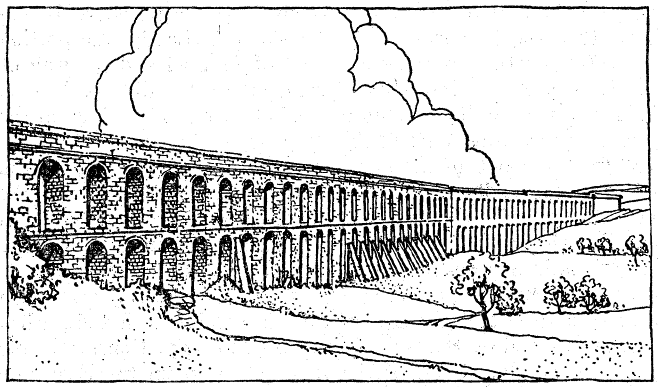
The Walls.—Notable points in the circuit of the walls of the city are the following: (1) The Golden Gate, now included in the Turkish fortress of Yedi Kuléh. It is a triumphal archway, consisting of three arches, erected in honour of the victory of Theodosius I. over Maximus in 388, and subsequently incorporated in the walls of Theodosius II., as the state entrance of the capital. (2) The gate of Selivria, or of the Pegé, through which Alexius Strategopoulos made his way into the city in 1261, and brought the Latin empire of Constantinople to an end. (3) The gate of St. Romanus (Top Kapusi), by which, in 1453, Sultan Mahommed entered Constantinople after the fall of the city into Turkish hands. (4) The great breach made in the ramparts crossing the valley of the Lycus, the scene of the severest fighting in the siege of 1453, where the Turks stormed the city, and the last Byzantine emperor met his heroic death. (5) The palace of the Porphyrogenitus, long erroneously identified with the palace of the Hebdomon, which really stood at Makrikeui. It is the finest specimen of Byzantine civil architecture left in the city. (6) The tower of Isaac Angelus and the tower of Anemas, with the chambers in the body of the wall to the north of them. (7) The wall of Leo, against which the troops of the Fourth Crusade came, in 1203, from their camp on the hill opposite the wall, and delivered their chief attack. (8) The walls protecting the quarter of Phanar, which the army and fleet of the Fourth Crusade under the Venetian doge, Henrico Dandolo, carried in 1204. (9) Yali Kiosk Kapusi, beside which the southern end of the chain drawn across the mouth of the harbour during a siege was attached. (10) The ruins of the palace of Hormisdas, near Chatladi Kapu, once the residence of Justinian the Great and Theodora. It was known in later times as the palace of the Bucoleon, and was the scene of the assassination of Nicephorus Phocas. (11) The sites of the old harbours between Chatladi Kapu and Daud Pasha Kapusi. (12) The fine marble tower near the junction of the walls along the Marmora with



THE MOSQUE OF THE STANDARD BEARER
Erected by Mohammed the Conqueror in 1463–69 in memory of the Standard Bearer of the Prophet, this was the first imperial mosque

the landward walls.

Internal.—Arrangements inside the city were determined by the configuration of its site, which falls into three great divisions—the level ground and slopes looking towards the Sea of Marmora, the range of hills forming the midland portion of the promontory, and the slopes and level ground facing the Golden Horn. In each division a great street ran through the city from east to west, generally lined with arcades on one side, but with arcades on both sides when traversing the finer and busier quarters. The street along the ridge formed the principal thoroughfare, and was named the Mesé (Μέση), because it ran through the middle of the city. On reaching the west of the third hill, it divided into two branches, one leading across the seventh hill to the Golden gate, the other conducting to the church of the Holy Apostles, and the gate of Charisius (Edirnéh Kapusi). The Mesé linked together the great fora of the city,—the Augustaion on the south of St. Sophia, the forum of Constantine on the summit of the second hill, the forum of Theodosius I. or of Taurus on the summit of the third hill, the forum of Amastrianon where the mosque of Shah Zadéh is situated, the forum of the Bous at Ak Serai, and the forum of Arcadius or Theodosius II. on the summit of the seventh hill. This was the route followed on the occasion of triumphal processions.



THE LONG AQUEDUCT (USUN KEMER) NEAR PYRGOS

Of the edifices and monuments which adorned the fora, only a slight sketch can be given here. On the north side of the Augustaion rose the church of St. Sophia, the most glorious cathedral of Eastern Christendom; opposite, on the southern side of the square, was the Chalcé, the great gate of the imperial palace; on the east was the senate house, with a porch of six noble columns; to the west, across the Mesé, were the law courts. In the area of the square stood the Milion, whence distances from Constantinople were measured, and a lofty column which bore the equestrian statue of Justinian the Great. There also was the statue of the empress Eudoxia, famous in the history of Chrysostom, the pedestal of which is preserved in the Museum gardens. The Augustaion was the heart of the city's ecclesiastical and political life. The forum of Constantine was a great business centre. Its most remarkable monument was the column of Constantine, built of 12 drums of porphyry and bearing aloft his statue. Shorn of much of its beauty, the column still stands to proclaim the enduring influence of the foundation of the city.

In the forum of Theodosius I. rose a column in his honour, the basis of which was identified in 1927. There also was the Anemodoulion, a beautiful pyramidal structure, surmounted by a vane to indicate the direction of the wind. Close to the forum, if not in it, was the capitol, in which the university of Constantinople was established. The most conspicuous object in the forum of the Bous was the figure of an ox, in bronze, beside which the bodies of criminals were sometimes burnt. Another hollow column, the pedestal of which is now known as Avret Tash, adorned the forum of Arcadius. A column in honour of the emperor Marcian still stands in the valley of the Lycus, below the mosque of Sultan Mohammed the Conqueror. Many beautiful statues, belonging to good periods of Greek and Roman art, decorated the fora, streets and public buildings of the city, but conflagrations and the vandalism of the Latin and Ottoman conquerors of Constantinople have robbed the world of most of those treasures.

The imperial palace, founded by Constantine and extended by his successors, occupied the territory which lies to the east of St. Sophia and the Hippodrome down to the water's edge. It consisted of a large number of detached buildings, in grounds made beautiful with gardens and trees, and commanding magnificent views over the Sea of Marmora, across to the hills and mountains of the Asiatic coast. The buildings were mainly grouped in three divisions—the Chalcé, the Daphné and the "sacred palace." Labarte, Paspates and Ebersolt have attempted to reconstruct the palace, taking as their guide the descriptions given of it by Byzantine writers. The work of Ebersolt is specially valuable, but without proper excavations of the site all attempts to restore the plan of the palace with much accuracy lack a solid foundation. With the accession of Alexius Comnenus, the palace of Blachernae, at the north-western corner of the city, became the principal residence of the Byzantine court, and was in consequence extended and embellished. It stood in a more retired position, and was conveniently situated for excursions into the country and hunting expeditions. Of the palaces outside the walls, the most frequented were the palace at the Hebdomon, now Makrikeui, in the early days of the empire, and the palace of the Pegé, now Balukli, a short distance beyond the gate of Selivria, in later times. For municipal purposes, the city was divided, like Rome, into fourteen regions.

CHURCHES

As the seat of the chief prelate of Eastern Christendom, Constantinople was characterized by a strong theological and ecclesiastical temperament. It was full of churches and monasteries, enriched with the reputed relics of saints, prophets and martyrs, which consecrated it a holy city and attracted pilgrims from every quarter to its shrines. It was the meeting-place of numerous ecclesiastical councils, some of them ecumenical (*see* below, CONSTANTINOPLE, COUNCILS OF). It was likewise distinguished for its numerous charitable institutions. Only some 20 of the old churches of the city are left. Most of them have been converted into mosques, but they are valuable monuments of the art which flourished in New Rome. Among the most interesting are the following: St. John of the Studium (Emir-Achor Jamissi) is a basilica of the middle of the 5th century, and the oldest ecclesiastical fabric in the city; it is now, unfortunately, almost a complete ruin. SS. Sergius and Bacchus (Kutchuk Aya Sofia) and St. Sophia are erections of Justinian the Great. The former is an example of a dome placed on an octagonal structure, and in its general plan is similar to the contemporary church of S. Vitale at Ravenna. St. Sophia (*i.e.*, Ἁγία Σοφία, Holy Wisdom) is the glory of Byzantine art, and one of the most beautiful buildings in the world. St. Mary Diaconissa (Kalender Jamissi) is a fine specimen of the work of the closing years of the 6th century. St. Irené, founded by Constantine, and repaired by Justinian, is in its present form mainly a restoration by Leo the Isaurian, in the middle of the 8th century. St. Mary Panachrantos (Fenari Isa Mesjidi) belongs to the reign of Leo the Wise (886–912). The Myrelaion (Bodrum Jami) dates from the 10th century. The Pantepoptes (Eski Imaret Jamissi), the Pantocrator (Zeirek Kilissè Jamissi), and the body of the church of the Chora (Kahriyeh Jamissi) represent the age of Comneni. The Pammakaristos (Fetiyeh Jamissi), St. Andrew in Krisei (Khoja Mustapha Jamissi), the narthexes and side chapel of the Chora were, at least in their present form, erected in the times of the Palaeologi. It is difficult to assign precise dates to SS. Peter and Mark (Khoda Mustapha Jamissi at Aivan Serai), St. Theodosia (Gul Jamissi), St. Theodore Tyrone (Kilissé Jamissi). The beautiful façade of the last is later than the other portions of the church, which have been assigned to the 9th or 10th century.

For a study of the church of St. Sophia, the reader must consult the article BYZANTINE ART. The present edifice was built by Justinian the Great, under the direction of Anthemius of Tralles and his nephew Isidorus of Miletus. It was founded in 532 and dedicated on Christmas Day 538. It replaced two earlier churches of that name, the first of which was built by Constantius and burnt down in 404, on the occasion of the exile of Chrysostom, while the second was erected by Theodosius II. in 415, and destroyed by fire in the Nika riot of 532. Naturally the church has undergone repair from time to time. The original dome fell in 558, as the result of an earthquake, and among the improvements introduced in the course of restoration, the dome was raised 25 ft. higher than before. Repairs are recorded under Basil I., Basil II., Andronicus III. and Cantacuzene. Since the Turkish conquest a minaret has been erected at each of the four exterior angles of the building, and the interior has been adapted to the requirements of Muslim worship, mainly by the destruction or concealment of most of the mosaics which adorned the walls. In 1847–48, during the reign of Abd-ul-Mejid, the building was put into a state of thorough repair by the Italian architect Fossati. Happily the sultan allowed the mosaic figures, then exposed to view, to be covered with matting before being plastered over. They may reappear in the changes which the future will bring. The dome, which had fallen into considerable disrepair, was reinforced on the outside and reroofed in 1926–27.

The Hippodrome.—Citizens of Constantinople found recreation in the chariot-races held in the Hippodrome, now the At Meidan, to the west of the mosque of Sultan Ahmed. So much did the race-course (begun by Severus) enter into the life of the people that it has been styled "the axis of the Byzantine world." It was not only the scene of amusement, but on account of its ample accommodation it was also the arena of much of the political life of the city. The factions, which usually contended there in sport, often gathered there in party strife. There emperors were acclaimed or insulted; there military triumphs were celebrated; there criminals were executed, and there martyrs were burned at the stake. Three monuments remain to mark the centre of the building; an Egyptian obelisk of Thothmes III., on a pedestal covered with bas-reliefs representing an emperor, presiding at scenes in the Hippodrome; the triple serpent column, which stood originally at Delphi, to commemorate the victory of Plataea 479 B.C.; an obelisk, once covered with plates of gilded bronze. Excavations begun by the British Academy in 1927 have recovered the plan and dimensions of the Hippodrome. It is 480 metres long and 117·5 wide.

The city was supplied with water mainly from two sources; from the streams immediately to the west, and from the springs and rain impounded in reservoirs in the forest of Belgrade, to the north-west, very much on the system followed by the Turks. The water was conveyed by aqueducts, concealed below the surface, except when crossing a valley. Within the city the water was stored in covered cisterns, or in large open reservoirs. The aqueduct of Justinian, the Crooked aqueduct, in the open country, and the aqueduct of Valens that spans the valley between the 4th and 3rd hills of the city, still carry on their beneficent work, and afford evidence of the attention given to the water-supply of the capital during the Byzantine period. The cistern of Arcadius, to the rear of the mosque of Sultan Selim (having, it has been estimated, a capacity of 6,571,720 cu.ft. of water), the cistern of Aspar, a short distance to the east of the gate of Adrianople, and the cistern of Mokius, on the seventh hill, are specimens of the open reservoirs within the city walls. The cistern of Bin Bir Derek (cistern of Illus) with its 224 columns, each built up with three shafts, and the cistern Yeri Batan Serai (Cisterna Basilica) with its 420 columns show what covered cisterns were, on a grand scale. The latter is still in use.[1]

Byzantine Constantinople was a great commercial centre. To equip it more fully for that purpose, several artificial harbours were constructed along the southern shore of the city, where no natural haven existed to accommodate ships coming up the Sea of Marmora. For the convenience of the imperial court, there was a small harbour in the bend of the shore to the east of Chatladi Kapu, known as the harbour of the Bucoleon. To the west of that gate, on the site of Kadriga Limani (the Port of the Galley), was the harbour of Julian, or, as it was named later, the harbour of Sophia (the empress of Justin II.). Traces of the harbour styled the Kontoscalion are found at Kum Kapu. To the east of Yeni Kapu stood the harbour of Kaisarius or the Heptascalon, while to the west of that gate was the harbour which bore the names of Eleutherius and of Theodosius I. A harbour named after the Golden gate stood on the shore to the south-west of the triumphal gate of the city.

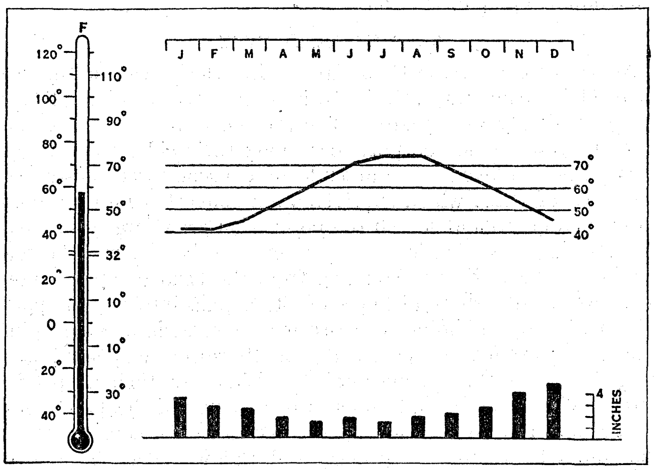
[1]For the ancient water-supply *see* Count A. F. Andréossy, *Constantinople et le Bosphore;* Tchikatchev, *Le Bosphore et Constantinople* (2nd ed., 1865); Forchheimer and Strzygowski, *Die byzantinischen Wasserbehälter;* also article AQUEDUCTS.

THE MODERN CITY

As the capital of the Ottoman empire, the aspect of the city changed in many ways. The works of art which adorned New Rome gradually disappeared. The streets, never very wide, became narrower, and the porticoes along their sides were almost everywhere removed. A multitude of churches were destroyed, and most of those which survived were converted into mosques. In race and garb and speech the population grew largely oriental. One striking alteration in the appearance of the city was the conversion of the territory extending from the head of the promontory to within a short distance of St. Sophia into a great park, within which the buildings constituting the seraglio of the sultans, like those forming the palace of the Byzantine emperors, were ranged around three courts, distinguished by their respective gates—Bab-i-Humayum, leading into the court of the Janissaries; Orta Kapu, the middle gate, giving access to the court in which the sultan held state receptions; and Bah-i-Saadet, the gate of Felicity, leading to the more private apartments of the palace. From the reign of Abd-ul-Mejid, the seraglio was practically abandoned, first for the palace of Dolmabagché on the shore near Beshiktash, and then for Yildiz Kiosk, on the heights above that suburb. The older apartments of the palace, such as the throne-room, the Bagdad Kiosk, and many of the objects in the imperial treasury are of extreme interest to all lovers of oriental art. The seraglio was thrown open to the public in 1926. Another great change in the general aspect of the city has been produced by the erection of stately mosques in the most commanding situations. The most remarkable mosques are the following:—The mosque of Sultan Mohammed the Conqueror, built on the site of the church of the Holy Apostles (1463–69), rebuilt in 1768 owing to injuries due to an earthquake; the mosques of Sultan Selim, of the Shah Zadeh, of Sultan Suleiman and of Rustem Pasha—all works of the 16th century, the best period of Turkish architecture; the mosque of Sultan Bayezid II. (1497–1505); the mosque of Sultan Ahmed I. (1610); Yeni-Validé-Jamissi (1615–1665); Nuri-Osmanieh (1748–1755); Laleli-Jamissi (1765). The Turbehs containing the tombs of the sultans and members of their families are often beautiful specimens of Turkish art.

In their architecture, the mosques present a striking instance of the influence of the Byzantine style, especially as it appears in St. Sophia. The architects of the mosques have made a skilful use of the semi-dome in the support of the main dome of the building, and in the consequent extension of the arched canopy that spreads over the worshipper. In some cases the main dome rests upon four semi-domes. At the same time, when viewed from the exterior, the main dome rises large, bold and commanding, with nothing of the squat appearance that mars the dome of St. Sophia, with nothing of the petty prettiness of the little domes perched on the drums of the later Byzantine churches. The great mosques express the spirit of the days when the Ottoman empire was still mighty and ambitious.

For all intents and purposes, Constantinople is now the collection of towns and villages situated on both sides of the Golden Horn and along the shores of the Bosporus, including Scutari and Kadikeui. But the chief parts of this group of towns are Istanbul, or Stamboul (from Gr. εἰς τὴν πόλιν, "into the city"), the official name of the city since the founding of the republic, Galata and Pera. Galata has a long history, which becomes of general interest after 1265, when it was assigned to the Genoese merchants in the city by Michael Palaeologus, in return for the friendly services of Genoa in the overthrow of the Latin empire of Constantinople. In the course of time, notwithstanding stipulations to the contrary, the town was strongly fortified and proved a troublesome neighbour. During the siege of 1453 the inhabitants maintained on the whole a neutral attitude, but on the fall of the capital they surrendered to the Turkish conqueror, who granted them liberal terms. The walls have for the most part been removed. The tower, however, which formed the citadel of the colony, still remains. There are also churches and houses dating from Genoese days. Galata is the chief business centre of the city, the seat of banks, post-offices, steamship offices, etc. Pera is the principal residential quarter of the European communities settled in Constantinople.



WEATHER GRAPH OF CONSTANTINOPLE. THE THERMOMETER INDICATES THE ANNUAL MEAN TEMPERATURE. THE CURVE SHOWS THE MONTHLY MEAN TEMPERATURE, AND THE COLUMNS, THE NORMAL MONTHLY PRECIPITATION

Since the middle of the 19th century the city has yielded more and more to western influences, and is fast losing its oriental character. The Galata quay, completed in 1889, is 756 metres long and 20 metres wide; the Stamboul quay, completed in 1900, is 378 metres in length. The harbour, quays and facilities for handling merchandise, which have been established at the head of the Anatolian railway, at Haidar Pasha, would be a credit to any city. The growth of the imperial museum of antiquities, under the direction of Hamdy Bey and Halil Bey has been remarkable; and while the collection of the sarcophagi discovered at Sidon constitutes the chief treasure of the museum, the institution has become a rich storehouse of many other valuable relics of the past. The museum of Ottoman art in Tchinili Kiosk and the museum of the ancient Orient are two new additions since 1923. The fine medical school between Scutari and Haidar Pasha, the Hamidieh hospital for children and the asylum for the poor tell of the advance of science and humanity in the place.

Many foreign educational institutions flourish in Constantinople itself, and they are largely attended by the youth belonging to the native communities of the country. The Greek population is provided with excellent schools and gymnasia, and the Armenians also maintain schools of a high grade. The old War Office (Seraskerat) in Stamboul is now used to house the University of Stamboul, a new but flourishing institution, based upon the French system.

Transfer of the Capital.—Constantinople passed through several periods of political and economic disaster, relieved only by very brief periods of normal life and prosperity, during the years 1900 to 1925. Four wars following each other in quick succession caused at times a complete cessation of trade, the influx of hordes of refugees, demoralization in the organization and regulation of civic life, loss of population and an acute impoverishment of all classes. Within this period also Constantinople lost, in theory as well as in fact, the position held well-nigh uninterruptedly for 16 centuries—that of the headship of a great empire. During the Balkan wars (1912–13) the city narrowly escaped capture by the Bulgarians; the refugees who poured in from Thrace taxed the resources of the city to the utmost, and the loss of European provinces unfavourably affected its trade position. During World War I the city was in a state of complete blockade by sea, subjected to numerous air attacks, and during the last months before the Armistice, almost denuded of food, fuel and other necessities of life. The outstanding features of the period of the occupation by Great Britain, France and Italy (Nov. 13, 1918–Oct. 2, 1923) were: a short period in 1919–20 of intense commercial activity and relative prosperity, brought to an abrupt end in 1921 by the combined effects of the war in Anatolia and the worldwide trade depression; the outbreak in 1919 of the nationalist movement and the Greek war; the invasion of the city in 1919 and 1920 by some 100,000 destitute refugees, the bulk of whom were Turks (30,000) and Russians (65,000); the arrival in the city at intervals, mostly in 1922 and 1923, of over 200,000 Greek deportees from Anatolia, most of whom were speedily moved on to Greece; the seizure of the machinery of government by the nationalists after the Mudaniya armistice in Oct. 1922; the flight of the deposed sultan, Mehmed VI., on Nov. 17, 1922; and the formal evacuation of the city by the Allies on Oct. 2, 1923.

The vital factor in the fortunes of the city was its relation to the nationalist movement. When, in March 1920, the British attempted to suppress the activities of those supporters of the nationalist movement who were still in the city, many were exiled to Malta, and thousands of sympathizers left for Anatolia to assist in the task of liberation. The Anatolian leaders determined that Constantinople should no longer exact that tragic tribute of lives and treasure which had repeatedly exhausted their country in the past and the subordination of Constantinople to Angora and Anatolia was definite and complete when, on March 3, 1924, the caliph, Abdul Mejid, was expelled.

During World War II Constantinople was on a constant *qui vive*, especially after the axis conquest of the Balkans, fearing a German attempt to drive through Turkey to the middle east or the southern Caucasus.

Climate.—The climate of the city is healthful, but relaxing. It is damp and liable to sudden and great changes of temperature. The winds from the north and those from the south are at constant feud, and blow cold or hot in the most capricious manner, often in the course of the same day. "There are two climates at Constantinople, that of the north and that of the south wind." The winters may be severe, but when mild they are wet and not invigorating. In summer the heat is tempered by the prevalence of a north-east wind that blows down the channel of the Bosporus. Observations at Constantinople and at Scutari give the following results, for a period of twenty years.

	Constantinople	Scutari
Mean temperature	57° 17′	58° 1′
Maximum	99° 1′	103° 6′
Minimum	17° 2′	13° 0′
Rain	28·3 in.	29·29 in.
Number of rainy days	112	128·6

The sanitation of the city has been improved, although much remains to be done in that respect. No great epidemic has visited the city since the outbreak of cholera in 1866. Typhoid and pulmonary diseases are common.

Population.—The population in 1940 was 793,949 for the city and 991,237 for the vilayet. The census of 1927 credited the vilayet with 794,444, of whom 547,126 were Muslims, 100,214 Greeks, 53,129 Armenians, 47,035 Jews, 23,930 Catholics, and 4,421 Protestants. The pop. of the city in 1927 was 690,857.

Water-supply.—The sultans enlarged and increased the reservoirs in the forest of Belgrade, and new aqueducts were added to those erected by the Byzantine emperors. Old cisterns within the walls were abandoned, and water led to basins in vaulted chambers (*Taxim*), from which it is distributed by underground conduits to fountains.

For the supply of Pera, Galata and Beshiktash, Sultan Mahmud I. constructed, in 1732, four bends in the forest of Belgrade, N.N.W. and N.E. of the village of Bagchekeui, and the fine aqueduct which spans the head of the valley of Buyukderé. After 1885 a French company, La Compagnie des Eaux, rendered a great service by bringing water to Stamboul, Pera, and the villages on the European side of the Bosporus, from Lake Dercos, which lies close to the shore of the Black Sea some 29 mi. distant from the city. The Dercos water is laid on in many houses. After 1893 a German company supplied Scutari and Kadikeui with water from the valley of the Sweet Waters of Asia.

Administration.—For the preservation of order and security, the city is divided into four divisions (Belad-i-Selassi), viz., Stamboul, Pera-Galata, Beshiktash and Scutari.

The municipal government of the four divisions of the city is in the hands of a prefect, appointed by the president of the republic, and subordinate to the minister of the interior. He is officially styled the prefect of Stamboul, and is assisted by a council of twenty-four members, appointed by the president or the minister of the interior. The city is furthermore divided into ten municipal circles as follows. In Stamboul: (1) Sultan Bayezid, (2) Sultan Mehemet, (3) Djerah Pasha (Psamatia); on the European side of the Bosporus and the northern side of the Golden Horn: (4) Beshiktash, (5) Yenikeui, (6) Pera, (7) Buyukderé; on the Asiatic side of the Bosporus: (8) Anadol Hissar, (9) Scutari, (10) Kadikeui. Each circle is subdivided into several wards (*mahalleh*). The outlying parts of the city are divided into six districts (*Cazas*), namely, Princes' islands, Guebzeh, Beicos, Kartal, Kuchuk-Chekmedjé and Shilé, each having its governor (*kaimakam*). These districts are dependencies of the ministry of the interior, and their municipal affairs are directed by agents of the prefecture.

Modernization of Constantinople.—The modernization of the city made remarkable strides in spite of the adverse conditions. In 1912 electric lighting and in 1913 and 1914 the first electric tramways and telephones were introduced. During World War I the municipal organization and services seriously deteriorated. With the restoration of complete Turkish control, and particularly under the energetic administration of the prefect, Dr. Emin Bey, a decided change for the better took place. A genuinely effective fire-fighting organization was created for the first time in the history of the city, periodically devastated throughout its long history by terrible fires; the condition of the streets, which during the occupation were morally and materially in a deplorably unclean state, was improved; 25 km. of new roads were constructed and 250 km. of old roads repaired; the water supply was augmented; the construction of a thoroughly modern sewage system was begun in Stamboul; a new slaughter house, an ice factory and refrigerating plant, six dispensaries and a hospital were built and placed under municipal management.

The city remains the educational and cultural centre of the nation. The National university was installed in the commodious buildings of the old war office. It was founded in 1900 and completely reorganized in 1933. In 1936 it had 4,812 students, among whom were 929 women. The two normal schools, one for men and one for women, continue to function. The foreign schools which existed before 1914 are allowed to continue their work, but no new ones may be opened, and like all private schools they are under strict supervision of the ministry of public education.

The most striking social changes relate to the status of women. The veil was almost completely discarded during World War I, and in 1925 the European hat began to supplant the traditional "charshaf." Men and women mingle freely in the streets and at public gatherings, and the compartments reserved for women in public conveyances have been done away with. The university has opened all its departments to women. The new municipal law of 1930 granted Turkish women the right to vote and to be elected in municipal elections. In Dec. 1934 they received the same right for national elections. The complete suppression in 1925 of the fez and the adoption of European headgear for men removed one more picturesque and distinctive feature of the life of the city, as did the introduction of the Latin alphabet in 1928 instead of the picturesque Arab characters.

The capitulations (*q.v.*) were abolished in 1914 and their abolition confirmed by the treaty of Lausanne. The old Ottoman code has been replaced by one based upon the Swiss code. It became effective in Oct. 1926. Foreigners have a right to establish their own schools and hospitals, and to hold their special religious services.

The commercial life of Constantinople was revolutionized by the wars of 1912–23. In 1919 and 1920 the port revived in connection with transit trade to Russia and Rumania, but in 1921 this revival collapsed. Instability of Turkish currency, world-wide trade depression and war in Anatolia were prime causes. However, there was a gradual improvement until the world depression of the 1930s. Coastwise trade was reserved for Turkish vessels, and a port monopoly for handling goods was established. The tonnage of vessels in transit through the port of Constantinople in 1926 was only 11.6% less than the corresponding tonnage for 1908, and the years after 1926 showed a further gain in the traffic of the port as Turkish commercial life was stimulated by government measures. In 1938, 15,041 ships of 13,059,000 tons passed through the Bosporus and 9,025 ships of 15,370,000 tons through the Dardanelles. Air service connects Istanbul with Ankara during the summer. (A. van M.; X.)

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CONSTANTINOPLE, COUNCILS OF. Of the numerous ecclesiastical councils held at Constantinople the most important are the following:

(1.) The second ecumenical council, in 381, which was in reality only a synod of bishops from Thrace, Asia and Syria, convened by Theodosius with a view to uniting the church upon the basis of the orthodox faith. No Western bishop was present, nor any Roman legate; from Egypt came only a few bishops, and these tardily. Yet, despite its sectional character, the council came in time to be regarded as ecumenical alike in the West and in the East. The council reaffirmed the Nicene faith and denounced all opposing doctrines. The so-called "Niceno-Constantinopolitan Creed," which has almost universally been ascribed to this council, is probably a Jerusalem baptismal formula revised by the interpolation of a few Nicene test-words. More recently its claim to be called "Constantinopolitan" has been challenged. It is not found in the earliest records of the acts of the council, nor was it referred to by the council of Ephesus (431), nor by the "Robber Synod" (449), although both of these confirmed the Nicene faith. At all events, it became the creed of the universal church, and has been retained without change, save for the addition of *filioque.*

(2.) The council of 553, the fifth ecumenical (acknowledged to be so in 680), grew out of the controversy of the "Three Chapters," an adequate account of which, up to the time of the council, may be found in the articles Justinian I and Vigilius. It was utterly subservient to the emperor. The "Three Chapters" were condemned, and their authors, long dead, anathematized, without, however, derogating from the authority of the council of Chalcedon, which had given them a clean bill of orthodoxy. The orthodox faith was set forth in fourteen anathemas with special reference to Nestorians (*q.v.*). Opinion is still divided as to whether Origen was condemned. His name occurs in the eleventh anathema, but some consider it an interpolation; Hefele defends the genuineness of the text, but finds no evidence for a special session against Origen, as some have conjectured. A smaller council was held in Constantinople in 543 to which the anathemas against

Origen probably belong.

(3.) The sixth ecumenical council (680–681) was convened by the emperor Constantine Pogonatus to terminate the Monothelite (*q.v.*) controversy. All the patriarchates were represented, Constantinople and Antioch by their bishops in person, the others by legates. The council approved the first five ecumenical councils and reaffirmed the Nicene and "Niceno-Constantinopolitan" creeds. Monothelitism was unequivocally condemned; Christ was declared to have had "two natural wills and two natural operations, without division, conversion, separation or confusion." Prominent Monothelites, living or dead, were anathematized, in particular Sergius and his successors in the see of Constantinople, the former pope, Honorius, and Macarius, the patriarch of Antioch. An imperial decree confirmed the council, and commanded the acceptance of its doctrines under pain of severe punishment. The Monothelites took fright and fled to Syria, where they gradually formed the sect of the Maronites (*q.v.*).

(4.) The "Quinisext Synod" (692), so-called because it was regarded by the Greeks as supplementing the fifth and sixth ecumenical councils, was held in the dome of the Imperial Palace (*"In Trullo,"* whence the synod is called also "Trullan"). Its work was purely legislative and its decisions were set forth in 102 canons. The sole authoritative standards of discipline were declared to be the "eighty-five apostolic canons," the canons of the first four ecumenical councils, of the Eastern Fathers and of Cyprian, and also of a number of Eastern synods. They proceeded to add a series of disciplinary canons which became a recognized part of the canon law of the Eastern church. The council was confirmed by the emperor and accepted in the East; but the pope protested against various canons, chiefly those respecting the rank of Constantinople, clerical marriage, the Saturday fast, and the use of the symbol of lamb; and refused, despite express imperial command and threat, to accept the "Pseudo-Sexta." So that while the synod adopted a body of legislation that has continued to be authoritative for the Eastern Church, it did so at the cost of aggravating the irritation of the West, and by so much hastening the inevitable rupture of the church.

The iconoclastic synods of 754 and 815, both of which promulgated harsh decrees against images and neither of which is recognized by the Latin Church, and the synod of 842, which repudiated the synod of 815, approved the second council of Nicaea, and restored the images, are described under the "iconoclastic controversy" in the general histories of the Eastern Church, to which the reader is also referred for details of the synods of 869 and 879. The former, regarded by the Latin Church as the eighth ecumenical council, condemned Photius as an usurper and restored Ignatius to the see of Constantinople; the latter, which the Greeks considered to have been the true eighth ecumenical council, held after the death of Ignatius and the reconciliation of Photius with the emperor, repudiated the synod of 869, restored Photius, and condemned all who would not recognize him.

Bibliography.—Darwell Stone, art. "Councils, early Christian" in Hastings, *Encyclopaedia of Religion and Ethics,* vol. iv.; Hauck, "Synoden" in Herzog-Hauck, *Realencyklopaedie,* vol. xix.; Wilhelm, "Councils" in *Catholic Encyclopaedia,* vol. iv.; Rackham, "The Position of the Laity in the Early Church," in *Essays in Aid of the Reform of the Church,* ed. Gore (1888); *Report on the position of the Laity* (Canterbury Convocation Committee, 1902).

CONSTANTINOPLE, SIEGE OF (A.D. 1453). Mohammed II., becoming sultan of the Ottoman empire, in Feb. 1451, set his heart on the capture of Constantinople. A pretext was found, and a castle was at once built on the Bosphorus to secure his army during the projected siege. On June 21, 1452, the Greek Emperor, Constantine Palaeologus, closed the gates of Constantinople, and the sultan declaring war appeared before the city at the head of 250,000 men supported by a blockading fleet of 300 galleys and 200 smaller ships. Fourteen batteries of cannon were at once brought to play on the land face of the city, among which was an immense piece drawn by 50 oxen. The garrison of Constantinople was weak, comprising 5,000 armed Greeks, 2,000 foreigners and some 400 Genoese who were the heart and soul of the defence. The fleet of the emperor consisted of 13 war ships, and his artillery was vastly inferior to Mohammed's.

Whilst the bombardment was in progress, 150 Turkish vessels attempted to force the harbour, and astonishing as it may seem were defeated by one Greek and five Genoese galleys. Mohammed then dragged 72 galleys five miles over land from the Bosphorus to the inner part of the harbour, and to assist their work he built a bridge of casks across the harbour, but all to no purpose. Bombardment and assault having failed, the sultan sent his brother-in-law to treat with the emperor, who refused to yield. Thereupon the sultan announced to his army that on May 28 a general assault would take place. Trumpets were sounded and fires lit around the city until it was surrounded by a glowing half-moon of flame symbolic of its approaching capture.

The defences were held as follows: The gate of St. Romanus by the emperor, Gustiniani, captain of the Genoese, and Don Francis of Toledo; that of "The Thousand Men," by Paul and Anthony Troilus Bochiardi of Genoa; the Charsis gate by Theodorus of Caristos, the noted archer, and John Grant the German artillerist. At the gate of Kynegion was posted Cardinal Isodorus, whilst the palace of Blachernae was held by Jerome Minotto the Venetian. At the Xyloporta stood the Genoese, Leonard of Langasco. Then along the harbour came Lucas Notarias, high admiral, Gabriel Trevisano, the galley-captain, Andreas Dinio and Pedro Giuliani, the Spaniard. Between the Golden Gate and the gate of Selivria stood Maurice Cataneo, and Theophilus Paleologus held the defences between Selivria and the gate of St. Romanus.

The assault took place on May 28, and after two hours' fierce fighting was repulsed. Gustiniani was, however, wounded, and to the consternation of the emperor retired to his galley and sailed for Galata. A second assault was then made and repulsed, when an astonishing event took place. The Kerkoporta, or gate of fluted wood, long ago blocked up by Isaac Comnenus to frustrate a prophecy that the Emperor Frederick would enter the city by it, had been a few days before opened up to facilitate a sortie, but so accustomed had the defenders become to disregard it that no garrison was posted over it. Fifty Turks stole through this gate, and though they were at once despatched, this rear attack, one of the most famous in all history, was followed by the direst results. A cry went up that the Turks were in the city. The garrison, overwrought by the strain of the defence, suddenly took panic. Mohammed, noticing the disorder, flogged his men on to a third assault, and the almost undefended walls were scaled. The emperor seeing his men fall back cried: "Is there, then, no Christian who will kill me," and rushing on his enemy, he fell under the swords of the Osmanli. Thus perished the last of the Roman emperors.

See Von Hammer, *Geschichte des Osmanischen Reiches;* J. C. Engel, *Geschichte des Ungrischen Reichs* (1813); G. Finlay, *History of the Byzantine and Greek Empires, from 1057 to 1453* (1854); G. B. Malleson, *Ambushes and Surprises* (1885). (J. F. C. F.)

CONSTANTINUS, pope from 708 to 715, was a Syrian by birth. He asserted the supremacy of the papal see and at the command of the emperor Justinian II. visited Constantinople. He died on April 9, 715.

CONSTANTIUS III. was born in Illyria in the second half of the 4th century A.D. He fought for Honorius against Gerontius in Gaul and Spain, reduced Arles and captured Constantine the Tyrant. He was consul in 414, defeated Ataulphus and married Placidia, the sister of Honorius. In 421 he was named Augustus and co-emperor of the West, and he died at Ravenna in September of that year.

See Zosimus v. and vi.

CONSTANTIUS, FLAVIUS JULIUS (317–361), emperor of the East 337–361, was the son of Constantine the Great and Fausta, and was born at Sirmium in Pannonia on Aug. 6, 317. When the three sons of Constantine were made Caesars, Constantius was given the Eastern provinces. Constantine's death in 337 was followed by a wholesale massacre of the rest of the family by the soldiers, to secure the succession of the designated sons, in which only Julian and Gallus escaped. A conference in Pannonia followed, at which it was arranged that Constantine II. took the West, Constantius the East (Thrace, Macedonia, Greece, Asia and Egypt) and Constans Italy and Illyricum. Constantius was immediately plunged into war with Shapur (*q.v.*), which lasted throughout the reign. The early campaigns are obscure and seem to have been indecisive, but he won a fairly complete victory at Singara in 344 or 348. In 350 occurred the revolt of the West and the usurpation of Magnentius. Constantius refused to abandon the war with Shapur, but took advantage of the insurrection of Vetranio to use him against Magnentius. Then Shapur's attention was diverted by the Massagetae; Constantius at once sent Gallus to Syria with the title of Caesar, and turned west to join Vetranio. Together they defeated Magnentius at a great battle at Mursa on the Drave on Sept. 28, 351. The losses on both sides were enormous, and the Roman forces were permanently weakened. The eastern and western empires were thus again united under Constantius, a monarchy of the oriental type.

In 355 the critical situation in Gaul led to the appointment of Julian as commander there, which was entirely successful (for these campaigns *see* JULIAN). Constantius visited Rome in 357, where he set up the obelisk from Heliopolis (now the Lateran obelisk) in the Circus Maximus, and moved the altar of Victory from the Curia, marking the end of official paganism. In 359 he went back to Asia to meet Shapur. His order that the Gallic troops should come East after Julian's victories in Gaul led to their revolt and proclamation of Julian as emperor. Constantius was unwilling to leave the war with Shapur, and both sides made attempts at compromise. Eventually Constantius started to march West, but he died on the way, near Tarsus in Cilicia, on Nov. 3, 361.

Constantius took his responsibilities as emperor very seriously. On two critical occasions he sacrificed his own interests to the claims of the empire, and stayed on the eastern frontier when his fortunes were at stake in Gaul. His fault was his dependence on the inner circle of palace officials, due to the unapproachable nature of the oriental monarchy founded by Diocletian. In the religious quarrels of the time he supported the anti-Athanasian party, was forced by Constans to take Athanasius back in 346, but had him accused at Arles after his victory over Magnentius in 351.

See Amm. Marc., xiv.–xxi.; Zosimus, ii., iii.; Agathion, iv.; Zonaras, xiii.; *Cambridge Mediaeval History,* vol. i.

CONSTANTIUS, FLAVIUS VALERIUS, commonly called CHLORUS (the Pale), Roman emperor and father of Constantine the Great (*q.v.*), was born about A.D. 250. He was of Illyrian origin. Having distinguished himself by his military ability and his able and gentle rule of Dalmatia, he was, on March 1, 293, adopted and appointed Caesar by Maximian. In the distribution of the provinces Gaul and Britain were allotted to Constantius. But Britain, where Allectus had declared himself independent, was not re-united to the empire until 296. In 298 Constantius overthrew the Alamanni in the territory of the Lingones (Langres) and strengthened the Rhine frontier. During the persecution of the Christians in 303 he behaved with great humanity. He obtained the title of Augustus on May 1, 305, and died the following year before July 25 at Eboracum (York) during an expedition against the Picts and Scots.

See Aurelius Victor, *De Caesaribus,* 39; Eutropius ix. 14–23; Zosimus ii. 7.

CONSTELLATION, in astronomy the name given to certain groupings of stars (from the Lat. *constellatus,* studded with stars; *con,* with, and *stella,* a star).

From the earliest times the star-groups known as constellations, the smaller groups (parts of constellations) known as asterisms, and also individual stars, have received names connoting some meteorological phenomena, or symbolizing religious or mythological beliefs. At one time it was held that the constellation names and myths were of Greek origin; this view has now been disproved, and an examination of the Hellenic myths associated with the stars and star-groups in the light of the records revealed by the decipherment of Euphratean cuneiforms leads to the conclusion that in many, if not all, cases the Greek myth has a Euphratean parallel, and so renders it probable that the Greek constellation system and the cognate legends are primarily of Semitic or even pre-Semitic origin.

The Sumerians and Accadians, the non-Semitic inhabitants of the Euphrates valley prior to the Babylonians, described the stars collectively as a "heavenly flock"; the sun was the "old sheep"; the seven planets were the "old-sheep stars"; the whole of the stars had certain "shepherds," and *Sibzianna* (which, according to Sayce and Bosanquet, is the modern Arcturus, the brightest star in the northern sky) was the "star of the shepherds of the heavenly herds." The Accadians bequeathed their system to the Babylonians, and cuneiform tablets and cylinders, boundary stones, and Euphratean art generally point to the existence of a well-defined system of star names in their early history. From a detailed study of such records, in their nature of rather speculative value, R. Brown, junr. (*Primitive Constellations,* 1899) has compiled a Euphratean planisphere, which he regards as the mother of all others. The tablets examined range in date from 3000–500 B.C., and hence the system must be anterior to the earlier date. Of great importance is the *Creation Legend,* a cuneiform compiled from older records during the reign of Assur-bani-pal, *c.* 650 B.C., in which there occurs a passage interpretable as pointing to the acceptance of 36 constellations: 12 northern, 12 zodiacal, and 12 southern.

The Phoenicians—a race dominated by the spirit of commercial enterprise—appear to have studied the stars more especially with respect to their service to navigators; according to Homer "the stars were sent by Zeus as portents for mariners." But all their truly astronomical writings are lost, and only by a somewhat speculative piecing together of scattered evidences can an estimate of their knowledge be formed. The inter-relations of the Phoenicians with the early Hellenes were frequent and far-reaching, and in the Greek presentation of the legends concerning constellations a distinct Phoenician, and in turn Euphratean, element appears. One of the earliest examples of Greek literature extant, the *Theogonia* of Hesiod (*c.* 800 B.C.), appears to be a curious blending of Hellenic and Phoenician thought. Although not an astronomical work, several constellation subjects are introduced. In the same author's *Works and Days,* a treatise which is a sort of shepherd's calendar, there are distinct references to the Pleiades, Hyades, Orion, Sirius, and Arcturus. It cannot be argued, however, that these were the only stars and constellations named in his time; the omission proves nothing.

The same is true of the Homeric epics wherein the Pleiades, Hyades, Ursa major, Orion, and Boötes are mentioned, and also of the stars and constellations mentioned in Job. Further support is given to the view that, in the main, the constellations were transmitted to the Greeks by the Phoenicians from Euphratean sources in the fact that Thales, the earliest Greek astronomer of any note, was of Phoenician descent. According to Callimachus he taught the Greeks to steer by Ursa minor instead of Ursa major; and other astronomical observations are assigned to him. But his writings are lost, as is also the case with those of Phocus the Samian and the history of astronomy by Eudemus, the pupil of Aristotle; hence the paucity of our knowledge of Thales's astronomical learning.

From the 6th century B.C. onwards, legends concerning the constellation subjects were frequently treated by the historians and poets. Aglaosthenes or Agaosthenes, an early writer, knew Ursa minor as Κυνόσουρα, Cynosura, and recorded the translation of Aquila; Epimenides the Cretan (*c.* 600 B.C.) recorded the translation of Capricornus and the star Capella; Pherecydes of Athens (*c.* 500–450 B.C.) recorded the legend of Orion and stated the astronomical fact that when Orion sets Scorpio rises; Aeschylus (525–456 B.C.) and Hellanicus of Mytilene (*c.* 496–411 B.C.) narrate the legend of the seven Pleiades.

In the 5th century B.C. the Athenian astronomer Euctemon, according to Geminus of Rhodes, compiled a weather calendar in which Aquarius, Aquila, Canis major, Corona, Cygnus, Delphinus, Lyra, Orion, Pegasus, Sagitta, and the asterisms Hyades and Pleiades are mentioned, always, however, in relation to weather changes. The earliest Greek work which purported to treat the constellations *qua* constellations, of which we have certain knowledge, is the Φαινόμενα of Eudoxus of Cnidus (*c.* 403–350 B.C.). The original is lost, but a versification by Aratus (*c.* 270 B.C.), a poet at the court of Antigonus Gonatas, king of Macedonia, and an Ἐξήγησις or commentary by Hipparchus are extant.

THE OLD CONSTELLATION FIGURES.

PROJECTED ON THE PLANE OF THE ECLIPTIC.

FROM SIR WM. PECK, "THE OBSERVER'S ATLAS OF THE HEAVENS" (GALL & INGLIS)

In the *Φαινόμενα* of Aratus 44 constellations are enumerated, viz., 19 northern: Ursa major, Ursa minor, Boötes, Draco, Cepheus, Cassiopeia, Andromeda, Perseus, Triangulum, Pegasus, Delphinus, Auriga, Hercules, Lyra, Cygnus, Aquila, Sagitta, Corona and Serpentarius; 13 central or zodiacal; Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricornus, Aquarius, Pisces and the Pleiades; and 12 southern: Orion, Canis, Lepus, Argo, Cetus, Eridanus, Piscis australis, Ara, Centaurus, Hydra, Crater and Corvus. In this enumeration Serpens is included in Serpentarius and Lupus in Centaurus; these two constellations were separated by Hipparchus and, later, by Ptolemy. On the other hand, Aratus kept the Pleiades distinct from Taurus, but Hipparchus reduced these stars to an asterism. Aratus was no astronomer, while Hipparchus was; and from the fact that the latter adopted, with but trifling exceptions, the constellation system portrayed by Aratus, it may be concluded that the system was already familiar in Greek thought.

Three hundred years after Hipparchus, the Alexandrian astronomer, Ptolemy, adopted a very similar scheme in his uranometria, which appears in the seventh and eighth books of his *Almagest*, the catalogue being styled the Ἔκθεσις κανονική or "accepted version." The names and orientation of the 48 constellations therein adopted are, with but few exceptions, identical with those used at the present day; and as it cannot be doubted that Ptolemy made only very few modifications in the system of Hipparchus, the names were adopted at least three centuries before the *Almagest* was compiled.

A later innovator of moment was Johann Bayer, a German astronomer, who published a *Uranometria* in 1603, in which 12 constellations, all in the southern hemisphere, were added to Ptolemy's 48, viz., Apis (or Musca) (Bee), Avis Indica (Bird of Paradise), Chameleon, Dorado (Sword-fish), Grus (Crane), Hydrus (Water-snake), Indus (Indian), Pavo (Peacock), Phoenix, Piscis volans (Flying fish), Toucan, Triangulum australe. According to W. Lynn (*Observatory*, 1886, p. 255), Bayer adapted this part of his catalogue from the observations of the Dutch navigator Petrus Theodori (or Pieter Dirchsz Keyser), who died in 1596 off Java.

The *Coelum stellatum Christianum* of Julius Schiller (1627) is noteworthy for the attempt made to replace the names connoting mythological and pagan ideas by the names of apostles, saints, popes, bishops, and other dignitaries of the Church, etc. Aries became St. Peter; Taurus, St. Andrew; Andromeda, the Holy Sepulchre; Lyra, the Manger; Canis major, David; and so on. This innovation (with which the introduction of the 12 apostles into the solar zodiac by the Venerable Bede may be compared) was shortlived. A similar confusion was attempted by E. Weigelius, who sought to introduce a *Coelum heraldicum*, in which the constellations were figured as the arms or insignia of European dynasties, and by symbols of commerce.

In Edmund Halley's southern catalogue (*Catalogus stellarum australium*), published in 1679 and incorporated in Flamsteed's *Historia coelestis* (1725), the following constellations are named: Piscis australis, Columba Noachi, Argo navis, Robur Caroli, Ara, Corona australis, Grus, Phoenix, Pavo, Apus or Avis Indica, Musca apis, Chameleon, Triangulum australe, Piscis volans, Dorado or Xiphias, Toucan or Anser Americanus, and Hydrus. Flamsteed's maps also contained Mons Menelai. This list contains nothing new except Robur Caroli, since Columba Noachi (Noah's dove) had been raised to the skies by Bartschius in 1624.

In 1690 two posthumous works of Johann Hevelius (1611–87), the *Firmamentum sobiescianum* and *Prodromus astronomiae*, added several new constellations to the list, viz., Canes venatici (the Greyhounds), Lacerta (the Lizard), Leo minor (Little Lion), Lynx, Sextans Uraniae, Scutum Sobieskii (the shield of Sobieski), Vulpecula et Anser (Fox and Goose), Cerberus, Camelopardus (Giraffe), and Monoceros (Unicorn); the last two were originally due to Jacobus Bartschius. In 1679 Augustine Royer introduced the most interesting of the constellations of the southern hemisphere, the Crux australis or Southern Cross.

Nicolas Louis de Lacaille, who made extended observations of the southern stars in 1751 and in the following years, and whose results were embodied in his posthumous *Coelum australe stelliferum* (1763), introduced the following new constellations: Apparatus sculptoris (Sculptor's workshop), Fornax chemica (Chemical furnace), Horologium (Clock), Reticulus rhomboidalis (Rhomboidal net), Caela sculptoris (Sculptor's chisels), Equuleus pictoris (Painter's easel), Pyxis nautica (Mariner's compass), Antlia pneumatica (Air pump), Octans (Octant), Circinus (Compasses), Norma *alias* Quadra Euclidis (Square), Telescopium (Telescope), Microscopium (Microscope), and Mons Mensae (Table Mountain).

Attempts have been made to introduce new constellations since that date, but none of these is now accepted. The large Ptolemaic constellation of Argo is, however, subdivided into Vela (Sails), Puppis (Stern), and Carina (Keel).

The delimitation of precise boundaries for the constellations was undertaken by a committee of the International Astronomical union. At the present time (1945) it is possible to assign any star to its proper constellation without ambiguity.

The following list contains the constellations now used. The Ptolemaic constellations are printed in small capitals. Those marked with an asterisk are the subject of separate articles.

Northern:

*ANDROMEDA	*CYGNUS	*OPHIUCHUS
*AQUILA	DELPHINUS	*PEGASUS
*AURIGA	*DRACO	*PERSEUS
*BOÖTES	EQUULEUS	SAGITTA
Camelopardalis	*HERCULES	SERPENS
*Canes Venatici	Lacerta	TRIANGULUM
*CASSIOPEIA	Leo Minor	*URSA MAJOR
*CEPHEUS	Lynx	*URSA MINOR
*Coma Berenices	*LYRA	Vulpecula
CORONA BOREALIS		

Zodiacal:

*AQUARIUS	*GEMINI	*SAGITTARIUS
*ARIES	*LEO	*SCORPIUS
*CANCER	*LIBRA	*TAURUS
*CAPRICORNUS	*PISCES	*VIRGO

Southern:

Antlia	Dorado	*ORION
Apus	ERIDANUS	Pavo
ARA	Fornax	Phoenix
Caelum	Grus	Pictor
*CANIS MAJOR	Horologium	Piscis Austrinus
CANIS MINOR	HYDRA	Puppis
Carina	Hydrus	Pyxis
*CENTAURUS	Indus	Reticulum
*CETUS	LEPUS	Sculptor
Chamaeleon	LUPUS	Scutum
Circinus	Mensa	Sextans
Columba	Microscopium	Telescopium
CORONA AUSTRINA	Monoceros	Triangulum Australe
CORVUS	Musca	Tucana
CRATER	Norma	Vela
Crux	Octans	Volans

(C. E.; A. S. E.; X.)

CONSTIPATION, the condition of body when the faeces are unduly retained, or there is difficulty in evacuation (*see* DIGESTIVE ORGANS; and THERAPEUTICS). It may be due to constitutional peculiarities, sedentary or irregular habits, improper diet, etc. The treatment varies with individual cases, according to the cause at work, laxatives, dieting, massage, tonics, etc., being prescribed. In diagnosis it is essential to eliminate constipation due to intestinal obstruction, peritonitis and similar conditions.

CONSTITUENCY, a political term for the body of electors within a defined political area who choose a representative for parliament or other public assembly, for the place or district so represented, and for the residents therein generally.

CONSTITUTION, the fundamental system of laws governing a country. For U. S. Constitution *see* the articles UNITED STATES and CONSTITUTION AND CONSTITUTIONAL LAW.

CONSTITUTION, a United States frigate familiarly known as "Old Ironsides," is without doubt the most famous ship in the annals of the American navy. She was one of the first three naval vessels built by the United States; designed by Joshua Humphreys of Philadelphia, her keel was laid at Hartt's ship-yard, Boston, in 1794. She was launched in 1797 and in the following year was first commissioned and placed in service against the French privateers then infesting American waters. In 1804–05, the "Constitution" participated in the war against Tripoli, which resulted in peace with the Barbary States, and stopped the tribute the United States had been paying the African pirates. It was not until the War of 1812, however, that she won her enduring place in American history. On Aug. 19, 1812, when the moral of the country was at its lowest ebb, the "Constitution," under the command of Captain Isaac Hull, won a brilliant victory over the British frigate "Guerrière." This naval duel was followed by numerous other victories hardly less notable, the better known being the destruction of the "Java" (Dec. 29, 1812) and the capture of the two armed vessels "Cyane" and "Levant" on Feb. 20, 1815. It was during the "Constitution's" engagement with the "Guerrière" that the American sailors, on seeing the British shot bounding off the solid oak sides of their ship, dubbed her "Old Ironsides," and it is by this name that she is known to millions of Americans to-day.

On June 16, 1927, "Old Ironsides" was dry-docked at the Charlestown navy yard, Boston, for her fourth reconstruction, a fact which testifies to the abiding place which she holds in the love and admiration of the American people. Congress, on March 3, 1925, authorized her restoration by funds raised by popular subscription. The greater part of the necessary funds (estimated at $650,000) have been raised by the donations of school children. When the work is completed, this historic old ship will again be able to sail the seas. "Old Ironsides" is what is generally known as a 44-gun frigate, although she always carried more than that number; in the battle with the "Guerrière" she carried 55 guns and 456 men. Her length over all is 204 ft., beam 44 ft. 8 in., draught 22 ft. 6 in., armour $21\frac{1}{2}$ in. oak, and gun range 1,200 yards. She was originally built of live oak and red cedar, all well seasoned wood, and the bolts which fastened her timbers and the copper sheathing were made in Paul Revere's shop. The present restoration is to follow faithfully her original lines.

See F. A. Magoun, *The "Constitution" and other Historic Ships* (1928); and the *Scientific American* vol. cxxxiii., p. 20 and vol. cxxxvii., p. 530.

CONSTITUTION AND CONSTITUTIONAL LAW.

The word constitution is in its modern sense a term which, originally generic, has, like the word "parliament" undergone a specialization of function. In the time of Cicero it (*constitutio*) is used indifferently for a point in rhetoric, the nature or form of the human body, and lastly, in a legal, but very wide, sense, any regulation or ordinance. In this last application it acquires majestic significance in the time of Justinian as a term for a law or collection of laws issued by the sovereign. Such were the many hundreds of *novellae constitutiones* or "novels" in which Justinian codified the law of Rome. In this plural use it makes one of its rare appearances in English history, namely in those Constitutions of Clarendon (1164) in which Henry II. attempted to delimit the spiritual and temporal jurisdictions in this country, "the first authoritative redaction" in our history, as Pollock and Maitland call them, "of hitherto unwritten custom." But it was still an exotic word, belonging to the civil and canon law, and never took root in our legal language. Instead of it we find "Assize" or "Charter" for a law or collection of laws, to be displaced later by the words "Statute" and "Ordinance." When it re-emerges in England in the 18th century, it is as a word used exclusively in the singular, not in the plural, and with a specialized and somewhat abstract meaning. It then came to mean in English what it means to-day, *i.e.,* no longer any particular law, or any particular collection of laws, but the whole structure of a political society, its legislative and executive organs and their function, and, also, the rights and duties of subjects in relation to the supreme power in the State. This is as near to a general definition as one can get, but it is at best a loose definition for the simple reason that the term, although definitely naturalized in the domain of "Public Law," has a different meaning in different countries. How different may be illustrated by contrasting Chesterfield's statement in the 18th century that "England is the only monarchy in the world that properly can be said to have a constitution" with De Tocqueville's declaration a hundred years later that England was the only country which had got no constitution at all. What De Tocqueville meant was that England has no fundamental law or written instrument creating, organizing and defining the legislature and the executive and delegating to them certain powers. That is true enough and the term "constitution" in nearly every modern country, except England, means just this, because they possess, and England does not, an instrument of this character.

The Sovereign and the Constitution.—What Chesterfield meant, on the other hand, was that England was the only country in which the exercise of the power of the sovereign was subject to the control of the courts of law and of parliament. In other words by a "constitution" he meant certain legal principles restrictive of arbitrary power. And this also was true. In all other countries at that time the king was above the law, alike in the executive sphere and in the legislative. And it was just because the sovereign was above the law in every country but our own that a revolution was necessary to subjugate him to it and to create legislatures, more or less representative of the public will, to control him. Hence the appearance with the French Revolution in 1789, still more with the revolutions of 1848, of "written" constitutions on the continent of Europe. Parliaments, *i.e.,* assemblies of "estates," once universal in Europe, had disappeared everywhere, except in England, in the 17th century and it was necessary to re-create them. That could only be done by a supreme act of legislation, namely a "written" constitution. So, too, with the invasion of Roman law, which England alone escaped, the will of the sovereign had become supreme over his subjects and it was necessary to concede to them "rights" which, again, could only be done by some written constitution. Such "constitutions" have nearly all originated in secession, as in the case of the United States, or in revolution as in France or, as in the case of the Treaty of Versailles, in the creation of new States by treaty. In England, owing to the continuity of her parliament and still more the supremacy of her common law (*q.v.*), with its doctrine that the king has no prerogatives except those which the common law allows him, no such written constitution—except during the revolutionary and republican interval of the Commonwealth and Protectorate—was ever necessary. Hence the notable fact that both the substantive "constitution" and the adjective "constitutional" are unknown to English law; they are not what English lawyers call "words of art"; they have no technical meaning. Blackstone in his more literary moments sometimes, but rarely, speaks of "our constitution," but the term finds no place in the rubrics of his chapters; Bolingbroke appears to have been the first to use it, and he uses it, like Chesterfield and Burke, in a philosophical sense as meaning the principles of English liberty.

The Term "Unconstitutional."—To-day the term "unconstitutional" in England is yet more vague. It does not mean, as it does in the United States, "illegal," but unconventional, that is to say, something which, though legal, is unusual or contrary to political usage. It is "unconstitutional" for the prime minister to remain in office after a vote of "no confidence" by the House of Commons but it is in no sense illegal, for the law, which knows not the office of prime minister nor the conventional usage of the responsibility of the executive to parliament, is silent on the point. But where, as in most modern states, the constitution is embodied in a fundamental law, the executive and the legislature are, with certain exceptions, alike subject to it, are indeed delegations of it, and their proceedings, if contrary to its provisions, *may* be illegal in the strictest sense of the term, *i.e.,* such as the courts will refuse to enforce. In such a case the legislature is, of course, not sovereign. In England, on the other hand, parliament, in the absence of any such "constitution," is supreme. But an Act of the American congress may be declared "unconstitutional" by the Supreme Court or rather disregarded and such a declaration, or rather such a repudiation means that it is "illegal." An Act of the British parliament, on the other hand, can never be illegal although its Acts have often been called "unconstitutional" in the sense of being arbitrary or unprecedented. This sharp distinction between "legal" and "constitutional," in the case of the

English use of the adjective, does not, however, extend to the use of the substantive.

The Theory of the English Constitution.—The "constitution" in England includes both law, *i.e.*, common law and statute law, in so far as they deal with the sovereign's power and the rights of the subject as against it, and conventional usage. The strictly legal theory of the English constitution involves a dualism, *i.e.*, the legislative power is in the king in parliament and the executive power is in the king in council, and each is independent of the other. But political usage or convention has developed an informal body known as the "cabinet" which, legally speaking, is merely a meeting of certain members of the privy council, but conventionally is a meeting of privy councillors who should be, and invariably are, members of one or other house of parliament and belong to the party which is in a majority, whether an absolute or a relative majority, in the lower house. Political usage also dictates that if this body ceases to command the confidence of a majority in the house of commons the members shall either resign their respective offices, although they are *legally* responsible only to the king, or shall, through the prime minister, ask the king to exercise his prerogative of dissolution and here again political usage dictates, though the law does not, that the king shall not refuse the prime minister its exercise. The legal theory, and the political usages which thus qualify it, are both included in the term "the English constitution"; so also are included all that part of the common law which recognizes and enforces the rights of the subject such as the right to a writ of Habeas Corpus (*q.v.*), the right to trial by jury (*see* PRACTICE AND PROCEDURE), and the right to sue any officer of the Crown for wrongful acts even though committed in his official capacity. This last brings out another characteristic of the term "constitution" in England, that British law knows not the distinction, familiar in Europe, between "public law" (*droit public* in France, *Staatsrecht* in Germany) and "private law" (*droit privé* or *Privatrecht*), between law relating to the State and law relating to private individuals. In other words so much of the English constitution as is not to be found in statute law or political usage is to be found—and it is by far the larger part—in the common law. Even a right so "political," and therefore so peculiar in other countries to the domain of "public law," as the right to vote was in England as much a "private" right as the right to sue for trespass or for recovery of one's freehold. It was, except in the parliamentary boroughs, simply a right arising out of the law of real property, namely, a freeholder's right, and a returning officer who refused to allow the freeholder to exercise it could be sued in an ordinary "private" action for damages. In a word British constitutional law, if we exclude mere conventional usages, is common law, and the common law, which is "unwritten," is supreme. The difference between Great Britain and the United States may with some exaggeration be expressed by reversing the historic words of Article VI. of the "written" American Constitution, which declares "This Constitution . . . shall be the supreme law of the land." In England we may say "the supreme law of the land *is* the constitution." England's statute law does, indeed, also secrete some part of her constitutional law, but more often than not, especially in earlier times, such statutes purported merely to declare the common law, as in the case of the Statute of Treasons, or to bond the king by a kind of contract to cease disregarding the common law, as in the case of the Petition of Right, or to expedite the existing process of the common law, as in the case of the Habeas Corpus Acts. Other "constitutional" statutes have indeed changed the law, the most notable example being the Parliament Act (1911) which, in effect, destroyed the legislative power of the house of lords as one of the estates of the realm.

Written Constitutions.—Far too much has been made, however, by jurists, particularly by Dicey, of the distinction between countries with a "written" constitution, or fundamental law, and countries without it. A written constitution can never exhaust the whole sphere of constitutional law. Such a constitution always presupposes an advanced state of society with a common law of its own, without which, indeed, the written constitution is unintelligible for its very terms have to be interpreted in the light of it. In Germany, where "written" constitutions came into existence as long ago as 1848, jurists have been quick to see this. As Hatschek (*Deutsches und Preussisches Staatsrecht,* I., p. 8), employing the German juristic distinction of "material" law and "formal" law, points out, every State, just because it is a State, has always had a constitution in the "material" sense, *i.e.,* some common law ruling the relation between subject and sovereign. Such a "constitution" belongs to every State as the clothes belong to the body—"*es gehört zu jedem Staat wie das Kleid zum Körper.*" Without it there is no State except that "state of nature," so satirized by Hobbes, which was naked indeed. This material constitution is to be found in the customary law (*Gewohnheitsrecht*) even though the country knows nothing of representative institutions and the will of the monarch be supreme. A "constitution" in the "formal" sense, *i.e.,* a written fundamental law (a *Grundgesetz*), may be wrested from the monarch but even if it were revoked the "material" constitution would remain. This is equally true of the United States.

In the United States.—The United States constitution is full of terms such as "treason," "trial by jury," "the obligation of contracts," all of which imply, as a condition precedent to the constitution, the pre-existence of common law, and the first two are some of the constitutional elements in the common law which the English settlers carried with them across the Atlantic. The constitutional law of America is therefore not to be found solely in the "constitution" but also in the common law. It has been said that there is no common law of the United States and that there is only the common law of the individual States. This is true enough as regards criminal law (*cf.* Mr. Justice Chase in *U.S.* v. *Warrall*: 1798; 2 Dallas, 384). The common law, it has been declared, could "only be made part of our federal system by legislative adoption" (*Wheaton* v. *Peters,* 8 Pet., 591), a statement which requires some qualification when it comes to the interpretation of the duties of common carriers in interstate commerce. But in the interpretation of the American constitution itself the Supreme Court has been driven to admit that the common law must be resorted to for the definition of terms used in the Constitution when such terms are not there defined (*United States* v. *Smith,* 5 Wheaton, 153). In this sense, and to this extent, the "constitution" of America itself is unwritten. Behind the framework of the formal constitution there stands the "material" constitution of the English common law, without which the American constitution is but a skeleton. As is well observed by Mr. Burdick, the American constitution is not an invention but a codification. Furthermore, there has been an accretion of "conventional" usage, particularly as to the relations between president and congress, of a non-legal character in America just as there has been in England. No country can ever be permanently imprisoned in the strait-jacket of a written constitution. Either the jacket is "stretched" by judicial interpretation—witness the immense developments, in the hands of the Supreme Court, of the Interstate Commerce clause—or it is expanded by the growth of "conventions." If it were not, a written constitution would indeed be the lethal thing of De Maistre's epigram: "*Dès que l'on écrit une constitution, elle est morte.*" (*See* United States section of this article further on.)

The Legislature and the Constitution.—Nor, again, is the distinction in the powers of the legislature which Dicey makes between countries with a written constitution and countries without one at all as sharp and decisive as Dicey makes it. That distinguished writer assumes, almost as a matter of course, that when a country has a written constitution, two things follow, (1) that the legislature is "subordinate" to the constitution, (2) that statutes passed by it in conflict with the constitution are *ultra vires,* and, as a necessary consequence, that the courts can refuse to enforce them. But this is only true of federal constitutions, *i.e.,* constitutions where the legislative power is divided (and, with it, the "internal sovereignty" of the country) between a central legislature and a number of local legislatures, each supreme in its respective sphere. In such a case the central legislature, as in the United States and in Germany, is restricted to legislation in respect of certain enumerated subjects, but in respect of them is "supreme" or as it is tersely put in the new German constitution "Federal law fractures (*bricht*) State law." In case of conflict, *i.e.*, when it is a question whether the overriding federal law is within federal competence, some kind of external arbitration is necessary and this is naturally found in a court. In the case of the United States this arbitral power was, curiously enough, never expressly entrusted to the Supreme Court, it assumed it (in *Marburg* v. *Madison*, 1 Cranch, 137) or more truly, it inherited it from the privy council, and, even so, the court never directly *declares* a Federal (or State) statute *ultra vires*, it merely refuses to enforce it when it arises as an issue in legislation. In the new German constitution (Article 13), however, express provision is made for the direct reference of such conflicts to the Reichsgericht, *i.e.*, the Supreme Court at Leipzig, which was formally invested with this "constitutional" jurisdiction by a Reich Statute of April 8, 1921. But in a non-federal or "unitary" country like France, the existence of a written constitution in no way implies any power on the part of the courts to declare an enactment of the legislature unconstitutional. The interpretation of the constitution is in France entrusted to a branch of the legislature, viz., the Senate, on the initiative of the Government. If the interpretation is disputed as amounting to a judicial act, the decision of the senate is treated as equivalent to a "revision" or amendment of the constitution. In that case the two chambers sitting together under the name of the "National Assembly" decide the issue. The French legislature, in spite of the existence of a written constitution, is thus in reality sovereign. It is sovereign not only in the immunity of its legislation from the control of the courts but also in its power to change the constitution itself. No external authority, such as a plebiscite as in Australia and Switzerland or a majority of the State legislatures as in America, is required in France to effect a change in the constitution. The legislature has therefore the "constituent" power, and is truly sovereign. So too in Germany, alike under the old imperial constitution (Act 78) and the constitution of 1919, "the constitution can be altered in the ordinary course of legislation." The American idea of some power superior to the Federal legislature, and external to it, in the matter of constitutional change is, as Anschütz remarks, quite "foreign" to German public law. And ever since the decision of the Privy Council in *McCauley* v. *the King*, A.C. (1920), 691, it can no longer be said of the British colonies with their written constitutions, that their legislatures are, as Dicey said they were, "subordinate" bodies unable to pass laws which conflict with their "constitution." In that case it was held that, unless the constitution itself specifically prescribes a special procedure for its amendment, it can be amended by mere implication by an ordinary law with no more formality than "an Act for the licensing of dogs." A "written" constitution therefore in no way excludes the existence of a "sovereign" legislature except in a Federal system. It all depends on the terms of the constitution, or, to quote Lord Birkenhead's phraseology in the *McCauley case*, whether it is "controlled" or "uncontrolled."

The Sphere of Constitutional Law.—It will be fairly obvious from what has been said above that restrictive attempts to define the sphere of constitutional law as something distinct from other branches of law are futile. It cannot be segregated, whether the constitution be written or unwritten, from the common law of each particular country. Hence the futility of those frequent excursions into its domain by the exponents of what is called "Political Science" who, ignorant of law, are the unlicensed practitioners of this branch of learning. So far as they treat of a particular constitution they are ill-informed; so far as they attempt generalizations from all constitutions they are beating the air. As Maitland ironically observed, "Political Science is very apt to look like sublimated jurisprudence," but it is jurisprudence without jurists, a kind of cloudy exhalation of sociology, ethics, economics, "crowd psychology," with a little ill-digested law to give it a certain density of atmosphere. There is no such thing as a "science" of State institutions even in the case of "Federalism" which, as Jellinek, himself a lawyer, points out in his *Allgemeine Staatslehre* (3rd ed., s. 737) is not a "general concept" (*Allgemeinbegriff*) at all but resolves itself into the legal study of each particular "empirical type" of Federation.

Sovereign Power and the Referendum.—One of the chief problems with which constitutional law is occupied is the definition of the sovereign power in the State. But it is by no means the only problem. For this reason Austin's attempt to delimit the scope of "constitutional law" is singularly unsatisfactory. He describes it in the following terms: "In a country governed by a monarch, constitutional law is extremely simple, for it merely determines the person who shall bear the sovereignty." Simple indeed is such a definition, and all too passive, for it excludes the activity of the legislature and the executive, *i.e.*, the process of legislation, the modes in which the sovereign power is exercised, the sanctions attendant on its exercise, the control of the courts over the executive, the "rule of law" and the whole sphere of the rights of the subject. Nor is his attempt, followed by Holland, to distinguish constitutional law from "administrative law" any happier. There is no such thing as administrative law in England in any technical sense of the term at all, nor, even if there were, would it be possible to separate the functional activity of the institutions of the State from their organic character. Such ill-nourished definitions, if accepted, would exclude, for example, all consideration of two such great instruments of the English constitution as the writ of mandamus and the writ of habeas corpus.

None the less, the definition of the sovereign power is, as has been observed, important; and Austin's definition of it, famous for its heresy, is, although universally rejected, and rightly so, by English lawyers, interesting and, if applied to other countries than England, including certain British colonies, not quite so questionable as it was. He defines it as residing not in the king, lords and commons, in other words in "parliament" but as in the king, lords and the electorate. But this, to adopt the terminology of Bryce in his *Essays in Jurisprudence*, is to confound "political" sovereignty with "legal" sovereignty. The commons are, it is true, merely representatives of the electorate and may be called to account by the latter, but in the interval between one general election and another the participation of the commons with the king and the lords in the sovereign power is unquestionable—"the English people" as Rousseau, writing in the days of the Septennial Act, said, "are free only once every seven years." To-day he would have said every "five." And there is nothing to prevent parliament postponing the appeal to the electorate indefinitely by prolonging its own existence. It did so in the 17th century during the Civil War, again in the 18th century when it repealed the Triennial Act, and again in the present century when, during the World War, it lengthened its term of existence from the five years prescribed by the Parliament Act to eight. Where, however, as in Queensland and Manitoba, infected by the political experiments of the Western States of America, British colonies have, by adopting the referendum, introduced a new factor into legislation, namely a plebiscite, it may be argued with much plausibility that the "sovereignty" has passed to the electorate. The argument, however, is not decisive, for the simple reason that, both in Manitoba and in Queensland, the legislature remains sovereign inasmuch as it can at any time repeal the Acts instituting the referendum and thereby deprive the electorate of the voice in legislation conferred on it. Moreover the decision as to *what* bills shall be submitted to the referendum rests, in the case of Queensland, with the Government which is not bound to submit them at all (see *Taylor* v. *the Attorney General of Queensland* [1917] 23 Commonwealth Law Reports 457). Where, as in the case of Manitoba, provision is made not only that bills must be submitted to the electorate but that the electorate may *"initiate,"* as well as vote upon, legislative proposals, to which, in the event of a majority of votes being cast for them the Lieut.-Governor shall give his assent as though the proposal had been passed by the legislature itself, we seem to encounter the "sovereign people" in the full sense of the word, as in the Western States of America—where such institutions had been adopted on the principle that, as Ostrogorski puts it, "the best cure for democracy is more democracy." But not quite! The Manitoba Act itself still excluded Supply Bills and Appropriation Bills from the proposed referendum, for the very obvious reason that if it lay with the electorate to vote taxes it would vote none. The legislature therefore remained supreme in certain matters. This "Initiative and Referendum Act" was, however, declared *ultra vires* by the privy council (*see* A.C. [1919], p. 935), on the ground, among others, that it purported to deprive the Crown, *i.e.*, the Lieut.-Governor, of its voice in legislation. Indeed, there can be no doubt that great as the "constituent" powers of British legislatures in the Dominions are, as has been seen above, they do not include the power either of excluding the Crown as a factor in legislation or of depriving the legislature of its representative character. The legislature is internally sovereign but its sovereignty stops short of the paradoxical power of destroying its own existence and substituting for it that of the electorate. The same is true of the German Reichstag under the present German constitution. That constitution is remarkable for the extent to which it adopts the institution of the Referendum, not merely in the matter of revision of the constitution but of ordinary legislation which *must* be submitted to a referendum if the president so decides or one-fourth of the members so request, and it *may* be so submitted if one-tenth of the electorate so petition. But as Hatschek observes, not one of these provisions makes the popular decision (*Volksentscheid*) an independent source of law, and all of them require the co-operation of the Reichstag at one stage or another. The Reichstag, together with the Reichsrat, continue to participate in the sovereign power of legislation, in so far as, under a Federal system, a Federal legislature is "sovereign" at all. The most that can be said in such cases of the Referendum is that sovereignty is *shared* with the electorate. Indeed it is impossible to say that the people are ever sovereign, in the full legal sense, in any country with a legislature in the real sense of the word, except where it comes to a revision of the constitution, and not always even then. The sacramental words, faithfully copied in the preamble of the Australian constitution, with which the constitution of the United States commences: "We, *the people* of the United States, in order to form a more perfect Union . . . do ordain and establish this "Constitution" no more confer sovereignty on "the people" in America than in Australia. This, because the people who "ordained and established" the constitution have no power to change it; a majority of the State legislatures alone can do that. The same is the case in Australia, because, in spite of the fact that constitutional amendment is referred to the electorate, such amendment can only take effect if the majority of the electorate also represents a *majority of the States*. And as in Australia, so in Switzerland. Popular sovereignty is therefore apt to resolve itself, legally speaking, into a myth in any organized society. It is a purely primitive idea, belonging to the days when, in the words of Tacitus, the freemen of the German tribes decided every question with a loud shout and, we may surmise, by knocking the minority on the head. We may also find the idea of popular sovereignty in the Anglo-Saxon folkmote and the Landesgemeinde of the forest cantons of Switzerland: we shall find it nowhere else.

Federal Constitutions.—The sovereignty of the legislature is, as has been seen, qualified in the case of a federal system by the fact that the powers of the central legislature are limited, and can only be increased, by an external authority, namely the constituent States, who have been, and are, the contracting parties to the federal contract. Is it qualified in the case of a unitary State? Laband, by far the most authoritative of the older generation of constitutional lawyers in Germany, answers the question (*Reichsstaatsrecht* Bd. IV., pp. 5 *et seqq.*, 1914) by saying "Yes" in the case of a monarchy, "No" in the case of a republic. To Englishmen his affirmative would seem unintelligible. England is a monarchy, they would retort, the legislature is the "king in parliament" and parliament is supreme. So too, one might say, was the Landtag of Prussia from 1851 to 1919. But looking at the matter from the point of view of French and German constitutional law, Laband was right. The sovereignty of the legislature in the Prussian monarchy *was* qualified because, to a German jurist no law, even when assented to by the king of Prussia as part of the legislature, was complete without a "sanction" and Laband carefully distinguishes between the sanction of the law (*Gesetzbefehl*) and the law itself (*Gesetzinhalt*). Now in England no separate "sanction" is necessary to every Act of Parliament (it is an imputed misdemeanour at common law to disobey any Act of parliament, for the law imputes a command to obey it, whether the Act itself provides for a penalty or not), and the legal obligation of the Act is complete from the moment it receives the royal assent. But in Germany and in France an Act of the legislature is incomplete until a decree is issued by the head of the State to "promulgate" it. This promulgation was in those countries the exclusive prerogative of the monarch, and he could withhold it as the head of the Executive, even when he had assented to the "law" as the head of the legislature. To-day no president has replaced the king of Prussia where, by a curious anomaly, the prime minister elected by the legislature, is the only visible head of the State. But in the "Empire" (Reich), the president, who has replaced the kaiser, has no power to withhold the decree of promulgation, although he may, in his discretion, submit the bill to a referendum; while in France all that the president can do is to postpone the *promulgation*—the *"acte de naissance"* of the law, as Moreau calls it—by asking the two chambers to reconsider the bill, a power which, in fact, has never been exercised and would only encounter defeat if it were. Hence it is that Laband regards the sovereignty of the legislature as only complete in countries with a republican form of government.

The Sovereignty of the Executive.—So far we have confined our consideration of sovereignty to legislative sovereignty. But in spite of Austin, legislative sovereignty is not the whole of sovereignty. There is the sovereignty of the executive, and we have authority for the distinction. Both Laband and Salmond make it. Laband treats the enforcement of a law as of equal importance with the enactment of it, and points out that this power resides in the monarch alone, or, as we should say in England, in the "king in council" and in such of the king's servants as the Attorney General, the Director of Public Prosecutions and the police. Here we come up against the venerable principle, originating with Montesquieu, of "the separation of powers." This doctrine may be said to originate in that famous chapter of Montesquieu's (*Esprit de Lois* liv. ix. chap. vi.) in which he describes the ideal constitution from the point of view of political liberty as that where the legislature, the executive and judiciary are mutually independent of one another. That chapter has been much misunderstood, for he reduces the ultimate "powers" in a State not to three but to two, namely the legislature and the executive. Obviously if the judiciary were invested with a co-equal and irreducible power, there could be no legislation without its consent, which is exactly what happened in France when the "Parlement of Paris," which was a court, and nothing else, claimed to control with a kind of judicial veto, exercised by way of "registration," the legislative powers of the king on the one hand, and the States General on the other; a claim which, as Aubert, the historian of the Parlement of Paris observes, had no real foundation in law or in fact, and was easily overcome by a *lettre de jussion, i.e.*, a formal command of the king. The important thing, in the interest of the liberty of the subject, is not that the judiciary should be supreme but that the judges should be independent—in other words secure in their tenure of office. Practically every country has adopted this principle; it took root in Prussia as early as the time of Frederick the Great and in the Germany of to-day no judge can be removed from his office except by a judgment of his colleagues. Beyond this the doctrine of separation of powers has nowhere taken root with any degree of completeness except in America, where the "Fathers of the Constitution" adopted Montesquieu's theory, or what they took to be such, as if they believed in the doctrine of verbal inspiration. Hamilton's great sentence in No. 47 of the *Federalist* is classic: "The accumulation of all powers, legislative, executive and judiciary, in the same hands, whether of one, a few or many, and whether hereditary, self-appointed or elected, may justly be pronounced the very definition of tyranny." Upon this rock the American constitution is built. The Supreme Court is established, and its jurisdiction to a large extent determined, by the constitution itself and to that extent it is co-ordinate with the legislature and independent of it. The same holds good of Australia where the adoption of this American principle qualifies the British principle of parliamentary sovereignty which otherwise prevails—the qualification was inevitable if one adopted, as the Australian Convention was determined to do, the American model of a Federal system. But even congress may regulate the jurisdiction of the Federal Courts, as it has done by the Judicial Code, and the judges are necessarily subject to the joint authority of the president and congress in that their appointment must be vested somewhere. The most striking feature of the American constitution is the complete separation of the executive and the legislature—here there is not only, as in England, a dualism in law, but a dualism in fact. On the other hand in England the legislature being omnipotent can delegate its powers of legislation to the Executive—and does so to an increasing extent—whereas in America it is a fundamental principle, resulting from the separation of powers and the theory that congress itself is but a delegate of the constitution, that the Federal legislature cannot in turn delegate its power of law-making to the executive. But the Supreme Court had had to keep pace with the development of governmental functions attendant on the increasing complexity of society, and it has come to recognize as "constitutional" the devolution by congress of powers of "subordinate legislation" to commissions particularly the Interstate Commerce Commission (see *Interstate Comm. Comm.* v. *Illinois Cent. R. R. Co.* [1910] 215 U.S. 452). The truth is that a complete separation of powers is impossible in any highly organized political society. The Executive, quite apart from the powers of legislation delegated to it, in Parliamentary times, has always legislated in monarchical countries, just as the courts have always legislated by developing the Common Law (*q.v.*). Until the 17th century the king legislated by proclamation in this country; and in some matters, such as the King's Regulations and the Orders in Council regulating the Civil Service, he—or rather his Government—legislates still, although he cannot create new offences. But in Prussia, till 1919, the relative sphere of royal ordinances and parliamentary statutes was, in spite of the constitution of 1851, a debatable subject, and Bismarck did not hesitate, in his conflict with the Prussian chamber, to fall back on an ordinance (*Verordnung*) when he could not procure a statute (*Gesetz*). The position taken up by the putative fathers of the new Reich and Prussian constitutions of 1919 is that the executive shall have no power to make regulations affecting the rights and duties of the citizen except when empowered to do so by statute. In this sense, and to this extent, all modern executives legislate. The result is often to confer, by a draft statute, powers of a most arbitrary kind upon Government departments—even to the paradoxical extent of enabling them to make regulations inconsistent with the Act under which they are made—*cf.* sect. 67 (1) of the Rating and Valuation Act of 1925 and *Rex* v. *Ministry of Health* (T.L.R., April 30, 1927). So too judicial powers are sometimes conferred on Government departments in the interpretation of statutes without appeal to the courts (*cf.* Small Holdings Act, 1908, and *Ex parte Ringer* 25 T.L. Rep. p. 718). Such developments are objectionable, not because they offend against any abstract theory of separation of powers, still less because they are unprecedented, for there was a time when the king's council legislated, administered and judged, and until 1888 (and to some extent still) the lower organs of the governmental hierarchy, namely the Justices of the Peace, were both judges and administrators. The real objection is that no Government department should be judge in its own cause, or act as a legislator without the check of popular control. The great constitutional problem in most countries today is how to subjugate these encroachments of the bureaucracy to the continuous control of the courts on the one hand and of the legislature on the other.

The Elasticity of Constitutions.—It will be apparent from the foregoing that there are no fixed principles in constitutional law. Here, as elsewhere, the life of the law, to adapt the words of O. W. Holmes, "is not logic but experience." Constitutional law is not a matter for categories. Some writers have indeed distinguished constitutions into "rigid" and "flexible," but even the most rigid of constitutions, such as the Federal type, have their elasticity. The "War Power" under the American constitution has, under the inexorable test of the World War, proved itself an instrument capable of completely transforming, for the time being, all constitutional limitations on the legislative power of Congress, enabling, as it has been held to do, congress to regulate prices, requisition ships, control railroads, and even temporarily to enforce "Prohibition" (cf. *Hamilton* v. *Kentucky Distilleries Co.*, 251 U.S. 146, 1919) before the Constitution had been amended. This magic invocation of the "War Power" completely upset the carefully devised balance of powers between the Federal and the State legislatures. Exactly the same thing happened in the federally constituted Dominions of the British Empire—in Canada (cf. *Fort Frances Pulp Co.* v. *Manitoba Free Press Co.*, A.C. [1923] p. 695), and in Australia (cf. *Farey* v. *Barrett* 21 C.L.R. 433) where the "Defence Power" was held, like the "War Power" in America, to cover, *in time of war*, all kinds of extensions of Federal powers which, in time of peace, would be "a trespass on the reserved powers of the States." In constitutions, as in other things, it is the letter that killeth and the spirit that giveth life.

In no department of law has there been so much conscious imitation as in constitutional law. It is, indeed, the only department of law in which nations have deliberately borrowed from one another on a large scale, and it is fashionable to say that England is the foster-mother of the constitutions of the world. A very little reflection should, in the light of what has been written above, serve to show that this is only very partially true. No country could borrow our "constitution" without first destroying its common law and adopting our own. Such a repudiation of its historic past would be impossible. It is only that part of the constitution which relates to the legislature, in particular the bi-cameral system and the law and custom of parliament, that has been deliberately copied from England. Here, indeed, the transcription has been great. When England, almost alone among the countries of Europe, escaped the shock of the French Revolution, the prestige of her constitution became immense. Montesquieu had already singled out the English constitution for the admiration of mankind as the one polity which secured the liberty of the subject—and in his time he was right. After the French Revolution, men set themselves everywhere in Europe to follow Burke's advice and "study the British constitution." From Guizot to Gneist a whole school of European thinkers set themselves to understand it, and indeed to transplant it. And yet even here it may be said, paradoxically enough, that it was only possible to imitate the English constitution in proportion as it was possible to misunderstand it. No constitution will ever bear transplantation from one political climate, *i.e.*, from one legal atmosphere, to another. It is always an exotic. Of no institution is this more true than of our own Second Chamber. Hamilton counselled the adoption of a Second Chamber in the American constitution by analogies drawn from the functions of the house of lords—"a most noble institution" he called it—as a council of the Crown which, at the time he wrote in the *Federalist*, it appeared to be but no longer was. The result is that the American senate has acquired an ascendancy in the American legislature which, ever since the Reform Act took the constituencies out of the pockets of the peers, the house of lords has definitely lost, and no two institutions could be more unlike. Exactly the same divergence has occurred in the case of another "second chamber" which was deliberately adopted from our own country; the French senate—the creation of the Monarchists—has become the creature of the Republicans by that strangest of political ironies by which, as a classical authority tells us, "men realized a Republic while dreaming of a monarchy." None the less, the house of lords stood in the eyes of continental jurists for a principle, namely the division of the legislative body into two chambers, of which bi-cameral principle Esmein remarks, with perfect truth, that it is "*une institution presque générale chez les peuples qui pratiquent le gouvernement représentatif*" and, equally truly, that "*toutes les nations qui ont adopté ce système l'ont directement, ou indirectement, emprunté à l'Angleterre.*" But beyond the mere "division" of the legislature they borrowed little or nothing, and the second chambers of European countries exhibit little or no uniformity of type and in their constitution no resemblance whatsoever to the house of lords—it would have been necessary to borrow our law of incorporeal hereditaments, in other words our law of peerage, before such a resemblance could have been achieved. Another institution which was copied with some fidelity from England was the principle of "responsible government." Here, however, the transcription came much later. Before 1919 responsible government did not exist in Germany. In France, indeed, it has existed ever since 1870, and at intervals before that date, and yet here again it has only been possible to adopt it by transforming it. Hanotaux describes the French cabinet in terms borrowed from Bagchot's account of the English analogue when they have already ceased to apply to the original. The most definitive feature of cabinet government in England to-day is the prescriptive right of a prime minister to exercise the prerogative of dissolution, but a French prime minister has no such power, and the cabinet in France, as also in post-war Germany, is subject to a degree of control by committees of the legislature which would be inconceivable in this country.

There are thus no general principles, common to all mankind, in constitutional law. If there were, it would partake of the character of International Law, whereas its character is almost as national as common law itself. Many a revolution, and with it the apparent "adoption" of an exotic constitution may appear to contradict this but, in the long run, nations always "revert to type."

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UNITED STATES

The term "Constitutional Law" has, in the United States, the restricted meaning of the law that is handed down by courts in construing and applying the provisions of written Constitutions, State and Federal. It is not commonly used to embrace the political practices of departments of Government or the legislation and the executive action in the exercise of the powers conferred by Constitutions. In the United States as in England there are customs and conventions which influence or control the relations between the different departments of Government and are therefore part of the fundamental law of the land. In a broad sense they belong to the realm of constitutional law. The narrow use of the term in the United States is due to the fact that the judicial interpretation of Constitutions controls constitutional development to an extent unknown in any other country.

State and Federal Constitutions in the United States not only distribute powers of government but contain restraints on governmental action in favour of individual liberty and property. The Federal Constitution restricts State as well as national action. Some of its restrictions on State action are for the purpose of leaving the field clear for national authority; others are to leave individuals free from State coercion. All these restrictions are interpreted and applied by courts. State courts are final authorities on the application of State Constitutions to State executive and legislative action. The U.S. Supreme Court is the final authority on the application of the Federal Constitution to national and State legislative and executive action.

Strangely enough this power of the courts to interpret and enforce constitutional clauses is not explicitly granted in American Constitutions. It has been inferred by the courts from the existence of the constitutional restrictions and the duty of courts to apply in lawsuits the higher law of the Constitution against the inferior law of the legislatures whenever the courts find a conflict between the two. The exercise of the judicial power is confined to lawsuits, though in some States there is the practice of securing advisory opinions from the judiciary upon the request of the governor or the legislature. Such opinions may indicate what the court would do if legislation should come before it in its judicial capacity, but it is not strictly a binding adjudication of constitutional law.

Requirement of Due Process.—The powers of the national Government are dependent upon grant in the Federal Constitution and any statute of Congress may be questioned in the courts on the ground that the Constitution did not confer the authority to enact it. Thus when Congress imposed an additional tax on the net income of employers who made use of the labour of children under designated ages or beyond designated hours, the Supreme Court held that the detailed enumerations in the statute indicated clearly that it was in substance a regulation of child labour rather than a tax, and therefore was not within any power conferred on Congress. An earlier statute of Congress which prohibited the inter-State transportation of products from factories in which children worked was also held to be a regulation of the manufacture rather than of the interstate commerce and therefore an encroachment on the reserved powers of the States. These illustrations indicate that the question whether a statute is constitutional may be a very debatable one which the court answers without any clear guidance in the language of the Constitution. This is even more apparent when the courts are called upon to decide whether statutes are void because they deprive persons of liberty or property without due process of law. The requirement of due process is not confined to the procedure by which law is made or enforced, but is held to apply to the substance of the command or the prohibition of a statute. A statute violates the requirement of due-process if it comes within the judicial condemnation of arbitrariness. The due-process clauses in State and Federal Constitutions set no standard by which to determine what is arbitrary and what is reasonable. The courts set the standards as well as apply them. Since the Federal Constitution subjects both State and national legislation to this test of the judicial conception of due-process, the U.S. Supreme Court may in cases properly before it annul for undue harshness not only statutes of Congress but acts of State legislatures and ordinances of municipal councils.

This power of courts in the United States to annul statutes because, to the judicial mind, they seem unreasonable, is peculiar to the American system of government. It differs from the executive veto power only because the opportunity for judicial action must arise in an actual lawsuit and because the courts practice a degree of self-restraint in positing the limit of reasonableness. Courts undoubtedly sustain as constitutional many statutes for which they would not vote as members of the legislature or would not approve as governor. None the less, it is apparent from the actual results of the judicial decisions that in many instances the controlling element in judicial annulment of statutes is the aversion of a majority of the court to the policy of the legislation before it. A striking illustration of this is the decision of the U.S. Supreme Court by a five to three vote that an employer is denied due process of law if compelled to pay women employés a living wage so long as he retains them in his employ. This question came before 45 judges of State and Federal courts, of whom 35 thought the legislation constitutional and ten thought it unconstitutional. The negative opinion of five out of nine justices of the Supreme Court outweighs the affirmative opinion of 35 judges and annuls minimum wage legislation both by Congress and by State legislature. No such legislation can be enforced until the majority of the Supreme Court changes its mind or until there is an amendment to the Federal Constitution.

At one time the Supreme Court held that a State may not restrict hours of labour in bakeries to ten a day, but later a ten-hour law applying to all factories was sustained. The court has allowed the States to prescribe the minimum weight of loaves of bread but prohibited them from fixing maximum weights in order to prevent confusion. The States may regulate employment agencies in a number of ways but may not forbid private agencies to accept fees from employés seeking work. While in an emergency landlords may be restricted in the rents charged, ticket scalpers may not be forbidden to charge more than 50 cents in excess of the box-office price.

More numerous are the decisions sustaining State regulatory laws. Many trivial objections are brought to the Supreme Court year by year to meet with merited rejection. Among the more important legislation to find judicial approval are laws requiring banks to contribute to a guarantee fund to secure the safety of deposits in all banks, laws substituting the system of workmen's compensation for the common law of liability to injured employés and laws establishing a zoning plan which designates areas in which manufacturing or commerce is forbidden and which excludes apartments or two-family houses from certain residential districts.

Control of Taxation.—Questions raised by tax laws of the States and of the United States bring many constitutional issues before the courts. Most important is the issue of jurisdiction, since it is held to be a denial of due process to tax persons or property not subject to the jurisdiction of the taxing authority. The equal-protection clause of the 14th amendment is a safeguard against unjustified discrimination in imposing taxes, and the courts have to pass on the question whether it is reasonable to impose special taxes on special enterprises, to vary the rates on different kinds of property, to impose progressive rates on inheritances or incomes or to indulge in eccentricities in assessing property. While the Supreme Court has been liberal in allowing variations in the tax systems of the States, it is not infrequent that a discrimination is held to be without justification.

Under the canon that a tax is unconstitutional unless it is levied for a public purpose, the courts review the propriety of the enterprises into which public moneys are put. The Supreme Court has held the States to rather strict account in their various efforts to appropriate money in aid of private enterprises conducted by private corporations or by individuals, but has shown liberality in allowing States and cities to go into businesses that compete with private undertakings. The North Dakota enterprise of operating State banks, State grain elevators and State home-building agencies was sustained by an unanimous Supreme Court, and there seems little likelihood that any business conducted by States or cities will be declared unconstitutional under the 14th amendment. The spending power of the United States may go even farther, both because of the difficulty of getting any complaint before the courts for consideration and because of the latitude which the Supreme Court has shown toward contributions by the United States in aid of individuals.

Owing to the constitutional requirement that all direct taxes levied by the United States must be apportioned among the several States in accordance with their population, there has arisen the important question of what is a direct tax. At one time the Supreme Court announced that it was doubtful whether any tax is a direct tax except capitation taxes and taxes on land. This, however, was receded from, and the court held that income taxes are in substance direct taxes when levied on income from property, thereby overruling an earlier decision which had sustained the Civil War income taxes. This change of judicial front led to the adoption of the 16th amendment which relieves income taxes from the requirement of apportionment among the States. This makes a constitutional issue out of the question what is income and what is capital. The Supreme Court has laid down that income from capital must be a gain derived from capital and separated therefrom. It held, therefore, that a stock dividend is not income, because such a dividend withdraws no assets from the corporation to turn over to the stockholder. Some payments by one corporation to another have been held not income because the two corporations though separate in form were regarded as identical in substance. All genuine dividends by which a corporation pays corporate assets to a distinct corporation or to an individual stockholder are treated as income, even though in fact they may represent no economic gain to the recipient, because he paid for his stock a price determined by the expectancy of the dividend.

Other Federal taxes held to be indirect taxes are customs duties, excises on doing business in corporate form or in special kinds of business like extracting oil, manufacturing tobacco or liquor, making oleomargarine, and taxes on estates or legacies. The constitutional requirement that duties, imposts and excises shall be uniform throughout the United States is construed to require only geographical uniformity. The United States may therefore impose progressive rates on incomes and inheritances and may select the enterprises it will tax and those it will exempt about as whimsically as it chooses. The smoker and the motorist and the theatre-goer still suffer from the incidence of Federal excises which are not applied to manufacture and sales generally. The Federal customs tariffs have from the beginning been discriminatory, and there is no judicial doubt as to their constitutionality, notwithstanding contrary constitutional doctrine occasionally announced in political party platforms.

Eminent Domain.—Taxation and regulatory legislation bring to the courts most of the cases involving constitutional issues. There is also the power of eminent domain under which the Government takes private property for public use, or authorizes such taking by railroads and other enterprises, privately owned and managed, but regarded as quasi-public. In every case it is a judicial question whether the taking is for a public use and whether the compensation offered is just. This power of eminent domain must be distinguished from the police power under which noxious activities may be suppressed without compensation. The injury from a police prohibition may be greater than that from an eminent domain injury such as the obstruction to light, air and access caused by the erection of an elevated railroad in the highway, but for the latter there must be compensation, while for the former there is no redress. The theory is that the police power is confined to the suppression of what is harmful, while the power of eminent domain causes an injury by actually taking title to property or preventing the full enjoyment of it. These constitutional questions as to the propriety of exercises of the powers of police, taxation and eminent domain arise under broad constitutional clauses which leave the courts fairly free to apply such canons as they choose. In addition to these broad limitations there are in the Federal Constitution a number of more specific restrictions applying mainly to the action of the National Government. Similar clauses in State Constitutions restrict the action of State authorities. Prohibitions against *ex-post-facto* legislation, against laws impairing the obligation of contracts, against unreasonable searches and seizures, against compulsory self-incrimination, against cruel and unusual punishments and against conviction and imprisonment except after indictment by grand jury and trial by petit jury are contained in the Federal Constitution and in many State Constitutions. Even these specific clauses leave to the courts a considerable latitude in interpreting them, and from year to year novel questions arise which provoke contrariety of judicial opinion. Many State courts allow the use of evidence obtained by wrongful searches and seizures though the Supreme Court holds that the introduction of such evidence amounts to compulsory self-incrimination. On the whole, the Supreme Court applies these restrictions on Federal action more rigidly than State courts apply corresponding restrictions on State action.

These specific clauses designed to keep governmental action within the limits of propriety arose out of historic abuses from which the colonists deemed that they had suffered. They derive from English precedents and were regarded as guarantees of the historic rights of Englishmen. They have, however, been of relatively less importance in American constitutional law, partly perhaps because their monitions have commonly been heeded, but largely because they are confined mainly to modes of executing the laws while the due-process and equal-protection clauses apply to the substantive commands of legislation. Judicial control of the methods of governmental action is of minor importance compared with judicial control of the sphere of governmental action. These broad constitutional restrictions in favour of individual liberty and private property put it within the power of the judiciary to impose the judicial conception of the proper scope of governmental activity upon the contrary conceptions of legislatures and electorates, except as these agencies act by way of constitutional amendment. It is this far-reaching power of the courts to set limits to the ends to be sought by legislation that makes American constitutional law a unique phenomenon in the process of government.

Federal System.—Since the Federal Constitution ordains a Federal system of government, it is necessary to have some organ vested with authority to restrict the States and the nation to their respective spheres. The Constitution declares itself to be the supreme law of the land, and directs State judges to disregard State statutes that are in conflict with valid exercises of national power. This is ample warrant for the power exercised by the Supreme Court to declare State statutes invalid as encroachments on national authority and to declare national statutes invalid as encroachments on State authority. The States do not look to the Federal Constitution as the source of their powers. They have all powers of government not denied to them by prohibitions in the Federal Constitution or by inference from grant of competing powers to the National Government. Since many of the clauses granting power to the National Government do not explicitly make the national authority exclusive, the Supreme Court has to determine for itself whether an exercise of State power is consistent with the possession of a similar power by the United States or with an exercise thereof.

For half a century the Supreme Court was uncertain as to whether the grant of power to Congress to regulate interstate and foreign commerce should be construed as a negation of State power over such commerce. Then it decided that no single answer could be given to the question. In some ways and for some purposes the States may regulate interstate commerce and in other ways and for other purposes they may not. Though the court has framed formulae for marking the division between what the States may and may not do, the formulae are not sufficiently explicit to be much more than baskets into which to put the decisions after they have been reached. Thus there comes before the Supreme Court an infinite variety of problems each with peculiarities that leave each case to turn pretty much on its own facts. The only general rule that can be laid down is that the States may regulate interstate commerce somewhat but not too much, and this is so general that it does not give much guidance.

State police power has been allowed to forbid the exportation to a sister State of dead game, green lemons and water from running streams, but not natural gas or oil. States may prevent the entrance of oleomargarine coloured to resemble butter but not of cigarettes or intoxicating liquor, except as authorized by Congress or by the 18th amendment. States may require some interstate trains to stop at some cities but not other interstate trains at other cities. States may regulate interstate ferry fares but not interstate railroad rates. What the court does is to compare the need of the State for the local regulation with the need of the nation for interstate commerce measurably free and unfettered, and to decide in each case which need seems to be the greater. As cases accumulate, some more general canons develop, and standards appear to aid in deciding cases that arise later.

Regulation of Commerce.—State taxation is a form of regulation which is said to be invalid when applied to interstate commerce. The doctrine is better expressed that the States may not tax interstate commerce "as such." They may, by taxes on property or on net income, take toll from the economic fruits of inter-State commerce, since such taxation is not regarded as a burden on the commerce itself. The decisions in this field of constitutional law have often seemed erratic, and lower courts have frequently confessed or proved their inability to discern the purport of Supreme Court distinctions. If we look at the results of the Supreme Court decisions we find that in economic fact the States are allowed to tax interstate commerce in ways that afford adequate safeguards that this commerce will not be burdened more heavily than property and business generally.

This work of umpiring the Federal system without any clear guidance in the language of the Constitution is a work that the courts cannot escape if the Federal system is to continue. The Constitution for the most part contents itself with broad outlines and eschews details. Had it done otherwise, it could hardly have lasted so long with so little formal amendment. In effect it left to the judiciary the work of drafting details which the framers wisely failed to do. Thus the courts are year by year makers of the Constitution in the sense of the Constitution that actually controls. Constitutional law in the United States is continuous Constitution-making by judiciary. In conventional theory, constitutional law is the interpretation of the language of the Constitution, but in plain fact it is to a large extent a law created by the courts from considerations of statesmanship and with but little restraint or direction in the language of the written instrument. The written instrument is but a small part of the real effective Constitution. The actually controlling Constitution is in large part the constitutional law that the courts have made in the name of the written instrument. (T. R. P.)

CONSTITUTION OF ATHENS, a work attributed to the philosopher Aristotle (384–322 B.C.), forming one of a series of *Constitutions,* 158 in number, which treated of the institutions of the various states in the Greek world. The work was extant until the 7th century A.D., or even later, but was subsequently lost. A copy of the treatise was discovered in Egypt in 1890 and acquired by the trustees of the British Museum, for whom it was edited by Mr. (now Sir) F. G. Kenyon, at that time an assistant in the department of manuscripts.

Date.—It may be regarded as established by internal evidence that the treatise was composed sometime between 329 and 322 B.C. In *c.* 54, 7 an event is dated by the archonship of Cephisophon (329); on the other hand in *c.* 42, 1 the author proceeds to describe the constitution as it existed *in his own day*—a democracy —but the democratic constitution was abolished, and a timocracy established, on the surrender of Athens to Antipater, at the end of the Lamian war, in the autumn of 322.

Authorship.—There can be no question that the treatise discovered in Egypt is identical with the work upon the constitution of Athens which is repeatedly referred to by writers such as Plutarch, and by the scholiasts and lexicographers, and which passed in antiquity under the name of Aristotle. Of 91 quotations from Aristotle, bearing on Athenian constitutional history, of which 58 are expressly referred to "The Constitution of Athens," 78 are found in our treatise. The remaining 13 must have come either from the beginning of the work, which is wanting in the papyrus, or from the latter portion of it, which is mutilated. Controversy has centred mainly round the question, In what sense is the treatise "Aristotelian"? Is it the work of Aristotle himself, or is it the work of a pupil or pupils and so has merely proceeded from his school?

The objections urged against the attribution of the work to Aristotle himself have been based partly on three contradictions between the *Constitution* and the *Politics* and partly on style. One of the contradictions is easily resolved, and as regards the remaining two there is nothing improbable in the suggestion that as the *Constitution* is a later work than the *Politics,* Aristotle found reason in the interval to change his mind on certain points. In the matter of style, stress has been laid on the occurrence in the "Constitution" of many words that are not found in the other writings of Aristotle, and, conversely, on the absence of so many of the expressions that are typical of his style. But such arguments are beside the point; the "Constitution" is a historical work intended for popular use; hence its style must necessarily be different from that of a philosophical treatise. The one serious argument against the attribution of the work to Aristotle himself is that drawn from its general character. Many scholars, deeply concerned for the credit of Aristotle as a historian, have argued that a treatise so inadequate could not possibly have come from his pen. They point to the absence of proportion in the narrative part, to the acceptance of erroneous views and to the undue predominance of the anecdotic element. But on the other side is the consensus of antiquity. Every ancient writer who mentions the "Constitution" attributes it to Aristotle, while no writer is known to have questioned its genuineness. Again the date which can with certainty be assigned to its composition, on internal grounds, coincides with the period of Aristotle's second residence in Athens. Doubtless a series such as the "Constitutions," 158 in number, might well be entrusted to pupils working under the direction of their master, but the "Constitution of Athens" must have been infinitely the most important of the series and one that would most properly be reserved for the master's hand.

Contents.—The treatise consists of two parts, one historical, and the other descriptive. The first 41 chapters compose the former part, the remainder of the work the latter. The first part comprised an account of the original constitution of Athens, and of the 11 changes through which it successively passed. The papyrus, however, is imperfect at the beginning, but a reference to chap. 41 makes it clear that the missing chapters contained a sketch of the original constitution and of the changes introduced in the time of Ion and Theseus. In this connection it is remarkable that while mention is made of "the constitution of Theseus," there is no reference to the incorporation of Attica into one state or process of *Sunoikismos,* traditionally associated with the name of Theseus. Such a process may have been effected only gradually and may not have been complete before the 7th century, but the final result of it surely merited a place among the "changes," or constitutional landmarks, of Athenian history. Its importance in the minds of the Athenians of the age of Pericles is sufficiently indicated by Thucydides (II. chap. 15) who points to the festival of the *Sunoikia.*

The second part describes the constitution as it existed at the period of the composition of the treatise (329–322 B.C.); the subjects which receive the fullest treatment are the Council, the Archons and the Law-courts.

Sources.—The labours of several workers in this field, notably Keil and Wilamowitz-Möllendorf, have rendered it comparatively easy to form a general estimate of Aristotle's indebtedness to previous writers.

Among these sources are unquestionably Herodotus, Thucydides, Xenophon, and the poems of Solon. There is now among critics a general consensus in favour of the view that the most important of his sources was the *Atthis* of Androtion. An *Atthis* is a local history of Athens and Attica. This *Atthis* was published only a few years earlier than the "Constitution," probably about 340. From it are derived not only the passages which are annalistic in character and read like excerpts from a chronicle (*e.g.,* chap. 13 *init.,* in which is described the "anarchy" which followed the legislation of Solon, and chap. 22, which contains an account of "ostracism" and a list of ostracized statesmen), but also most of the matter common to the "Constitution" and to Plutarch's *Solon.* It is also generally agreed that among the sources was a work, written towards the end of the 5th century B.C., by an author of oligarchical sympathies, with the object of defaming the character and policy of the heroes of the democracy. This source can be traced in passages such as chap. 6.2 (Solon turning the *Seisachtheia* to the profit of himself and his friends) and chap. 27.4 (Pericles' motive for the introduction of the dicasts' pay). The authorship of this pamphlet is uncertain, as is also its relationship to another source of importance, viz., that from which are derived the accounts of the Four Hundred and the Thirty. The chief characteristics of that part of the "Constitution" are the prominence given to the term "traditional constitution" (πάτριος πολιτεία) and the favourable view taken of the character and aims of Theramenes. It has been maintained, on the one hand, that this last source (the authority followed in the accounts of the Four Hundred and the Thirty) is identical with the oligarchical pamphlet, and, on the other, that it is none other than the *Atthis* of Androtion. The former hypothesis is possible. The latter is impossible. We know from the fragments that have descended to us that the Atthides uniformly adopted a democratic tone. We also know that Androtion belonged to the radical wing of the democratic party at Athens. The probability is that Aristotle followed not one but several oligarchical works composed about the end of the 5th or at the beginning of the 4th century B.C. and that he was indebted to one or other of these, not merely in his account of the Four Hundred and the Thirty but also in the earlier constitutional history. (*Cf.* the prominence assigned to the Areopagus throughout the treatise.)

Value.—It will be realized that the value of any particular statement will vary with the character of the source from which it comes. For the history of the 5th century the passages which come from Androtion's *Atthis* carry with them a high degree of authority, but in passages which are derived from other sources than the *Atthis* a much lower degree of authority can be claimed, even for statements relating to the 5th century. The constitution of Dracon in chap. 4 is certainly an interpolation; the 17 years' ascendancy of the Areopagus after the Persian Wars must be regarded as unhistorical, also the introduction of payment for the citizens by Aristeides and the association of Themistocles with Ephialtes in the overthrow of the Areopagus. It is remarkable that there is not a word about the organization of the Empire in the 5th century. The period between Cleisthenes and the Peloponnesian War is treated very inadequately. But even so it must be admitted that our debt to the narrative contained in the first part is great. Much new material has been supplied which throws light not only on the Solonian reforms but also on the economic and political conditions of Athens in pre-Solonian days and on the period of confusion which immediately followed the reforms. To estimate what the discovery of the treatise has meant to our knowledge of Cleisthenes, it is only necessary to compare the histories of Greece written before 1891 with those published after that date. Many questions which had given rise to controversy in the past are now settled; the Areopagus was in existence long before Solon; Solon, however, not Cleisthenes was the founder of the Heliaea; the Archons were not appointed by lot until 487 B.C., and Ephialtes, not Pericles, was the democratic leader when the Areopagus was deprived of its powers. Further, from the treatise we realize the great part played by the moderate men in the revolutions of the Four Hundred and the Thirty.

Again, there can be no question as to the importance, or the trustworthy character of the Second Part. True, there are some omissions even here, *e.g.*, the Ecclesia is touched on only incidentally, but it remains as our chief authority for the institutions of the 4th century. We need, however, to be continually on our guard against arguing from the practice of the 4th century to that of the 5th, unless corroborative evidence is available.

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Works dealing with the subject: Bruno Keil, *Die Solonische Verfassung nach Aristoteles* (1892), and most important of all U. von Wilamowitz-Möllendorf, *Aristoteles und Athen* (1893; also in anastatic reprint). *See* also Vol. 2 of G. Busolt, *Griechische Staatskunde*, new edition by Swoboda (Munich, 1926). (E. D. T. J.)

CONSUETUDINARY, customary, especially in law, as opposed to statutory. As a noun, a manual of the ritual customs of a particular monastery, cathedral or religious order.

CONSUL, the title borne by the highest of the ordinary magistrates of Rome during the republic. The consulship arose with the fall of the ancient monarchy (*see* ROME: *Ancient History: The Republic*). The deep-seated Roman reverence for the abstract conception of the magistracy, as expressed in the *imperium* and the *auspicia,* led to the preservation of the regal power in a qualified form. The two new officials who replaced the king bore the titles of leaders (*praetores*) and of judges (*iudices*). But the new fact of colleagueship (*collegium*) caused a third title to prevail, that of *consules* or "partners." This first example of the collegiate principle assumed the form familiar in the Roman commonwealth. Each of the pair of magistrates could act up to the full powers of the *imperium;* but the dissent of his colleague rendered his decision or his action null and void. At the same time the principle of a merely annual tenure of office was insisted on. The two magistrates at the close of their year of office were bound to transmit their power to successors; and these successors, whom they nominated, were obliged to seek the suffrages of the people. The only body known to us as electing the consuls during the republican period was the *comitia centuriata* (*see* COMITIA). The consulate was originally confined to patricians. A struggle for office ensued between patricians and plebeians which was brought to an end by the Licinio-Sextian laws of 367 B.C., which enacted that one consul must be a plebeian (*see* PATRICIANS).

The executive power of the consuls was gradually limited (1) in jurisdiction, by the grant of appeal (*provocatio*), the growth of the praetorship and the publication of law (*e.g.*, the XII. Tables); (2) in administration, by the appointment of the tribunes of the *plebs* and the creation of new magistrates (censor in 443, curule aediles in 367 B.C.) to take over parts of their functions. The result of these limitations and of this specialization of functions in the community was to leave the consuls with less specific duties at home than any magistrates in the State. But this may be of itself a sign of a general duty of supervision. The consuls were in a very real sense the heads of the State. They exercised control in concert with the senate, whose chief servants they were. They were the most regular consultants of this council, they formulated its decrees as edicts, and they brought before the people legislative measures which the senate had approved. They also represented the State to the outer world and introduced foreign envoys to the senate. The consulate was, as Cicero expresses it, the culminating point in an official career. The consuls retained certain powers of jurisdiction. This jurisdiction was either (1) administrative or (2) criminal. (1) Their administrative jurisdiction was concerned with financial matters such as claims made by the State and by individuals against one another, when the censors were not in office, and with disputes about property between the cities of Italy. (2) Their criminal jurisdiction was of three kinds. In the first place, it was their duty to set in motion the criminal law for ordinary, as opposed to political crimes. The reference of such cases to the assembly of the people was effected through their quaestors (*see* QUAESTOR). Secondly, when the people and senate, or the senate alone, appointed a special commission (*see* SENATE), the commissioner named was often a consul. Thirdly, we find the consul conducting a criminal enquiry raised by a point of international law. It is possible that in this case his advising body (*consilium*) was composed of the *fetiales* (*see* HERALD, *ad fin*).

The consuls were recognized as the heads of the administration abroad as well as at home. It thus became necessary that departments of administration (*provinciae*) should be determined and assigned. The method of assignment varied. Foreign wars often demanded the attention of both consuls. In this case the regular army of four legions was usually divided between them. When it was necessary that both armies should co-operate, the principle of rotation was adopted, each consul having the command for a single day—a practice which may be illustrated by the events preceding the battle of Cannae (Polybius iii. 110; Livy xxii. 41). During the great period of conquest from 264 to 146 B.C. Italy was generally one of the consular "provinces," some foreign country the other; and when at the close of this period Italy was at peace, this distinction approximated to one between civil and military command. The consuls settled their departments by agreement or by lot (*comparatio, sortitio*); the power of declaring what should be the consular *provinciae* was usurped by the senate (*see* SENATE). But the home officials invested with the *imperium* proved insufficient for the military needs of the empire, and the system of prolonging the command (*prorogatio imperii*) grew up (*see* PROVINCE). The ex-magistrates after their year of office began to go abroad to undertake a year of provincial government and, in some special cases, appointments were made by law for longer periods. Technically the provinces might still be consular, actually they were proconsular. The Lex Pompeia, 52 B.C., established a five years' interval between home and foreign command.

Since the theory of the persistence of the republican constitution was of the essence of the principate, the consuls necessarily lost little of their outward position and dignity under the rule of the Caesars. In the interval between the death or deposition of one princeps and the appointment of another the consuls resumed their normal position as the heads of the State. As the presidents of the senate, who after A.D. 14 elected them to their office, they directed that high criminal jurisdiction which the senate of this period assumed (*see* SENATE). A restored power of jurisdiction is indeed one of the features of their position during this time, and it is probable that the civil appeals which came to the senate were delegated to the consuls. They acted for a time as delegates to the princeps in matters of chancery jurisdiction such as trusts and guardianship. The consulship was also a preparation for certain commands abroad, and for the praefecture of the city. The tenure of the office was progressively shortened. In the early principate the consuls held office for six months, later for four to two months. The consuls appointed for Jan. 1 were called *ordinarii,* the others *suffecti;* and the whole year was dated by the names of the former. This distinction continued in the empire of Diocletian and Constantine. The *ordinarii* were nominated by the emperor, the *suffecti* by the senate, and their appointment was ratified by the emperor. The consulship was still the greatest dignity which the empire had to bestow; and the pomp and ceremony of the office increased in proportion to the decline in its actual power. The entry of the consuls into office was celebrated by a great procession, by games given to the people and by a distribution of gifts. But the senate, over which they presided, was little more than the municipal council of Rome; and the justice which they meted out had dwindled down to formal and uncontested acts. The last consul born in a private station was Basilius in the East in A.D. 541. But the emperors continued to bear the title for some time longer.

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IN MODERN TIMES

A consul is a public officer authorized by the state whose commission he bears to protect the interests and to foster the commercial affairs of its subjects in a foreign country, and formally permitted by the government of the country wherein he resides to perform the duties which are specified in his commission. (For the ancient magisterial office of consul *see* above.)

A consul, as such, is not invested with any diplomatic character, and he cannot enter on his official duties until permission in the form of an exequatur has been granted to him by the authorities of the state to which his nomination has been communicated by his own government. The exequatur may be revoked at any time at the discretion of the government where he resides. The status of consuls commissioned by the Christian powers to reside in certain oriental countries, and to exercise judicial functions in civil and criminal matters between their own countrymen and strangers, is exceptional to the common law, and has been founded on special conventions or capitulations (*q.v.*).

History.—The title of consul, in the sense in which it is used in international law, is derived from that of certain magistrates in the cities of mediaeval Italy, Provence and Languedoc, charged with the settlement of trade disputes whether by sea or land (*consules mercatorum, consules artis maris,* etc.). With the growth of trade it early became convenient to appoint agents with similar powers in foreign parts, and these often, though not invariably, were styled consuls (*consules in partibus ultramarinis*).

It was not till the beginning of the 19th century, that the system developed universally. Hitherto consuls had, for the most part, been business men with no special qualification as regards training; but the French system, under which the consular service had been long established as part of the general civil service of the country—a system that had survived the Revolution unchanged—was gradually adopted by other nations; though, as in France, consuls not belonging to the regular service, and having an inferior status, continued to be appointed. In Great Britain the consular service was organized in 1825; in France the series of ordinances and laws by which its modern constitution was fixed began in 1833. In Germany progress was at first hindered by the political conditions of the country under the old confederation, but a well organized consular system followed the establishment of the united empire. The functions, duties and privileges of French and German consuls do not differ materially from those of British consuls; but there is a great difference in the organization and personnel of the various consular services. In France, Germany, Italy, the United States, Japan, Belgium and other countries, members of the consular and diplomatic services are interchangeable; in Great Britain, although the entrance examination is practically the same, the consular and diplomatic services are still entirely separate. It was France which led the way in amalgamating these two services, by decrees of July 10, 1880, and April 27, 1883, and other countries have gradually followed its example.

Few countries can afford the cost of career officers at every consular post, and the corps of career officials is therefore supplemented by honorary officers, usually residents engaged in trade, who are citizens of the country which nominates them, or in which they reside.

Privilege.—Whereas diplomatic privileges and immunities are clearly defined, those to be enjoyed by consuls are not yet established, and considerable difference of opinion exists on the subject. France on the one hand has negotiated many consular conventions; Great Britain, on the other, has always refused to be a party to one. The right to establish consuls is now universally recognized by Christian civilized states. Jurists at one time contended that according to international law a right of "ex-territoriality" attached to consuls, their persons and dwellings being sacred, and themselves amenable to local authority only in cases of strong suspicion on political grounds. Apart from treaty and convention, custom has established very few consular privileges, and the 20th century view is that perhaps consuls may be arrested and incarcerated, not merely on criminal charges, but for civil debt; and that, if they engage in trade or become the owners of immovable property, their persons certainly lose protection. This question of arrest has been frequently raised in Europe:—In the case of Barbuit, a tallow-chandler, who from 1717 to 1735 acted as Prussian consul in London, and to whom the exemption conferred by statute on ambassadors was held not to apply; in the case of Cretico, the Turkish consul in London in 1808; in the case of Begley, the United States consul at Genoa, arrested in Paris in 1840; and in the case of De la Fuente Hermosa, Uruguayan consul, whom the *Cour Royale* of Paris in 1842 held liable to arrest for debt. In the same way consuls are often exempt from all kinds of rates and taxes, and always from personal taxes. They are exempt from billeting and military service, but are not entitled (except in the Levant, where also freedom from arrest and trial is the rule), to have private chapels in their houses. The right of consuls to exhibit their national arms and flag over the door of the consular office is not disputed, and the inviolability of consular archives is generally admitted.

GREAT BRITAIN

Until the year 1825 British consuls were usually merchants engaged in trade in the foreign countries in which they acted as consuls, and their remuneration consisted entirely of fees. An act of that year, however, organized the consular service as a branch of the civil service, with payment by a fixed salary instead of by fees; consuls were forbidden also to engage in trade, and the management of the service was put under the control of a separate department of the foreign office, created for the purpose. The restriction as to engaging in trade was withdrawn in 1832, except for salaried members of the British consular service. Since then, and especially as the result of the reorganization of the consular service, consequent on the recommendations as to the creation of new posts, training, pay and allowances made by Sir Arthur Steel-Maitland in 1919, the service has become a first-class one, and its members are recruited from the same examination as the higher division of the home civil service, the foreign office and diplomatic service, and the Indian civil service. (*See* CIVIL SERVICE.) It is now grouped in three divisions, (1) the general service, (2) the Levant, (3) the far east (China, Japan and Siam).

At posts where the cost of living is very high, local allowances are granted in addition.

Routine.—The routine duties of a British consul are very varied; his chief work is connected with shipping, commercial, political, judicial and notarial matters. Under the Merchant Shipping acts of 1894 and 1906, British consuls have certain statutory duties and powers relating mainly to the welfare of the crew and to discipline on board. At a foreign port engagements and discharges of seamen have to be sanctioned by the consul, who arranges suitable hospital treatment for sick seamen, and takes charge of their wages. The consul also provides for the subsistence of seamen who are shipwrecked or left behind; they are generally sent home in the first British ship. Complaints by crews as to their treatment on board are investigated by the consul, who enters a statement in the log book and reports to the board of trade. When an offense has been committed on the high seas by British seamen, the consul may make inquiry on oath and send home the offender and the witnesses. In certain cases, a consul can summon a naval court to deal with a grave offense or casualty, but the procedure is cumbersome, and effect cannot always be given to the findings. Naval courts are now rarely called. The master of every British ship, not carrying passengers, is obliged to deposit at the consular office at a port where there is a British consul the copy of the articles of agreement with the crew, if the ship remains 48 hours in port. It has been the aim of the British government to reduce consular formalities in connection with shipping to a minimum, and foreign ships, as well as British, are saved time and money by this enlightened policy.

Having regard to the great importance attached to the commercial duties of a British consul and as the result of a recommendation contained in the majority report of a committee set up in 1919, under the chairmanship of Lord Cave, to examine the question of Government machinery for dealing with trade and commerce, the Consular department of the Foreign Office, which is responsible for the administration of the consular service, was placed under the administrative control of the department of Overseas Trade, a joint department of the Foreign Office and the Board of Trade. This department is also authorized to communicate with, and give instructions to, consuls on all questions relating to commercial intelligence and the development of British overseas trade. Consuls report direct to the department of Overseas Trade on commercial matters, and they are also, as regards the commercial side of their work, under the general supervision of the commercial diplomatic officer attached to the embassy or legation to the country in which they are stationed. By this co-operation of the consular and commercial diplomatic services a net-work of Government commercial representatives is thrown over the majority of foreign countries. Thus suitable prominence is given to this side of a consul's duties, and proficiency in this respect is now an important factor in deciding upon claims for promotion.

It is the duty of a consul to deal to the best of his ability with all questions on commercial subjects addressed to him not only by the departments at home but also by individual British traders. He is expected also to furnish on his own initiative reports on matters of commercial interest. In addition to such important questions as tariffs, customs regulations, patents, regulations respecting commercial travellers and their samples, formation of industrial syndicates, legislation regarding transport, organization of international exhibitions and fairs, aerial navigation, labour legislation, crops and fishery matters, the consul is expected to report regularly on changes in the general financial and other conditions affecting local trade and industry; openings for the sale of British goods and effects of foreign competition; the development and organization of local industry, trade, finance, public utilities and means of transport; and the development of local export trade in raw materials.

The furnishing of reports on individual trades or industries is amongst the most important of the consul's duties, and necessitates making exhaustive and at times difficult enquiries into the extent of the demand for the particular goods in question, the nature of foreign and local competition, the buying methods of local purchasers and the selling methods of competitors, as well as into such cognate subjects as suitable packing, distribution of trade literature, advertising and transport. The consul has also to report, so soon as it comes to his notice, any specific opening for the introduction of British manufactures, such for instance, as a public works contract. Another matter of great importance to the British manufacturer at home is the knowledge of new sources of supply of raw materials for use in industry, and the consul must watch developments in this direction.

A consul may be called upon, in connection with his commercial work, to answer inquiries of the nature outlined above received from firms in the British dominions or from the Trade Commissioners of any dominion Government. It is, in fact, the function of a consul to help British trade within his area in every way in which he properly can.

Political and judicial duties form a large part of the work of the Levant and Far East consular services.

The consul acts as a notary public; he draws up marine and commercial protests, attests documents, draws up wills, and powers of attorney. He celebrates marriages, or witnesses marriages performed by a local authority, and, if required, reads the burial service when the ministrations of a clergyman cannot be obtained. He gives advice to British subjects of whatever race, issues passports, and at most posts keeps a register of British residents. A system of inspection was inaugurated in 1913, and developed after the World War. This work is carried out by a corps of four inspector-generals, whose duty it is to visit consular posts all over the world, furnish reports and make recommendations as regards personnel, work and conditions, to the Consular department of the Foreign Office.

UNITED STATES

After the War of the Revolution, the United States appointed unpaid consuls from among American merchants residing abroad. This system worked badly and although the consular system was established by acts of Congress in 1790 and 1792, it was not until 1856 that the organization of the service was effected in a satisfactory manner. By a law passed by Congress in that year the service was reduced to a regular system similar to the British consular service. Salaries were fixed and the relations between official and business duties were clearly defined. The appointment of consular officers was placed in the hands of the President.

The consular service continued to operate under this law until the Rogers Act was passed in 1924, when complete re-organization of the diplomatic and consular services was effected, the two being merged in the "Foreign Service of the United States." Although these services had been on a civil service basis for almost two decades there was much criticism regarding salaries, promotions, interchangeability of position between the two services, and retirement provisions.

The new act took cognizance of rewards for meritorious service, the admission of persons not possessing independent means, the development of a schedule of advancement whereby an official of the consular service may rise to the rank of a minister, the adoption of an adequate pension and retirement system, and the principle of the interchangeability of diplomatic and consular posts. The old classes were abolished and all officials below the rank of minister were designated as Foreign Service officers. Nine new classes were created with salaries ranging from $9,000 a year in class one, down to $3,000 a year in class nine. Unclassified subordinates draw salaries of $3,000 or less.

Only those who pass a satisfactory examination and serve a probationary period, or who may be transferred after a period of five years continuous service in the Department of State, are eligible for appointment in the Foreign Service. The Secretary of State refers to the President matters relating to applicants and promotions. Although "representation allowances" may be granted by the President, Ambassadors and Ministers receive no increase in salaries, which are fixed at $7,500 and $10,000 (with a maximum of $12,000) respectively. A board dealing with all matters relating to personnel and a Foreign Service school, which provides for one year of instruction, were established in 1924.

The duties of the American consuls include discharge and relief of seamen of American vessels; issuing and viséing of passports; settlement of estates of American citizens who may die intestate in foreign countries; issuance of bills of health certifying to the sanitary condition of passengers, cargo and crew of vessels clearing from foreign ports for ports of the United States; and certification of invoices on dutiable merchandise for export to the United States.

The solemnization of marriages is not permitted by consuls but they may be witnesses thereto. Consular officers in China, Morocco, Maskat, Siam, Persia, Zanzibar and Tripoli are invested with judicial powers. The exemptions and privileges of consular officers depend largely upon the treaties existing between the United States and the countries to which they are credited.

The duties of consular officers with respect to the development of American foreign trade are of comparatively recent origin but of great importance today. Every member of the service is expected to have accurate and full knowledge of all conditions affecting trade and industry in the community to which he is accredited. He reports to the government new markets for American manufactures and notes all developments. Much of this information is published in *Commerce Reports,* issued weekly. On the basis of this material monthly and yearly studies of trade are compiled and are issued by the government under the name of *Monthly Consular Reports* and *Commercial Relations.* For special manufactures, at the suggestion of individuals or firms seeking information, independent studies are made by consuls and printed in separate form. (E. T. F. C.)

"CONSULATE OF THE SEA," a celebrated collection of maritime customs and ordinances (*see* also SEA LAWS) in the

Catalan language, published at Barcelona, Spain, in the latter part of the 15th century. Its proper title is *The Book of the Consulate,* or in Catalan, *Lo Libre de Consolat,* the name being derived from the fact that it embodied the rules of law followed in the maritime cities of the Mediterranean coast by the commercial judges known generally as consuls (*q.v.*). The earliest extant edition of the work, which was printed at Barcelona in 1494, is without a title page or frontispiece, but it is described by the above-mentioned title in the epistle dedicatory prefixed to the table of contents. The only known copy of this edition is preserved in the National library in Paris. Capmany, in his *Codigo de los costumbres maritimas de Barcelona* (Madrid, 1791), states that there was extant to his knowledge a more ancient edition of the *Book of the Consulate,* printed in semi-Gothic characters, which he believed to be prior to 1484. This is the earliest period to which any historical record of the *Book of the Consulate* being in print can be traced back. There are, however, two Catalan mss., preserved in the National library in Paris, the earliest of which (ms. Espagnol 124) contains the first two treatises in the *Book of the Consulate* of 1494, written in a hand of the 14th century.

The edition of 1494, which is justly regarded as the *editio princeps* of the *Book of the Consulate,* contains (1) a code of procedure issued by the kings of Aragon for the guidance of the courts of the consuls of the sea, (2) a collection of ancient customs of the sea and (3) a body of ordinances for the government of cruisers of war. A colophon at the end states that "the book commonly called the *Book of the Consulate* ends here"; after which there follows *The Acceptations,* which purports to record that the previous chapters and ordinances had been approved by the Roman people in the 11th century, and by various princes and peoples in the 12th and 13th centuries, but this document clearly has no proper reference to the *Book of the Consulate,* and is, in fact, of no historical value whatsoever. The remainder of the volume consists of what may be regarded as an appendix to the original *Book of the Consulate.* This appendix contains various maritime ordinances of the kings of Aragon and of the councillors of the city of Barcelona, ranging over a period from 1340 to 1484.

An excellent translation into French of "The Customs of the Sea," which are the most valuable portion of the *Book of the Consulate,* was published by Pardessus in the second volume of his *Collection des lois maritimes* (1834), under the title of "La Compilation connue sous le nom de consulat de la mer." *See* introduction, by Sir Travers Twiss, to the *Black Book of the Admiralty* (London, 1874), which in the appendix to vol. iii contains his translation of "The Customs of the Sea," with the Catalan text.

CONSUMER ADVERTISING, advertising directed to those who use or consume goods rather than to wholesalers, retailers, or others who are interested in distributing the goods. Advertising directed to distributors is called dealer advertising.

CONSUMERS' CREDIT: *see* INSTALMENT SELLING.

CONSUMER'S SURPLUS, in economics, the excess which the purchaser of an article would be willing to pay over the price which he actually pays rather than go without it. Thus, "consumer's surplus" is an economic expression of the surplus satisfaction which a bargain yields to the purchaser. In the case of a good bargain there is a big consumer's surplus, as when a woman buys at a low price a fine dress for which she would willingly pay much more. For many articles consumers would gladly give higher prices rather than go without them. The news of the day, well printed for a penny, is a case in point; probably a few would give five shillings, many would give sixpence, and tens if not hundreds of thousands would give twopence, rather than go without a newspaper. Here is a very clear case of consumer's surplus. The intelligent consumer strives so to apportion his expenditures as to make his total consumer's surplus a maximum. (*See* ECONOMICS.)

CONSUMPTION, in economics, means much more than the "destroying" or "consuming" which is the literal meaning of the word (Lat. *consumere*). The economist means by consumption the utilization of services or material goods for the gratification of human beings. This is not destruction, for that implies failure to satisfy wants. (*See* ECONOMICS.)

CONSUMPTION: *see* TUBERCULOSIS.

CONSUS, an ancient Italian deity, cult partner of Ops. The time at which his festival was held (after harvest and seed sowing), the nature of its ceremonies and amusements, his altar at the end of the Circus Maximus always covered with earth except on such occasions, all point to his connection with agriculture. His name is clearly derived from *condere,* to store away, and he is in all probability god of the store bin. Anciently, when the true meaning of his cult was forgotten, three explanations were rife: (1) he was a god of good counsel (*consilium*): Varro *ap.* Augustine, *Civ. Dei,* iv, 11; (2) he was Neptunus Equester; *i.e.,* Poseidon *Hippios:* Dion. Hal., i 33, 2; (3) he was god of hidden or secret (*condita*) policy, Dion. Hal., ii, 31, 3.

His festival was celebrated on Aug. 21 and Dec. 15. On the former date, the flamen Quirinalis, assisted by the vestals, offered sacrifice, and the pontifices presided at horse and chariot races in the circus. Horses and mules, crowned with garlands, were given rest from work. A special feature of the games in the circus was chariot racing, in which mules took the place of horses. The origin of these games was generally attributed to Romulus, sometimes to Evander. There was a sanctuary of Consus on the Aventine, dedicated by L. Papirius Cursor in 272 B.C.

BIBLIOGRAPHY.—*See* W. W. Fowler, *Roman Festivals,* p. 207; G. Wissowa, *Religion u. Kultus* (2nd ed.), p. 201 et seq.

CONTACT WEATHER denotes the state of atmospheric turbidity and cloudiness to provide sufficient visibility for an aircraft to be navigated and manoeuvred by visual reference.

Rules governing contact flight vary with the location and altitude of flight. In 1946 in the U.S., in regions of potentially heavy traffic, such as inside airport traffic zones and control areas, the pilot had to have at least 3 mi. visibility and remain 500 ft. vertically and 2,000 ft. horizontally clear of clouds. A control tower or control centre could issue a traffic clearance when visibility was less than 3 mi. but the aircraft had to remain clear of clouds.

Outside an airport approach zone and airport traffic zone, or inside a control area with traffic clearance, at least 1 mi. visibility was required in 1946. Elsewhere, if the flight was at an altitude of 700 ft. or less above the surface, the 500 ft. vertical and 2,000 ft. horizontal cloud proximity limit did not apply but the aircraft had to remain clear of clouds.

See Civil Air Regulations, U.S. Part 60. (E. J. MR.)

CONTAINERS, METALLIC, a phrase describing cylinders, tank cars, barrels, drums and cans used to hold substances either in gaseous solid or liquid form at atmospheric or high pressures.

Cylindrical Types.—Cylindrical containers are built to withstand rough usage and high pressure. Gases and liquids under pressure that are likely to be explosive, highly combustible or poisonous are usually held in them. Increases in temperature due to weather or fire might easily double or treble the original pressure in the container and if the strength of the container were insufficient, an explosion causing serious damage or loss of life might result. These containers or cylinders range in size from very small flasks containing only a few ounces of material to tank cars carrying a battery of tanks designed to carry several tons. The design of cylinders varies depending on the physical and chemical properties of the material to be shipped. Some are equipped with special safety devices which operate when the internal pressure increases to a point where further increase in pressure might rupture the container. Others are equipped with devices to permit the escape of the contents when the temperature of the vessel and contents becomes excessive. Substances shipped in cylinders are oxygen, acetylene, hydrogen, nitrogen, chlorine, sulphur dioxide, nitrous oxide, ethylene, methyl chloride, ammonia, carbonic acid gas, liquefied petroleum gases, helium, argon, blaugas, pintsch gas and a number of others.

Containers designed to transport materials having considerable weight, or bulk, which are in suitable form to permit being shipped at ordinary atmospheric pressure are designated as tank cars, barrels, drums and cans (*see* CANNING, COMMERCIAL).

Tank Cars.—These consist of railway cars equipped with one or more tanks, the total capacity being generally about 8,000 gallons. They are equipped with piping for heating and liquefying viscous liquids, valves and vents to facilitate filling and emptying. Where large quantities of material are to be transported, and the existing regulations permit that material to be shipped in bulk, these tank cars offer a very economical service as containers.

Barrels.—Because the number of consumers whose business warrants delivery of material in tank cars is limited, barrels, drums and cans play a large part in the distribution of many products to the consumer. Those containers having a bilged shape similar to the wooden barrel or keg, are termed barrels. They are made of heavy gauge steel and are designed to withstand extreme abuse. Their shape makes them easy to handle especially when filled with heavy materials, and because of their sturdy construction and long life they are treated as transport equipment, being depreciated on a basis of probable life and number of trips through which they are likely to remain sound. Records show that bilged steel barrels of the seamless type have a life of over 20 years with an average of eight trips per year. Bilged type containers of 30 and 50 gal. sizes are produced in the United States. Germany produces bilged steel barrels up to 110 gal. capacity. There are two distinct types of barrels, those fitted with threaded bung and vent for liquid substances and those equipped with removable plates or full removable heads to facilitate emptying semi-liquids, paste or solid substances. These containers having straight sides and a capacity ranging from 10 gal. up to 110 gal. are usually termed drums. They are made in a variety of designs depending on the product to be shipped. For liquid products they are provided with threaded bungs and vents. For semi-liquids, pastes and solid substances the drums are equipped with removable heads to facilitate the removal of the contents.

Drums.—Two distinct types of drums are produced in the United States. Heavy gauge drums are required for the shipment of substances which are combustible, explosive or corrosive. Those for highly corrosive substances such as acids, are specifically designed to give service under extreme conditions. Substances having a low flash point, or those of the non-corrosive type may be shipped in very light gauge steel drums used only for one shipment, the drum being destroyed after it has been emptied. When the material shipped is non-combustible or non-corrosive and where long distance shipments are made, or where the substances pass through several hands before reaching the ultimate consumer, the light gauge single trip drum is economical. Where return freight rates are not excessive and when marketing conditions are favourable the returnable type or heavy gauge drum and the bilged type steel barrel have proved themselves to be an economy over the light gauge single trip container of the drum type.

Cans.—The number of consumers who purchase smaller quantities of materials than are contained in standard drum sizes, is legion. Also many substances are of such a nature that they are used in small quantity by the consumer. For these substances cans of a variety of shapes and sizes varying from a few ounces to 10 gal. capacity are manufactured. They are strictly of the single trip container type, are sold with their contents, are non-returnable and are often made non-refillable. Tank cars, barrels, drums and cans are used for the distribution of vegetable, animal and mineral oils, gasolene, kerosene, turpentine, alcohol, soaps, ink, paint, varnish, shellac, lacquers, putty, lard and lard substitutes, acids, medicines and many thousands of chemical compounds.

The construction of the large majority of tank cars, cylinders, barrels, drums and cans is often (particularly in the United States) under Government supervision. (H. ME.)

CONTANGO, a Stock Exchange term for the rate of interest paid by a "bull" who has bought stock for the rise and who, when the settlement arrives, is unable or unwilling to take it up and pay for it. He arranges to "carry over" or "continue" his bargain, and does so by entering into a fresh bargain with his seller, or some other party, by which he sells the stock for the settlement and buys it again for the next, the price at which the bargain is entered being called the making-up price. The rate that he pays for this accommodation, which amounts to borrowing the money involved until the next settlement, is called the contango.

CONTARINI, a distinguished Venetian family, who gave to the republic eight doges and many other eminent citizens. The story of their descent from the Roman family of Cotta, appointed prefects of the Reno valley (whence Cotta Reni or Conti del Reno), is probably a legend. One Mario Contarini was among the 12 electors of the doge Paulo Lucio Anafesto in 697. Domenico Contarini, elected doge in 1043, subjugated rebellious Dalmatia and recaptured Grado from the patriarch of Aquileia. He died in 1070. Jacopo was doge from 1275 to 1280. Andrea was elected doge in 1367; during his reign the war of Chioggia took place (1380); he was the first to melt down his plate and mortgage his property for the benefit of the state. Other Contarini doges were: Francesco (1623–24), Niccolò (1630–31), who built the church of the Salute, Carlo (1655–56), during whose reign the Venetians gained the naval victory of the Dardanelles, Domenico (1659–75) and Alvise (1676–84). Many members of the family distinguished themselves in the wars against the Turks, and no less than seven Contarini fought at Lepanto. Other members of the house were famous as merchants, prelates and men of letters; among these we may mention Cardinal Gasparo Contarini (1483–1542), and Marco Contarini (1631–89), who was celebrated as a patron of music and collected at his villa of Piazzola a large number of valuable musical mss., now in the Marciana library at Venice.

See J. Fontana, "Sulla patrizia famiglia Contarini," in *Il Gondoliere* (1843).

CONTÉ, NICOLAS JACQUES (1755–1805), a French mechanical genius, chemist and painter, born at Aunou-sur-Orne, near Sées, on Aug. 4, 1755. The war with England deprived France of plumbago; he substituted for it an artificial substance obtained from a mixture of graphite and clay. In 1795 he was associated with Monge and Berthollet in experiments for the inflation of military balloons, was conducting the school for that department of the engineer corps at Meudon, was perfecting the methods of producing hydrogen in quantity, and was appointed (1796) by the Directory to the command of all the aerostatic establishments. He was at the head of the newly created Conservatoire des arts et métiers, and occupied himself with experiments in new compositions of permanent colours, and in 1798 constructed a metal-covered barometer for measuring comparative heights, by observing the weight of mercury issuing from the tube. As chief of the aerostatic corps in the expedition to Egypt, he was for three years and a half, to quote Berthollet, "the soul of the colony." He made, in an almost uncivilized country, utensils, tools and machinery of every sort from simple windmills to stamps for minting coin. The expedition was provided with bread, cloth, arms and munitions of war; the engineers with the exact tools of their trade; the surgeons with operating instruments. He made the designs, built the models, organized and supervised the manufacture, and seemed to be able to invent immediately anything required. He died at Paris on Dec. 6, 1805.

CONTE, literally a "story," is a word so frequently used in English literary criticisms that some definition of it seems to be demanded. A *conte,* in French, differs from a *récit* or a *rapport* in the element of style; it may be described as an anecdote told with deliberate art, and in this introduction of art lies its peculiar literary value. As early as the 13th century, the word is used in French literature to describe an anecdote thus briefly and artistically told, in prose or verse. The fairy-tales of Perrault and the apologues of La Fontaine were alike spoken of as *contes,* and stories of peculiar extravagance were known as *contes bleus,* because they were issued to the common public in coarse blue paper covers. The most famous *contes* in the 18th century were those of Voltaire, who has been described as having invented the *conte philosophique.* But those brilliant stories, *Candide, Zadig, L'Ingénu, La Princesse de Babylone* and *Le Taureau blanc,* are not, in the modern sense, *contes* at all. The same may be said of those of Marmontel, and of the insipid imitations of Oriental fancy which were so popular at the close of the 18th century. The most perfect modern writer of *contes* is Guy de Maupassant, and his celebrated anecdote called "Boule de suif" may be taken as an absolutely perfect example of this class of literature, the precise limitations of which it is difficult to define.

CONTEMPT OF COURT, in English law, any disobedience or disrespect to the authority or privileges of a legislative body, or interference with the administration of a court of justice.

The High Court of Parliament.—Each of the two houses of parliament has by the law and custom of parliament power to protect its freedom, dignity and authority against insult, disregard or violence by resort to its own process and not to ordinary courts of law and without having its process interfered with by those courts. The nature and limits of this authority to punish for contempt have been the subject of not infrequent conflict with the courts of law, from the time when Lord Chief Justice Holt threatened to commit the speaker for attempting to stop the trial of *Ashby* v. *White* (1701), as a breach of privilege, to the cases of *Burdett* v. *Abbott* (1810), *Stockdale* v. *Hansard* and *Howard* v. *Gosset* (1842, 1843), and *Bradlaugh* v. *Gosset* (1884). It is now the accepted view that the power of either house to punish contempt is exceptional and derived from ancient usage, and does not flow from their being courts of record. Orders for committal by the Commons are effectual only while the house sits; orders by the Lords may be for a time specified, in which event prorogation does not operate as a discharge of the offender. It was at one time considered that the privilege of committing for contempt was inherent in every deliberative body invested with authority by the constitution, and consequently that colonial legislative bodies had by the nature of their functions the power to commit for contempt. But in *Kielley* v. *Carson* (1843; 4 Moore, P.C. 63) it was held that the power belonged to parliament by ancient usage only and not on the theory above stated, and in each colony it is necessary to inquire how far the colonial legislature has acquired, by order in council or charter or from the imperial legislature, power to punish breach of privilege by imprisonment or committal for contempt. This power has in some cases been given directly, in others by authority to make laws and regulations under sanctions like those enforced by the houses of the imperial parliament. In the case of Nova Scotia the provincial assembly has power to give itself by statute authority to commit for contempt (*Fielding* v. *Thomas*, 1896; L.R.A.C. 600). In *Barton* v. *Taylor* (1886; 11 A.C. 197) the competence of the legislative assembly of New South Wales to make standing orders punishing contempt was recognized to exist under the colonial constitution, but the particular standing orders under consideration are held not to cover the acts which had been punished. (*See* May, *Parl. Pr.*, 10th ed., 1896; Anson, *Law and Custom of the Constitution*, 3rd ed., 1897.)

Courts of Justice.—The term contempt of court, when used with reference to the courts or persons to whom the exercise of the judicial functions of the Crown has been delegated, means insult offered to such court or person by deliberate defiance of its authority, disobedience to its orders, interruption of its proceedings or interference with the due course of justice, or any conduct calculated or tending to bring the authority or administration of the law into disrespect or disregard, or to interfere with or prejudice parties or witnesses during the litigation. For practical purposes most, if not all, contempts fall within the classification which follows:—

(*a*) Disobedience to the judgment or order of a court commanding the doing or abstaining from a particular act, *e.g.*, an order to execute a conveyance of property or an order on a person in a fiduciary capacity to pay into court trust moneys as to which he is an accounting party. This includes disobedience by the members of a local authority to a *mandamus* to do some act which they are by law bound to do.

(*b*) Disobedience by inferior judges or magistrates to the lawful order of a superior court. Such disobedience, if amounting to wilful misconduct, would usually give ground for amotion or removal from office, or for prosecution or indictment or information for misconduct.

(*c*) Disobedience or misconduct by executive officers of the law, *e.g.*, sheriffs and their bailiffs or gaolers. The contempt consists in not complying with the terms of writs or warrants sent for execution. A sheriff who fails to attend the assizes is liable to severe fine as being in contempt (Oswald, 51). The Sheriffs Act 1887 enumerates many instances in which misconduct is punishable under that act, but reserves to superior courts of record power to deal with such misconduct as a contempt (s. 29). *See* also *Harvey's Case*, 1884, 26 Ch. D. 644.

(*d*) Misconduct or neglect of duty by subordinate officials of courts of justice, including solicitors. In these cases it is more usual for the superior authorities to remove the offender from office, or for disciplinary proceedings to be instituted by the Law Society. But in the case of an unqualified person assuming to act as a solicitor or in the case of breach of an undertaking given by a solicitor to the court, proceedings for contempt are still taken.

(*e*) Misconduct by parties, jurors or witnesses. Jurors who fail to attend in obedience to a jury summons and witnesses who fail to attend on subpoena are liable to punishment for contempt, and parties, counsel or solicitors who practise a fraud on the court are similarly liable.

(*f*) Contempt *in facie curiae*. It is immaterial whether the offender is juror, party, witness, counsel, solicitor or a stranger to the case at hearing, and occasionally it is found necessary to punish for contempt persons under trial for felony or misdemeanour if by violent language or conduct they interrupt the proceedings at their trial.

(*g*) Attempts to prevent or interfere with the due course of justice, whether made by a person interested in a particular case or by an outsider. This branch of contempt takes many forms, such as frauds on the court by justices, solicitors or counsel, tampering with witnesses, threatening judge or jury or attempting to bribe them and the like; and also "scandalizing the court itself" by abusing the parties concerned in a pending case, or by creating prejudice against such persons before their cause is heard.

Invectives Against Judges.—The *locus classicus* on the subject of contempt by attacks on judges is a judgment prepared by Sir Eardley-Wilmot in the case of an application for an attachment against J. Almon in 1765, for publishing a pamphlet libelling the court of king's bench. The object of the discipline enforced by the court by proceedings for contempt of court is not now, if it ever was, to vindicate the personal dignity of the judges or to protect them from insult as individuals, but to vindicate the dignity and authority of the court itself and to prevent acts tending to obstruct the due course of justice. The question whether a personal invective against judges should be dealt with *brevi manu* by the court attacked, or by proceedings at the instance of the attorney-general by information or indictment for a libel on the administration of justice or on the judge attacked, or whether it should be dealt with by a civil action for damages, depends on the nature and occasion of the attack on the judge.

In *Macleod* v. *St. Aubyn*, 1899, A.C. 549 it was said that proceedings for scandalizing the court itself were obsolete in England. But in 1900 the king's bench division, following the Almon case, summarily punished a scurrilous personal attack on a judge of assize with reference to his remarks in a concluded case, published immediately after the conclusion of the case (*R.* v. *Gray*, 1900, 2 Q.B. 36). A recent example of the application of the principle laid down in this case will be found in *R.* v. *Editor of the New Statesman* (1928) 44 Times Law Reports 301. The same measure may be meted out to those who publish invectives against judges or juries with the object of creating suspicion or contempt as to the administration of justice. But the existence of this power does not militate against the right of the press to publish full reports of trials and judgments or to make with fairness, good faith, candour and decency, comments and criticisms on what passed at the trial and on the correctness of the verdict or the judgment. To impute corruption is said to go beyond the limits of fair criticism which is, of course, allowable.

The exact limits of the power to punish for contempt of court in respect of statements or comments on the action of judges and juries, or with reference to *pending* proceedings, have been the subject of some controversy, owing to the difficulty of reconciling the claims of the press to liberty and of the public to free discussion of the proceedings of courts of justice with the claims of the judges to due respect and of the parties to litigation that their causes should not be prejudiced before trial by outside interference. As the law now stands it is permissible to publish contemporaneous *reports* of the proceedings in cases pending in any court (Law of Libel Amendment Act 1888, s. 3), unless the proceedings have taken place in private (*in camera*), or the court has in the interests of justice prohibited certain references, such as to names, or even any report, until the case is concluded. But it is not permissible to make any comments on a pending case calculated to interfere with the due course of justice in the case, or to publish statements about the cause or the parties calculated to have that effect.

The difference between pending and decided cases has been frequently recognized by the courts. What would be a fair comment in a decided case may tend to influence the mind of the judge or the jury in a case waiting to be heard, and will accordingly be punished as a contempt. When an action is at an end the courts will not interfere though the proceedings are misrepresented to the injury of the applicant; but scandalizing the court, *e.g.*, by attacks on the judge, may be punished even after the end of the action (*Dunn* v. *Brown*, 1922, 1 Ch. 276).

Punishment.—"In the superior courts the power of committing for contempt is inherent in their constitution, has been coeval with their original institution and has been always exercised" (Oswald, *On Contempt*, 3). The high court in which these courts are merged is the only court which has a general jurisdiction to deal summarily with all forms of contempt. Each division of that court deals with the particular contempts arising with reference to proceedings before the division; but the king's bench division, in the exercise of the supervisory authority inherited from the old court of king's bench as *custos morum*, also from time to time deals with acts constituting interference with justice in other inferior courts whether of record or not.

Inferior courts of record have, as a general rule, power to punish only those contempts which are committed *in facie curiae* or consist in disobedience to the lawful orders or judgments of the court. For instance, a county court may summarily punish persons who insult the judge or any officer of the court or any juror or witness, or wilfully interrupt the proceedings, or misbehave in the court-house (County Court Act 1888, s. 162), and may also attach persons who, having means, refuse to comply with an order to pay money, or refuse to comply with an order to deliver up a specific chattel or disobey an injunction. A court of quarter sessions has at common law a like power as to contempts *in facie curiae* and is said to have power to punish its officials for contempt in non-attendance or neglect of duty.

Contempt of court is a misdemeanour and is punishable by fine and imprisonment or either at discretion. The offence may be tried summarily, or may be prosecuted on information or on indictment. The prerogative of pardon extends to all contempts of court which are dealt with by a sentence of clearly punitive character; but it is doubtful whether it extends to committals for disobedience to orders made in aid of the execution of a civil judgment.

Except in cases of contempt *in facie curiae* evidence on oath as to the alleged contempt must be laid before the court, and application made for the "committal" or "attachment" of the offender. The differences between the two modes are technical rather than substantial.

The procedure for dealing with contempt of court varies somewhat according as the contempt consists in disobeying an order of the High Court made in a civil cause, or in interference with the course of justice by persons not present in court nor parties to the cause. In the first class of cases the court proceeds by order of committal or giving leave to issue writ of attachment. In proceedings on the Crown side of the king's bench division it is still usual to apply in the first place for a rule *nisi* for leave to attach the alleged offender who is given an opportunity of explaining, excusing or justifying the incriminated acts. The king's bench procedure is that generally used for interference with the due course of criminal justice or disobedience to prerogative writs such as *mandamus*.

An order of committal is an order in execution specifying the nature of the detention to be suffered, or the penalty to be paid. The process of attachment merely brings the accused into court; he is then required to answer on oath interrogatories administered to him, so that the court may be better informed of the circumstances of the contempt. If he can clear himself on oath he is discharged; if he confesses the court will punish him by fine or imprisonment, or both, at its discretion.

Scotland.—In Scotland the courts of session and justiciary have, at common law, and exercise the power of punishing contempt committed during a judicial proceeding by censure, fine or imprisonment *proprio motu* without formal proceedings or a summary complaint. The nature of the offence is there in substance the same as in England (*see* Petrie, 1889: 7 Rettie Justiciary 3; Smith, 1892: 20 Rettie Justiciary 52).

Ireland.—In Ireland the law of contempt is on the same lines as in England, but conflicts have arisen between the bench and popular opinion, due to political and religious differences, which have led to proposals for making juries and not judges arbiters in cases of contempt.

British Dominions Beyond Seas.—The courts of most British possessions have acquired and freely exercise the power of the court of king's bench to deal summarily with contempt of court; and it is not infrequently the duty of the privy council to restrain too exuberant a vindication of the offended dignity of a colonial court. In British Guiana proceedings for contempt, not committed *in facie curiae*, must be tried before a jury.

In the United States, contempt also exists as applied to legislative bodies. A person who has offended the dignity of the Senate or House of Representatives of Congress, may be brought before the offended body by its sergeant-at-arms and reprimanded by its presiding officer. In the event of an individual having defied the authority of either House of Congress, he may be indicted by the Federal Courts, when such defiance becomes a matter of fact. The state legislatures are similarly protected by state constitutions and statutes from contempt.

Contempt of court in the Federal and State courts exists: In direct cases, in the presence of the court; in constructive cases, not in the presence of the court; in criminal cases, such as bribery of court officials; and in civil cases, where an individual declines to observe a civil order of the court, but does not offend the dignity of the court. Contempt cases are punished by the court, without the intervention of a jury.

CONTI, PRINCES OF. The title of prince of Conti, assumed by a younger branch of the house of Condé, was taken from Conti-sur-Selles, a small town about 20m. S.W. of Amiens, which came into the Condé family by the marriage of Louis of Bourbon, first prince of Condé, with Eleanor de Roye in 1551.

FRANÇOIS (1558–1614), the third son of this marriage, was made marquis de Conti, and between 1581 and 1597 received princely rank. Conti appears to have taken no part in the wars of religion until 1587, when he declared in favour of Henry of Navarre, afterwards King Henry IV. of France. He signed the declaration recognizing Henry IV. as king, and he continued to support Henry, although on the death of Charles, cardinal de Bourbon, in 1590 he himself was mentioned as a candidate for the throne. In 1605 Conti married, as his second wife, the beautiful and witty Louise Marguerite (1574–1631), daughter of Henry duke of Guise and Catherine of Cleves, whom, but for the influence of his mistress Gabrielle d' Estrées, Henry IV. would have made his queen. Conti died in 1614. His widow was secretly married to François de Bassompierre (*q.v.*) who joined her in conspiring against Cardinal Richelieu. Upon the exposure of the plot the cardinal exiled her to her estate at Eu, near Amiens, where she died. The princess wrote *Aventures de la cour de Perse*, in which, under the veil of fictitious scenes and names, she tells the history of her own time.

In 1629 the title of prince de Conti was revived in favour of ARMAND DE BOURBON (1629–1666), second son of Henry II. of Bourbon, prince of Condé, and brother of Louis, the great Condé. He played a conspicuous part in the two Frondes, and then fought in the Italian and Spanish campaigns, but after his defeat before Alessandria in 1657 retired to Languedoc, where he devoted himself to study and mysticism until his death. At Clermont, Conti had been a fellow-student of Molière's for whom he secured an introduction to the court of Louis XIV.

LOUIS ARMAND DE BOURBON, prince de Conti (1661–1685), eldest son of the preceding, succeeded his father in 1666, and in 1680 married Marie Anne, a daughter of Louis XIV. and Louise de la Vallière. He served with distinction in Flanders in 1683, and against the wish of the king went to Hungary, where he assisted the Imperialists to defeat the Turks at Gran in 1683.

FRANÇOIS LOUIS DE BOURBON, prince de Conti (1664–1709), younger brother of the preceding, was known until 1685 as prince de la Roche-sur-Yon. In 1683 he assisted the Imperialists in Hungary, and while there he wrote some letters in which he referred to Louis XIV. as *le roi du théâtre,* for which on his return to France he was temporarily banished to Chantilly. Conti was a favourite of his uncle, the great Condé, whose granddaughter Marie Thérèse de Bourbon (1666–1732) he married in 1688. In 1689 he accompanied his intimate friend, Marshal Luxembourg, to the Netherlands, and shared in the French victories at Fleurus, Steinkirk and Neerwinden. In 1697 Louis XIV. offered him the Polish crown, and by means of bribes the abbé de Polignac secured his election. Conti started rather unwillingly for his new kingdom, probably, as St. Simon remarks, owing to his affection for Françoise, wife of Philip II., duke of Orléans, and daughter of Louis XIV. and Madame de Montespan. When he reached Danzig and found his rival Augustus II., elector of Saxony, already in possession of the Polish crown, he returned to France. The misfortunes of the French armies during the earlier years of the war of the Spanish Succession compelled Louis to appoint Conti, whose military renown stood very high, to command the troops in Italy. He fell ill before he could take the field, and died on Feb. 9, 1709.

LOUIS ARMAND DE BOURBON, prince de Conti (1696–1727), eldest son of the preceding, was a prominent supporter of the financial schemes of John Law, by which he made large sums of money.

LOUIS FRANÇOIS DE BOURBON, prince de Conti (1717–1776), only son of the preceding, saw his first fighting in Bohemia in 1741. He was appointed to command the army in Italy, where he forced the pass of Villafranca and won the battle of Coni in 1744. In 1745 he was sent to check the Imperialists in Germany, and in 1746 was transferred to the Netherlands, where some jealousy between Marshal Saxe and himself led to his retirement in 1747. In this year a faction among the Polish nobles offered Conti the crown of that country, and was supported by Louis XV. Although Conti did not secure the Polish throne he remained in the confidence of Louis until 1755, when his influence was destroyed by the intrigues of Madame de Pompadour. When the Seven Years' War broke out in 1756 he was refused the command of the army of the Rhine, and began the opposition to the administration which caused Louis to refer to him as "my cousin the advocate." In 1771 he was prominent in opposition to the chancellor Maupeou. He supported the parlements against the ministry, was especially active in his hostility to Turgot, and was suspected of aiding a rising which took place at Dijon in 1775. Conti, who died on Aug. 2, 1776, inherited literary tastes from his father, was a brave and skilful general, and a diligent student of military history. His house, over which the comtesse de Boufflers presided, was the resort of many men of letters, and he was a patron of Jean Jacques Rousseau.

LOUIS FRANÇOIS JOSEPH, prince de Conti (1734–1814), son of the preceding, distinguished himself during the Seven Years' War. He took the side of Maupeou in the struggle between the chancellor and the parlements, and in 1788 declared that the integrity of the constitution must be maintained. He left France in 1789, but returned in 1790. Arrested by order of the National Convention in 1793, he was acquitted, but his estates were confiscated. The Directory banished him from France, but he took no part in royalist intrigues, and lived in retirement at Barcelona till his death in 1814, when the house of Conti became extinct.

See G. Tallemant des Reaux, *Historiettes* (1854–60); R. L. Marquis d'Argenson, *Journal et mémoires* (1859–65); E. Boutaric, *Correspondence sécrète de Louis XV. sur la politique étrangère* (1866); L. de R. duc de Saint Simon, *Mémoires* (1873); P. Foncin, *Essai sur le ministère de Turgot* (1877); E. Bourgeois, *Neûchatel et la politique prussienne en Franche-Comté* (1877); F. de Bassompierre, *Mémoires* (1877); F. J. de P. cardinal de Bernis, *Mémoires et lettres* (1878); J. V. A. duc de Broglie, *Le Sécret du roi* (1878); P. A. Cheruel, *Histoire de la Minorité de Louis XIV. et du Ministère de Mazarin* (1879); C. E. duchesse d'Orléans, *Mémoires* (1880).

CONTI, NICOLO DE' (*fl.* 1419–1444), Venetian explorer and writer, was a merchant of noble family, who left Venice about 1419 for 25 years. We next find him in Damascus, whence he made his way over the north Arabian desert, the Euphrates and southern Mesopotamia, to Baghdad. From Baghdad he sailed down the Tigris to Basra and the head of the Persian gulf; he next descended the gulf to Ormuz, coasted along the Indian ocean shore of Persia to Cambay, where he began his Indian life and observations. He next dropped down the west coast of India and struck inland to Vijayanagar, the capital of the principal Hindu state of the Deccan (destroyed in 1555), of which he gives an interesting description. Thence he travelled to Maliapur near Madras, the traditional resting-place of the body of St. Thomas, and the holiest shrine of the native Nestorian Christians. He then went for a year to Sumatra, gaining a good knowledge of the cannibal natives, and of the camphor, pepper and gold of this "Taprobana." From Sumatra he took a stormy voyage of sixteen days to Tenasserim, near the head of the Malay peninsula. We then find him at the mouth of the Ganges, which he ascends and descends, visiting Burdwan and Aracan, penetrating into Burma, and navigating the Irrawaddy to Ava. From Pegu he went to Java, his farthest point. After remaining there for nine months, he returned by Ciampa (usually Cochin-China in later mediaeval European literature, but here perhaps some more westerly portion of Indo-China), Coloen (Kulam or Quilon), Cochin, Calicut and Cambay, to Sokotra, which he describes as still mainly inhabited by Nestorian Christians; to the "rich city" of Aden; to Gidda (or Jidda), the port of Mecca; over the desert to Cairo; and so to Venice, arriving in 1444.

As a penance for his (compulsory) renunciation of the Christian faith during his wanderings, Eugenius IV. ordered him to relate his history to Poggio Bracciolini, the papal secretary. The narrative closes with Conti's replies to Poggio's questions on Indian life, social classes, religion, fashions, manners and customs. Conti divides the Indies into three parts; from Persia to the Indus; from the Indus to the Ganges; and beyond the Ganges. This last he considered to excel the others in wealth and culture, and to be abreast of Italy in civilization. He notes many interesting Indian customs, and reproduced several old legends. Conti's name-forms, partly through Poggio's vicious classicism, are often unrecognizable, but on the whole this is the best account of southern Asia by any European of the 15th century; while the traveller's visit to Sokotra is an almost unique performance for a Latin Christian of the middle ages.

The original Latin is in Poggio's *De varietate Fortunae,* book iv. (ed. Abbé Oliva, Paris, 1723). The Italian translation printed in Ramusio's *Navigationi et viaggi,* vol. i., is from a Portuguese translation. *India in the Fifteenth Century* (1857), contains an English translation made by J. Winter Jones for the Hakluyt Society, with an introduction by R. H. Major.

CONTINENT, a term used in physical geography for the larger continuous masses of land, namely: Asia, Africa, North America, South America, Europe and Australia in the order of their size. *See* CONTINENTS, ORIGIN OF; CONTINENTAL SHELF.

It is interesting to take into consideration that the areas of volcanic activity are mostly where continent and ocean meet; and that around the continents there is an almost continuous "deep" from 100 to 300m. broad, of which the Challenger Deep (11,400ft.) and the great Tuscarora Deep are fragments. The great floating segments are the Eurasian (with an area roughly of 24, reckoning in millions of square miles), strongly ridged on the south and east, and relatively flat on the northwest; the African (twelve) rather strongly ridged on the east, less abruptly on the west and north; the North American (ten), strongly ridged on the west, more gently on the east, and relatively flat on the north and in the interior; the South American (nine), strongly ridged on the west and somewhat on the northeast and southeast, leaving ten for the smaller blocks. The delicate balance or isostasy of lighter land material and heavier ocean bed substance was made the subject of considerable work by Hayford in *The Figure of the Earth and Isostasy* (1909) and a statement of modern views on the subject was made by A. Morley Davies in the *Geographical Journal* (July 1925).

The foundation structures of the continents are similar. Their rocks and soils are due to differential minor movements in the past, by which various deposits were produced. These movements, followed by long periods of rest, allow of the development and migration of forms of life, the development of varied characteristic land forms, the migration and settlement of human beings and intercourse between races and communities, with finally the commercial interchange of commodities produced upon different parts of the continental surface by varying soil and climatic conditions; in short, for those geographical factors which form the chief influences upon past and present human history. That such movements have not ceased is known by the fact that certain coastal regions are now undergoing changes of level by which land is emerging from the sea, or sinking beneath it. Such changes take place very slowly. There is general agreement that the positions of the present continents were determined as long ago as archaean times. (*See* GEOGRAPHY.)

CONTINENTAL CAOUTCHOUC AND GUTTA PERCHA COMPANY. This rubber company was founded in Hanover, with a capital of 900,000 marks, in Oct. 1871. Owing to difficulties in construction, etc., the actual work of the company was not begun until Sept. 1873. The first full year was 1874, when a loss of 26,587 marks was sustained. In the course of time, new uses were being found for rubber and the gradual growth of the concern may be judged from the increase in the number of employees: (1874) 246; (1884) 450; (1889) 500, and during the years of World War I, 8,000 in Hanover and, including all others elsewhere in the pay of the company, 13,000. In the three years 1910–13 the capital of the Continental rose from 9,000,000 to 15,000,000 marks. The activities of the company fall into several well-defined classes. The surgical productions comprise hot-water bags, ice-bags, bathing caps, air cushions, syringes, sponges, surgical gloves, bath shoes, bath mats, shaving brushes and so forth; the industrial products include motor car accessories of all kinds, from tires, mats, treads, insulating pads, grips, rings, tubes, etc.; there are also specialized technical products connected with electrical undertakings, typewriters (platens, etc.) and even furnishings, covers for upholstery, etc.

The company has several times extended its premises in the course of its development, has large works and a spacious residential clubhouse for employees. The workers publish a monthly called *Echo Continental,* with a circulation of 90,000. (W. HR.)

CONTINENTAL CONGRESS, THE, representing the British colonies in America, met on Sept. 5, 1774, in Carpenters' hall, Philadelphia, to consider colonial rights and liberties and their violation through a series of oppressive measures imposed by Great Britain. Growing resistance to a common source of grievances bound them into a loose unity which was finally activated when British authorities closed the port of Boston (*see* UNITED STATES OF AMERICA: *History*). On May 27, 1774, at an unofficial meeting of the Virginia burgesses, the Boston Port act was denounced as a "most dangerous attempt to destroy the constitutional liberty and rights of all North America," and a protest meeting of colonial representatives was suggested. Similar action was soon proposed and acted upon in all of the 13 colonies but Georgia, and a date set for committees from the colonies to meet in Philadelphia.

Delegates were not chosen with any particular rule as to number. When the congress assembled, there were 44 members, originating as follows: two each from New Hampshire and Rhode Island; three each from Connecticut, Delaware and Maryland; four from Massachusetts; five each from New York, New Jersey and South Carolina; and six each from Virginia and Pennsylvania. Three delegates arrived later from North Carolina, and when all late comers had reported, the delegates numbered 54. (Georgia did not participate until 1775 during the second congress.) Each committee had been commissioned by its electors, but not all credentials bore an equal weight. Those for Rhode Island carried the governor's signature, those for Massachusetts, the clerk's; others offered as their credentials the vote of their assemblies. Methods of elections varied as well, including election by provincial congresses (Md., N.J., Del., N.C.), by deputies appointed by the several towns (N.H.) and by "a general meeting of the inhabitants," later ratified by the assembly (S.C.). Peyton Randolph of Virginia was unanimously chosen president of the congress, and the historic choice of the terms president and congress, for the chairman and the assemblage, were also made at this time. Charles Thomson was elected secretary, and served in this office during the 15 years that the congress functioned. The question of voting gave rise to considerable debate, with arguments ranging from Patrick Henry's for a vote based on population (excluding Negroes), and a compromise proposal based on population and property, to those of the smaller colonies who argued for absolute equality. Practically no statistics on population were available, and it was agreed that each colony was to have one vote.

The congress had not been called with any design toward changing the administrative structure of the colonies. The Virginia delegation, for example, which included Washington, Henry and Randolph, was commissioned simply to "procure a redress of grievances for the much injured province of Massachusetts" which they were nevertheless cautioned to do "in the most proper and effectual manner" by "operating upon the commercial connection of the colonies with the mother country."

On Oct. 14, a declaration of rights was adopted, listing among others, the rights of life, liberty, property, assembly, trial by jury, representative government and the freedom from a standing army in time of peace. But the most significant outcome of this first congress was the adoption, on Oct. 20, of the plan of the association, a series of resolutions calling for commercial nonintercourse with Great Britain. These resolutions, enforced by committees set up in the colonies, became the first evidence of a practical union among the soon to be federated states. A petition addressed to the king was adopted on Oct. 26, after which the first congress adjourned, having agreed to return to Philadelphia on May 10, 1775, should its grievances remain unanswered.

When the second congress reassembled on that date at the state house, its character had become less that of a deliberative assembly than a provisional government. For armed conflict had broken out some weeks earlier in Massachusetts, and public opinion behind the congress had grown substantially. Having been forced to take up arms in self-defense, a declaration to justify such action was proposed in the spring of 1776 and adopted on July 2 (*see* DECLARATION OF INDEPENDENCE). Delegates had in fact come prepared. The commission of Francis Hopkinson of New Jersey, read into the *Proceedings* of June 28, instructed him, if necessary, "to join in declaring the United Colonies independent of Great Britain, entering into a confederation for union and common defence," etc. By the close of 1775, the congress had accepted the duties of an executive and legislative body charged with the conduct of a war (*see* AMERICAN REVOLUTION, THE). In 1777 an instrument of self-government was drawn up, entitled the articles of confederation, under which the united colonies operated imperfectly but successfully until 1789, when they formed the United States.

Sessions of the continental congress were begun as follows: Sept. 5, 1774, and May 10, 1775, at Philadelphia; Dec. 20, 1776, at Baltimore; March 4, 1777, at Philadelphia; Sept. 27, 1777, at Lancaster, Pa.; Sept. 30, 1777, at York, Pa.; July 2, 1778, at Philadelphia; June 30, 1783, at Princeton, N.J.; Nov. 26, 1783, at Annapolis, Md.; Nov. 1, 1784, at Trenton, N.J.; and Jan. 11, 1785, at New York. The latter continued to be the meeting place

Presidents of the Continental Congress, 1774 to 1788

	From	Elected
Peyton Randolph	Virginia	Sept. 5, 1774
Henry Middleton	South Carolina	Oct. 22, 1774
Peyton Randolph	Virginia	May 10, 1775
John Hancock	Massachusetts	May 24, 1775
Henry Laurens	South Carolina	Nov. 1, 1777
John Jay	New York	Dec. 10, 1778
Samuel Huntington	Connecticut	Sept. 28, 1779
Thomas McKean	Delaware	July 10, 1781
John Hanson	Maryland	Nov. 5, 1781
Elias Boudinot	New Jersey	Nov. 4, 1782
Thomas Mifflin	Pennsylvania	Nov. 3, 1783
Richard Henry Lee	Virginia	Nov. 30, 1784
Nathaniel Gorham	Massachusetts	June 6, 1786
Arthur St. Clair	Pennsylvania	Feb. 12, 1787
Cyrus Griffin	Virginia	Jan. 22, 1788

until the adoption of the United States constitution. From 1781 to 1788, congress met annually on the first Monday in November as provided in the articles of confederation.

CONTINENTAL ILLINOIS NATIONAL BANK AND TRUST COMPANY OF CHICAGO, chartered Oct. 15, 1932, under the National Bank act, succeeded the Continental Illinois Bank and Trust company, chartered under the laws of the state of Illinois, through an exchange of stock, share for share. The present bank represents a union, consummated March 18, 1929, of the Continental National Bank and Trust Company of Chicago and the Illinois Merchants Trust company, and is the outgrowth of a series of consolidations and mergers of banks, savings associations and trust companies in Chicago, the oldest of which was chartered in 1857.

The Continental National Bank and Trust Company of Chicago, one of the two components of the present bank, resulted Dec. 1, 1927, from a union of the business of the Continental and Commercial National Bank of Chicago and its state chartered affiliate, the Continental and Commercial Trust and Savings bank. These merging banks were themselves integrations of 14 banking institutions. The oldest of this group, the Merchants association, had been founded in 1861.

The Illinois Merchants Trust company, the other component bank, assumed corporate existence April 9, 1923, as a consolidation of the Illinois Trust and Savings bank and The Merchants Loan and Trust company. The Corn Exchange National Bank of Chicago was a member of this merging group, but was not physically united with the Illinois Merchants Trust company until Sept. 29, 1924. The oldest component of this group, the Merchants Savings Loan and Trust company, had been organized in 1857. Four other banks also were identified with the Illinois Merchants group through consolidation prior to 1903 with the Corn Exchange National Bank of Chicago.

As of March 26, 1940, the capital account of the Continental Illinois National Bank and Trust company was \$97,776,000, consisting of: common stock \$50,000,000 (with par value of \$33⅓); surplus, \$30,000,000; undivided profits, \$17,776,000.

Reserve for contingencies was \$16,154,000. Total resources amounted to \$1,422,505,000, while aggregate deposits stood at \$1,301,972,000. The bank is housed in the building originally erected for the Illinois Merchants Trust company, and is a member of the federal reserve system, the Federal Deposit Insurance corporation and the Chicago Clearing House association.

CONTINENTAL SHELF, the term in physical geography for the submerged platform upon which the continental areas stand in relief. The volume of the hydrosphere is a little too great for the true ocean basins, and it runs over, covering the borders of the continents. If a medal be partly sunk under water the image and superscription standing above water would represent a continent with adjacent islands and the sunken part just submerged would represent the continental shelf. The lithosphere's surface may be considered to consist of three parts, namely, the continent heights 21%, the deep ocean 64½% and a transitional area separating them. This transitional area of slight gradient is almost bisected by the present coast-line, for nearly one-half of it (10,000,000 sq.mi.) lies under water less than 600 ft. deep, and the remainder is under 600 ft. in elevation. The former is called the continental shelf, and represents the area which would be added to the continents if the land rose 600 ft. This shelf varies in width; surrounding it, leading to the great depths, is Wagner's continental slope. Around Africa—except for isolated patches—and off the western coasts of America the shelf scarcely exists. It is wide under the British Isles and northern France, and extends as a continuous platform under the whole of the North sea except off southwest Norway. It unites Australia to New Guinea on the north and to Tasmania on the south, connects the Malay Archipelago along the broad shelf east of China with Japan and unites northwestern America with Asia. It curves southward outside Newfoundland and northward holds Hudson bay in the centre of a shallow dish. It adds considerable areas to the real oceanic boundaries of eastern United States, Florida, the gulf states, eastern Central America and equatorial Brazil, while southward the Falklands rise from its eastern border. In many places it is a plain of marine denudation, where the waves have battered down the cliffs and dragged the eroded material under the present sea level. If there were no compensating action in the differential movement of land and sea in the transitional area the whole of the land would be gradually planed down to a submarine platform, and all the globe would be covered with water. There are, however, periodical movements of this transitional area by which fresh areas of land are raised above sea level, while the sea sinks more deeply into the great ocean basins, and the enlarged continents offer a new strip to the unceasing action of the waves.

CONTINENTAL SYSTEM, the name given to Napoleon's design for paralysing Great Britain through the destruction of her commerce. By the Berlin decree (Nov. 21, 1806) and the Milan decree (Dec. 17, 1807) he declared Great Britain to be in a state of blockade, and forbade either neutrals or French allies to trade with her or her colonies. To Napoleon's "continental system" England responded by orders in council which subjected all countries in alliance with Napoleon to a counter-blockade. The campaign of starvation brought great suffering to both countries, and vast annoyance to neutrals, causing in particular the Anglo-American War of 1812. But since England held the command of the sea with an overwhelming superiority never before witnessed, the contest proved disastrous to Napoleon—not only because of the resulting privations, but also because, in the effort to maintain his system, Napoleon was forced to undertake responsibilities too great for him to support. (*See* FRANCE: *History;* ENGLISH HISTORY; NAPOLEON I, etc.)

CONTINENTS, ORIGIN OF. Throughout the greater part of the 19th century geologists in general believed that our present continents and oceans were only temporary features of the globe. In the last quarter of the century, however, the idea of the permanence of the ocean basins began to gain ground. It cannot be said that there is any universal agreement upon the question even yet. Many geologists are now inclined to ascribe a high antiquity to the Pacific ocean but to look upon the Atlantic and Indian oceans as comparatively modern. Haug and others still suspect the former existence of a Pacific continent. If continents and oceans are not permanent, the present distribution of land and sea is only an episode in the history of the globe and has no more significance than the distribution in the past. It was not geologists, therefore, who first endeavoured to formulate general theories to account for the present shapes of continents and oceans. Those who made such attempts ignored the changes in the past and their speculations were received with little favour by geologists. The most suggestive of these speculations was the tetrahedral theory of Lowthian Green, who assumed that the earth is cooling, the interior contracting more rapidly than the exterior, and under the force of gravity the outer crust collapses. William Fairbairn's experiments on the crushing of wrought-iron tubes led him to believe that the collapsing sphere will tend to approach a tetrahedral form. The corners of the tetrahedron will rise above the water, forming triangular masses of land; the faces of the tetrahedron will remain covered and will form the oceans. He places one corner at the south pole and the other three in the northern hemisphere. The corner at the south pole is the Antarctic continent and the opposite face of the tetrahedron is covered by the Arctic ocean. The triangular masses of land formed by the other three corners are represented respectively by North and South America, Europe and Africa, Asia and Australia, all of them wide toward the north and tapering toward the south. The two last are united in the north, but the Caspian depression is below sea level and the plain of the Obi but little above it. Between these three land-masses lie the Atlantic, Indian and Pacific oceans, all narrowing toward the north and, in the south, where the tetrahedral edges are lowest, uniting into a continuous belt around the globe. The actual form which Lowthian Green believes the earth to have reached is the hexakistetrahedron with all the faces so much rounded that the departure from the spheroidal form is slight. Lowthian Green's theory was entirely neglected in England for many years, but was more favourably received in France. Albert de Lapparent seems to have been the first to recognize it as a probable hypothesis, and at a later date both Michel Lévy and Marcel Bertrand adopted it in a modified form. After the closing years of the 19th century a tetrahedral theory in some shape or other was accepted by many writers in England, Germany and America; but once more it is generally discredited. On physical grounds objection has been raised that the tetrahedron is not a figure of equilibrium for a rotating earth, and even a slight approximation to it cannot be retained.

Suess's Theories.—A great advance in our knowledge of the history of the globe was made by Eduard Suess in his *Das Antlitz der Erde*. He showed that there are large areas where even the oldest fossiliferous beds still lie horizontal. Here the crust of the earth has been rigid, in the ordinary sense of the term, from Cambrian times. It has broken, but it has never crumpled. Between these areas lie broad belts in which the strata are often folded. Here the crust has been weaker and has yielded to tangential pressures by crumpling and overthrusting. The crumpling was not a continuous process. There were well-defined periods of folding separated by intervals during which the whole earth was free, or almost free, from such disturbances. During these intervals, however, fracturing of the resistant areas took place and large blocks sank; and there were also wide extensions or *transgressions* of the sea over the land.

In the northern hemisphere there are three areas in which the Cambrian beds remain unfolded. These are: (1) *Laurentia,* which includes most of Canada east of the Rockies and probably stretched to the western islands of Scotland, (2) the *Baltic shield* and *Russian platform,* (3) *Angara land,* which includes a great part, but not the whole, of eastern Siberia.

In the southern hemisphere also there are areas in which the oldest fossiliferous beds known show no folding. The most extensive is *Gondwanaland,* which includes the greater part of South America east of the Andes, most of Africa between the Atlas and the mountains of the Cape, Arabia, Syria and the peninsula of India. The upper Cretaceous sea extended over a considerable area and even marine Jurassic beds are found in places, but much the larger part was land throughout the Mesozoic era. A similar remark applies to a great part of Australia. Between the Mesozoic land-areas of the north and those of the south lies a belt in which the Mesozoic beds are for the most part marine. This is the *Tethys* of Suess. Between the rigid masses of the north and those of the south the more yielding crust beneath the sea of Tethys was crushed, and the great series of mountain ranges which run from west to east across the old world was elevated. Tethys was much reduced in size and is now represented chiefly by the Mediterranean sea. About the same time Laurentia and Gondwanaland broke up, large portions sinking beneath the sea, and thus the present Atlantic came into existence. The Pacific appears to have been sea throughout the Mesozoic era at least, but nevertheless it has functioned as a rigid area.

The Wegener Hypothesis.—Alfred Wegener introduces an entirely different conception, according to which the relative positions even of whole continents have altered greatly in quite recent times. It has long been known to geologists that the visible part of the earth's crust consists chiefly of the lighter and more acid rocks, and beneath this it has been commonly supposed that there lies a layer of the denser and more basic rocks. The interior core must be denser still. In formulating these ideas Suess proposed the names *sal, sima* and *nife* for the three concentric regions respectively. The term sal is now usually replaced by *sial,* and with this modification Suess's nomenclature is widely adopted. It has generally been supposed that the sial covers the whole globe. It may be thinner under the oceans and thicker on the continents, but it is present everywhere. Wegener believes that it is discontinuous. The floor of the ocean is formed of sima, and the continents are sheets of sial floating in the sima. Because the sial is of smaller density its surface rises above the surface of the sima. The sima is not liquid in the ordinary sense of the word; but there is no perfect solid, and the sheets of sial, supposed to be about 61 mi. thick, could not lie upon the sima without the force of gravity pressing them in until they floated.

Wegener's view is that the sheets of sial are not only separate and floating in the sima but also moving laterally, and that their positions relatively to one another have altered in the past and are altering still. According to him if we take the edge of the continental shelf as the edge of the sial sheets and allow for the effects of Tertiary folding, the pieces of sial can be fitted together into one continuous sheet covering about a third of the globe. This, he thinks, was the condition at the close of the Palaeozoic era. He does not follow the edge of the continental shelf with any precision, and the allowance that he makes for the Tertiary folding is purely fanciful.

It is in the southern hemisphere that the geological evidence for a former union of the continental masses is strongest, and it is perhaps significant that the nearest approach to a fit is that between Africa and South America. The close similarity between the rocks and fossils of these two areas has led most geologists to assume a former land connection. Both regions are characterized by the occurrence of the fossil *Glossopteris* flora, which differs considerably from the contemporaneous flora of Europe. The same flora has also been found in India and Australia. All these are brought together in Wegener's scheme and the similarity in rocks and fossils is at once explained. But the *Glossopteris* flora is also found in Siberia and northern Russia, which in his reconstruction become farther away from the presumed home of *Glossopteris* than they are at present.

Joly and Radioactivity.—John Joly's theory is based on the effects of radioactivity. He thinks that the continents are sheets of sial floating in the sima, which forms the floor of the ocean. Relative displacements of the continents may have taken place at certain periods. The sial and the sima are both radioactive and the radioactive elements in them are continually generating heat. Unless this heat can escape the temperature must rise. The melting point of the sial rocks is known to be much higher than that of the sima, which is basaltic in composition.

Suppose that at a certain period the whole of the sial is solid and the sima also is solid down to a considerable depth. Heat can only escape by the slow process of conduction. Beneath the sial, according to Joly, there will be no escape from the sima, because the base of the sial itself, owing to its own radioactivity, must be nearly at the melting point of sima. Since the escape of heat is so slow the temperature rises and the sima melts from below upward. Tidal movements in the molten sima acting upon the downward projections of the sial move the whole crust so that the local accumulations of heat originally formed beneath the sial come to lie under the thin layer of solid sima beneath the ocean. This is quickly thinned still further, and molten sima escapes through fractures. The loss of heat now becomes more rapid and an era of cooling and consolidation begins.

We must suppose, then, that there are periods during which the sima layer melts more or less completely and periods during which it solidifies down to a considerable depth. It has been shown experimentally that basalt, and most other rocks that have been tested, expand on melting and decrease in density. As the sima melts it expands, and therefore the general level of the earth's surface is raised. But because the density of the sima is decreased the masses of sial which are floating in it sink more deeply into the layer. Their surfaces, owing to the general rise, become farther from the earth's centre, but, relatively to the surface of the sima they are depressed. In this way the widespread transgressions characteristic of certain geological periods are explained. As the sima cools again and becomes denser the surface falls but the sial masses rise relatively to the sima. When the sima begins to cool, the crust upon it, if not already complete, is soon completed by the consolidation of molten material in its fissures. Together with the sial masses it now covers the whole globe. But the sima continues to contract further and the covering becomes too large. Now begins a period of folding and other earth movements to enable the crust to descend with the sima.

The great merit of the theory, from the geological point of view, is that it offers an explanation of the most remarkable features in the history of the globe, the periodicity of earth-folding and sea-transgressions and their widespread character. However, in view of our ignorance of what goes on in by far the greater part of the interior of the globe it remains improbable that any theory founded on examination of a thin external skin can be complete.

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CONTINUATION: *see* CARRYING OVER (CONTINUATION); CONTANGO.

CONTINUATION SCHOOLS (DAY AND EVENING). Early in the 19th century, it came to be recognized in Great Britain that the existing elementary schools could no longer satisfy the national educational needs, which had increased through the immense social and economic changes brought about by the industrial revolution: accordingly, attempts were made to supplement their work by that of night schools for persons fully occupied during the daytime. Under the influence of such men as Dr. George Birkbeck and Lord Brougham, "Mechanics' Institutes" were founded to give factory workers instruction in the scientific principles of workshop practice. (*See* also COMMERCIAL EDUCATION.)

These institutes at first attracted large numbers of artisans, but their popularity amongst working men quickly declined; one of the most important reasons for this was that the elementary education of the workman was in general not sufficient to enable him to profit by the instruction provided in science and mathematics. Other organizations, including "night schools" taught by elementary teachers, came into existence and were carried on for many years without any public assistance. In 1851, however, the government decided to make additional grants to elementary day schools which held continuation classes and the number of these increased steadily until 1870, when they had more than 80,000 students. Elementary education became compulsory after 1876 and the attendance at night schools declined for a time; the attendance increased, however, after the removal by the evening school code of 1893 of the previous age limit of 21 and of the requirement that all scholars should be instructed in elementary subjects.

The Act of 1902.—Side by side with these night schools, there were in existence from 1856 state-aided classes in science and art. There was, however, no definite connection between the two, though after the fusion of the education department and the science and art department into a single board of education, steps were taken in 1901 to secure some connection between the two groups of schools. The Education Act of 1902, which placed the responsibility for both elementary schools and schools for "further education" on the county and county borough authorities, made it possible to organize continuation schools and to fix their position in schemes of education.

When pupils leave full time day education and commence work, provision is now generally made for them to continue their education in the evenings: the courses of instruction usually require attendance at school for two hours on three evenings a week from September until Easter. For boys who are in industrial occupations, instruction is usually given in mathematics, technical drawing or workshop practice, science and English. For those in commercial occupations, the instruction includes English and arithmetic, together with subjects of a more vocational character. For those not needing vocational instruction or for whom organized courses may not be suitable, instruction is provided which is designed to create interest and stimulate intellectual enthusiasm. After World War I, the increase in the demand for adult education continued in remarkable fashion.

During the year 1926–27—the latest period for which statistics are available—there were 727,650 students (18.5 per 1,000) in England and Wales in attendance at evening technical courses; of these 389,813 were men and boys and 337,837 women and girls. In the day continuation courses, 23,884 boys and girls (6 per 10,000) were in attendance.

Act of 1918.—The Education Act of 1918 (later included in the Education Act 1921) laid upon local authorities for higher education the duty of establishing and maintaining day continuation schools in which suitable courses of general instruction (up to 16) and with a vocational bias (from 16 to 18) were to be provided for all "young persons"; attendance to be compulsory and free.

Some of the smaller as well as some of the larger L.E.A.'s (Local education authorities) decided to exercise their powers at once and proceeded to establish day continuation schools; accordingly in 1921–22 there were in the country 122 of these schools with 95,530 pupils. During the next year all the authorities except Rugby closed their compulsory schools, mainly owing to the financial crisis through which the country was passing at that time. Moreover, an important administrative difficulty had not been fully appreciated, though it had been foreseen, viz.: the "appointed day" for the operation of the continuation school clauses was not fixed. L.E.A.'s were allowed to fix their own "appointed days"; and, in consequence, the enforcement of the act created obvious unfairness between the juveniles living in an area where the act was in operation, and juveniles in a contiguous area which had decided not to establish compulsory day continuation schools; also, the small employer who had a very limited number of junior employees was more heavily handicapped by the withdrawal of his assistants during working hours than the big employers who had large staffs of juniors.

The compulsory schools were, however, open for long enough to reveal that there was a real demand among certain classes for the continued education of their children, and some L.E.A.'s opened voluntary schools in order to meet it. It was significant also that within a short time of the closing of the compulsory schools it was found to be necessary to open unemployment educational centres throughout the country for juveniles who were in receipt of the out-of-work donation. Proprietary schools and colleges also increased in number and enrolments.

The V.D.C. Schools.—The voluntary day continuation schools supply the needs chiefly of two types of juveniles: (*a*) those whose parents cannot afford to pay school fees but are able to maintain their children while they are receiving a training designed to enable juveniles to escape "blind alley" occupations; (*b*) those who have the opportunity of "earning and learning" at the same time. The numbers of students provided by these two categories are relatively small at present, though persistent. There remains the type of juvenile who regards organized education as finished when the wage-earning period commences and moreover does not enter a club, church or social organization of any kind; the Education Act of 1918 brought these juveniles under continuous educational control until they reached 18 years; at the present time they are free and a potential menace to progress.

In London an endeavour has been made to entice these juveniles (who incidentally are in danger of permanent blind alley occupation) into a special type of evening institute where the instruction is just that which makes an appeal to boys whose daily occupations are of a routine or repetitive kind. The subjects offered in these institutes are mainly practical, *e.g.*, woodwork, metal work, boot-repairing, hobbies, physical exercises and boxing, drawing and painting; the amenities of club life are also available. Similar provision has been made for the corresponding type of girls in the (free) women's evening institutes. There has been a very marked tendency in recent years to increase and widen the scope of the teaching in the evening schools, this applies to both vocational and nonvocational instruction; the former has been greatly encouraged by various well-known examining bodies while the latter has received invaluable support from the L.E.A.'s and the adult education movement which has succeeded, especially after World War I, in reaching types of students who have hitherto shown little desire to pursue any form of cultural study.

Co-operation with Employers and Outside Bodies.—Employers are now attaching more importance to "further education" and are either co-operating effectively with the L.E.A.'s or maintaining their own works schools and classes; this co-operation is no longer confined to the better known occupations (*e.g.* engineering, building, commerce, printing, etc.) but is being extended to such occupations as the distributing and outfitting trades, grocery and meat trades, laundries, milk shops, etc. The readiness with which employers are prepared to serve on advisory and consultative education committees is also indicative of an awakened interest. Co-operation between L.E.A.'s and the Boy Scouts' association, Girl Guides, Church Lads' brigade, Juvenile advisory committees, Juvenile organization committees, Toc H and organizations of this kind is doing much to ensure that the work begun in the day elementary schools is carried to a more profitable stage in the day continuation and evening schools, and eventually into the polytechnics, higher commercial schools and schools of art.

The aim of "further education" at the present time is to make a provision which recognizes the facts that hours of labour are not so long as formerly and that the work itself has become more tedious and monotonous owing to improvements in mechanical methods and appliances. The general tendency therefore is in the direction of securing that form of co-operation between employers, social agencies and educational bodies by which the increased leisure time of the workers may be occupied more happily and, at the same time, technical skill in daily occupations so developed as to improve the workers' own economic position *pari passu* with the industry in which they are engaged. (B. I.)

UNITED STATES

In the United States continuation (or compulsory part-time) schools are found in more than half the states, the age of required attendance reaching 17 or 18 in several states, as New York, California and Wisconsin. Generally, however, four to six hours of daytime attendance per week are required for all employed young persons between 14 and 16 years of age. The first state to establish compulsory continuation schools was Wisconsin (1909). Before 1915 Massachusetts and New York had enacted legislation permitting any community to require such attendance. All other state legislation has been enacted after 1915, and its application very generally is state-wide, leaving no option to local areas.

U.S. interest in continuation schools derives from several sources. As far back as the middle of the 19th century the decay of apprenticeship as a means of superior technical training led to the foundation of "Mechanics' Institutes" in many cities. These inspired the extensive establishment of public evening classes, especially in industrial centres. But evening classes, valuable as they might be for young adults, seemed poorly adapted for juvenile workers.

Investigations made in Massachusetts (1905), New York (1919) and elsewhere very generally indicated: (*a*) excessive withdrawal from schools of poorly equipped juvenile workers between 14 and 16 years of age; (*b*) unsuitability of evening classes for their needs, and (*c*) possibilities of either full-time or part-time training, for industrial pursuits or for still much needed general education of part-time day attendants. The successful examples of Bavaria, Saxony, Baden and Scotland in providing such schools were carefully studied. The passage of the (English) Education Act of 1918 served as an additional stimulus.

Continuation schools are generally administered by city and town school authorities, but with fairly close state and some federal supervision because of the fact that relatively large proportions of their support derive, not from local funds, but from state and (under the Smith-Hughes act) federal sources. A few cities (notably Boston, Milwaukee, New York and Newark) have established central schools exclusively for continuation-school pupils. In some cases classes are maintained in commercial or industrial establishments employing large numbers of workers within the required attendance age.

The difficulty of providing competent teachers for continuation schools has heretofore prevented the public from having anything like a full realization of their possible benefits. Classes or groups formed in continuation schools are necessarily more heterogeneous than are classes in ordinary public schools. Each teacher must meet from 150 to 300 pupils per week, with a consequent dispersion of personal contact and impairment of understanding. Theoretically the subjects taught should be very differently organized from subjects of similar names in ordinary public schools.

The problems of appropriate curricula have been found still more complicated. Doubtless many of the earlier supporters of compulsory part-time schools believed that these schools would solve the problems of vocational training. In practice they have done so only in a limited number of instances. At best these schools have been found very efficacious in making more real and significant such kinds of general education as pupils had already had, and also in keeping them in touch with school procedures in such ways that many have returned to full-time schools.

Authorities still differ as to the actual educational functions that should be made the primary objectives of continuation schools. One group favours a considerable range of studies, even though profound learning is not practicable within the limits of the time available. Another group favours concentration on the part of individual pupils according to bent, outside employment, prospects and the like. In the meantime, minority groups of dissatisfied employers or parents in certain states have made many attempts to repeal the legislation establishing continuation schools. In practically no instance have these attempts succeeded. It is reasonable to assume that continuation school education has been adopted as an integral and important part of the U.S. public school system.

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CONTINUED FRACTIONS. A continued fraction is obtained from a sequence of ordinary fractions a_1/b_1, a_2/b_2, a_3/b_3, $\cdots$, called partial quotients, by adding each fraction to the denominator of the preceding fraction of the sequence, thus

$$\cfrac{a_1}{b_1+\cfrac{a_2}{b_2+\cfrac{a_3}{b_3+\ddots}}}.$$

To this may be added a number b_0. The partial numerators a_p and partial denominators b_p may be any real or complex numbers. The continued fraction may terminate, or there may be infinitely many partial quotients. The ordinary fractions

$$\frac{A_0}{B_0}=\frac{b_0}{1},\quad \frac{A_1}{B_1}=\frac{b_0b_1+a_1}{b_1},\quad \frac{A_2}{B_2}=\frac{b_0b_1b_2+a_1b_2+a_2b_0}{b_1b_2+a_2},\ \cdots,$$

obtained by cutting off the continued fraction with the successive partial quotients are called the approximants. These may be computed by means of the fundamental recurrence formulas

$$\begin{matrix} A_p=b_pA_{p-1}+a_pA_{p-2}, \\ B_p=b_pB_{p-1}+a_pB_{p-2}, \end{matrix}\quad p=2, 3, 4, \cdots,$$

starting with the initial values $A_0=b_0$, $A_1=b_0b_1+a_1$, $B_0=1$, $B_1=b_1$. If the denominators B_p are different from zero from and after some value of p, and the sequence of approximants converges to a finite limit V, then the continued fraction is said to converge, and V is called its value. Otherwise the continued fraction is said to be divergent, and is assigned no value.

Continued fractions occupy an important place in mathematics because of their interesting properties and their connections with many different branches of science: number theory, theory of equations, probability, summability, theory of integration, infinite matrices and the theory of functions. They find applications in the physical sciences, for instance in the theory of electrical networks and in certain problems in dynamics. Some questions relating to convergence and divergence of continued fractions will be discussed first and then some of the above-mentioned connections described.

Convergence and Divergence.—It is easily seen that the values of the approximants of the continued fraction are unchanged if a_p and b_p are replaced by $c_{p-1}c_pa_p$ and c_pb_p, respectively, $(p=1, 2, 3, \cdots)$, where $c_0=1$, and $c_1, c_2, c_3, \cdots$ are any numbers not zero. This is called an equivalence transformation. If the a_p are different from zero, the c_p can always be chosen so that the transformed continued fraction will have all its partial numerators equal to unity. Similarly, if the b_p are different from zero, the continued fraction is equivalent to another whose partial denominators are all equal to unity. Thus, most continued fractions can be written in the forms

$$\text{(A)}\quad b_0+\cfrac{1}{b_1+\cfrac{1}{b_2+\cfrac{1}{b_3+\cdots}}}\quad\text{and}\quad\text{(B)}\quad b_0+\cfrac{a_1}{1+\cfrac{a_2}{1+\cfrac{a_3}{1+\cdots}}}.$$

If the denominators B_p of the continued fraction are different from zero, then the continued fraction is equivalent, in a certain sense, to the infinite series

$$\frac{A_0}{B_0}+\sum_{p=1}^{\infty}\left(\frac{A_p}{B_p}-\frac{A_{p-1}}{B_{p-1}}\right).$$

In fact, the sum of the first n terms of this series is precisely the nth approximant of the continued fraction. If the series converges, its sum is the value of the continued fraction, and if the series diverges, the continued fraction diverges. The general term of the series is equal to $(-1)^{p-1}a_1a_2\cdots a_p/B_pB_{p-1}$. This is an immediate consequence of the determinant formula

$$A_pB_{p-1}-A_{p-1}B_p=(-1)^{p-1}a_1a_2\cdots a_p,$$

which one may readily obtain from the fundamental recurrence formulas. By way of illustration, consider the so-called simple continued fraction, which is of the form (A) where b_0 is an integer, and $b_1, b_2, b_3, \cdots$ are positive integers. Then, $B_0=1$, $B_1=b_1$, $B_2=b_1b_2+1$, $\cdots$ are positive integers, and $B_0\leqq B_1<B_2<B_3<\cdots$. The above series is now $b_0+\Sigma_{p=1}^{\infty}(-1)^{p-1}/B_pB_{p-1}$. This is an alternating series in which the terms decrease numerically to zero, and is therefore convergent. Hence the simple continued fraction is convergent. If V is its value, then the alternating character of the series shows that the even approximants increase to the limit V, the odd approximants decrease to the limit V, and

$$\left|V-\frac{A_n}{B_n}\right|\leqq\frac{1}{B_nB_{n+1}}<\frac{1}{B_n^2}.$$

If the b_p are arbitrary numbers such that the series $\Sigma|b_p|$ converges, then (A) is divergent. Thus, a necessary condition for (A) to converge is that the series $\Sigma|b_p|$ diverge. This condition is sufficient only when the b_p are subject to certain restrictions, *e.g.*, if the b_p are real and positive, or if $b_1\neq 0$ and $0<c\leqq\arg b_p\leqq\pi-c$, $p=1, 2, 3, \cdots$, where c is a positive constant. One may easily verify that if $b_p=(-1)^{p+1}$, then (A) is divergent although the series $\Sigma|b_p|$ diverges.

The continued fraction (B) converges if $|a_p|\leqq 1/4$, $p=2, 3, 4, \cdots$. On the other hand, it is divergent if $a_p=-1/4-c$, $p=2, 3, \cdots$, $a_1\neq 0$, where c is any positive constant. For convenience, let $b_0=0$ and $a_1=1$ in (A). In the plane of the complex variable $z=x+iy$, draw the parabola whose equation is $y^2=x+1/4$. If $a_2, a_3, a_4, \cdots$ are in any bounded portion of the region contained in this parabola, then the continued fraction converges, and its value is in the circle whose equation is $x^2-2x+y^2=0$. The statement is no longer true if either the circle is replaced by a smaller region, or the parabolic region is replaced by a larger region which is symmetrical with respect to the x-axis.

These statements may perhaps serve to indicate some of the remarkable convergence properties of continued fractions.

The Arithmetic Theory.—It has been shown that the simple continued fraction is always convergent. Every real number has a simple continued fraction expansion, which terminates if and only if the number is rational. To obtain the expansion of a rational fraction, one uses the familiar Euclidean algorithm for the greatest common divisor. For example, $31/17=1+14/17$, $17/14=1+3/14$, $14/3=4+2/3$, $3/2=1+1/2$, so that

$$\frac{31}{17}=1+\cfrac{1}{1+\cfrac{1}{4+\cfrac{1}{1+\cfrac{1}{2}}}}.$$

To expand an irrational number w, put $w=b_0+w_1$, where b_0 is the largest integer less than w, so that $0<w_1<1$. Then put $1/w_1=b_1+w_2$, where b_1 is the largest integer less than $1/w_1$, so that $0<w_2<1$. On continuing this process one obtains step by step the simple continued fraction expansion (A) for the number w. For example, if $w=\sqrt{7}$, we find that $w_1=\sqrt{7}-2$, $w_2=(\sqrt{7}-1)/3$, $w_3=(\sqrt{7}-1)/2$, $w_4=(\sqrt{7}-2)/3$, $w_5=\sqrt{7}-2=w_1$. Therefore, $b_0=2$, $b_1=1$, $b_2=1$, $b_3=1$, $b_4=4$, $b_5=1$, $\cdots$. The partial denominators run 1, 1, 1, 4, 1, 1, 1, 4, 1, 1, 1, 4, $\cdots$, repeating in blocks of four. Thus, the continued fraction is periodic. It can be shown that every quadratic surd has a periodic expansion, and that every periodic simple continued fraction is equal to a quadratic surd. From the above example one finds the following approximations to $\sqrt{7}$: $2/1$, $3/1$, $5/2$, $8/3$, $37/14$, $45/17$, $\cdots$. These fractions are alternately less than and greater than $\sqrt{7}$. It is easy to obtain the value of a periodic continued fraction. For example, let $b_0=1$, $b_p=2$, $p=1, 2, 3, \cdots$. Then if v is the value, we must have $(v+1)=2+1/(v+1)$, $(v+1)^2-2(v+1)-1=0$, $v=\pm\sqrt{2}$. Since v cannot be negative, then $v=\sqrt{2}$.

The rational approximants for $\sqrt{N}$ obtained from the simple continued fraction have interesting geometrical properties. Consider the equation $x^2-Ny^2=h$, where h is an integer. This may be written in the form $(x/y)-\sqrt{N}=h/[(x/y)+\sqrt{N}]y^2$. If $x=A_n$ and $y=B_n$, the left-hand member of this equality is less in absolute value than $1/y^2$, and therefore $|h|<(A_n/B_n)+\sqrt{N}$, so that $|h|\leqq 2\sqrt{N}$. This shows that if one substitutes $x=A_n$ and $y=B_n$ in the expression x^2-Ny^2, and lets $n=0, 1, 2, \cdots$, then this expression can take on but a finite number of different values. Geometrically, this means that there are a finite number of hyperbolas all having the line $x-\sqrt{N}y=0$ as asymptote, such that for every n the point with co-ordinates (A_n, B_n) lies on one of them. If $N=7$, the first six of these points are (*vide supra*) (2,1), (3,1), (5,2), (8,3), (37,14), (45,17). There are in this case three hyperbolas, namely $x^2-7y^2=1$, $x^2-7y^2=2$, $x^2-7y^2=-3$. The equation $x^2-Ny^2=1$ is called Pell's equation. It can be shown that every solution in positive integers of Pell's equation is of the form $x=A_n$, $y=B_n$, where A_n/B_n is the nth approximant of the simple continued fraction for $\sqrt{N}$.

Irrational numbers which are not quadratic surds have infinite nonperiodic simple continued fractions. For example, in the simple continued fraction for $e=2.71828\cdots$, $b_0=2$, and $b_1, b_2, b_3, \cdots$ are 1, 2, 1, 1, 4, 1, 1, 6, 1, 1, 8, $\cdots$. In the case of $\pi=3.14159\cdots$, $b_0=3$, and $b_1, b_2, b_3, \cdots$ are 7, 15, 1, 292, 1, 1, 1, 2, $\cdots$, where the law of formation is not known. The numbers e and π have been proved transcendental, *i.e.*, they are not roots of algebraic equations with integral coefficients. Historically, the first proof of the existence of transcendental numbers was given by Joseph Liouville by means of continued fractions. He showed that if for every positive integer n an index k can be found such that $b_{k+1}>B^n$, then the simple continued fraction is equal to a transcendental number. One could, for instance, take $b_{k+1}=1+B_k^k$, $k=0, 1, 2, \cdots$.

The first half of the book of O. Perron, *Die Lehre von den Kettenbrüchen* (Leipzig and Berlin, 1929) is devoted to the arithmetic theory of continued fractions.

The Analytic Theory.—The most important continued fractions in the analytic theory are

$$\text{(C)}\quad \cfrac{1}{b_1+z-\cfrac{a_1^2}{b_2+z-\cfrac{a_2^2}{b_3+z-\cdots}}} \quad\text{and (D)}\quad \cfrac{1}{k_1z+\cfrac{1}{k_2+\cfrac{1}{k_3z+\cfrac{1}{k_4+\cdots}}}}.$$

Here the a_p and k_p are constants not zero, the b_p are constants, and z is a complex variable; (C) is called a Jacobi-fraction or J-fraction, and (D) is called a Stieltjes-fraction or S-fraction. The J-fraction is closely related to the Jacobi-matrix or J-matrix, which is the infinite matrix of coefficients of the system of equations

$$-a_px_p+(b_p+z)x_{p+1}-a_{p+1}x_{p+2}=0,\quad p=0, 1, 2, \cdots, (a_0=0).$$

The notation is chosen in (C) in such a way as to avoid square roots in the coefficients in this matrix. The theory of the J-fraction may be regarded as a part of David Hilbert's theory of infinite matrices and quadratic forms in infinitely many variables.

T. J. Stieltjes used the continued fraction (D), with the k_p real and positive, to solve his celebrated moment problem. Let $x_1, x_2, x_3, \cdots$ be an increasing sequence of points along the positive half of the x-axis, and let m_p be a positive mass concentrated at x_p. If the sums $c_p=\Sigma_{k=1}^{\infty} x_k^p m_k$, $p=0, 1, 2, \cdots$, are finite, they are called the moments of the distribution of mass. The Stieltjes moment problem is the problem of determining a distribution of mass which will have preassigned moments $c_0, c_1, c_2, \cdots$. Stieltjes found that the problem has a solution if and only if the formal power series $\Sigma_{p=0}^{\infty}(-1)^pc_p/z^{p+1}$ has an S-fraction expansion (D) in which the k_p are positive. He then constructed from the S-fraction by successive approximation a system of masses having the given moments. He had to permit continuous as well as discontinuous distributions of mass. Moreover, there is just one solution of the moment problem if the series Σk_p diverges. In this case, the S-fraction converges to a function of the form $\int_0^{\infty}dm(u)/(z+u)$. The function $m(u)$ then gives the distribution of mass, and $c_p=\int_0^{\infty}u^pdm(u)$, $p=0, 1, 2, \cdots$. If the series Σk_p converges, then the problem has infinitely many different solutions.

This moment problem has been extended and applied in various directions. For instance, the ideas of Stieltjes are in the background of Hilbert's famous theory of quadratic forms in infinitely many variables; they were used by Felix Hausdorff in his method of summing divergent series; and T. Carleman applied the theory to prove the fundamental theorems on quasi-analytic functions. The more general problem in which a distribution of mass is allowed along the entire real axis has been solved by means of J-fractions.

An important role of the continued fraction is to serve as an intermediary between a divergent power series and a definite integral. Whenever the power series has a J-fraction or S-fraction expansion of suitable type, then it is necessarily asymptotically equal to one or more definite integrals of the form $\int_{-\infty}^{+\infty}dm(u)/(z+u)$. Consider, for example, the totally divergent series $\Sigma_{p=0}^{\infty}(-1)^pp!/z^{p+1}$. This has the S-fraction expansion (D) in which $k_1=1$, $k_2=1$, $k_3=1$, $k_4=1/2$, $k_5=1/3$, $k_6=1/4$, $\cdots$. This S-fraction converges, and its value is $\int_0^{\infty}e^{-u}du/(z+u)$, a function which may be regarded as the "sum" of the divergent series. In a comprehensive class of problems the continued fraction can be used in this way to connect divergent series with definite integrals. Continued fractions are used to construct electrical networks which will have preassigned properties embodied in a given function. If this function is expanded into a continued fraction the characteristics of the required network can be read off immediately.

In certain problems of stability of dynamical systems it is important to have a simple algorithm for deciding whether or not all the zeros of a polynomial $p(z)=z^n+a_1z^{n-1}+a_2z^{n-2}+\cdots$ have negative real parts. In case the coefficients a_p are real, it is only necessary to expand $Q(z)/P(z)$, where $Q(z)=a_1z^{n-1}+a_3z^{n-3}+a_5z^{n-5}+\ldots$, into a continued fraction of the form

$$\cfrac{1}{c_1z+1+\cfrac{1}{c_2z+\cfrac{1}{c_3z+\begin{matrix}\cdot\\ \cdot\\ \cdot\end{matrix}\; +\cfrac{1}{c_nz}}}}.$$

The required criterion is that the c_p be all positive. This expansion can be obtained by ordinary long division. If k of the c_p are positive and $n-k$ are negative, then k of the zeros of the polynomial have negative real parts and $n-k$ have positive real parts. This algorithm may be modified to cover polynomials with arbitrary complex coefficients.

Continued fractions are often useful in computing values of functions. For example, perhaps the best way to compute values of the integral $\int_0^a e^{-x^2}dx$ is to use the expansion $\sqrt{\pi}/2-e^{-a^2}K$, where K is the continued fraction in which $b_0=0$, the sequence of partial numerators is $1, 1, 2, 3, 4, 5, \cdots$, and the sequence of partial denominators is $2a, a, 2a, a, 2a, a, \cdots$. Karl F. Gauss obtained a continued fraction expansion for the quotient $F(a, b+1, c+1; z)/F(a, b, c; z)$ of contiguous hypergeometric functions. By specializing the parameters a, b, c one may obtain expansions for many particular functions.

It is natural to ask whether or not it is possible to express, in a simple way, the sum, difference, product or quotient of two continued fractions as a continued fraction. The answer is in the negative. The operations of differentiation and integration are not suited to continued fractions. Thus, one is denied the use of these familiar operations of analysis. The operations which can be performed stem from the fact that a continued fraction is essentially the symbolic product of infinitely many linear fractional transformations in the complex plane. It may also be regarded as arising from a single linear transformation in the space of infinitely many variables. From the first point of view, the continued fraction theory becomes a part of the theory of Möbius transformations; while from the second point of view, it becomes a part of the theory of infinite matrices and of quadratic forms in infinitely many variables.

Bibliography.—The one existing treatise on continued fractions is the book of O. Perron, *Die Lehre von den Kettenbrüchen* (Leipzig and Berlin, 1929, and an earlier edition of 1913). Several treatises on algebra have chapters on continued fractions. E. B. Van Vleck, *Selected Topics in the Theory of Divergent Series and of Continued Fractions* (1905) contains an introduction to the analytic theory, and an extensive bibliography. The celebrated memoir of T. J. Stieltjes, "Recherches sur les Fractions Continues," *Oeuvres*, vol. 2, pp. 407–566 (1894), ranks among the most important mathematical papers of modern times. A large number of papers on continued fractions have appeared in the mathematical journals, especially in the periods from 1920–23 and from 1940–45. (H. S. Wl.)

CONTINUITY. The mathematical concept of continuity has been made completely clear and unambiguous only in comparatively recent times. It is a pertinent concept in geometry and in the theory of functions, and so enters into their applications to the physical world. Intuitively, an entity is regarded as continuous if it is unbroken, that is, has no gaps. Physical space and time are commonly considered as continuous. On the other hand matter is discrete, that is, it is made up of particles which are separated in space. However, for convenience matter is frequently treated as if it were continuous, when this gives a sufficiently close approximation to the observed facts.

More precise definitions follow. In geometry, a straight line is said to be continuous in case: (1) between every two points on the line there is a third point on the line, and (2) whenever the line is separated into two pieces there is always an extreme point on one of the pieces which may be taken to define the separation. This property of the straight line is an assumption or postulate, and geometric systems have been studied in which it is absent. The continuity property of the real number system consists of two corresponding parts: (1) between every two real numbers there is a third real number, and (2) if the real numbers are separated into two subclasses A and B such that every number in A is less than every number in B, then either A contains a greatest number, or else B contains a least number. For the real numbers this property may be proved. Thus the possibility of setting up a correspondence between the real numbers and the points on a line, such as lies at the basis of analytic geometry, depends on the continuity postulate in geometry. The rational numbers do not form a continuous system according to the definition above, since for example if A consists of all negative rational numbers, and all positive rational numbers whose squares are less than two, and if B consists of the remaining rational numbers, then A contains no greatest number, and B contains no least.

A function $f(x)$ is said to be continuous at a point c in case it has a value at c, and $f(x)$ approaches $f(c)$ when x approaches c. (*See* LIMIT, and also FUNCTION.) A function is continuous in a domain if it is continuous at every point of the domain. A continuous curve in a plane in which an xy-co-ordinate system has been set up consists of the points given by two continuous functions $x=f(t)$, $y=g(t)$ of a real variable t on an interval $a \leqq t \leqq b$. In topology the notion of continuous curve is used in a somewhat different sense. (*See* TOPOLOGY.)

See E. W. Hobson, *Theory of Functions of Real Variables,* vol. i, (3rd ed., 1927); Pierpont, *Theory of Functions of Real Variables,* vol. i, (1905). (L. M. G.)

CONTINUO (BASSO CONTINUO): *see* FIGURED BASS.

CONTINUOUS VOYAGE: *see* CONTRABAND; NEUTRALITY.

CONTINUOUS WAVES, in radio communication, alternating electric waves in space, of constant amplitude and frequency. They are produced by certain types of radio transmitting sets, the waves being made the "carrier" of the desired intelligence by modulating them by an appropriate method.

CONTOUR, CONTOUR LINE, a line drawn upon a map through all the points upon the surface represented that are of equal height above sea level. The word is French and means generally "outline," from the med. Lat. *contornare,* to round off. The points mentioned lie upon a horizontal plane at a given elevation passing through the land shown on the map, and the contour line is the intersection of that horizontal plane with the surface of the ground. The contour line of O, or *datum level,* is the coastal boundary of any land form. If the sea be imagined as rising 100 ft. a new coastline with bays and estuaries indented in the valleys would appear at the new sea level. If the sea sank again to its former level the 100 ft. contour would be represented by the beach mark made when the sea was 100 ft. higher. If instead of receding the sea rose continuously at 100 ft. per day a series of levels 100 ft. above one another would be marked daily upon the land until at last the highest mountain peaks appeared as islands less than 100 ft. high. A record of this series of advances marked upon a flat map of the original country would give a series of contour lines at 100 ft. intervals. Contour lines of this character, at varying intervals according to the scale of the map, are marked on most maps that indicate topographical features.

CONTRABAND, a term denoting commodities the import or export of which is prohibited by law. With the development of neutrality (*q.v.*) it was extended to those commodities which the subjects of neutral states were forbidden to supply to belligerents. These became known as "contraband of war." Under the British system contraband has been defined as "neutral property found on board ship either on the high seas, or in the territorial waters of either belligerent, which is by nature capable of being used to assist in, and is on its way to assist in, the naval or military operations of the enemy" (see *Parl. Pap.* 1909 [Cd. 4,554] p. 3). Speaking on this point in the house of commons as long ago as 1801 Sir William Grant, then solicitor general, declared that the distinction of contraband was artificial; there was no such distinction; all articles designed for and conducive to the advantage of the enemy were inadmissible to be freely conveyed and therefore contraband. Nevertheless, a distinction was drawn by Great Britain, adopting the classification propounded by Grotius, viz.:—(1) absolute contraband, *i.e.,* articles primarily adapted and used for purposes of war, *e.g.,* arms, ammunition and materials for making the same, articles of military equipment, military and naval stores and the like; (2) conditional and occasional contraband, *i.e.,* articles *ancipitis usus,* capable of use in peace or war, *e.g.,* provisions, money, railway and transport material, horses, hay, hemp and the like; such articles were only to be liable to seizure and condemnation if shown to be destined for the naval or military forces of the enemy or for a place of naval or military equipment belonging to or occupied by him. In declarations notifying neutrals, the crown was entitled to extend or reduce the lists of both absolute and conditional contraband, subject to any restriction by treaty or international law.

The harshness of the doctrine of conditional contraband was in practice mitigated by the British practice of pre-emption.

With this view the United States and Japan substantially agreed. Continental opinion, on the other hand, was opposed to the doctrine of conditional contraband and sought to restrict contraband to articles of immediate warlike use. In practice, however, many continental powers when belligerents enforced rules of contraband even more severe than those under the British system. France, for instance, in her war with China in 1885 declared rice bound for ports north of Canton absolute contraband although Great Britain refused to recognize this unless the rice was destined to a place of naval or military equipment (see *Parl. Pap.* 1885 [Cd. 4,359]). Spain in the Spanish-American War of 1898 claimed to include anything which the government might determine as contraband; whilst Russia in the Russo-Japanese War of 1904 declared foodstuffs, fuel and raw cotton to be absolute contraband whether bound for a military destination or not (see *Parl. Pap.* 1900 [Cd. 2,348]). Seizures under this declaration aroused strong remonstrances from both Great Britain and the United States which led to some revision whereby articles unless consigned to the belligerent government or its administration, or to its armed forces, fortresses or naval ports, or consigned to agents or contractors for the naval or military authorities, were exempt from capture.

In consequence of these differences of opinion and of practice, not only between different states but also in the practice of the same state at different times, according to whether it was neutral or belligerent, an attempt, which proved abortive, was made at The Hague Peace Conference of 1907 to settle the vexed distinction between absolute and conditional contraband. Ultimately at the London Conference of 1908–09 after much discussion and many compromises an agreement found expression in the declaration of London. Three lists of articles were drawn up. By art. 22 the articles therein described, viz., articles exclusively used in war, such as arms, etc., and some articles also used in peace, such as horses, might without notice be treated as absolute contraband. By art. 23 articles exclusively used in war might be added to this list by declaration followed by notification to the powers. By art. 24 articles *ancipitis usus,* such as foodstuffs, fodder, clothing, money, vehicles, vessels, railway material, aircraft, fuel, powder and explosives not specially prepared for use in war, barbed wire, horseshoes, harness, field-glasses and nautical instruments, might be treated as conditional contraband if shown to be destined to (1) the armed forces of the enemy, or (2) a government department, *i.e.,* either to enemy officials or to a contractor in the enemy territory who notoriously supplies articles of this kind to the enemy, or (3) to a fortified place belonging to the enemy or to any other place serving as a base of operations. The latter phrase was, as Pitt Cobbett suggested it might be, interpreted by Germany in World War I to mean "a base of supply." By Arts. 33 and 36 where a belligerent had no seaboard, conditional contraband was liable to capture even though bound for a neutral port, if shown to be destined for the use of the armed forces or of a Government department. With this exception "the doctrine of continuous voyage" was wholly excluded in the case of conditional contraband, although by Art. 30 absolute contraband was liable to capture if destined to the territory belonging to or occupied by the enemy or his armed forces, and this whether directly or by transhipment or by subsequent land transport. By Art. 27 articles not susceptible of use in war might not be declared contraband of war, and by Arts. 28 and 29 the articles therein described might not be declared contraband of war, including raw cotton, wool, silk, jute, flax, hemp and other raw materials of the textile industries and yarns of the same, rubber, metallic ores, paper, soap and articles serving exclusively to aid the sick and wounded. By Art. 37 a vessel carrying contraband with a hostile destination was liable to capture and condemnation throughout the whole of her voyage, but by Art. 38 this liability ceased with the deposit of the goods. By Art. 39 the contraband itself was liable to condemnation, but by Art. 40 the vessel was only liable to condemnation if the contraband amounted to more than one-half of the cargo. If the contraband were less than one-half, the vessel by Art. 41 was only liable to the costs and expenses incurred by the captor. By Art. 42 all other goods belonging to the owner of the contraband were liable to condemnation. Where the vessel was ignorant of the outbreak of war or of some declaration adding to or altering the existing lists, Art. 43 gave the captor the right of pre-emption of such part of the cargo as was contraband. With some notable exceptions these provisions were in substantial agreement with Anglo-American doctrines and practice. It was these exceptions which caused the House of Lords to refuse to ratify the Declaration. Nevertheless upon the outbreak of the World War the Declaration was adopted by all the belligerents, but with important modifications. As, however, the war progressed the list of conditional contraband became merged in that of absolute contraband and the "free list" practically disappeared. Germany was the first to declare cotton absolute contraband. Rubber was declared absolute contraband by Great Britain in Oct. 1914. Foodstuffs, however, remained in the British and German lists as conditional contraband. But with the application of the doctrine of continuous voyage by the Allies, and the treatment of every Allied port by Germany as a base of supplies, continued adherence to this provision of the Declaration became impracticable. Accordingly by the British and French Orders of July 7, 1916, the Declaration was formally abandoned and all commodities directly or indirectly of use to the enemy in the prosecution of the war were declared absolute contraband. Another innovation was the rejection by the British Prize Courts of the old rule which excluded the captor's evidence. Evidence "out of the ship's mouth," *i.e.*, the evidence supplied by the ship's papers, was found in modern conditions to be insufficient. In lieu of this it has been suggested that the system embodied in the treaty between Great Britain and Sweden of 1661, whereby the ship's papers should be officially certified at the port of export, should be substituted. But whilst it would protect the normal trade of a neutral, it would also protect an abnormal trade. Belligerents cannot be expected to permit neutrals to carry on an abnormal trade which is of direct assistance to the enemy and helps to prolong the war. Just as neutrals are entitled to supply either belligerent with all commodities at their own risk, so either belligerent may prevent such commodities reaching the other by blockade and the application of the doctrine of continuous voyage. The right to declare any article of direct or indirect use to the enemy in the prosecution of the war appears to some to be a naval weapon conferring upon a belligerent the right to starve the civilian population. It was so regarded by Germany, and the German jurist, Dr. Sieveking, accepts the doctrine that the distress of the civil population is a legitimate and indeed the chief weapon of a modern belligerent. But it is conceived that the chief aim of Great Britain was not to starve the civilian population. It was a return to her old principle stated at the head of this article, viz., to prevent commodities which would be of use in the prosecution of the war from reaching the enemy. A belligerent will no more allow, for instance, jute and cotton from which high explosives may be manufactured to reach the enemy in the future than he allowed hemp and timber in the past. "In view of present conditions of both war and commerce," writes the American Charles Cheney Hyde, "a belligerent should enjoy the right to intercept and condemn all articles capable of assisting the enemy, even though consigned to neutral territory, if shown to be ultimately destined by land or sea to the domain of the enemy, and that irrespective of the final destination of ships which bear them on their way towards an intervening port." (H. H. L. B.)

CONTRACEPTION: *see* BIRTH CONTROL.

CONTRACT, the legal term for a bargain or agreement; some writers, following the Indian Contract Act, confine the term to agreements enforceable by law: this, though not yet universally adopted, seems an improvement. Enforcement of good faith in matters of bargain and promise is among the most important functions of legal justice. It might not be too much to say that, next after keeping the peace and securing property against violence and fraud so that business may be possible, it is the most important. Yet we shall find that the importance of contract is developed comparatively late in the history of law. The commonwealth needs elaborate rules about contracts only when it is advanced enough in civilization and trade to have an elaborate system of credit. The Roman law of the empire dealt with contract, indeed, in a fairly adequate manner, though it never had a complete or uniform theory; and the Roman law, as settled by Justinian, appears to have satisfied the Eastern empire long after the Western nations had begun to recast their institutions, and the traders of the Mediterranean had struck out a cosmopolitan body of rules and custom known as the Law Merchant, which claimed acceptance in the name neither of Justinian nor of the Church, but of universal reason. It was amply proved afterwards that the foundations of the Roman system were strong enough to carry the fabric of modern legislation. But the collapse of the Roman power in western Christendom threw society back into chaos.

In this condition of legal ideas, which it would be absurd to call jurisprudence, the general duty of keeping faith is not recognized except as a matter of religious or social observance. Those who desire to be assured of anything that lies in promise must exact an oath, or a pledge, or personal sureties; and even then the court of their people—in England the Hundred Court in the first instance—will do nothing for them in the first case, and not much in the two latter. Probably the settlement of a blood-feud, with provisions for the payment of the fine by instalments, was the nearest approach to a continuing contract, as we now understand the term, which the experience of Germanic antiquity could furnish. It is also probable that the performance of such undertakings, as it concerned the general peace, was at an early time regarded as material to the commonweal; and that these covenants of peace, rather than the rudimentary selling and bartering of their day, first caused our Germanic ancestors to realize the importance of putting some promises at any rate under public sanction. The history of the law, and even the present form of much law still common to almost all the English-speaking world, can be understood only when we bear in mind that our forefathers did not start from any general conception of the State's duty to enforce private agreements, but, on the contrary, the State's powers and functions in this regard were extended gradually, unsystematically, and by shifts and devices of ingenious suitors and counsel, aided by judges, rather than by any direct provisions of princes and rulers. Money debts, it is true, were recoverable from an early time. But this was not because the debtor had promised to repay the loan; it was because the money was deemed still to belong to the creditor, as if the identical coins were merely in the debtor's custody. The creditor sued to recover money, for centuries after the Norman Conquest, in exactly the same form which he would have used to demand possession of land; the action of debt closely resembled the "real actions," and, like them, might be finally determined by a judicial combat; and down to Blackstone's time the creditor was said to have a property in the debt—property which the debtor had "granted" him. Giving credit, in this way of thinking, is not reliance on the right to call hereafter for an act, the payment of so much current money or its equivalent, to be performed by the debtor, but merely suspension of the immediate right to possess one's own particular money, as the owner of a house let for a term suspends his right to occupy it. This was no road to the modern doctrine of contract, and the passage had to be made another way.

In fact the old action of debt covered part of the ground of contract only by accident. It was really an action to recover any property that was not land; for the remedy of a dispossessed owner of chattels, afterwards known as detinue, was only a slightly varying form of it. If the property claimed was a certain sum of money, it might be due because the defendant had received money on loan, or because he had received goods of which the agreed price remained unpaid; or, in later times at any rate, because he had become liable in some way by judgment, statute or other authority of law, to pay a fine or fixed penalty to the plaintiff. Here the person recovering might be as considerable as the lord of a manor, or as mean as a "common informer"; the principle was the same. In every case outside this last class, that is to say, whenever there was a debt in the popular sense of the word, it had to be shown that the defendant had actually received the money or goods; this value received came to be called *quid pro quo*—a term unknown, to all appearance, out of England. Nevertheless the foundation of the plaintiff's right was not bargain or promise, but the unjust detention by the defendant of the plaintiff's money or goods.

Modes of Proof.—We are not concerned here to trace the change from the ancient method of proof—oath backed by "good suit," *i.e.*, the oaths of an adequate number of friends and neighbours—through the earlier form of jury trial, in which the jury were supposed to know the truth of their own knowledge, to the modern establishment of facts by testimony brought before a jury who are bound to give their verdict according to the evidence. But there was one mode of proof which, after the Norman Conquest, made a material addition to the substantive law. This was the proof by writing, which means writing authenticated by seal. Proof by writing was admitted under Roman influence, but, once admitted, it acquired the character of being conclusive which belonged to all proof in early Germanic procedure. Oath, ordeal and battle were all final in their results. When the process was started there was no room for discussion, though any formal irregularity was fatal. So the sealed writing was final too, and a man could not deny his own deed. We still say that he cannot, but with modern refinements. Thus the deed, being allowed as a solemn and probative document, furnished a means by which a man could bind himself, or rather effectually declare himself bound, to anything not positively forbidden by law. Whoever could afford parchment and the services of a clerk might have the benefit of a "formal contract" in the Roman sense of the term. At this day the form of deed called a bond or "obligation" is, as it stands settled after various experiments, extremely artificial; but it is essentially a solemn admission of liability, though its conclusive stringency has been relaxed by modern legislation and practice in the interest of substantial justice. By this means the performance of all sorts of undertakings, pecuniary and otherwise, could be and was legally secured. Bonds were well known in the 13th century, and from the 14th century onwards were freely used for commercial and other purposes; as for certain limited purposes they still are. The "covenant" of modern draftsmen is a direct promise made by deed; it occurs mainly as incident to conveyances of land. The mediaeval "covenant," *conventio,* was, when we first hear of it, practically equivalent to a lease, and never became a common instrument of miscellaneous contracting, though the old books recognize the possibility of turning it to various uses of which there are examples; nor had it any sensible influence on the later development of the law. On the whole, in the old common law one could do a great deal by deed, but very little without deed. The minor bargains of daily life, so far as they involved mutual credit, were left to the jurisdiction of inferior courts, of the Law Merchant, and—last, not least—of the Church.

Fidei Laesio.—Popular custom, in all European countries, recognized simpler ways of pledging faith than parchment and seal. A handshake was enough to bind a bargain. Whatever secular law might say, the Church said it was an open sin to break plighted faith; a matter, therefore, for spiritual correction, in other words, for compulsion exercised on the defaulter by the bishop's or the archdeacon's court, armed with the power of excommunication. In this way the ecclesiastical courts acquired much business which was, in fact, as secular as that of a modern county court, with the incident profits. Mediaeval courts lived by the suitors' fees. What were the king's judges to do? However high they put their claims in the course of the rivalry between Church and Crown, they could not effectually prohibit the bishop or his official from dealing with matters for which the king's court provided no remedy. Continental jurists had seen their way, starting from the Roman system as it was left by Justinian, to reduce its formalities to a vanishing quantity, and expand their jurisdiction to the full breadth of current usage. English judges could not do this in the 15th century, if they could ever have done so. Nor would simplification of the requisites of a deed, such as has now been introduced in many jurisdictions, have been of much use at a time when only a minority even of well-to-do laymen could write.

There was no principle and no form of action in English law which recognized any general duty of keeping promises. But could not breach of faith by which a party had suffered be treated as some kind of legal wrong? There was a known action of trespass and a known action of deceit, this last of a special kind, mostly for what would now be called abuse of the process of the court; but in the later middle ages it was an admitted remedy for giving a false warranty on a sale of goods. Also there was room for actions "on the case," on facts analogous to those covered by the old writs, though not precisely within their terms. If the king's judges were to capture this important branch of business from the clerical hands which threatened to engross it, the only way was to devise some new form of action on the case. There were signs, moreover, that the court of chancery would not neglect so promising a field if the common law judges left it open.

Assumpsit.—The mere fact of unfulfilled promise was not enough, in the eyes of mediaeval English lawyers, to give a handle to the law. But injury caused by reliance on another man's undertaking was different. The special undertaking or "assumption" creates a duty which is broken by fraudulent or incompetent miscarriage in the performance. I profess to be a skilled farrier, and lame your horse. It is no trespass, because you trusted the horse to me; but it is something like a trespass, and very like a deceit. An action on the case was allowed without much difficulty for such defaults. The next step, and a long one, was to provide for total failure to perform. A builder, instead of doing bad work, does nothing at all within the time agreed upon for completing a house. Can it be said that he has done a wrong? At first the judges felt bound to hold that this was going too far; but suitors anxious to have the benefit of the king's justice persevered, and in the course of the 15th century the new form of action, called *assumpsit* from the statement of the defendant's undertaking on which it was founded, was allowed as a remedy for non-performance as well as for faulty performance. Being an action for damages, and not for a certain amount, it escaped the strict rules of proof which applied to the old action of debt; being in form for a kind of trespass, and thus a privileged appeal to the king to do right for a breach of his peace, it escaped likewise the risk of the defendant clearing himself by oath according to the ancient popular procedure. Hence, as time went on, suitors were emboldened to use "assumpsit" as an alternative for debt, though it had been introduced only for cases where there was no other remedy. By the end of the 16th century they got their way; and it became a settled doctrine that the existence of a debt was enough for the court to presume an undertaking to pay it. The new form of action was made to cover the whole ground of informal contracts, and, by extremely ingenious devices of pleading, developed from the presumption or fiction that a man had promised to pay what he ought, it was extended in time to a great variety of cases where there was in fact no contract at all.

Consideration.—The new system gave no new force to gratuitous promises. For it was assumed, as the foundation of the jurisdiction, that the plaintiff had been induced by the defendant's undertaking, and with the defendant's consent, to alter his position for the worse in some way. He had paid or bound himself to pay money, he had parted with goods, he had spent time in labour, or he had foregone some profit or legal right. If he had not committed himself to anything on the strength of the defendant's promise, he had suffered no damage. To sum up the foregoing in modern language, the plaintiff must have given value of some kind, more or less, for the defendant's undertaking. This something given by the promisee and accepted by the promisor in return for his undertaking is what we now call the *consideration* for the promise. In cases where debt would also lie, it coincides with the old requirement of value received (*quid pro quo*) as a condition of the action of debt being available. But the conception is far wider, for the consideration for a promise need not be anything capable of delivery or possession. It may be money or goods; but it may also be an act or series of acts; further (and this is of the first importance for our modern law), it may itself be a promise to pay money or deliver goods, or to do work, or otherwise to act or not to act in some specified way. Again, it need not be anything which is obviously for the promisor's benefit. His acceptance shows that he set some value on it; but in truth the promisee's burden, and not the promisor's benefit, is material. The last and not strictly logical refinement of holding that, when mutual promises are exchanged between parties, each promise (though by itself of no value) is a consideration for the other and makes it binding, was conclusively accepted only in the 17th century. The result was that promises of mere bounty could no more be enforced than before, but any kind of lawful bargain could; and there is no reason to doubt that this was in substance what most men wanted. Ancient popular usage and feeling show little more encouragement than ancient law itself to merely gratuitous alienation or obligations. Also (subject, till quite modern times, to the general rule of common-law procedure that parties could not be their own witnesses, and subject to various modern statutory requirements in various classes of cases) no particular kind of proof was necessary. The necessity of consideration for the validity of simple contracts was unfortunately confused by commentators, almost from the beginning of its history, with the perfectly different rules of the Roman law about *nudum pactum*, which very few English lawyers took the pains to understand.

The doctrine of consideration is in fact peculiar to those jurisdictions where the common law of England is in force, or is the foundation of the received law, or, as in South Africa, has made large encroachments upon it in practice. Substantially similar results are obtained in other modern systems by professing to enforce all deliberate promises, but imposing stricter conditions of proof where the promise is gratuitous.

As obligations embodied in the solemn form of a deed were thereby made enforceable before the doctrine of consideration was known, so they still remain. When a man has by deed declared himself bound, there is no need to look for any bargain, or even to ask whether the other party has assented. This rugged fragment of ancient law remains embedded in our elaborate modern structure. Nevertheless gratuitous promises, even by deed, get only their strict and bare rights. There may be an action upon them, but the powerful remedy of specific performance—often the only one worth having—is denied them. For this is derived from the extraordinary jurisdiction of the chancellor, and the equity administered by the chancellor was not for plaintiffs who could not show substantial merit as well as legal claims. The singular position of promises made by deed is best left out of account in considering the general doctrine of the formation of contracts; and as to interpretation there is no difference. In what follows, therefore, it will be needless, as a rule, to distinguish between "parol" or "simple" contracts, that is, contracts not made by deed, and obligations undertaken by deed.

Promise and Offer.—From the conception of a promise being valid only when given in return for something accepted in consideration of the promise, it follows that the giving of the promise and of the consideration must be simultaneous. Words of promise uttered before there is a consideration for them can be no more than an offer; and, on the other hand, the obligation declared in words, or inferred from acts and conduct, on the acceptance of a consideration, is fixed at that time, and cannot be varied by subsequent declaration, though such declarations may be material as admissions. It was a long while, however, before this consequence was clearly perceived. In the 18th century it was attempted, and for a time with considerable success, to extend the range of enforceable promises without regard to what the principles of the law would bear, in order to satisfy a sense of natural justice. This movement was finally checked as late as 1840, and traces of it remain in certain apparently anomalous rules which are indeed of little practical importance, but which private writers, at any rate, cannot safely treat as obsolete. However, the question of "past consideration" is too minute and technical to be pursued here. The general result is that a binding contract is regularly constituted by the acceptance of an offer, at the moment it is accepted. It also follows that an offer before acceptance creates no duty of any kind; which is by no means necessarily the case in systems where the English rule of consideration is unknown. The question what amounts to final acceptance of an offer is, on the other hand, a question ultimately depending on common sense. The rules that an offer is understood to be made only for a reasonable time, according to the nature of the case, and lapses if not accepted in due time; that an expressed revocation of an offer can take effect only if communicated to the other party before he has accepted; that acceptance of an offer must be according to its terms, and a conditional or qualified acceptance is only a new proposal, and the like, stand on general convenience as much as on any technical ground.

Correspondence.—Great difficulties have arisen, in other systems as well as in the English, as to the completion of contracts between persons at a distance. There must be some rule, and yet any rule that can be framed must seem arbitrary in some cases. On the whole the modern doctrine is as follows:

The proposer of a contract can prescribe or authorize any mode, or at least any reasonable mode, of acceptance, and if he specifies none he is deemed to authorize the use of any reasonable mode in common use, and especially the post. Acceptance in words is not always required; an offer may be well accepted by an act clearly referable to the proposed agreement, and constituting the whole or part of the performance asked for—say the despatch of goods in answer to an order by post, or the doing of work bespoken; and it seems that in such cases further communication—unless expressly requested—is not necessary as matter of law, however prudent and desirable it may be. Where a promise and not an act is sought (as where a tradesman writes a letter offering goods for sale on credit), it must be communicated; in the absence of special direction letter post or telegraph may be used; and, further, the acceptor having done his part when his answer is committed to the post, English courts have held for about half a century (since 1879), after considerable previous doubt, that any delay or miscarriage in course of post is at the proposer's risk, so that a man may be bound by an acceptance he never received. It is generally thought—though there is no English decision—that, in conformity with this last rule, a revocation by telegraph of an acceptance already posted would be inoperative. Much more elaborate rules are laid down in some Continental codes. It seems doubtful whether their complication achieves any gain of substantial justice worth the price. At first sight it looks easy to solve some of the difficulties by admitting an interval during which one party is bound and the other not. But, apart from the risk of starting fresh problems as hard as the old ones, English principles, as above said, require a contract to be concluded between the parties at one point of time, and any exception to this would have to be justified by very strong grounds of expediency. We have already assumed, but it should be specifically stated, that neither offers nor acceptances are confined to communications made in spoken or written words. Acts or signs may and constantly do signify proposal and assent. One does not in terms request a ferryman to put one across the river. Stepping into the boat is an offer to pay the usual fare for being ferried over, and the ferryman accepts it by putting off. This is a very simple case, but the principle is the same in all cases. The term "implied contract," current in this connection, is ambiguous. It sometimes means a contract concluded by acts, not words, of one or both parties, but still a real agreement; sometimes an obligation imposed by law where there is not any agreement in fact, for which the name "quasi-contract" or "constructive contract" is more appropriate and now usual.

Interpretation.—The obligation of contract is an obligation created and determined by the will of the parties. Herein is the characteristic difference of contract from all other branches of law. The business of the law, therefore, is to give effect so far as possible to the intention of the parties, and all the rules for interpreting contracts go back to this fundamental principle and are controlled by it. Every one knows that its application is not always obvious. Parties often express themselves obscurely; still oftener they leave large parts of their intention unexpressed, or (which for the law is the same thing) have not formed any intention at all as to what is to be done in certain events. But even where the law has to fill up gaps by judicial conjecture, the guiding principle still is, or ought to be, the consideration of what either party has given the other reasonable cause to expect of him. The court aims not at imposing terms on the parties, but at fixing the terms left blank as the parties would or reasonably might have fixed them if all the possibilities had been clearly before their minds. For this purpose resort must be had to various tests: the court may look to the analogy of what the parties have expressly provided in case of other specified events, to the constant or general usage of persons engaged in like business, and, at need, ultimately to the court's own sense of what is just and expedient. One important application of this principle is the doctrine of "frustration of the adventure" now largely developed in cases arising out of the World War. Where the fulfilment of a contract according to the true intention is rendered impossible by emergent facts not within the control or contemplation of the parties, the court will treat the contract as if it had been conditional and hold performance excused: a strictly exact statement cannot be given in a short compass, but the result is that the possibility of liberal performance has ceased to be an adequate test, and various detailed rules and exceptions are now brought under a more general concept. All auxiliary rules of this kind are subject to the actual will of the parties, and are applied only for want of sufficient declaration of it by the parties themselves. A rule which can take effect against the judicially known will of the parties is not a rule of construction or interpretation, but a positive rule of law. However artificial some rules of construction may seem, this test will always hold. In modern times the courts have avoided laying down new rules of construction, preferring to keep a free hand and deal with each case on its merits as a whole. It should be observed that the fulfilment of a contract may create a relation between the parties which, once established, is governed by fixed rules of law not variable by the preceding agreement. Marriage is the most conspicuous example of this, and perhaps the only complete one in our modern law.

There are certain rules of evidence which to some extent guide or restrain interpretation. In particular, oral testimony is not allowed to vary the terms of an agreement reduced to writing. This is really in aid of the parties' deliberate intention, for the object of reducing terms to writing is to make them certain. There are apparent exceptions to the rule, of which the most conspicuous is the admission of evidence to show that words were used in a special meaning current in the place or trade in question. But they are reducible, it will be found, to applications (perhaps oversubtle in some cases) of the still more general principles that, before giving legal force to a document, we must know that it is really what it purports to be, and that when we do give effect to it according to its terms we must be sure of what its terms really say. The rules of evidence here spoken of are modern, and have nothing to do with the archaic rule already mentioned as to the effect of a deed.

Performance.—Every contracting party is bound to perform his promise according to its terms, and in case of any doubt in the sense in which the other party would reasonably understand the promise. Where the performance on one or both sides extends over an appreciable time, continuously or by instalments, questions may arise as to the right of either party to refuse or suspend further performance on the ground of some default on the other side. Attempts to lay down hard and fast rules on such questions are now discouraged, the aim of the courts being to give effect to the true substance and intent of the contract in every case. Nor will the court hold one part of the terms deliberately agreed to more or less material than another in modern business dealings. "In the contracts of merchants time is of the essence," as the Supreme Court of the United States has said in our own day. Certain ancient rules restraining the apparent literal effect of common provisions in mortgages and other instruments were in truth controlling rules of policy. New rules of this kind can be made only by legislation. Whether the parties did or did not in fact intend the obligation of a contract to be subject to unexpressed conditions is, however, a possible and not uncommon question of interpretation, as we have noted above. One class of cases giving rise to such questions is that in which performance according to the real intent of the parties is frustrated by some external cause not due to the promisor's own fault. As to promises obviously absurd or impossible from the first, they are unenforceable only on the ground that the parties cannot have seriously meant to create a liability. For precisely the same reason, supported by the general usage and understanding of mankind, common social engagements, though they often fulfil all other requisites of a contract, have never been treated as binding in law. The singular case has actually occurred of parties framing a complete business agreement and adding an "honourable pledge clause" which expressly excluded legal jurisdiction. Here the manifest intention not to create an enforceable obligation prevents the other specific terms, however precise, from creating any.

Illegality.—In all matters of contract, as we have said, the ascertained will of the parties prevails. But this means a will both lawful and free. Hence there are limits to the force of the general rule, fixed partly by the law of the land, which is above individual will and interests, partly by the need of securing good faith and justice between the parties themselves against fraud or misadventure. Agreements cannot be enforced when their performance would involve an offence against the law. There may be legal offence, it must be remembered, not only in acts commonly recognized as criminal, disloyal or immoral, but in the breach or nonobservance of positive regulations made by the legislature, or persons having statutory authority, for a variety of purposes. Again, there are cases where an agreement may be made and performed without offending the law, but on grounds of "public policy" it is not thought right that the performance should be a matter of legal obligation, even if the ordinary conditions of an enforceable contract are satisfied. A man may bet, in private at any rate, if he likes, and pay or receive as the event may be; but for many years the winner has had no right of action against the loser. Unfortunate timidity on the part of the judges, who attempted to draw distinctions instead of saying boldly that they would not entertain actions on wagers of any kind, threw this topic into the domain of legislation; and the laudable desire of parliament to discourage gambling, so far as might be, without attempting impossible prohibitions, has brought the law to a state of ludicrous complexity in both civil and criminal jurisdiction. But what is really important under this doctrine of public policy is the confinement of "contracts in restraint of trade" within special limits. In the middle ages and down to modern times there was a strong feeling—not merely an artificial legal doctrine—against monopolies and everything tending to monopoly. Agreements to keep up prices or not to compete were regarded as criminal. Gradually it was found that some kind of limited security against competition must be allowed if such transactions as the sale of a going concern with its goodwill, or the retirement of partners from a continuing firm, or the employment of confidential servants in matters involving trade secrets, were to be carried on to the satisfaction of the parties. Attempts to lay down fixed rules in these matters were made from time to time, but they were finally discredited by the decision of the House of Lords in the Maxim-Nordenfelt company's case in 1894. Contracts "in restraint of trade" will now be held valid, provided that they are made for valuable consideration (this even if they are made by deed), and do not go beyond what can be thought reasonable for the protection of the interests concerned, and are not injurious to the public. (The Indian Contract Act, passed in 1872, has unfortunately embodied views now obsolete, and remains unamended.) All that remains of the old rules in England is the necessity of valuable consideration, whatever be the form of the contract, and a strong presumption—but not an absolute rule of law—that an unqualified agreement not to carry on a particular business is not reasonable.

Fraud.—Where there is no reason in the nature of the contract for not enforcing it, the consent of a contracting party may still not be binding on him because not given with due knowledge, or, if he is in a relation of dependence to the other party, with independent judgment. Inducing a man by deceit to enter into a contract may always be treated by the deceived party as a ground for avoiding his obligation, if he does so within a reasonable time after discovering the truth, and, in particular, before any innocent third person has acquired rights for value on the faith of the contract. (*See* FRAUD.) Coercion would be treated on principle in the same way as fraud, but such cases hardly occur in modern times. There is a kind of moral domination, however, which our courts watch with the utmost jealousy, and repress under the name of "undue influence" when it is used to obtain pecuniary advantage. Persons in a position of legal or practical authority—guardians, confidential advisers, spiritual directors and the like—must not abuse their authority for selfish ends. They are not forbidden to take benefits from those who depend on them or put their trust in them; but if they do, and the givers repent of their bounty, the whole burden of proof is on the takers to show that the gift was in the first instance made freely and with understanding. Large voluntary gifts or beneficial contracts, outside the limits within which natural affection and common practice justify them, are indeed not encouraged in any system of civilized law. Professional money-lenders were formerly checked by the usury law: since those laws were repealed in 1854, courts and juries have shown a certain astuteness in applying the rules of law as to fraud and undue influence—the latter with certain special features—to transactions with needy "expectant heirs" and other improvident persons which seem on the whole unconscionable. The Money-lenders Act of 1900 and subsequent amendments have fixed and (as finally interpreted by the House of Lords) also sharpened these developments. In the case of both fraud and undue influence, the person entitled to avoid a contract may, if so advised, ratify it afterwards; and ratification, if made with full knowledge and free judgment, is irrevocable. A contract made with a person deprived by unsound mind or intoxication of the capacity to form a rational judgment is on the same footing as a contract obtained by fraud, if the want of capacity is apparent to the other party.

Misrepresentation.—There are many cases in which a statement made by one party to the other about a material fact will enable the other to avoid the contract if he has relied on it, and it was in fact untrue, though it may have been made at the time with honest belief in its truth. This is so wherever, according to the common course of business, it is one party's business to know the facts, and the other practically must, or reasonably may, take the facts from him. In some classes of cases even inadvertent omission to disclose any material fact is treated as a misrepresentation. Contracts of insurance are the most important; here the insurer very seldom has the means of making any effective enquiry of his own. Misdescription of real property on a sale, without fraud, may according to its importance be a matter for compensation or for setting aside the contract. Promoters of companies are under special duties as to good faith and disclosure which have been worked out at great length in the modern decisions. But company law has become so complex within the present generation that, so far from throwing much light on larger principles, it is hardly intelligible without some previous grasp of them. Sometimes it is said that misrepresentation (apart from fraud) of any material fact will serve to void any and every kind of contract. It is submitted that this is certainly not the law as to the sale of goods or as to the contract to marry, and therefore the alleged rule cannot be laid down as universal. But it must be remembered that parties can, if they please, and not necessarily by the express terms of the contract itself, make the validity of their contract conditional on the existence of any matter of fact whatever, including the correctness of any particular statement. If they have done this, and the fact is not so, the contract has no force; not because there has been a misrepresentation, but because the parties agreed to be bound if the fact was so and not otherwise. It is a question of interpretation whether in a given case there was any such condition.

Mistake is said to be a ground for avoiding contracts, and there are cases which it is practically convenient to group under this head. On principle they seem to be mostly reducible to failure of the acceptance to correspond with the offer, or absence of any real consideration for the promise. In such cases, whether there be fraud or not, no contract is ever formed, and therefore there is nothing which can be ratified—a distinction which may have important effects. Relief against mistake is given where parties who have really agreed, or rather their advisers, fail to express their intention correctly. Here, if the original true intention is fully proved—as to which the court is rightly cautious—the faulty document can be judicially rectified.

Disability.—By the common law an infant (*i.e.,* a person less than 21 years old) was bound by contracts made for "necessaries," *i.e.,* such commodities as a jury holds, and the court thinks they may reasonably hold, suitable and required for the person's condition; also by contracts otherwise clearly for his benefit; all other contracts he might confirm or avoid after coming of age. An extremely ill-drawn act of 1874 absolutely deprived infants of the power of contracting loans, contracting for the supply of goods other than necessaries, and stating an account so as to bind themselves; it also disabled them from binding themselves by ratification. The liability for necessaries is now declared by legislative authority in the Sale of Goods Act, 1893; the modern doctrine is that it is in no case a true liability on contract. There is an obligation imposed by law to pay, not the agreed price, but a reasonable price. Practically, people who give credit to an infant do so at their peril, except in cases of obvious urgency.

Married women were incapable by the common law of contracting in their own names. At this day they can hold separate property and bind themselves to the extent of that property—not personally—by contract. The law before the Married Women's Property Acts (1882 and 1893, and earlier acts now superseded and repealed) was a very peculiar creature of the court of chancery; the cases in which it is necessary to go back to it are now, of course, very few. But a married woman can still be restrained from anticipating the income of her separate property, and the restriction is still commonly inserted in marriage settlements.

There is a great deal of philosophical interest about the nature and capacities of corporations, but for modern practical purposes it may be said that the legal powers of British corporations are directly or indirectly determined by acts of parliament. For companies under the Companies Acts the controlling instrument or written constitution is the memorandum of association. Company draftsmen, taught by experience, nowadays frame this in the most comprehensive terms. Questions of either personal or corporate disability are less frequent than they were. In any case they stand apart from the general principles of our law of contract.

Contract and Property.—The rights created by contract are personal rights against the promisors and their legal representatives, and therefore different in kind from the rights of ownership and the like which are available against all the world. Nevertheless they may be and very commonly are capable of pecuniary estimation and estimated as part of a man's assets. Book debts are the most obvious example. Such rights are property in the larger sense: they are in modern law transmissible and alienable, unless the contract is of a kind implying personal confidence, or a contrary intention is otherwise shown. The rights created by negotiable instruments are an important and unique species of property, being not only exchangeable but the very staple of commercial currency. Contract and conveyance, again, are distinct in their nature, and sharply distinguished in the classical Roman law. But in the common law property in goods is transferred by a complete contract of sale without any further act, and under the French civil code and systems which have followed it a like rule applies not only to movables but to immovables. In English law procuring a man to break his contract is a civil wrong against the other contracting party, subject to exceptions which are still not clearly defined. (F. Po.)

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UNITED STATES

In a few points the American law differs from the English. The deed has rather generally been deprived of its full effect in creating a contractual obligation without consideration, by legislation providing that a seal shall merely raise a rebuttable presumption of consideration being present. As to usury, the States have almost all maintained in general the older English policy of fixing a statutory maximum interest rate, and in some manner penalizing the contracting for more. (*See* USURY; on contracts in restraint of trade in America *see* especially TRUSTS: *Legal Position of: United States.*)

The rule that inducing one contracting party to break his contract is a legal wrong to the other contracting party has become of great social importance in the United States in recent years in the field of labour and its relations; this not so much because of the usual remedy for civil wrongs, by way of damages, as because of the willingness of the courts to find an "irreparable injury" threatened, and hence to issue an injunction against inducing such breach. The usual case is that of attempted organization of a non-union factory personnel by union organizers. Where the men are employed from week to week, inducing them to quit work has generally been recognized as enjoinable; and a similar rule has sometimes been applied even where the employment was from day to day. Open shop employers, to bring themselves within the protection of the rule, have often required their employés to sign, as part of their contract of employment, an agreement not to join a union (except, perhaps, a designated company union) while they continue on the job; such an agreement has been held to make an attempt to unionize the men enjoinable.

This leads directly into two other major phases of contracts in the United States: (1) liberty of contract under the Constitution; and (2) the use of standardized contract.

Liberty of Contract.—The Federal Constitution not only guarantees contract by forbidding any State to pass "any law impairing the obligation of contracts," but provides also in the 5th and 14th amendments that neither Congress nor any State shall deprive any person of "liberty or property" "without due process of law." Since the '90s a good deal of legislation which attempted to restrict the theretofore customary scope of property rights or of freedom of economic action has been declared unconstitutional—and therefore invalid—under these clauses. The argument of unconstitutionality has been pressed with peculiar force against restrictions on a worker's freedom to contract for employment, irrespective of whether the legislation was intended for the worker's benefit and designed to remedy abuses which his power to choose between jobs seemed insufficient to prevent. Thus statutes have fallen which made it an offence to make employment conditional upon the worker's agreement not to join a union; or required him to be paid in money rather than in truck or in a check on the company store; or prescribed a minimum wage for women employés; though hours and sanitary conditions of labour can validly be subjected to considerable regulation. Unconstitutionality has also afflicted, peculiarly, attempts at price regulation outside the businesses traditionally regarded as public utilities; prices, as the heart of free contract, are to be free from Government control; indeed, even private agreements by competitors to raise prices or keep them up are both illegal and penal offences. Finally, various attempts to regulate particular businesses by prescribing certain terms of contracts, *e.g.*, to prevent fraud (maximum and minimum sizes of loaves of bread), have been held invalid by the Supreme Court, as undue deprivations of liberty or property; the two concepts fuse in these cases. It is clear that two policies are here in conflict. One is the traditional view of the 19th century, buttressed by the individualism of a territory far from fully exploited; a free hand in acting and bargaining is the country's salvation—hence the constitutional language should be construed to annul any legislative restraint. The other is the need to control those abuses which emerge repeatedly when the powerful bargainer crushes the weaker, or when the anonymous producer slips fraudulent or dangerous articles into an uncontrolled market; under this view no reasonable legislative restraint on contract should be annulled, and a liberal view should be taken as to what is reasonable. Which view will prevail in new cases is still extremely difficult to predict.

Standardization of Contract.—The freedom of contract thus guaranteed by the Constitution extends to wide freedom in drawing up the terms of association of any group. This is a sort of private self-government, recognized and intended by law. Private government of this sort, but of some persons over others, develops, however, to an unanticipated extent, where freedom of contract is accompanied by concentration of bargaining power, on the one hand, and by the introduction of standardized forms of contract, on the other. Such standardized contracts are of vast and increasing importance. In a sense the law itself provides them, in such codes as the Uniform Sales Act (*see* SALE OF GOODS) or the Negotiable Instruments law (*see* BILL OF EXCHANGE), which lay down a sort of frame for all contracts which come within their terms and hence cover hundreds of unforeseen possibilities which the contracting parties did not stop to consider. But the law in such matters is commonly directed largely to indicating results *where the expressed agreement is silent.* It thus becomes feasible and useful for concerns specializing in particular lines to capitalize their experience by building form-contracts which expressly resolve in their own favour all the points commonly left to implication. The advantages of this are obvious. Not only are the scales tipped, in most of the possible contingencies, in favour of the concern drawing the form, but that concern can automatically make available to untrained clerks or salesmen the full skill, forethought and experience of both the high executives and legal counsel; moreover, the contracts being standardized, the handling of performance as well as of claims and disputes becomes simpler and cheaper. Some effects of standardized employment contracts have been mentioned above. Those of standardized business contracts fall into two classes. On the one side are the cases where bargaining power on the two sides is somewhat even, as where associated buyers negotiate a form of contract with associated sellers; the uniform bill of lading is in substance of this character, with the consequence of reasonable and careful protection of all parties concerned. On the other side are the cases where bargaining power is not balanced, and one side must take or leave what the other offers; the forms of residence and small office lease, of policies of insurance, of contracts for sale of agricultural implements and of automobile agency contracts are examples. Here the law has sometimes intervened to hold the scales more even. The courts often "construe the contract strictly" in the interests of fairness; they have often made use of the doctrine of consideration to hold what seemed an unfair contract to be wholly unenforceable because one side was not sufficiently bound to do anything for the other; finally, in fields where experience showed the need, there has come in due time legislative regulation of the permissible forms of contract, notably in the case of insurance policies. The whole situation brings out clearly the sometimes neglected fact that free contract, as a device to accomplish the multitude of adjustments no Government can foresee or attend to, is for proper effectiveness none the less conditioned by the existence and continuance of something approaching equality of power among the bargaining parties. Most legislative interference with freedom of contract, whether constitutional or not, will be found traceable to the absence of such substantial equality.

In closing, it should be noted that during the 19th century the field of contract was the scene of a hitherto unparalleled development of Anglo-American legal theory. Out of a great variety of traditional specific relations—"vendor and purchaser," "buyer and seller of goods," "bailor and bailee," etc.—a sustained effort was made to build a general law and theory of contract. It was the first sweeping attempt to systematize a large field of the common law in the manner in which the civil law of the Continent is systematized. For good or for bad it was really most remarkably successful; the results reaching their fruition in the restatement of the law of contracts approved in 1928 by the American Law Institute. As yet the movement toward systematization shows less promise in other sections of American law.

See Pound, 18 Yale, L.J. 454 (1908); Ely, *Property and Contract in their Relation to the Distribution of Wealth* (1914); Williston, *Contracts* (1920); Isaacs, 27 Yale L.J. 34 (1926); *Restatement of the Law of Contracts* (American Law Institute, 1928). (K. N. L.)

CONTRACT BRIDGE, which, since 1930, has won a worldwide popularity unequalled in the history of cards, is the fourth in a succession of card games of which the basic game is Whist. In Contract Bridge, two pairs of players, as partners, compete for tricks, as in Whist; the cards of one player, known as the dummy, are exposed upon the table, as in Bridge-Whist, the second game of the series; and the four players bid for the right to name the trump suit, as in Auction Bridge, the third game of the series. The distinctive feature of Contract Bridge is that a pair cannot score the tricks it wins toward making a game unless it previously has contracted to win those tricks.

A game is won and ended when a pair scores 100 points for tricks as contracted. For this purpose, the value of tricks is translated into points, varying with the suit named as trump. Each trick over six contracted for and won counts, if spades are trumps, 30; hearts, 30; diamonds, 20; clubs, 20; notrumps, 40 for the first trick and 30 thereafter. The pair which first makes two games wins the rubber. If the opposing side has made a game, the rubber-winning pair scores a bonus of 500 points and, if the opposing side has not made a game, a bonus of 700 points. All bonuses and all points, other than trick points toward game, are scored as premiums. These premiums include the regular points for tricks won but not contracted for; undertrick penalties when opponents fail to fulfill their contract; bonuses for bidding and making a small slam (twelve tricks) or a grand slam (thirteen tricks); and 100 points for holding four trump honours in one hand, or 150 points for holding, in one hand, five trump honours, or all four Aces, if there are no trumps.

When a pair has made a game it is "vulnerable" and undertrick penalties and slam bonuses are affected by vulnerability. A contract may be doubled and redoubled, which doubles or quadruples the trick points toward game if the contract is fulfilled. When not doubled, each undertrick costs a penalty of 50 points not vulnerable and 100 points vulnerable. When doubled, the first undertrick counts 100 points not vulnerable and 200 points vulnerable, and subsequent undertricks 200 points not vulnerable and 300 points vulnerable. Not vulnerable, the small slam bonus is 500 points and the grand slam bonus 1000 points; vulnerable, they are 750 and 1500 points respectively. Overtricks at a doubled contract count 100 each not vulnerable, 200 vulnerable. Redoubling doubles the value of doubled undertricks or overtricks.

Contract Bridge, as it is played today, originated in November, 1925, in a Bridge game on a steamship enroute from Los Angeles to Havana. Harold S. Vanderbilt, one of the participants in this game, is credited with introducing the game to New York clubs, in which it gradually supplanted Auction Bridge. The game of plafond, developed in France about 1922, as an evolution of Auction Bridge, already had introduced the condition that tricks must be contracted for in order to be scored toward game, but Mr. Vanderbilt added the vulnerability feature, the slam bonuses, and a new schedule of scoring which, with a few variations, remains in force today.

A greater measure of skill is required in Contract Bridge than in its predecessors. Whereas, in Auction Bridge, the object of calling (bidding) was solely to name the trump suit, players at Contract Bridge must determine how many tricks they can expect to win. To accomplish this, an interchange of accurate partnership information is essential. Ely Culbertson of New York conceived, for this purpose, the method of systematic bidding which now is in general use by Contract Bridge players. He introduced to Contract Bridge the Approach Principle, which holds that suit bids should be preferred to notrump bids and he originated the Forcing Principle, under which certain bids require partner to make some responding bid. His system of bidding is called the Culbertson or Approach-Forcing System.

Those who had been active in writing and teaching the game of Auction Bridge soon turned to Contract Bridge and developed or recommended various systems of bidding. Many of these made use of artificial conventions, with certain calls which indicated a certain number of high cards rather than willingness to play at the contract named. Mr. Vanderbilt's system, in which an opening bid of one club shows three "quick" tricks in Aces and Kings, remains the most popular of these systems. Most systems of bidding have now disappeared and those which remain are so similar that, except for the few users of artificial conventions, good players throughout the world use the same methods. These, in basis, comprise the original Approach-Forcing system.

Contract Bridge was not generally adopted in Great Britain until 1930. The leading Whist and Bridge players in the London clubs objected to the use of systematic bids, and, even when they turned to Contract Bridge, their sentiment was against all "systems." Their playing methods, however, approximate those of all other good players, and they actually play a system without so terming it. The adoption of Contract Bridge in Great Britain was rapid after an American team, which included Mr. and Mrs. Culbertson, Theodore A. Lightner and Waldemar von Zedtwitz, played a series of matches in London in 1930 against teams made up of Lt.-Colonel Walter E. Buller, Mrs. Gordon Evers, Lieutenant Cedric Kehoe and Dr. Nelson Wood-Hill, and two teams representing Crockford's Club of London, one team being Colonel H. M. Beasley, Sir Guy Domville, George Morris and Captain K. Hogg, the other Miss Ethel Thomas, Mrs. Cavendish-Bentinck, F. Lyon and Ivor Birts. In 1933 Charles M. Schwab of New York offered a trophy for a World's Championship match, in which American and British teams competed in 1933 and 1934. The American team both years included Mr. and Mrs. Culbertson and Lightner, with Michael T. Gottlieb in 1933 and Albert Morehead in 1934. The 1933 British team was made up of Colonel Beasley, Domville, Morris, P. V. Tabbush, Graham Mathieson and Lady Doris Rhodes; the 1934 team, of R. Lederer, W. Rose, H. St. J. Ingram and S. Hughes, with Colonel G. G. J. Walshe and A. Frost as alternates. The American teams won all these matches, the three in 1930 and the contests for the Schwab Trophy in 1933 and 1934.

The first laws drafted for Contract Bridge were issued by the Knickerbocker Whist Club in New York, but were replaced a few months later in 1927 by a code promulgated by The Whist Club of New York. International interest in Contract Bridge made it desirable that there be an international code, and in 1932 the Portland Club of London, which had been making the laws for Great Britain and several European countries since it issued its first code in January 1929, cooperated with The Whist Club of New York and with the Commission Française du Bridge in the drafting of the first International Code. This was replaced, in March 1935, by the present International Code, which is followed in nearly every country in the world.

Contract Bridge tournaments are played in duplicate; the cards dealt to each player are kept separated so that other players may later have exactly the same cards, and the luck of the deal is eliminated. Duplicate tournaments are governed by laws which follow the International Code except for a few differences which are unavoidable because of the difference in playing procedure.

The popularity of Contract Bridge has made it an industry which gives employment, directly or indirectly, to thousands. (E. Cul.)

CONTRACTILE VACUOLE, in biology, a spherical space filled with liquid, which at intervals discharges into the medium; it is found in all fresh-water groups of Protozoa (*q.v.*), also in the naked aquatic reproductive cells of Algae and Fungi. It is absent in states with a distinct cell-wall to resist excessive turgescence. Its function is to remove the water which must diffuse into unprotected cells in a medium of lower osmotic pressure than themselves. Possibly, it also serves as an organ of excretion.

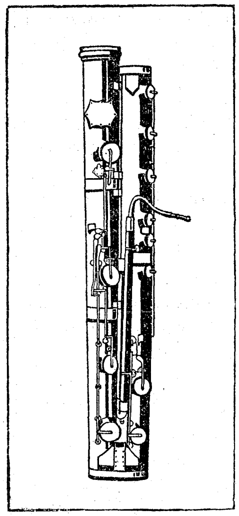
CONTRACT NOTE. A document issued by a stockbroker to his client, giving details of the sale or purchase of stock on the client's account. In the case of the London Stock Exchange, a typical contract note shows the cost of the shares, the cost of the Government stamp duty required to legalise the transfer, the fee charged by the company for registering the transfer and issuing a new certificate, the brokerage charged by the stockbroker. It also states the settlement day when the shares must be paid for.

CONTRADICTION, PRINCIPLE OF (*principium contradictionis*), in logic, the term applied to the second of the three primary "laws of thought." The oldest statement of the law is that contradictory statements cannot both at the same time be true, *e.g.,* the two propositions "A is B" and "A is not B" are mutually exclusive. A may be B at one time, and not at another; A may be partly B and partly not B at the same time; but it is impossible to predicate of the same thing, at the same time, and in the same sense, the absence and the presence of the same quality. This is the statement of the law given by Aristotle. It takes no account of the truth of either proposition; if one is true, the other is not; one must be false.

Modern logicians, following Leibniz and Kant, have generally adopted a different statement, by which the law assumes an essentially different meaning. Their formula is "A is not not–A"; in other words it is impossible to predicate of a thing a quality which is its contradictory. Unlike Aristotle's law this law deals with the necessary relation between subject and predicate in a single judgment. Whereas Aristotle states that *one* or *other* of two contradictory propositions must be false, the Kantian law states that a particular kind of proposition is *in itself* necessarily false. On the other hand there is a real connection between the two laws. The denial of the statement "A is not–A" presupposes some knowledge of what A is, *i.e.,* the statement A is A. In other words a judgment about A is implied. Kant's analytical propositions depend on presupposed concepts which are the same for all people. His statement, regarded as a logical principle purely, does not therefore amount to more than that of Aristotle.

CONTRAFAGOTTO, DOUBLE BASSOON or **CONTRABASSOON,** a wood-wind instrument of the double reed family, which it completes as the bass, the other members being the oboe, cor anglais, and bassoon. The modern wooden contrafagotto (there is also a type made of brass) has a pitch one octave below that of the bassoon and three below that of the oboe, its compass extending from 16ft. C. to middle C. The notes of both extremes are difficult to produce. The quality of tone is somewhat rough. The contrafagotto has a complete chromatic compass, and it may therefore be played in any key. It forms a fine bass to the reed family, and supplies in the orchestra the notes missing in the double-bass in order to reach 16ft. C.

The origin of the contrafagotto, like that of the oboe (*q.v.*) must be sought in the highest antiquity (*see* Aulos). Its immediate forerunner was the double bombard or bombardino, or the great double quint-pommer. Handel scored for the instrument and it was used in military bands before being adopted in the orchestra. Owing to its faulty construction and harsh tone the double bassoon fell into disuse, in spite of the fact that Haydn, Mozart, and Beethoven all scored for it abundantly; the last used it in the C minor and choral symphonies and wrote an *obbligato* for it in *Fidelio.* Improved methods of construction have, however, restored it to favour as an instrument of value for sparing use.



FROM SCHLESINGER, "INSTRUMENTS OF THE ORCHESTRA AND PRECURSORS OF THE VIOLIN FAMILY" (BESSON & CO.)

THE CONTRAFAGOTTO

CONTRALTO, the term for the lowest variety of the female voice, as distinguished from the soprano and mezzo-soprano. Originally it signified, in choral music, the part next higher than the alto, given to the falsetto counter-tenor.

CONTRAPUNTAL FORMS, in music. The forms of music may be considered in two aspects, the texture of the music from moment to moment, and the shape of the musical design as a whole. Historically the texture of music became definitely organized long before the shape could be determined by any but external or mechanical conceptions. The laws of musical texture were known as the laws of "Counterpoint" (*see* Counterpoint and Harmony). The "contrapuntal" forms, then, are historically the earliest and aesthetically the simplest in music; the simplest, that is to say, in principle, but not necessarily the easiest to appreciate or to execute. Their simplicity is like that of mathematics, the simplicity of the elements involved; it develops into results more subtle and intricate than popular; whereas much of the art that is popular contains many and various elements combined in ways which, though familiar in appearance, are often not recognized for the complex conventions of civilization that they really are.

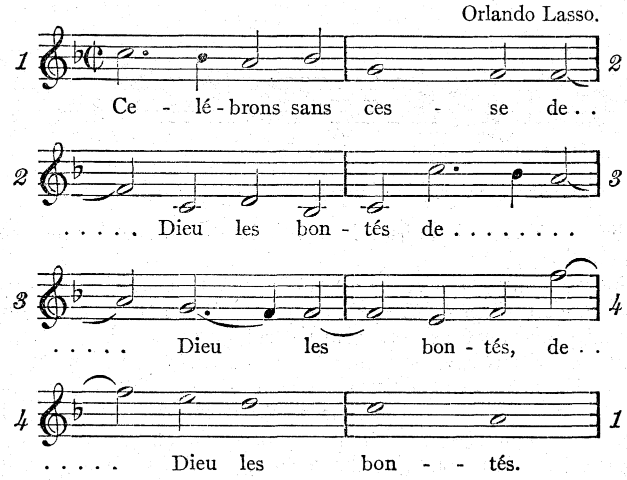
I. CANONIC FORMS AND DEVICES

In the *canonic* forms, the earliest known in music as an independent art, the laws of texture also determine the shape of the whole, so that it is impossible, except in the light of historical knowledge, to say which is prior to the other. The principle of canon being that one voice shall reproduce note for note the material of another, it follows that in a composition where all parts are canonic and where the material of the leading part consists of a pre-determined melody, such as a Gregorian chant or a popular song, the composer has nothing to do but to adjust minute detail till the harmonies fit. The whole composition is the predetermined melody plus the harmonic fitness. The art does not teach composition, but it does teach fluency under difficulties, and thus the canonic forms play an important part in the music of the 15th and 16th centuries; nor indeed have they since fallen into neglect without grave injury to the art. But strict canon is inadequate, and may become a nuisance, as the sole regulating principle in music; nor is its rival and cognate principle of counterpoint on a Canto Fermo (*see* p. 349) more trustworthy in primitive stages. These are rigid mechanical principles; but even mechanical principles may force artistic thought to leave the facile grooves of custom and explore the real nature of things. Even to-day the canonic forms are great liberators if studied with intelligence.

The earliest canonic form is the *rondel* or *rota* as practised in the 12th century. It is, however, canonic by accident rather than in its original intention. It consists of a combination of short melodies in several voices, each melody being sung by each voice in turn. Now it is obvious that if one voice began alone, instead of all together, and if when it went on to the second melody the second voice entered with the first, and so on, the result would be a canon in the unison. Thus the difference between the crude counterpoint of the rondel and a strict canon in the unison is a mere question of the point at which the composition begins, and a 12th century rondel is simply a canon at the unison begun at the point where all the voices have already entered. There is some reason to believe that one kind of rondeau practised by Adam de la Hale was intended to be sung in the true canonic manner of the modern round; and the wonderful English rota, "Sumer is icumen in," shows in the upper four parts the true canonic method, and in its two-part *pes* the method in which the parts began together (*see* MUSIC, Ex. 1). In these archaic works the canonic form gives the whole a stability contrasting oddly with its cacophonous warfare between nascent harmonic principles and ancient antiharmonic criteria. As soon as harmony became established on the true contrapuntal basis, the unaccompanied round attained the position of an elegant trifle, with hardly more expressive possibilities than the triolet in poetry, a form to which its brevity and lightness renders it fairly comparable. Orlando Lasso's *Célébrons sans cesse* is a beautiful example of the 16th century round with a delightful climax in its fourth line: (*see* I., below).

I. *Round (originally for male voices). When the first voice reaches the 2nd line, the 2nd voice begins the 1st line, and so on.*

Orlando Lasso.



In classical times the possibilities of the round enormously increased; and with the aid of elaborate instrumental accompaniments it plays an important feature at points where a *tableau* is possible in an operatic *ensemble.* In such a round the first voice can execute a long and complete melody before the second voice joins in. Even if this melody be not instrumentally accompanied, it will imply a certain harmony, or at all events arouse curiosity as to what the harmony is to be. And the sequel may shed a new light upon the harmony, and thus by degrees the whole character of the melody may be transformed. The humorous and subtle possibilities of this form were first fully revealed by Mozart, whose astounding unaccompanied canons would be better known but for his habit of extemporizing unprintable texts for them.

The round or the *catch* (which is simply a specially jocose round) is a favourite English art-form, and the English specimens of it are almost as numerous and sometimes as anonymous as folksongs. But they are apt to achieve only the easy task comprised in a good piece of free and fairly contrapuntal harmony in three or more parts, so arranged that it remains correct when the parts are brought in one by one. Even Cherubini gives hardly more than a valuable hint that the round may rise to higher things; and, unless he be an adequate exception, the unaccompanied rounds of Mozart and Brahms stand alone as works that raise the round to the dignity of a serious art-form.

With the addition of an orchestral accompaniment the round obviously becomes a larger thing; and in such specimens as that in the finale of Mozart's *Così fan tutte,* the quartet in the last act of Cherubini's *Faniska,* the wonderfully subtle quartet "Mir ist so wunderbar" in Beethoven's *Fidelio,* and the very beautiful numbers in Schubert's masses where Schubert finds expression for his genuine contrapuntal feeling in lyric style, we find that the length of the initial melody, the growing variety of the orchestral accompaniment and the finality and climax of the free coda, combine to give the whole a character closely analogous to that of a set of contrapuntal variations, such as the slow movement of Haydn's "Emperor" string quartet, or the opening of the finale of Beethoven's 9th symphony. Berlioz is fond of beginning his largest movements like a kind of round; *e.g.* his *Dies Irae,* the *Scène aux Champs* in the Symphonie Fantastique, and the opening of his *Damnation de Faust.*

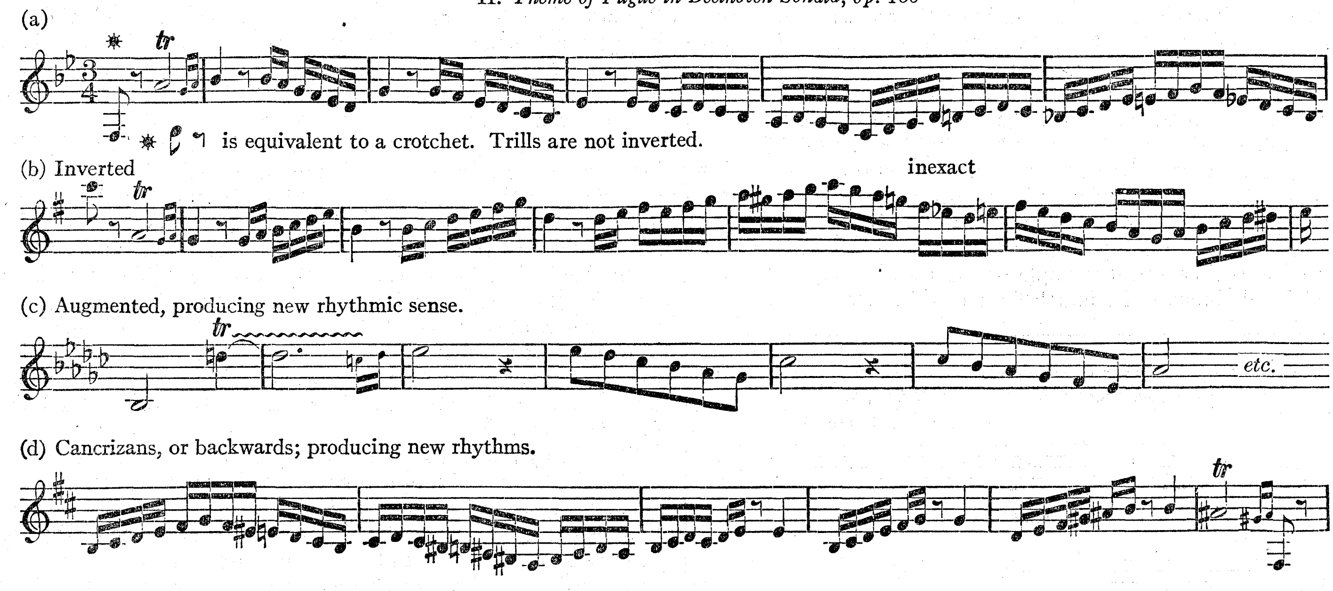
Three conditions are necessary if a canon is to be a round. First, the voices must imitate each other in the unison; secondly, they must enter at equal intervals of time; and thirdly, the whole melodic material must be as many times longer than the interval of time as the number of voices; otherwise, when the last voice has finished the first phrase, the first voice will not be ready to return to the beginning. Strict canon is, however, possible under innumerable other conditions, and even a round is possible with some of the voices at the interval of an octave, as is of course inevitable in writing for unequal voices. And in a round for unequal voices there is obviously a new means of effect in the fact that, as the melody rotates, its different parts change their pitch in relation to each other.

The art by which this is possible without incorrectness is that of double, triple and multiple counterpoint (*see* COUNTERPOINT). Its difficulty is variable, and with an instrumental accompaniment there is none. In fugues, multiple counterpoint is one of the normal resources of music; and few devices are more self-explanatory to the ear than the process by which the subject and countersubjects of a fugue change their positions, revealing fresh melodic and acoustic aspects of identical harmonic structure at every turn. This, however, is rendered possible and interesting by the fact that the passages in such counterpoint are often separated by episodes and are free to appear in different keys. Many fugues of Bach are written throughout in multiple counterpoint; but the possibility of this depends upon the freedom of the musical design which allows the composer to select the most effective permutations and combinations of his counterpoint, and also to put them into whatever key he chooses. Some of Bach's choruses might be called Round-Fugues, so regular is the course by which each voice proceeds to a new counter-subject as the next voice enters. *See* the *Et in terra pax* of the B minor Mass, and the great double chorus, *Nun ist das Heil.*

The resources of canon, when emancipated from the principles of the round, are considerable when the canonic form is strictly maintained, and are inexhaustible when it is treated freely. A canon need not be in the unison; and when it is in some other interval the imitating voice alters the expression of the melody by transferring it to another part of the scale. Again, the imitating voice may follow the leader at any distance of time; and thus we have obviously a definite means of expression in the difference of closeness with which various canonic parts may enter; as, for instance, in the stretto of a fugue. Again, if the answering part enters on an unaccented beat where the leader began on the accent (*per arsin et thesin*), there will be artistic value in the resulting difference of rhythmic expression. All these devices ought to be quite definite in their effect upon the ear, and their expressive power is undoubtedly due to their special canonic nature. The beauty of the pleading, rising sequences in crossing parts in the canon at the 2nd at the opening of the *Recordare* in Mozart's *Requiem* is attainable by no other technical means. The close canon in the 6th at the distance of one minim in reversed accent in the 18th of Bach's *Goldberg Variations* owes its smooth harmonic expression to the fact that the two canonic parts move in sixths which would be simultaneous but for the pause of the minim which reverses the accents of the upper part while it creates the suspended discords which give harmonic character.

Two other canonic devices have important artistic value, viz., *augmentation* and *diminution* (two different aspects of the same thing) and *inversion.* In augmentation the imitating part sings twice as slow as the leader, or sometimes still slower. This obviously should impart a new dignity to the melody, and in diminution the usual result is an accession of liveliness. Beethoven, in the fugues in his sonatas *opp.* 106 and 110, adapted augmentation and diminution to sonata-like varieties of thematic expression, by employing them in triple time, so that, by *doubling* the

II. *Theme of Fugue in Beethoven Sonata, op. 106*



length of the original notes across this triple rhythm, they produce an entirely new rhythmic expression. (*See* C.)

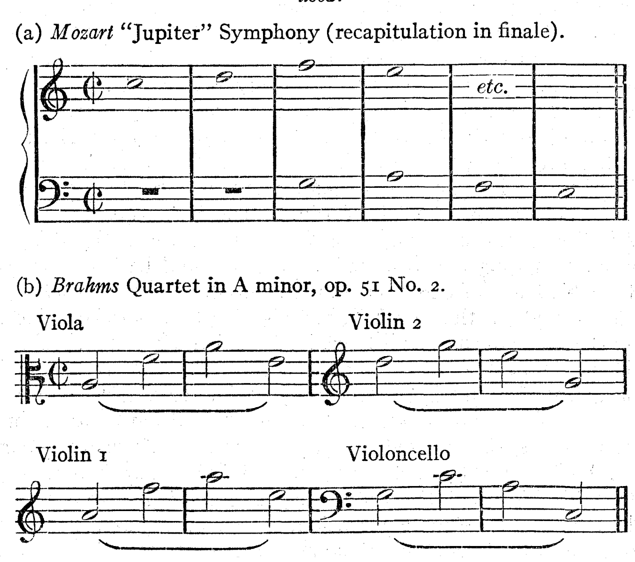
The device of *inversion* consists in the imitating part reversing every interval of the leader, ascending where the leader descends and *vice versa.* Its expressive power depends upon so fine a sense of the harmonic expression of melody that its artistic use is one of the surest signs of the difference between classical and merely scholastic music. There are many melodies of which the inversion is as natural as the original form, and does not strikingly alter its character. Such are, for instance, the theme of Bach's *Kunst der Fuge,* most of Purcell's contrapuntal themes, the theme in the fugue of Beethoven's sonata, *op.* 110, and the eighth of Brahms's variations on a theme by Haydn. But even in such cases inversion may produce harmonic variety as well as a sense of melodic identity in difference. Where a melody has marked features of rise and fall, such as long scale passages or bold skips, the inversion, if productive of good harmonic structure and expression, will be a powerful method of transformation. This is admirably shown in the 12th of Bach's *Goldberg Variations,* in the 15th fugue of the first book of his *Forty-eight Preludes and Fugues,* in the finale of Beethoven's sonata, *op.* 106, and in the second subjects of the first and last movements of Brahms's clarinet trio. The only remaining canonic device which figures in classical music is that known as *cancrizans,* in which the imitating part reproduces the leader backwards. It is of extreme rarity in serious music; and, though it sometimes happens that a melody or figure of uniform rhythm will produce something equally natural when read backwards (as in III.), there is only one example of its use that appeals to the ear as well as the eye. This is to be found in the finale of Beethoven's sonata, *op.* 106, where it is applied to a theme with such sharply contrasted rhythmic and melodic features that with long familiarity a listener would probably feel not only the wayward humour of the passage in itself, but also its connection with the main theme. All these devices are also independent of the canonic idea, since there are so many methods of transforming themes in themselves, and need not always be used in contrapuntal combination.

II. FUGUE

In the polyphonic 16th century motets the essentials of canonic effect are embodied in the entry of one voice after another with a definite theme stated by each voice, often at its own convenient pitch, thus producing a free canon for as many parts as there are voices, in alternate intervals of the 4th, 5th and octave, and at artistically proportionate distances of times. It is not necessary for the later voices to imitate more than the opening phrase of the earlier, or, if they do imitate its continuation, to keep to the same interval.

Such a texture differs in no way from that of the fugue of more modern times. But the form is not what is now understood as fugue, inasmuch as 16th century composers did not normally think of writing long movements on one theme or of making a point of the return of a theme after episodes. With the appearance of new words in the text, the 16th century composer naturally took up a new theme without troubling to design it for contrapuntal combination with the opening; and the form resulting

III. *Harmless cancrizans devices for the eye, depending on the clefs used.*



from this treatment of words was faithfully reproduced in the instrumental *ricercari* of the time. Occasionally, however, breadth of treatment and terseness of design combined to produce a short movement on one idea indistinguishable in form from a *fughetta* of Bach; as in the *Kyrie* of Palestrina's *Missa Salve Regina.* But in Bach's art the preservation of a main theme is more necessary the longer the composition; and Bach has an incalculable number of methods of giving his fugues a symmetry of form and balance of climax so subtle and perfect that we are apt to forget that the only technical rules of a fugue are those which refer to its texture.

In *Die Kunst der Fuge* Bach has shown with the utmost clearness how in his opinion the various types of fugue may be classified. That extraordinary work is a series of fugues, all on the same subject. The earlier fugues show how an artistic design may be made by simply passing the subject from one voice to another in orderly succession (in the first example without any change of key except from tonic to dominant). The next stage of organization is that in which the subject is combined with inversions, augmentations and diminutions of itself. Fugues of this kind can be conveniently called stretto-fugues.[1] The third and highest stage is that in which the fugue combines its subject with contrasted counter-subjects, and thus depends upon the resources of double, triple and quadruple counterpoint. But of the art by which the episodes are contrasted, connected climaxes attained, and keys and subtle rhythmic proportions so balanced as to give the true fugue-forms a beauty and stability second only to those of the true sonata forms, Bach's classification gives us no direct hint.

A comparison of the fugues in *Die Kunst der Fuge* with those elsewhere in his works reveals a necessary relation between the nature of the fugue-subject and the type of fugue. In *Die Kunst der Fuge* Bach has obvious didactic reasons for taking the same subject throughout; and, as he wishes to show the extremes of technical possibility, that subject must necessarily be plastic rather than characteristic. Elsewhere Bach prefers very lively or highly characteristic themes as subjects for the simplest kind of instrumental fugue. On the other hand, there comes a point when the mechanical strictness of treatment crowds out the rhetorical development of musical ideas; and the 7th fugue (which is one solid mass of stretto in augmentation, diminution and inversion) and the 12th and 13th (which are inverted bodily) are academic exercises outside the range of free artistic work. On the other hand, the fugues with well-developed episodes and the fugues in double and triple counterpoint are perfect works of art and as beautiful as any that Bach wrote without didactic purpose. The last fugue Bach worked out up to the point where three subjects, including the notes B, A, C, H, were combined. It has been found that the theme of the rest of *Die Kunst der Fuge* makes a fourth member of the combination and that the combination inverts. This accounts for the laborious exercises shown in the 12th and 13th fugues. It is high time that teachers of counterpoint took *Die Kunst der Fuge* seriously.

Fugue is still, as in the 16th century, a texture rather than a form; and the formal rules given in most technical treatises are based, not on the practice of the world's great composers, but on the necessities of beginners, whom it would be as absurd to ask to write a fugue without giving them a form as to ask a schoolboy to write so many pages of Latin verses without a subject. But this standard form, whatever its merits may be in combining progressive technique with musical sense, has no connection with the true classical types of fugue, though it played an interesting part in the renascence of polyphony during the growth of the sonata style, and even gave rise to valuable works of art (*e.g.* the fugues in Haydn's quartets, *op.* 20).

One of its rules was that every fugue should have a stretto. This rule, like most of the others, is absolutely without classical warrant; for in Bach the ideas of stretto and of counter-subject almost exclude one another except in the very largest fugues, such as the 22nd in the second book of the Forty-eight; while Handel's fugue-writing is a masterly method, adopted as occasion requires, and with a lordly disdain for recognized devices. But the pedagogic rule proved to be not without artistic point in later music; for fugue became, since the rise of the sonata-styles a contrast with the normal means of expression instead of being itself normal. And while this was so, there was considerable point in using every possible means to enhance the rhetorical force of its peculiar devices, as is shown by the astonishing dramatic fugues in Beethoven's last works. Nowadays, however, polyphony is universally recognized as a permanent type of musical texture, and there is no longer any reason why if it crystallizes into the fugue-form at all it should not adopt the classical rather than the pedagogic type. It is still an unsatisfied wish of accurate musicians that the term fugue should be used to imply rather a certain type of polyphonic texture than the whole form of a composition. We ought to describe as "written in fugue" such passages as the first subjects in Mozart's *Zauberflöte* overture, the andantes of Beethoven's first symphony and C minor quartet, the first and second subjects of the finale of Mozart's G major quartet, the second subject of the finale of his D major quintet, and the exposition of quintuple counterpoint in the coda of the finale of the *Jupiter Symphony,* and countless other passages in the developments and main subjects of classical and modern works in sonata form.

[1]For technical terms *see* articles COUNTERPOINT and FUGUE.

III. COUNTERPOINT ON A CANTO FERMO

The early practice of building polyphonic designs on a voice-part confined to a given plain-song or popular melody furnishes the origin for every contrapuntal principle that is not canonic, and soon develops into a canonic principle in itself. When the *canto fermo* is in notes of equal length and is sung without intermission, it is of course as rigid a mechanical device as an acrostic. Yet it may have artistic value in furnishing a steady rhythm in contrast to suitable free motion in the other parts. When it is in the bass, as in Orlando Lasso's six-part *Regina Coeli,* it is apt to cramp the harmony; but when it is in the tenor (its normal place in 16th century music) or any other part, it determines little but the length of the composition. It may or may not appeal to the ear; if not, it at least does no harm, for its restricting influence on the harmony is small if its pace is slower than that of its surroundings. If, on the other hand, its melody is characteristic, or can be enforced by repetition, it may become a powerful means of effect.

When the rhythm of the *canto fermo* is not uniform, or when pauses intervene between its phrases, whether these are different figures or repetitions of one figure in different parts of the scale, the device passes into the region of free art. An early example of its simplest use, as it appears in Josquin's wonderful Miserere, is described in the article MUSIC and in a motet by Lasso. A 16th century mass, when it is not derived from those secular melodies to which the Council of Trent objected, is often so closely connected with the Gregorian tones, or at least with the themes of some motet appropriate to the holy day for which it was written, that in a Roman Catholic cathedral service the polyphonic music of the best period co-operates with the Gregorian intonations to produce a consistent musical whole with a thematic coherence oddly suggestive of Wagnerian *Leitmotif.* In later times the Protestant music of Germany attained a similar consistency, under more popular and complex musical conditions, by the use of chorale-tunes; and in Bach's hands the fugal and other treatment of chorale-melody is one of the most varied and expressive of artistic resources. The chorale is not unknown in Handel's English works. The passage "the kingdoms of the world" in the "Hallelujah Chorus" (down to "and He shall reign for ever and ever") is a magnificent development of the second part of the chorale *Wachet auf* ("Christians wake, a voice is calling"); and it would be easy to trace a German or Roman origin for many of the solemn phrases in long notes which in Handel's choruses so often accompany quicker themes.

From the use of an old *canto fermo* to the invention of an original one is a small step; and merges into the free development of counterpart on a *canto fermo* the general art of combining melodies which gives harmony its deepest expression and musical texture its liveliest action. Nor is there any such line to separate polyphonic from non-polyphonic methods of accompanying melody; and Bach's *Orgelbüchlein* and Brahms's posthumous organ-chorales show every conceivable gradation between plain harmony or arpeggio and the most elaborate canon.

In Wagnerian polyphony canonic devices are rare except in such simple moments of anticipation or of communion with nature as we have before the rise of the curtain in the *Rheingold* and at daybreak in the second act of the *Götterdämmerung.* On the other hand, the art of combining contrasted themes crowds almost every other kind of musical texture (except tremolos and similar emotional symptoms) into the background, and is itself so transformed by new harmonic resources, many of which are Wagner's own discovery, that it may almost be said to constitute a new form of art. The influence of this upon instrumental music is as yet helpful only in forms which break away from the limits of the sonata style. Styles which break further away than the omnivorous art of Richard Strauss generally revolt against polyphony altogether. That revolt is suicidal, and polyphony returns every time a brand-new theory of harmony has pitchforked it out. All that is certain is that the two elements by which the music of the future will solve its problem are not those of instrumentation and external expression, but phrase-movement (or musical paragraphing) and counterpoint. These have always been the elements which suffered from neglect or anarchy in earlier transition periods, and they have always been the elements that gave rationality to the new art to which the transitions led. (D. F. T.)

CONTRAST, a term used in psychological discussion to designate the tendency of a given mental phenomenon to arouse or to encourage its opposite. Contrast has been alleged as one basis of "idea association," but its most definite demonstrations are found in the domain of sensation, particularly vision. The action may be either "simultaneous" or "successive," according as the aroused opposite appears concomitantly in a separate sensory area, or in the same area as the primary phenomenon at a later time. Thus, a bright surrounding field makes a grey spot look darker, while a dark outlying field causes it to appear brighter, than normal. After stimulation of the retina with white a dark after-image appears. Colour or chromatic contrast consists of an analogous tendency for each hue to arouse its complementary. Contrast is probably less potent for all aspects of mental life than is the opposed principle of *assimilation.*

CONTRAVALLATION: *see* CIRCUMVALLATION, LINES OF.

CONTREDANSE, a dance derived from the English country dance, whence also it takes its name, which enjoyed much popularity both in France and Germany during the 18th century and later. Although the derivation of the name has been disputed, it is confirmed by the character of the dance itself, which had obvious features in common with those of its English original. The name was also applied to the music for such dances, of which Beethoven and Mozart both left examples.

CONTRERAS, a hamlet about eight miles S.W. of the city of Mexico. It was in the vicinity of this small town that Maj-Gen. Winfield Scott, with some 4,200 American troops of his column in the southern campaign of the war between Mexico and the United States (1846–48) encountered first the difficult barriers of *pedregal* (lava beds) and lakes surrounding his adversary's capital. In this particular defence Gen. Santa Anna employed about 7,000 Mexicans, although possibly three times that number occupied forts and redoubts at critical points elsewhere about the city. Scott, having circled to the south of his goal, found, upon determined reconnaissance, that San Antonio directly in his front was so heavily defended that an assault might cripple him. He decided to build a road over the *pedregal* toward the west, thereby pinching out Santa Anna's strong position. Accordingly on Aug. 19, 1847, Maj.-Gen. G. J. Pillow's division was ordered to supply working parties and push forward the road the engineers were building and to brush aside any small resistance without bringing on a general engagement. Pillow, however, after being stopped, decided to attack. In the premature struggle only the natural team work of the trained leaders, such as Riley, Smith and Magruder, saved defeat until Scott, coming upon the field, ordered a concentration of his forces at San Gerónimo, the key position. Darkness, aggravated by a storm, cut Scott off from the knowledge of the whereabouts of his troops. In the early morning, Aug. 20, Capt. Robert E. Lee, after a voluntary, desperate ride across the *pedregal,* bore Scott the intelligence that Brig.-Gen. P. F. Smith had found a way to the enemy's rear and would attack at dawn. Scott prepared Twiggs to co-operate in front, and, as a result, San Gerónimo was taken in front, flank and reverse in less than 20 minutes. San Antonio was evacuated and the battle of Churubusco begun the same day. The cannon and ammunition captured from the Mexicans aided Scott materially. The Mexican losses were approximately 1,500 as against less than 100 Americans.

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(W. A. G.)

CONTREXÉVILLE, a watering-place of north-eastern France, in the department of Vosges, on the Vair, a tributary of the Meuse, 39 mi. W. of Épinal by rail. Pop. (1936) 959. Its mineral springs became generally known towards the end of the 18th century, and were developed after 1864 by the Société des Eaux de Contrexéville. The season is from May to September. The *Colonnade des Sources* (1911) covers most of the mineral springs in use, and their cold saline waters are drunk as treatment for gout and gravel. The surrounding hilly country (Monts Faucilles) is well wooded.

CONTROL, that which checks or regulates anything (Fr. *contrôle,* older form *contre rolle,* a counter roll or copy of a document used to check the original), and so especially command of body or mind by the will, and generally the power of regulation. In England the "Board of Control," abolished in 1858, was the body which supervised the East India Company in the administration of India. In the case of "controller," a general term for a public official who checks expenditure, the more usual form "comptroller" is a wrong spelling due to a false connection with "accompt" or "account." A "control" or "control-experiment," in science, is an experiment used, by an application of the method of difference, to check the inferences drawn from another experiment.

For control in wartime of trade, industry, shipping, etc., *see* WAR CONTROL OF FOOD; WAR CONTROL OF SHIPPING; ALLIED MARITIME TRANSPORT COUNCIL.

CONTROLLED ESTABLISHMENTS. Controlled establishments (1915–1918) were factories mobilized in Great Britain under the Munitions of War Act, passed in July 1915, shortly after the Ministry of Munitions was set up. Under this act, and the amending statute passed in Jan. 1916, the minister of munitions had power to make an order declaring any establishment to be controlled if munitions work were carried on in it, and if he judged such control to be expedient.

The term munitions work, in its extended use, embraced not only the manufacture of arms, ammunition and explosives, ships, vessels, vehicles and aircraft, but also the production of metals, machinery and tools, and the carrying out of other ancillary processes and services involved in munitions production, such as works of construction for naval or military purposes, the provision of houses for munition workers, work on docks and harbours, the supply of light, heat, water, power or tramways, and the repair of fire engines. The minister of munitions was thus given a wide discretion in selecting factories to be controlled as essential munition works.

Within a month of the passing of the act, 345 establishments were declared controlled, including the great armament and shipbuilding firms and firms making aircraft. To these the machine tool makers were added and the list was gradually extended to include all the principal firms in the engineering, iron and steel and chemical trades, together with makers of mechanical vehicles, rubber goods and optical instruments, as well as certain miscellaneous establishments engaged on textile and printing work. By Oct. 1915 the number had reached 1,000. It was 2,000 by December; 3,500 by May 1916; 4,600 by the end of that year. It reached 5,000 in July 1917, and the extension of control to certain smaller factories brought the final total up to 5,600 at the time of the Armistice. In Jan. 1918 more than 1,600,000 men and 600,000 women were employed in controlled establishments, including the 160 Government factories. While employment in controlled establishments accounted for only a portion of the 2,500,000 men and 1,000,000 women war workers in 1918, the importance of whose work was recognized by its inclusion in the "schedule of protected occupations," its true significance is shown by the fact that the controlled establishments included practically all the 1,200,000 workpeople estimated to have been employed at the date of the Armistice on the production of destructive munitions proper. These establishments thus constituted the central and essential nucleus of war-time factories, and their work was properly regarded as of the same order of importance as that of the national factories established during the World War and administered directly by the Government.

The Underlying Bargain.—The form of regulation to which an establishment was subjected by an order declaring it to be controlled was concerned primarily with: (*a*) the suspension of trade union rules and practices tending to restrict output, and the avoidance of strikes, (*b*) the limitation of the owners' profits to a reasonable level. The restriction of trade union activities on the one side, and of profiteering on the other, might appear at first sight to be less essential than the control of industrial and manufacturing activities proper. The explanation of this anomaly is historical, for the genesis of the controlled establishment lies in the vain efforts made during the first eight months of the war to secure sufficient labour for armament manufacture, and to mitigate disputes in the engineering and shipbuilding trades by negotiation. The culminating point in this process was reached at a conference with trade union leaders held on March 17–19, and March 25, 1915, at which the full forces of the Government were brought into play to secure a voluntary agreement ensuring industrial peace for the duration of the war. The outcome of the conference was a declaration, known as the Treasury Agreement, by which some 35 trade unions declared their willingness to recommend to their members that each union should take into favourable consideration such changes in working conditions and trade customs as might be necessary to accelerate output, and that during the war period there should in no case be any stoppage of work upon munitions.

In view of this declaration it was announced by the chancellor of the Exchequer (Mr. Lloyd George) that "it is the intention of the Government to conclude arrangements with all the important firms engaged wholly or mainly upon engineering or shipbuilding work for war purposes, under which their profits will be limited, with a view to securing that benefit resulting from the relaxation of trade restrictions or practices shall accrue to the State." It was further laid down that the contemplated relaxation of trade practices should apply solely to war work, for war purposes and during the war period. The pledge was thus limited on either side to a statement of intentions, and the trade unions looked to the Government to take the first step, believing that, so long as contractors' profits were unregulated, any sacrifice of rules and restrictions would directly enhance the profits of private persons. Thus three months went by. Then the Munitions of War Act was passed, containing among its leading provisions the necessary sanctions for the carrying out of the bargain.

Implications of Control.—The act prescribed that in a controlled establishment any rule, practice or custom tending to restrict production or employment should be suspended, and that the workpeople should be bound under penalties to observe rules, approved by the minister of munitions, affecting workshop discipline and efficiency. On the other hand the profits of the establishment were to be regulated, and any excess over a standard amount was to be paid into the Exchequer.

The broad principle under which limitation of profits was imposed was subject to important adjustments and qualifications necessitated by the increase of capital expenditure or the adoption of costly methods of speeding up output. To secure the maximum scale of production it was in fact as necessary to guarantee an equitable return as to confiscate the proportion of profit which might be held to be excessive. Clearly, as a mode of war-time taxation the munitions levy, with its narrowly restricted area of application, was something of an anomaly, and in any case this aspect of the controlled establishment lost its importance after Dec. 31, 1916, from which time the levy was merged in the provisions of the general excess profits tax instituted by the Finance Act of 1917.

In addition to the control of profits, the owner of a controlled establishment was in a special sense subjected to the oversight of the minister of munitions as regards wages and employment, these questions being inevitably involved in the endeavour to enforce the fulfilment of the terms of the Treasury Agreement, now enshrined in a schedule to the act. In carrying out this policy the owner received the fullest measure of official direction and assistance, and had substantial inducements to apply for control. In particular, submission to control earned the right to apply for skilled workmen enrolled as war munition volunteers, who could be assigned only to a controlled establishment.

A controlled establishment was thus an industrial concern in which the State held a partnership, sharing both in the management and in the profits. The extent of this participation was, however, strictly limited. The Government did not, as has often been supposed, take over the management of the establishment, nor did it accept financial responsibility for its operation or liabilities. There was no transfer of ownership, nor did the owner become an agent of the Government. The situation of a controlled establishment remained, indeed, throughout its history in sharp contrast to that of the new national factories built or established on Government account and occupied and operated by the State. These were in a different category, though by the powers of the Munitions of War (Amendment) Act, 1916, they were definitely classified among controlled establishments for purposes of labour regulation.

War-Time Control.—It is well to emphasize the fact that the forms of control specifically applicable to this special class of establishment constituted only a minor part of the general system of industrial control exercised by the minister of munitions, to say nothing of those parts of the industrial field which fell to the War Office, Admiralty and Air Ministry, the Board of Trade, the Ministry of Food, and other departments. The minister of munitions was armed with wider powers than those relating exclusively to controlled establishments not only by the Munitions of War Acts but also, and in particular, by the Defence of the Realm Acts. Thus the Defence of the Realm (Amendment) No. 2 Act, 1915, gave powers to take possession of and use *any* factory or workshop of whatever sort, or the plant of any factory. Authority was also given to require any work done in *any* factory or workshop to be carried on in accordance with directions given for the purpose of making the factory or workshop, or the plant or labour engaged in it, as useful as possible for the production of war material. This control included the right to restrict and regulate the kind of work done, the employment of labour, the supply of metals or materials, the transfer of plant to other establishments. One particularly important application of these powers was the imposition on industry generally of a system of priority control, devised to ensure that war work should receive preference over other work.

The official control of munitions industries could never have been effective had these regulative provisions been confined to controlled establishments, unless the latter category, as was never contemplated, had been made co-extensive with munitions manufacture. In point of fact the number of firms which executed contracts for the minister of munitions was three or four times as great as the number of controlled establishments. In such circumstances the regulations affecting labour inside controlled establishments clearly had to be applicable to similar labour elsewhere. So, again, the control over certain categories of wages in controlled establishments, set up by the Munitions of War (Amendment) act, 1916, inevitably spread over the whole sphere of industrial employment. Similarly the efforts to apply the policy of labour dilution by forcing the infiltration of women and semi-skilled workers, so as to make up for the ever growing scarcity of fully trained operatives, obviously implied the restriction of employment outside, as well as its encouragement inside, the sacred circle of essential occupations. Since the fulfilment of all the more urgent tasks of the Ministry of Munitions was conditional on the removal of these stumbling blocks, it was inevitable that the controlled establishment as such, had less and less administrative significance as the months grew into years and the mobilization of the whole of the national resources became more and more comprehensive.

Restoration of pre-war Practices.—The obligation to restore the practices and customs abandoned for war purposes was not likely to be overlooked by the trade unions concerned, and was, in fact, the subject of continuous and jealous watchfulness. Thus, when the amendment of the Munitions of War Act was under consideration in the summer of 1917, the inclusion of a clause providing guarantees and sanctions for fulfilment of the pledge was pressed upon the Government, but was postponed. A further bill was drafted and considered in the early months of 1918 in which this question was prominently dealt with, but action was again suspended, until the trade union protests became clamorous. It was feared that rigid insistence on immediate fulfilment might result in chaos, since it would involve the wholesale dismissal of dilutees and gravely accentuate the inevitable displacement of labour due to the cessation of the war demands. Finally, on Nov. 13, 1918, the prime minister (Mr. Lloyd George) and other ministers met representatives of employers and trade unions and asked for an advisory committee to consider and agree upon the form to be taken by the bill. It was not, however, until the spring of 1919 that agreement could be reached, and the Restoration of Pre-War Practices Act, 1919, was not actually passed until Aug. 15. Though admittedly incomplete, the records of departures from pre-war customs then numbered between 30,000 and 40,000. The act made it obligatory, subject only to mutual agreement, that these practices should be restored within two months and be maintained in force for one year thereafter. Thus was the Treasury Agreement finally implemented. (G. I. H. L.)

CONTROLLING INTEREST, a financial term having two significations: (1) a person or group of persons who own 51% or more of the voting stock of a corporation and who could thereby control stockholders' meetings; and, (2) a person or group of persons who either by ownership or proxy have the voting rights to a sufficient amount of the capital stock of a corporation to control a stockholders' meeting.

The voting rights to 51% of the voting stock will always give this power of control, but it can often be exercised with a much smaller percentage for one or more of the following reasons: (1) A considerable minority of the voting stockholders may be closely organized and in agreement to vote together on certain questions, or at an election. The remainder may be unorganized and their votes divided in several ways. Let us suppose that about 30% of the votes are banded together and that the other 70% have no organization. If the 70% is divided several ways, some of it even voting inadvertently with the organized minority, the minority will very probably carry its points. (2) A minority of all the stock may constitute a majority of the stock actually voting, as it is very unusual to have more than 75% of the stock represented at a meeting. In such a case a minority consisting of 38% of all the voting stock would control the meeting, even if all the remaining stock present were united against it. (3) Sometimes stock votes by classes and a minority class may be given the privilege of choosing a majority of the board of directors. Consider a case of a company whose common stock represents 60% and whose preferred stock represents 40% of the whole. If there are nine directors, it may be so arranged that the preferred stock always chooses five of them and the common stock the remaining four. In such a case, the majority of the preferred stock, which is about 21% of all the stock, can elect a majority of the directors and thus control. (4) Stock with a strict vetoing power exerts a strong negative control over various affairs. A certain class of stock, for example, 20% of the total, may be classified as non-voting for ordinary purposes, and yet the certificate of incorporation may provide that certain things may not be done without the consent of the majority of this class. In such a case, the holders of the majority of this stock, which would be only about 11% of the entire stock, can block action. (5) Where statutes do not prohibit it, certificates of incorporation sometimes provide that more than a bare majority of the total vote shall be required to perform certain acts, such as the election of directors, the necessary portion being sometimes $\frac{3}{5}$, $\frac{2}{3}$ or $\frac{3}{4}$. In such cases a minority once in power can remain so by blocking elections and other actions requiring the large vote. (J. H. B.)

CONTROLS, RECEIVING SET (RADIO): *see* RADIO RECEIVER.

CONTUMACY, a stubborn refusal to obey authority, obstinate resistance; particularly, in law, the wilful contempt of the order or summons of a court (*see* CONTEMPT OF COURT). In ecclesiastical law, the contempt of the authority of an ecclesiastical court is dealt with by the issue of a writ *de contumace capiendo* from the court of chancery at the instance of the judge of the ecclesiastical court; this writ took the place of that *de excommunicato capiendo* in 1813, by an act of George III ch. 127 (*see* EXCOMMUNICATION).

CONUNDRUM. Originally a term meaning whim, fancy or ridiculous idea; later applied to a pun or play upon words, and thus to a particular form of riddle in which the answer depends on a pun. The word is also used of any puzzling question or difficulty.

CONVECTION, the transference of a mass of fluid against the force of gravity. If a fluid is heated from below it becomes less dense than the super-incumbent fluid and rises, the latter falling and taking its place. This motion involves an upward transfer of heat and is quite distinct from conduction (*see* HEAT), whereby the heat is transferred in all directions equally by the vibrations of molecules (for isotropic media, ISOTOPES) and from radiation (*see* RADIATION, RAYS), which is transmitted by the ether (*q.v.*).

Convective equilibrium occurs in the atmosphere in temperate regions where a steady circulation of the atmosphere is preserved. It is adiabatic (*see* THERMODYNAMICS).

CONVENIENCE GOODS, a name applied in the United States to a large class of articles which, whatever the source, are so similar in quality that consumers will accept them without making any effort to enquire into them or to compare values. (*See* STANDARDIZATION.)

CONVENT, a term applied to the body of persons associated together in a monastery, whose official designation is "the abbot (or prior, etc.) and convent" of the place in question (Lat. *conventus,* from *convenire,* to come together). The popular use of the word for a nunnery, as distinct from a monastery or house of male religious, is strictly inaccurate: all houses of religious communities are monasteries, irrespective of the sex of the convent which inhabits them, and the term convent is equally free from such limitations.

CONVENTION, a word of very various meanings, but always conveying the sense of its Latin original (*conventio,* from *convenire,* to come together). Thus it may mean a meeting or assembly; an agreement between parties; a general agreement on which is based some custom, institution, rule of behaviour or taste, or canon of art; hence extended to the abuse of such an agreement, whereby the rules based upon it become "conventional" *i.e.* lifeless and artificial. The word is of some interest historically and politically. It is used of an assembly of the representatives of a nation, state or party, and is particularly contrasted with the formal meetings of a legislature. It is thus applied to those parliaments in English history which, owing to the abeyance of the crown, have assembled without the formal summons of the sovereign; *e.g.* the convention parliament which in 1660 restored Charles II. to the throne. More recently it has had the meaning of an assembly summoned to frame a constitution, as distinct from a merely legislative assembly. Such, at least in its original intention, was the National Convention which ruled France from Sept. 1792 to Oct. 1795. The statutory assembly of delegates which framed the Constitution of the United States of America in 1787 was called the Constitutional Convention; and the various American State Constitutions have been drafted and are from time to time revised by constitutional conventions. In the party system of the United States the nomination of party candidates for office or election was formerly in the hands of delegates chosen by the primaries, meeting in the convention of the party; and the convention system was universal, from the national conventions of the Republican and Democratic Parties, which still nominate the candidates for the Presidency and Vice-Presidency, down to city or county conventions, which nominated the candidates for local offices. Except for the nomination of candidates for the highest offices, the convention has been superseded by the primary election in most instances. In diplomacy, "convention" is a general name given to international agreements other than treaties, but not necessarily differing either in form or subject-matter from a treaty, and sometimes used quite widely of all forms of such agreements (*see* TREATIES).

CONVENTION, THE NATIONAL, in France, the constitutional and legislative assembly which sat from Sept. 20, 1792 to Oct. 26, 1795 (the 4th of Brumaire of the year IV.). It was the first French assembly elected by universal suffrage, without distinctions of class.

See FRANCE: *History;* GIRONDISTS; MOUNTAIN, THE; DANTON; ROBESPIERRE; MARAT, etc.

CONVERGENCE: *see* SERIES.

CONVERSANO, a town and episcopal see of Apulia, Italy, province of Bari, 17m. S.E. by rail from the town of Bari. Pop. (1936) 13,234 (town), 15,677 (commune). It has a fine southern Romanesque cathedral of the end of the 11th century (the interior was destroyed by fire in 1912) and a picturesque castle which from 1456 belonged to the Acquaviva family, dukes of Atri and counts of Conversano. The convent of S. Benedetto is one of the earliest offshoots of Montecassino.

CONVERSION, a general term for the operation of converting, changing or transposing; used technically in special senses in logic, theology and law. (Lat. *conversio,* from *convertere,* to turn or change.)

In logic, conversion is one of three chief methods of immediate inference by which a conclusion is obtained directly from a single premise without the intervention of another premise or middle term. A proposition is said to be "converted" when the subject and the predicate change places; the original proposition is the "convertend," the new one the "converse." The chief rule governing conversion is that no term which was not *distributed* in the convertend may be distributed in the converse; nor may the quality of the proposition (affirmative or negative) be changed. A term is said to be "distributed" when it is taken universally; in the proposition "men are mortal" (meaning "all men") the term "men" is "distributed" while "mortal" is undistributed, because there are mortal beings which are not men. It follows that of the four possible forms of propositions A, E, I and O, E and I can be converted simply. *No S is P* implies *No P is S;* and *Some S is P* implies *Some P is S.* This form of conversion is called Simple Conversion; E propositions convert into E, and I into I. On the other hand, A cannot be converted simply. If all men are mortal, the most that can follow by conversion is that some mortals are men. This is called Conversion by Limitation or *Per Accidens.* Only if it be known otherwise that the predicate also is distributed can there be simple conversion of a universal affirmative. Neither of these forms of conversion can be applied to the particular negative proposition O, which has to be dealt with under a secondary system of conversion, as follows. The terminology by which these secondary processes are described is not altogether satisfactory, and logicians are not agreed as to the application of the terms. The following system is perhaps the most commonly used. We have seen that the converse of *All S is P* is *Some P is S;* we can, in addition, derive from it another, though purely formal, proposition *No S is non-P, i.e.,* an E proposition. This process is called Obversion, Permutation or Immediate Inference by Privative Conception; it is applicable to every proposition including O. A further process known as Contraposition or Conversion by Negation, consists of conversion following on obversion. Thus from *All S is P* we get *No non-P is S.* In the case of the O proposition we get (by obversion) *Some S is non-P* and then (by conversion) *Some non-P is S* (*i.e.,* an I proposition). In the case of the I proposition the contrapositive is impossible, as infringing the main rule of conversion. Another term, Inversion, has been used by some logicians for a still more complicated process by the alternative use of conversion and obversion, which is applicable to A and E, and results in obtaining a proposition concerning the contradictory of the original subject; thus *All S is P* becomes *Some non-S is not P.*

Considerable discussion has centred on the problem as to whether the process of conversion can properly be regarded as inference. The essence of inference is that the conclusion should embody knowledge which is not in the premise or premises, and many logicians have contended that no fact is stated in the converse which was not in the convertend, or, in other words, that conversion is merely a transformation or verbal change of the same statement. Hence the term Eductions and Equivalent Propositional Forms have been given to converse propositions. It is clear, for instance, that if the universal affirmative is taken connotatively as a scientific law, and not historically, no real inference is achieved by stating as another scientific fact its converse, the particular affirmative. Moreover, even if the convertend is stated as an historic fact, though there is acquired a certain new significance, it may well be argued that the inference is not immediate but syllogistic.

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RELIGIOUS

Religious conversion is, in English, a convenient label for describing a considerable group of human experiences which have in common the one general feature that they involve a change from an unorganized life to a life organized around a central idea. Medical psychology has given its considered opinion that such organization is not only normal but necessary to the general well-being of the individual. Those persons who demur to the interpretation of life in any sense in terms of religion declare that conversion is merely a psychological phenomenon, though still a fact to be studied. Those, however, who accept the religious interpretation of life in its widest sense are universally agreed that whatever form conversion may take it is the most momentous event in the life of every individual and is indispensable to the task of making the best use of that life.

Essential Features.—The essential feature of conversion is the unification of character. Nevertheless, a distinction is to be drawn between true conversion and other kindred phenomena, which are described respectively as counter-conversion, reversion, recognition, return, development and crises of conscience. In the case of an ardent Roman Catholic priest who became a freethinker what happened may be described as "counter-conversion." The return of a lapsed individual to the faith of his earlier days may be more correctly termed "reversion." "Recognition" is the vital realization of a truth to which hitherto only verbal assent has been given. "Return" is either a conscious reversion to the faith and habits of childhood or an unconscious transference from systems which have weakened (because they have become unserviceable) to older objects of consciousness. "Development" may be distinguished from gradual conversion in that it involves no overturning of values. "Crisis of conscience" involves a change less searching than conversion, such, for example, as when a politician changes from one party to another. On the other hand, true moral conversion is an actual overturning of values and involves a species of new creation. It has been defined as "a mutation of life occurring under the impulse of an ultra-terrestrial ideal" (De Sanctis). Or again as "a reaction taking the form of a psychological surrender to an ideal and issuing in moral development" (Underwood). It has been further subdivided into gradual and sudden, or, as De Sanctis calls it, fulminant and progressive, and Starbuck, impulsive and volitional. There are those who shrink from admitting that any conversion is really sudden or fulminant, and will only allow that a gradual process extending over a considerable time may culminate in a crisis. In some cases a real change occurs, but the crisis is apparently absent; it would seem that these are not true conversions but merely instances of development, since the term "mutation" in zoology is applied only to sudden or saltatory changes. It must be admitted that those who have been brought up to expect a crisis often tend to experience one, or, at any rate, to think that they do. This may be due either to auto-suggestion or to inherited temperament. It is further to be noted that the so-called turning-point at which the consciousness of the absolute ideal, hitherto marginal and vague, becomes focal and clearly defined, not infrequently occurs at the beginning rather than at the end of the process. Thus it has been pointed out that not all the early Buddhist converts were unified and made happy as soon as they accepted the rule of life prescribed by the Buddha, and that John Bunyan was accustomed to date his conversion from the time when he gave up lying and profanity, although unification and happiness did not come to him until some years later. Among Christians the necessity of "conversion" has in particular always been strongly urged by the Methodists, as it was by their founder, John Wesley, and it is specially characterized by them as the "new birth." Re-birth from sin has certainly been a constant feature connected with Christian discipleship from the first, and among adult converts, especially in the mission-field, it is an indisputable fact. Revival preachers, and especially Salvationists, insist on the importance of instantaneous conversion.

Age When Experienced.—The main features of conversion have been traced, however, in the life-stories of adherents of most of the great religions of the world. It is said that the phenomena belong almost exclusively to the years between the ages of 10 and 25, and that the number of instances outside that range appear few and scattered; in other words, that conversion belongs distinctively to the years of adolescence. The American psychologist, Starbuck, holds that the event comes earlier in general among females than among males, and most frequently at the ages of 13 and 16, while among males it occurs most frequently at the age of 17 or immediately before or after. The difficulty about accepting these conclusions is that Starbuck, like his fellow-countryman, William James, has drawn nearly all his evidence from protestant evangelical circles, and seems to have overlooked the fact that outside these circles and even sometimes inside them conversion may take place at much later periods of life. The American school in general seems, in fact, to confine conversion to the moral and religious crisis of adolescence. But this, however important, is only one type of conversion, and it is by no means certain that many of the recorded instances of it are not the result of strong suggestion. The most that can be said is that the period between the ages of 15 and 25 is the time when the greatest changes occur in human personality, and that therefore this is the most propitious epoch for the occurrence of decisive events in the history of individuals. Adolescence is only an extrinsic or indirect cause, a provocative stimulus to an intellectual and ethical transformation which requires for its completion the additional presence of a psychic factor. Indeed, the physiological causes of conversion can be greatly exaggerated.

Accompanying Phenomena.—Certain features commonly accompany the change, and they so greatly resemble the phenomena belonging to eroticism that conversion has actually sometimes been defined as "falling in love with God." In less picturesque language it has been described as a concentration of affective energy on the object of faith, a practical revision and a new economy of love. It is marked by an ecstasy of joy, a sensation of heat or fire in the breast, or the consciousness of a bright light (technically called a photism), great buoyancy and lightheartedness, a feeling of peace and release from perplexity, a sense of newness of life extending even to the external world surrounding the converted individual, voices or auditions which appear to be sensorial automatisms produced by the excited physical and mental condition of the subject, and above all (except, perhaps, in Buddhism) a sense of being under divine control so that the conversion seems something given rather than something achieved and is, in fact, felt to be the product of divine grace, not of human energy. Considerable difference of opinion has always existed as to the relation of individual free will to such a bestowal of grace. Some have held that man is merely the passive recipient, while others declare that a preliminary act of free will is necessary. Autobiographical accounts of many conversions exist, and have been collected in recent years. Two of the most striking are those relating to St. Augustine of Hippo and to Blaise Pascal. It is necessary, however, to bear in mind that converted subjects tend to indulge in autobiography, and that many devout persons whose religious development has been tranquil and unruffled have no such tales to tell.

The important question has further been raised whether the sense of "givenness" or grace is an illusion and whether conversion is not a predictable phenomenon due entirely to natural causes. The antithesis is a dangerous one, and involves our whole conception of the nature of divine activity. If a predictable mutation is to be excluded from the sphere of divine activity, the operation of the divine is then limited to the abnormal and (at present) unexplained. Such a limitation is now less in favour among religious thinkers than formerly. Nevertheless, it is admitted by many psychologists on both sides of the Atlantic that conversion, even if it be a normal phenomenon, can only be systematized and predicted to a limited extent, since the object studied by psychology, *i.e.,* the way in which personal beings usually think and act, is in its nature essentially different from the object of the physical sciences.

Favouring Conditions.—The situations favourable for the occurrence of religious conversion in an individual may be briefly summarized as follows:

(1) The presence of general religious tendencies deriving either from heredity, from the family or from early impressions.

(2) An habitual tendency of the intellect towards absolute convictions.

(3) A tendency of the individual spontaneously to fix the attention beyond and above the realities of the senses.

(4) A richness of affective potential or psychic energy held in suspension by the individual.

(5) The tendency of the individual to transfer his chief interests to questions of origin, purpose, destiny, and so forth.

(6) The recurrence of painful experiences.

In a narrower sense "conversion" is used to denote the acceptance of Christianity by non-Christians or the acceptance of Catholicism by non-Catholics. The problem is often debated in Christian circles as to the relation of the sacraments to conversion, the general Catholic view being that sacraments convey grace and confer character, while the general Protestant view is that they declare in symbolic form a change which has already taken place as the result of an act of faith on the part of the individual.

Modern Views.—The modern critical study of the Old Testament, coupled with the conclusions of science as to man's ancestry, status and prospects, have greatly modified the belief in the relation of man to grace and conversion. The view stated in the tenth article of the Church of England was as follows: "The condition of man after the fall of Adam is such that he cannot turn and prepare himself by his own natural strength and good works to faith and calling upon God: wherefore we have no power to do good works pleasant and acceptable to God, without the grace of God by Christ preventing us that we may have a good will, and working with us when we have that good will"; but this is no longer literally held by many persons who would still insist that they were believing Christians. The results of the science of anthropology show no indication of a primeval fall, but rather of a struggle upward marred by acts and periods of retrogression. Man may in consequence be hindered and hampered in his response to the love of God, but although it might still be held that the Divine approach to man preceded man's response, man's feeble responsiveness would no longer be regarded as due to a single primeval catastrophe, but rather to the vestiges in his nature of a sub-human ancestry—the unwilling dross which checks the flight of the soul to its Creator—or at most to the wounds and disease produced by the failures and acts of rebellion committed in the course of human history.

Bibliography.—E. D. Starbuck, *Psychology of Religion* (1889); William James, *The Varieties of Religious Experience* (Gifford Lectures, 1901–02); R. H. Thouless, *Introduction to the Psychology of Religion,* chaps. xiii. and xiv. (1923); J. B. Pratt, *The Religious Consciousness,* chaps. vi.–ix. (1924); Underwood, *Conversion* (1926); S. De Sanctis, *Religious Conversion* (1927). (A. C. B.)

In English and American Law, conversion is the unauthorized exercise of dominion by one person over the property (other than money or chattels real) of another, in a manner inconsistent with his rights of possession. The history and exact definition of this form of actionable wrong have occupied the attention of many learned writers, and the incidents of actions to assert the rights of the true owner form a considerable part of treatises on the rules and forms of civil pleading. There are many ways in which the wrong may be committed. In some cases the exercise of the dominion may amount to an act of trespass or to a crime, *e.g.*, where the taking amounts to larceny or fraudulent appropriation by a person entrusted with the property of another. In such cases, except where money is taken, the civil remedy of the owner is by action for conversion or detention of the property. The remedy in use in these cases used to be by what was called an action on the case for trover and conversion, the plaintiff putting aside all suggestions of trespass and of crime, and resting his case on the fiction that the defendant had found and used goods not his own. The fictitious averment of loss, never required in the United States, was abolished in England by the Common Law Procedure Act 1852. Under the present procedure, in which the old forms of action are not in use, the remedy is by a claim (usually called conversion) for wrongfully depriving the true owner of personal property of its use and possession by some specified act inconsistent with his dominion over it, usually by dealing with the property in a manner inconsistent with the owner's rights. Originally, the action of trover and conversion was limited to goods and chattels, but it is now accepted as applying to valuable securities, such as cheques and bills of exchange.

Refusal to deliver up to the owner is sufficient to prove conversion, though it is often made the ground of an action for detinue, if the plaintiff desires to have the property returned in specie. The knowledge, motive or good faith of the person wrongfully dealing with the property of another is for civil purposes immaterial, and the action is often brought to try the title of two claimants to the same goods. Merely carrying or warehousing goods does not render the carrier or warehouseman liable for conversion, as they do not purport to change the property in the goods and exercise no dominion.

The exact measure of compensation due to a plaintiff whose goods have been wrongfully converted may be merely nominal if the wrong is technical and the defendant can return the goods; it may be limited to the actual damage where the goods can be returned, but the wrong is substantial; but in ordinary cases it is the full value to the owner of the goods of which he has been deprived. In fact the measure of damages is the loss actually sustained. Fraudulent conversion by any person to his own use (or that of persons other than the owner) of property entrusted to him was larceny at common law and under modern statutes (Larceny Act, 1916).

The term "conversion" is also used with reference to the rule of courts of equity which, in certain cases (following the maxim of treating as done what ought to have been done), treats as converted into personalty land which has been directed so to be converted by a will, contract, or settlement, or as converted into land personalty which has been by such instrument directed to be applied for purchase of realty. The rule is also applied where a vendor of land dies between the making of the contract of sale and its completion by conveyance of the land.

CONVERSION OF DEBT: *see* Debt Conversion.

CONVERTER: *see* Bessemer Steel.

CONVEX, the exterior of a rounded surface as opposed to "concave." (*See* Optics.)

CONVEYANCE, the act of conveying or transporting anything. The word is now used in three special senses: (1) a carriage or other means of transport; (2) in law, the transference of property by deed or writing between living persons; and (3) the written instrument by which such transference is effected. (*See* Laws Relating to Real Property and Conveyancing.)

CONVEYORS IN MASS PRODUCTION of manufactured articles of different kinds were used in non-mechanical industries long before the development of modern manufacturing made it profitable to consider their use. An indication of their age may be had from a book on millwrighting, published in Philadelphia by Oliver Evans in 1807 which shows the use of bucket, belt and screw conveyors in flour or grist mills. Whether these were in actual use or, like devices shown in some of Leonardo da Vinci's works, existed only in the mind of the author, it is impossible to say. Foundries were among the first of modern industries to adopt conveyors extensively, for the handling of materials on a large scale. Belts were used for carrying moulding sand for storing, for mixing or tempering, and for removing the sand from moulds. Moving platforms were also used at an early date for carrying moulds past the cupolas or pouring ladles, pausing long enough to have the metal poured and then continuing their travel until the moulds were cool enough to be dumped. This dumping in some cases, occurred while the metal casting was still very hot. Conveyors have been developed along many lines to meet the requirements of many industries. The best early example, and the one that probably gave the use of conveyors its greatest impetus, was in the Highland Park plant of the Ford Motor Company in Detroit, Mich. (*see* Mass Production). From a small beginning in one department this grew to enormous proportions, and contained many varieties of conveyors, devised or adapted to suit the peculiar requirements of the work in this plant. This development, beginning in about 1912 or 1913 has grown into use in practically every automobile plant, regardless of the size or quality of car built, and is now a standard part of factory equipment in any sort of manufacturing where the quantity handled is sufficient to justify it. The principle kept in mind in introducing conveyors at the Ford plant has been "to keep material three feet from the floor, and moving." The proper distance from the floor depends, of course, on the size and weight of the work and the convenience of the operator. One of the chief objects of the conveyor is to relieve the operators of as much manual labour as possible and so enable more and better work to be done. Keeping the work moving prevents the piling up of work in any department, avoids congestion around machines and aids in securing a steady flow of work by acting as a pacemaker to the men. This helps to secure a more constant output and at a higher rate than seems possible by the old method.

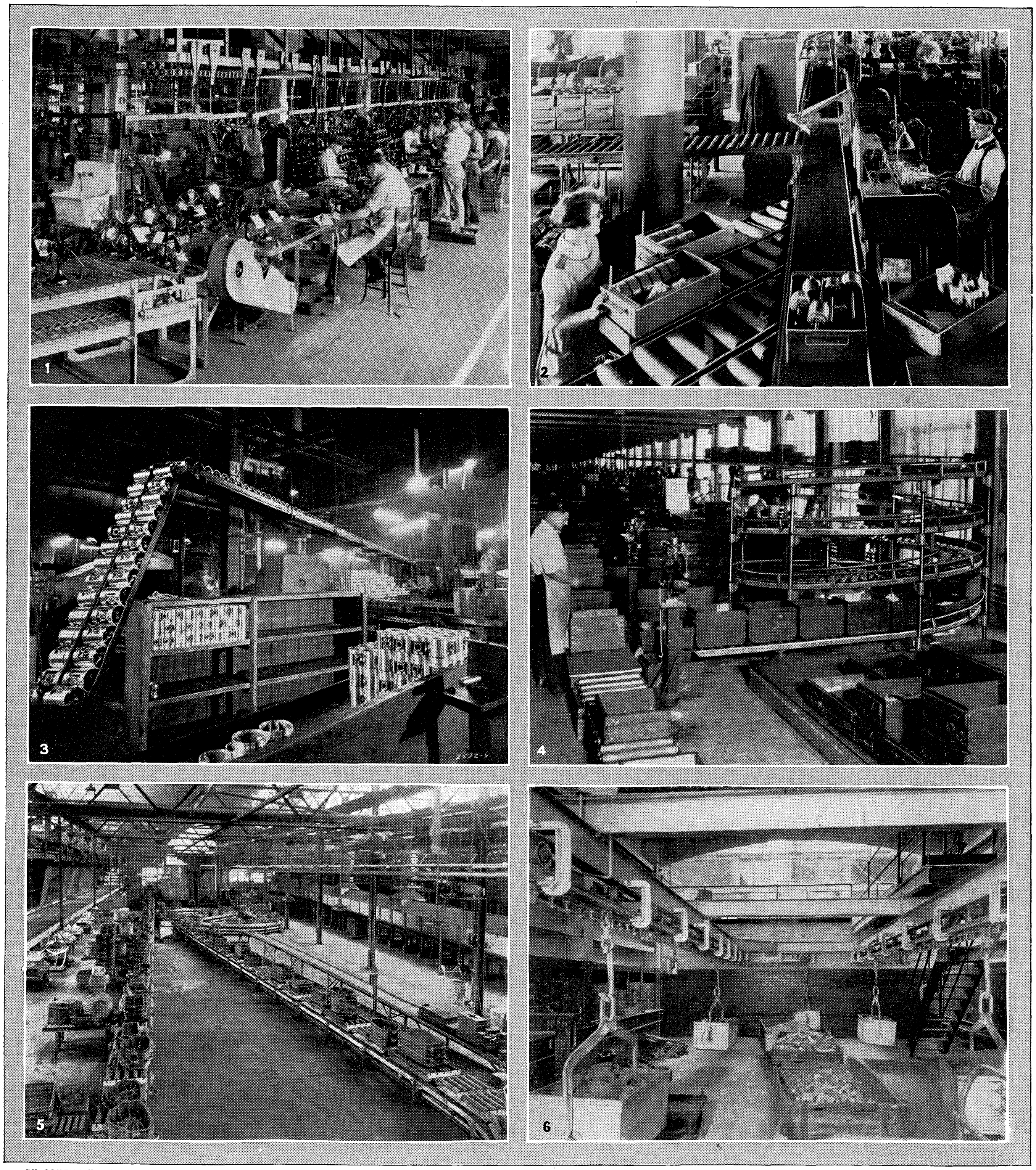
Conveyors are made in many forms and are adapted for use for widely diversified purposes. They may be gravity slides, rollers, either level or inclined enough to allow the work (either in single units or in some sort of container), to travel by gravity toward the next station. Power driven chains or belts, with cleats, hooks or other devices, carry raw materials, semi-finished or completed, from machine to machine, from department to department, from machine to inspection or to sub-assembly, and from there to the final assembly. The final assembly itself is frequently done on some sort of a chain, belt or truck that is power driven at a predetermined speed. Much ingenuity is displayed in devising special forms of conveying mechanisms by which the material being carried can be automatically diverted from one line to another, or be shunted to a side track to await removal. Conveyors move material, either by power or with a minimum of human effort, supply operators with material to work upon, and carry it away after the operations are completed. One of the advantages of conveyors is the reduction of the amount of material in process, since there is no accumulation of work or material in large quantities. This greatly reduces the amount of capital invested in material. The constant flow of material, coupled with the smaller quantities in process, also enables the output to be varied to meet sales requirements, as the work can be made to flow through at varying rates of speed.

Each type or system of conveying should have individual study, the best solution being largely influenced by the results of experience gained in previous installations. The main considerations are the convenience of the operator, keeping the conveyor and its load out of the way of operators and of the machines and benches. For work that is light in weight and is easily handled, the overhead conveyor is very convenient and is frequently employed in various forms. Such a conveyor is usually supported by wheels on each side of a suspended I-beam and has flat links with vertical pins so as to turn short corners. Joints must also be loose enough to permit an upward or downward movement. A typical overhead conveyor for handling fans is shown in plate I., fig. 1. It is over the assembly benches and the fan parts are hung on hooks within easy reach of the operator. The worker reaches up and picks off the part he needs. When the fan is completed it is placed on a belt conveyor in the centre of the bench. From here it goes to the waist high conveyor shown in the foreground at the left. This is a slow moving conveyor and is wired with electric current so that the fans can receive a running test of the desired duration before reaching the other end of their travel. The conveyor is wired for two kinds of current so that both types of fans can be tested at the same time. A notable feature of this conveyor combination is the compactness and the way in which it conserves space. It is interesting to note that the introduction of conveyors throughout a plant makes it frequently unnecessary to enlarge the factory to meet the needs of increased demands. This is possible both because of the saving in space and also because of the speeding up of production, through material being in front of the operators when needed. The waist high type of conveyor is probably used more than any other type, because of the convenience with which work can be handled from it and to it. When used in the production line it is frequently of the plain roller type and is not power driven. It is either set on a slight incline so that the work will move slowly from one machine to the next, or is level and a slight effort pushes the work along on the rollers. Conveyors of this type are usually behind the operator where the work is light enough to be easily handled. When however the pieces are heavy enough to be fatiguing, the conveyors run directly between the machines, where the operator has no lifting. He simply pushes the work over the rollers into the fixture on the machine. In some cases the rollers drop out of the way, in others the work is raised on locating points, but in most cases it simply slides on to the table of the machine and is located in various ways. After the operation is performed the work is restored to the production line and it proceeds to the next machine. In some cases spurs, or side tracks, are provided for taking work that requires a few extra operators. In other plants the conveyor line carries the work past the inspector's bench. After inspection it goes to the assembly line, is returned for salvage, or scrapped. The roller type conveyor probably finds wider application than any other. It is the least expensive to install, and operating and maintenance costs are very low. It can be used in plants with small output and it also has an important place in large plants, in connection with the various types of power driven conveyors that have become so much a part of modern manufacturing. An example of the utility of the roller conveyor in large or small plants is the case where a boxed article to be shipped comes down a line and is carried into the freight car where another short piece of roller conveyor, at right angles, carries it to the end of the car for stacking. These rollers can be moved without difficulty and aid greatly in loading easily and rapidly. Adaptations of this method are used in both large and small plants.

Power Driven Conveyors.—Power driven conveyors, of which the belt, platform and chain types are the most common, are of various types. There are also many modifications such as elevators, automatic or hand-controlled, for transferring articles from one floor to the next. Boxes are frequently carried by roller conveyor to an elevator where they are moved to floors above or below as desired. The boxes slide on carriers that hang from cross bars on the elevator chains and so remain right side up as the chain passes over the top of the wheel. The boxes can be unloaded at any desired floor by setting the necessary switches. There are two principal methods of using power driven conveyors: in connection with roller or other conveyors during the machining processes, and in the assembly of the various units and sub-assemblies into a complete whole. When used in the production division the power conveyor, usually a belt as shown in plate I., fig. 2, carries the work from one department to another, rather than from machine to machine. Here a power driven belt goes down one of the long bays of the shop, several hundred feet long. Boxes, usually of steel and called "tote" boxes, are placed on the power driven belt and start on their way down the shop. At the end of each box is a series of holes to receive pegs or bars that throw the proper switches and control the destination of the box. A peg at the left of the box in the foreground, for example, would strike the angular projection of the first switching arm and push the front end of the box to the left. By the time the switching peg reaches the end of the switching arm the box has been swung to the left sufficiently to clear the moving belt and to start it down the roller conveyor at right angles to the power belt in the centre. Similar switching stations are placed the whole length of the belt line so that work of various kinds can be sent to any desired department. The angular side tracks at the left enable the gathering of the desired material in boxes and sending it down the line to the other departments. In another type of belt conveyor line a wire stretched taut from the central position and a short distance above the belt, keeps the boxes or material placed on either side of the belt from becoming mixed with the other. In some cases a single, wide belt will carry several lines of material. In still another application from the same plant the belt ends at the bench and has numerous side tracks, each provided with a short roller conveyor, and a switch arm. When used for assembling, the conveyor belt may either carry parts to be used by the assemblers or carry the machine being assembled from the beginning to its completion. In some plants the belt moves in the centre of the bench and the operators pick off the pieces needed as they pass. The assembling is done on the bench in front of the operators.

Another method of using a belt conveyor for small parts is where boxes are placed on the belt and the proper parts are placed in the boxes as they move along in front of the assemblers who pick the necessary parts from the small bins in front of the belt line. In a combination of belt and chain conveyor, the belt, made up of wooden slats, carries such large pieces as cylinder blocks, transmission housings and manifolds from one shop to another, while the chain conveyor carries smaller parts than can be placed on hooks or carriers. In one installation they are carried between two buildings and require no handling except to put them on and take them off the conveyors. An excellent example of the use of gravity in handling finished work from the piston department in an automobile manufacturing plant is seen in plate I., fig. 3. After inspection the pistons are placed in the trough at the left, and, when this is filled, it is raised so as to let the pistons roll down the long inclined way to the line where the motors are being assembled. Conveyors now form a part of some types of machines. A case is found in an automobile plant where a standard washing machine is used for cleaning castings and metal parts from the oil and dirt which accumulates during the machining processes. The cylinder block in this case is placed on the conveyor and is fed slowly through the washing machine where jets of hot cleaning compound play on it from various nozzles. The speed of the conveyor is so timed that the cylinder block will be thoroughly cleaned when it reaches the other end of the machine. A somewhat similar application of the conveyor is in heat treating apparatus where the work to be treated passes through the furnace at a predetermined rate that gives it just the desired time in the furnace. With oil, gas or electric heat and pyrometer control of the heat, the use of conveyors give a much more uniform product than can possibly be secured by dependence on human observation and skill.

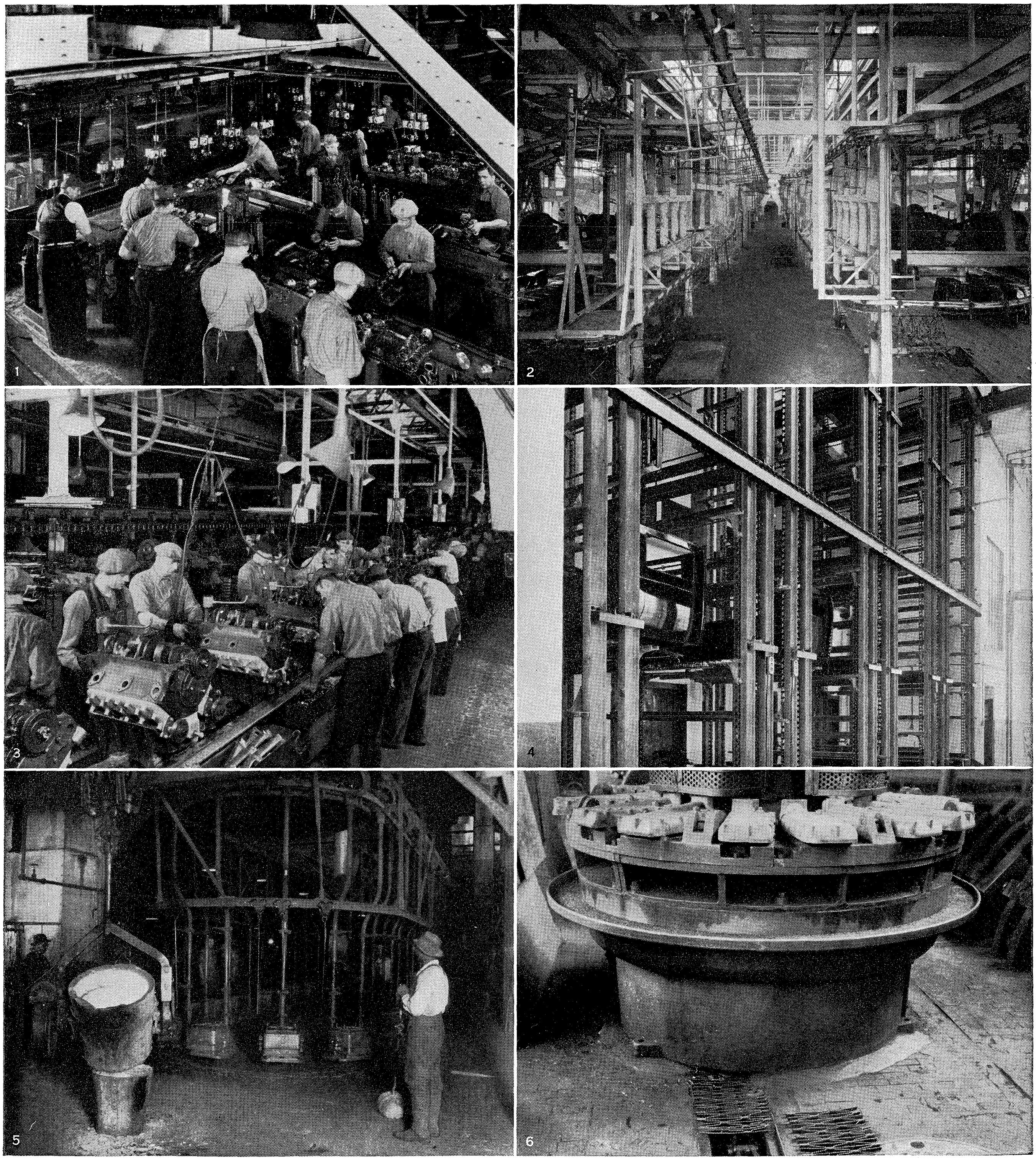
Roller Conveyors.—There are of course places where for one reason or another the work cannot well flow through at an absolutely uniform rate. Such a case might be where one man performed several different kinds of operations such as weighing and checking material as in plate I., fig. 4. Here the work comes in boxes from the other end of the building by a gravity roller conveyor, ending in a rather small radius spiral that delivers the boxes to the weigher at almost the floor level. This type of short radius spiral slows down the movement of the boxes due to the friction of the sides against the guard rail. This movement allows quite a number of boxes to accumulate until the weigher is ready to handle them. The boxes are delivered between two scales. the conveyors on each side taking the boxes away from



BY COURTESY OF (1, 2) ROBBINS AND MYERS, (3) THE HUDSON MOTOR CAR COMPANY, (4) THE NATIONAL CASH REGISTER COMPANY, (5, 6) THE JEFFREY MANUFACTURING COMPANY

TYPES OF AUTOMATIC CONVEYORS USED IN MANUFACTURING

1. Overhead conveyor, the parts travelling and being assembled by workers along the assembly bench
2. Power-driven conveyor. The boxes containing manufactured parts come along the conveyor belt (centre) and are directed to the proper side rollers by the triangular switch above the conveyor
3. Gravity conveyor, carrying finished pistons to the motor-assembly room of an automobile manufacturing plant
4. Roller conveyor, with spiral track to regulate speed of delivery and bring the boxes to proper level for weighing and inspection
5. Conveyor of car-type units with roller top, used for transporting moulds in foundries
6. Trolley conveyor in foundry



BY COURTESY OF (1, 3, 5, 6) THE FORD MOTOR COMPANY, (2, 4) THE HUDSON MOTOR CAR COMPANY

CONVEYORS IN LARGE SCALE AUTOMOBILE MANUFACTURING

1. Piston and connecting-rod assembly department. Visible in the photograph are both chain and belt types of conveyors, which carry the parts to the motor assembly department
2. Large rack type conveyors through which automobile bodies pass
3. Workmen assembling motors on a chain conveyor, before installation in the chassis
4. Large vertical conveyors, or elevators, which carry automobile bodies from upper floors for delivery to assembly department
5. Merry-go-round type of mould conveyor in an automobile foundry. The large ladle at the left fills the moulds as they reach the location
6. A milling machine containing automobile castings. The chips fall into the grating and are carried by conveyor back to the foundry

the scales in either direction, as desired. The boxes are delivered to the metal platform, slid on to either scale, weighed, and sent on their way. It will be noted that the nearest scale has rollers on the platform to aid in handling the boxes. There is also a tote box storage near the spiral where boxes of material are held for inspection. An installation of this kind is very flexible and can be used to advantage in shops that are comparatively small in size. A modification of the roller conveyor in the direct product line has also been adopted in some fields. Instead of rollers to form the track, two tubes act as rails and guide and support the work fixture under the machine as well as allow it to pass to the next operation without delay. There are many applications of this type of conveyor work fixtures which allows the work to remain in the same fixture but to be worked on by different machines in the production line. In this particular case the first machine drills all the holes in the top of the crank case and the second machine all of the holes in the bottom, without disturbing the work itself. Although a power conveyor could be used and so timed as to move intermittently between the drillings, it is not often practicable to do so. There are probably few cases where manual movement cannot be used to better advantage in work of this kind.

Positively driven conveyors are probably more used in assembling work than in the departments where the machining operations are performed. While in some cases the work is removed from the conveyor, this does not often fit in with the plan of the power driven idea, the purpose being to time the operations and to constantly urge a uniformly fast speed. It must not be forgotten however that while the power driven conveyor speeds up the slower operators it also slows down the very rapid workers, bringing them all to the greatest uniform speed that can be economically maintained. In spite of the necessary slowing down of the few extra fast workers however, the net gain is usually well worth while by increasing the speed of the great majority concerned.

Planning Installations.—It takes very careful planning and observation to determine the best speed and so to divide the work that each operator will have time to perform his or her operations satisfactorily, without either wasting time or hurrying the operators to the point of unprofitable nerve tension. After a little experience in a properly timed line however the average operator rather prefers to have his pace set for him, and the added earnings compensate for any sentimental objection that may be held. Farm machinery, electric refrigerators, carpet sweepers, cash registers and automobiles of all types are now assembled by the use of conveyors, usually power driven. Work of the highest grade can be secured in this manner by utilizing trained men and driving the conveyor at the proper speed. After assembling, many types of products are tested, painted, crated and deposited on the shipping platform without ever stopping. Nor is distance any longer a barrier. In one automobile plant a conveyor carries the completed engine a mile and a half, part of the way over the top of a large building, to meet the chassis on the assembly line. In another shop the building devoted to bodies contains over eight miles of conveyors handling the various parts and finally passing the completed body through the painting booths. Among the problems to be considered in installing moving conveyors are those of speed and flexibility. It is not possible to rely on maximum production at all times and the successful conveyor system must function satisfactorily when only half the maximum output is required. Conveyor assembly necessitates the division of the work into single operations, sometimes to the extent of putting in a single screw, in order to tie-up, or synchronize with the other operations that must be performed. Then when business falls off, one operator can do two or more operations and so keep the conveyors going at a portion of their capacity. In some cases of decreased production the men move with the conveyor through two or more stations. In other instances operators stop the conveyor periodically so that each man can handle two or more operations from the single station. Some of the largest users of this method claim greater flexibility than can be secured in any other way. They can increase or decrease the output at very short notice by changing the spacing of the men, the way in which they handle the operations, and by the speed of the conveyor.

When considering conveyors as an aid to production it must be remembered that the great consideration is the number of completed units or mechanisms per hour or per day that will pass inspection. Speed in one department or by a single operator does not necessarily aid final production of completed machines. Nothing is gained by piling up a surplus of certain parts if the rest of the mechanism lags behind. The surplus simply ties up both labour and material and reduces the turnover of capital. Exceptionally rapid operators are of little direct value on actual production except as spur to raising the average or unless they can be used as instructors for the same purpose. Increased output comes from raising the efficiency of the average operator and the power driven conveyor helps by holding them to the speed that experience shows to be practical, without undue fatigue. Too high speed means fatigue and poorer work and the percentage of spoiled work goes up. It is much more economical to run the conveyors a little more slowly and get perfect work than to increase the output 10% and have a 5% spoilage. So it is necessary to study the speed of power driven conveyors very carefully in order to secure the maximum output consistent with true economy, which must consider the quality of work and must not impose undue fatigue on the operators. Some classes of work make it advisable to have the conveyor movement automatically intermittent, moving a given space and stopping for a sufficient period to have the necessary work performed at that station. In other places the conveyor movement is manually controlled, usually by push button electric switch and varies according to the time required by the work in hand. This method is not at all common except in trying out the time at which to set the intermittent movement, or even the continuous movement.

Intermittently Moving Conveyors.—Perhaps the best example of intermittently moved conveyors in mass production work is the great specially built automobile frame making plant in Milwaukee, Wis. The cut sheets or strips that form the side rails of the frames come in from the side on a special conveyor that runs across the end of the main conveyor system. These strips are held under suitable dies and the "kink" or offset in the side frame is made to give the desired drop in the frame. After the strip is kinked the conveyor is so designed that it turns every second piece over on the other side so as to make pairs, or rights and lefts, before they reach the large presses that form these strips into channels with the proper offset and so complete the side rails. These side rails, in pairs of rights and lefts, now start down the great central conveyor, one on each side, stopping every 18 ft. Here previously formed cross members are fed in from the side and are put in place by operators. Special riveting machines held on long, pivoted arms, swing in from each side and rivet the cross members in place, withdrawing while the conveyor moves another 18 ft. and takes the first frame to the next position while a new frame has come into position for welding in the first cross member. At each station more parts are put into place and riveted either automatically or semi-automatically. Spring horns or supports, step brackets and other parts are fed to the central conveyor and attached to the frame at the proper point. When the conveyor has carried the frame to the other end it is complete and ready to be transferred to another conveyor that carries it into another building where it is automatically painted. The painting conveyor first carries the frame through a washing tank to remove all grease, after which it is dried before going into the paint tanks where the painting proper is done. From the paint tanks the frames go by devious routes to the storage racks where they dry. This is as high as a four or five storey building and can hold thousands of completed frames while they are awaiting shipment. Conveyors also carry them from the storage racks to the shipping platform, and to the cars that carry them away. The actuating mechanism of this huge intermittent conveying system is a very large Geneva stop motion, so designed and timed as to move the conveyor 18 ft.

and pause for a specific number of seconds while the various operations are performed. Although other mechanisms, such as interrupted gears or various linkages can be used to secure the same result, the Geneva stop motion has much to commend it for work of this kind.

Some idea of the engineering problem presented in designing this plant can be had from the rather startling fact that it was necessary to synchronize 552 operations in making the average automobile frame.

These operations, when performed on a day's production of 7,000 frames at the rate of 360 frames per hour, aggregate about 4,000,000 operations in the day's production. And yet, in spite of the necessary complications in such a plant, a force of 200 men can change the plant over for the production of an entirely different frame, in ten hours.

In one type of conveyor mechanism for motor car production, the frame conveyor is an entirely separate unit which comes to a junction with the final conveyor where the cars are completed. The frames are turned upside down on the first conveyor and both the front and rear axles are bolted in place, as well as the fuel tank, the step brackets and a few minor parts. The wheels are also mounted before the chassis reaches the end of the line.

At this point the frame pauses over a pair of substantial arms provided with hooks, which swing up over the side frames and clamp them to the arms.

Then suitable mechanism actuates a chain, and the arms swing over until the chassis is right side up and the wheels are in a set of V-shaped tracks.

When the chassis is deposited right side up in the assembly track, four clamps release automatically, and the arms swing back ready for the next chassis. The final assembly is driven by a chain located usually between the tracks, and just beyond this point the engine comes out of the test room on an overhead carrier and is lowered onto the front end of the chassis. The steering mechanism, body, etc., all feed into the assembly line within a short space.

An entirely different type of assembly line is one in which each end of the chassis is carried by a light four wheel truck. These trucks are moved from a chain located between the tracks, these tracks being channels sunk in the floor so that they may guide the wheels of the trucks. A short double conveyor for handling fenders is of the slat type. Slats with blocks support the fenders while they are being assembled to their running boards. Each belt has its own motor; the motion is reduced by gears from the motor to variable speed pulleys and further reduced by a worm gear speed reducer, a chain from this driving the conveyor, whose speed can be varied by adjustable cone pulleys.

Two motor lines, one empty so as to show the chain and carriers, can also be used.

Small trucks or carriers are fastened to the chain, the front truck having a trough to accommodate two different wheelbases. Steel racks containing small parts for the assembler are at convenient positions beside the track. Over the end of this line is a large opening in the floor through which the chassis is lifted to the second floor.

The two hoist operators control the monorail hoists which lift the chassis to the upper tracks and also handle the bodies over the chassis after it is in line.

The bodies come in from an opening in the side. These hoists are usually operated by girls, who become very expert and fast in their work.

Conveyors also play an important part in the construction of the bodies themselves. A general view down one of the aisles of a body plant, with its conveyors, is given in plate II., fig. 2. This building is approximately 1,000ft. long and perhaps 400ft. wide and contains $8\frac{1}{3}$mi. of conveyors. The bodies are on low trucks, the doors are hung, and they are nearly complete except for the roof. The seat cushions come from their special department on the conveyors shown and can be picked off and put into place with a minimum of effort. In another way of handling the bodies as they approach completion, trucks hold the bodies at the most convenient height for the final operations, but the trucks also fold down so that they can be used in the low position if desired. At the end of the building is a huge vertical conveyor plate II., fig. 4, which carries the bodies in an almost continuous stream, from the finished floor to the great body motor trailers that carry them to the shop where they are put on the chassis. Just outside the vertical conveyor is the body trailer, holding 16 bodies, on the low roller trucks that enable them to be rolled into place easily and quickly. Then the small tractor hauls them to the other plant.

An interesting conveyor application is shown in plate II., fig. 5. The first is in the foundry of an automobile plant and is known as the merry-go-round, where the moulds are carried past the pouring station, although, being small castings, the ladles of molten metal can be carried to any of the moulds. The metal comes to this conveyor in large ladles so as to reduce the labour of carrying to the minimum. After the castings reach the machine shop the chips, which accumulate rapidly in these days of modern machining, must be disposed of. To reduce labour and to keep the chips off the floor and out of the way, they are returned to the foundry without human labour by the conveyor in plate II., fig. 6. Running under the shop floor at convenient intervals, are chain conveyors with drags or scoops that carry the chips with them. Above the chain is a narrow opening covered by grating, part of which has been removed to show the conveyor chain beneath. This carries the chips direct to the foundry and is not only a convenience but a great time saver.

Both expansion and construction must be considered in planning a conveyor line, and great care and experience are required to get the best results from a given amount of floor space. Instead of using straight line conveyors it is frequently found advisable to curve the conveyor line and even to let it double on itself. Sometimes this doubling on itself occurs two or three times and may bring the finishing point rather near the beginning. In such a case the parts in question would probably be made or assembled in a department at right angles to the main conveyor line. This doubling, or sinuous conveyor line frequently lends itself to expansion more readily than the straight line conveyor. Where the department provides sufficient room for expansion, as is nearly always necessary, it has often been found more desirable to lay out a sinuous conveyor that doubles on itself before reaching the end of the department. With such a lay-out additional workers can be put on the conveyor line by extending one of the "loops," following this with other and similar extensions as occasion demands. One great advantage of this method is that, regardless of the expansion made in the department, the relation to the main conveyor line is not disturbed. The material continues to enter and leave the department at the same point until the room provided for the department is entirely outgrown. (*See* MECHANICAL HANDLING.) (F. H. C.; X.)

CONVICT, a term of somewhat loose signification technically applicable to anyone who has been adjudged guilty of a criminal offence by a court of competent jurisdiction. Specifically and in common parlance it is confined to one who has been convicted of what is known in England as an "indictable offence," *i.e.*, one triable by jury, and, in the United States, of an offence involving moral turpitude, usually punishable by death or by confinement in a State prison. It is not the plea of guilty nor the verdict of the jury that fixes the status of the culprit as a convict—the one may be rejected or the other set aside by the court—but the judgment of the court, and the same consequence follows whether punishment is imposed or sentence suspended. The status of convict thus created is put an end to by a reversal of the judgment, by an unqualified pardon or by the completion of the sentence that may have been imposed on the offender.

Apart from the punishment specifically imposed on him the convict incurs other incidental but heavy disabilities. Far the worst of these is the social stigma which attaches to him from the moment of his conviction and which, in the vast majority of cases, practically involves a species of outlawry for life from the law-abiding community. But the legal disabilities incurred are scarcely less onerous. By the English common law, if convicted of a felony—and most criminal offences were felonies punishable by death—the convict became civilly dead, his estate was forfeited to the Crown and he suffered "corruption of blood," with the result that he could neither inherit nor transmit property. Forfeiture of estate was abolished in England by Act of parliament in 1870 and, while nominally in effect, was never exacted in the English colonies in America.

In the United States to-day, in the same way as in England, the convict sentenced to a State or convict prison loses all his civil rights during the period for which he was sentenced. This loss or suspension of civil rights does not, however, place the convict outside the pale of the law. To kill him without warrant is murder and the person who assaults or robs him is no less amenable to the law of the land than he would be if the victim of the act had been a free citizen. So the prisoner may be sued and in most States may sue and bind himself by contract, may grant or devise real or personal property, and may be a witness in a civil or criminal action. Everywhere, however, the sentence or the judgment of conviction disqualifies the convict from holding public office, from serving as a juror and from exercising the elective franchise. These disabilities continue, even in the event of a parole or conditional release, until his status as a convict has been removed. (*See* CRIMINAL LAW; CRIMINOLOGY; JUVENILE OFFENDERS; PRISON.) (G. W KI.)

CONVOCATION, an assembly of persons met together in answer to a summons. The term (from Lat. *convocatio,* a calling together), is applied to assemblies of the clergy or of the graduates of certain universities, and in England to an assembly of the spirituality or clergy of the realm, summoned by the metropolitan archbishops of Canterbury and York respectively, within their ecclesiastical provinces, pursuant to a royal writ, whenever the parliament of the realm is summoned, and which is also continued or discharged, as the case may be, whenever the parliament is prorogued or dissolved. These assemblies consist of two Houses, an upper and lower. In the upper house sit the archbishops and bishops, and in the lower the deans and archdeacons of every cathedral, the provost of Eton College, with one proctor elected by each cathedral chapter and two by the beneficed clergy in each diocese in the province of Canterbury (in the province of York two proctors are elected by each archdeacon), with a prolocutor at their head.

For the early history of convocation in the Church of England the reader is referred to the works named at the close of this article, and to the relative portions of the articles ENGLISH HISTORY and ENGLAND, CHURCH OF. The present account proceeds from the period of the Reformation.

The period of greatest activity and greatest importance of convocation extends from about 1534 to 1664. It is marked by four important assemblies of the spirituality of the realm in pursuance of a royal writ—the two first of which occurred in the reign of Edward VI., the third in that of Elizabeth, and the fourth in that of Charles II. The two earliest were summoned to complete what is known as the reformation of the Church of England, which had been begun by Henry VIII., the third was called together to reconstruct that work, which had been interrupted by the reign of Mary (the consort of Philip II. of Spain), whilst the fourth was summoned to re-establish the Church of England, the framework of which had been demolished during the civil war. On all of these occasions the convocations worked hand in hand with the parliament of the realm under a licence and with the assent of the crown. On the restoration of the monarchy in 1661 convocation was not anxious to retain the liberty of taxing itself apart from the laity, seeing that its ancient liberty was likely to prove of questionable advantage to it. It voted, however, a benevolence to the crown on the occasion of its first assembling in 1661 after the Restoration and it continued to do so until 1664, when an arrangement was made between Archbishop Sheldon and Lord Chancellor Hyde, and afterwards confirmed by Act of Parliament, under which convocation silently waived its long-asserted right of voting its own subsidies to the crown, and submitted itself thenceforth to be assessed to the "aids" directly granted to the crown by parliament. In consequence of this practical renunciation of their separate status, as regards their liability to taxation, the clergy have assumed and enjoyed in common with the laity the right of voting at the election of members of the House of Commons, in virtue of their ecclesiastical freeholds.

The most important and the last work of the convocation during this period of its activity was the revision of the Book of Common Prayer which was completed in the latter part of 1661.

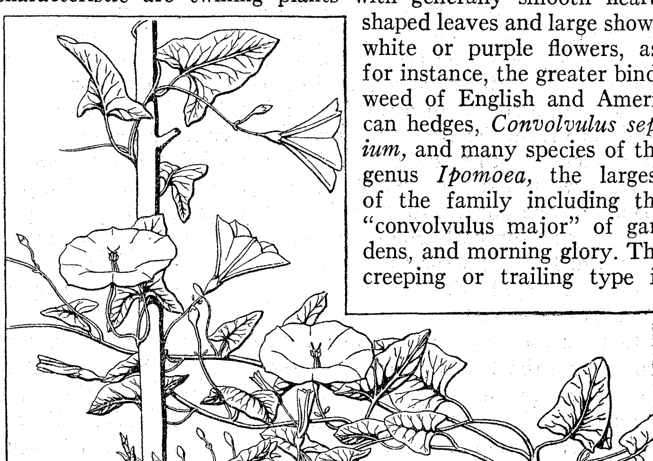
The Revolution in 1688 is the most important epoch in the next following period of the history of the synodical proceedings of the spirituality, when the convocation of Canterbury, having met in 1689 in pursuance of a royal writ, obtained a licence under the great seal to prepare certain alterations in the liturgy and in the canons and to deliberate on the reformation of the ecclesiastical courts. A feeling, however, of panic seems to have come over the Lower House, which took up a position of violent antagonism to the Upper House. This led to the prorogation of the convocation and to its subsequent discharge without any practical fruit resulting from its meeting. Ten years elapsed during which the convocation was prorogued from time to time without any meeting of its members for business being allowed. The next convocation which was permitted to meet for business, in 1700, was marked by great turbulence on the part of the members of the Lower House, who denied the right of the archbishop to prorogue their sessions. In the first year of Queen Anne convocation was summoned again, when the Lower House, under the leadership of Dean Aldrich, its prolocutor, again challenged the right of the archbishop to prorogue it, and presented a petition to the queen, praying her majesty to call the question into her own presence. The question was thereupon examined by the queen's council, which decided against the claim of the Lower House. During the remaining years of Anne's reign the two Houses were engaged either in internecine strife, or in censuring sermons or books, as teaching latitudinarian or heretical doctrines; and, when it had been assembled concurrently with parliament on the accession of George I., a great breach was before long created between the two Houses by the Bangorian controversy (*q.v.*). Dr. Hoadly, bishop of Bangor, having preached a sermon before the king, at St. James's Palace in 1717, against the principles and practice of the nonjurors, which had been printed by the king's command, the Lower House, which was offended by the sermon and had also been offended by a treatise on the same subject published by Dr. Hoadly in the previous year, lost no time in representing the sermon to the Upper House, and in calling for its condemnation. A controversy thereupon arose between the two Houses which was kept up with untiring energy, until the convocation was prorogued in 1717 in pursuance of a royal writ; from which time until 1861 no licence from the crown was granted to convocation to proceed to business. During this period, it was usual for a few members to meet when first summoned with every new parliament, in pursuance of the royal writ, for the Lower House to elect a prolocutor, and for both Houses to vote an address to the crown, after which the convocation was prorogued from time to time, pursuant to royal writs, and ultimately discharged when the parliament was dissolved.

In 1852 the clergy at last aroused themselves from their long repose, and the Upper House took the lead. The active spirit of the movement was Samuel Wilberforce, bishop of Oxford, but the master mind was Henry Phillpotts, bishop of Exeter. On the convocation assembling several petitions were presented to both Houses, praying them to take steps to procure from the crown the necessary licence for their meeting for the despatch of business, and an address to the Upper House was brought up from the Lower House, calling the attention of the Upper House to the reasonableness of the prayer of the various petitions. After some discussion the Upper House, influenced mainly by the argument of Henry, bishop of Exeter, consented to receive the address of the Lower House, and the convocation was thereupon prorogued, shortly after which it was discharged concurrently with the dissolution of parliament. On the assembling of the next convocation of the province of Canterbury, the sessions of the convocation were continued for several days; and from this time forth it may be considered to have resumed its action as a consultative body, while it has also been permitted on more than one occasion to exercise its functions as a deliberative body. In 1865, under licence from the crown, the convocations of Canterbury and York framed a limited number of new canons; and in 1872 it was empowered by letters of business from the crown to frame resolutions on the subject of public worship, which were incorporated in the Act of Uniformity Amendment act of that year.

As a deliberative body, convocation has done much useful work, but it suffers considerably from its unrepresentative nature. The nonbeneficed clergy still remain without the franchise, but the establishment of the groups known as Houses of Laymen for both provinces has, to a certain extent, secured the co-operation of the lay element. Several attempts were made to promote legislation to enable the convocations to reform their constitutions and to enable them to unite for special purposes; in 1905 a bill was introduced into the house of lords; it did not, however, get beyond a first reading. An important advance was made in 1920, when the *Church of England (Assembly) Powers Act* (1919) took effect. The assembly consists of three houses, composed of bishops, clergy, and laity respectively. The first two consist of the convocations of Canterbury and York, of which the respective upper houses form the *House of Bishops,* and the respective lower houses the *House of Clergy;* the *House of Laity* comprises representatives of the Laity of the provinces of Canterbury and York, elected every five years by the lay members of the diocesan conferences, which consist of representatives elected by the members of the Church of England on a roll prepared in each parish. None of the powers belonging to the convocations of Canterbury and York is to be diminished by the assembly, which is also prohibited from exercising any power belonging to the bishops by right of their episcopal office.

See Phillimore, *Ecclesiastical Law* (2nd ed., 1895); Joyce, *Handbook of Convocations of the Church of England* (1887); Lathbury, *History of Convocation* (1853); Cardwell, *Synodalia* (Oxford, 1842); and for sources: Gibson, *Synodus Anglicana* (1702; edited by Cardwell, 1854); Wilkins, *Concilia Magnae Britanniae et Hiberniae* (1737).

CONVOLVULACEAE, a botanical family belonging to the tube-flowered series of the group of Dicotyledons having joined petals. It contains about 50 genera with more than 1,000 species, and is found in all parts of the world except the coldest, but is best developed in tropical Asia and tropical America. The most characteristic are twining plants with generally smooth heart-shaped leaves and large showy white or purple flowers, as, for instance, the greater bindweed of English and American hedges, *Convolvulus sepium,* and many species of the genus *Ipomoea,* the largest of the family including the "convolvulus major" of gardens, and morning glory. The creeping or trailing type is common, as in the field bindweed (*Convolvulus arvensis*), which has also a tendency to climb, and *C. soldanella,* the sea bindweed, the long creeping stem of which forms a sand binder on temperate seashores; a widespread and efficient tropical sand binder is *Ipomoea Pes-Caprae.* In hot dry districts such as Arabia and northeast tropical Africa occur several genera with a low, much-branched, dense, shrubby habit, with small hairy leaves and very small flowers. An exceptional type is represented by *Humbertia;* a native of Madagascar, which forms a large tree; the dodder (*q.v.*) is a genus (*Cuscuta*) of leafless parasites with slender, thread-like twining stems. The flowers stand singly in the leaf-axils or form cymose inflorescences; they are sometimes crowded into small heads. The bracts are usually scale-like, but sometimes foliaceous, *e.g. Convolvulus* (section *Calystegia*), where they are large and envelop the calyx. In North America, much the largest genera are *Ipomoea* (morning glory), *Cuscuta* (dodder, love vine) and *Convolvulus* (bindweed).



HEDGE BINDWEED (CONVOLVULUS SEPIUM), A TWINING PLANT COMMON IN TEMPERATE REGIONS, SOMETIMES GROWN AS A TRELLIS VINE

The parts of the flower are in fives in calyx, corolla and stamens with two carpels which unite to form a superior ovary. The sepals, generally free, show much variation in size, shape and covering, and afford characters for the distinction of genera. The corolla is generally funnel-shaped, more rarely bell-shaped or tubular; the outer face is often marked out in longitudinal areas, five well-defined areas tapering from base to apex, and marked with longitudinal striae corresponding to the middle of the petals and alternating with five nonstriated weaker triangular areas. The slender filaments of the stamens vary widely, often in the same flower; the anthers are linear to ovate in shape, attached at the back to the filament and open lengthwise. The ovary is generally two-chambered, with two inverted ovules standing side by side at the inner angle of each chamber. The style is simple or branched, and the stigma linear, capitate or globose. The fruit is usually a capsule opening by valves; the seeds, where four are developed, are each shaped like the quadrant of a sphere; the seed coat is smooth, warty or hairy; the embryo is large with generally broad cotyledons surrounded by a horny endosperm. *Cuscuta* has a thread-like spirally twisted embryo with no trace of cotyledons.

The large showy flowers are visited by insects for the honey secreted by a ring-like disk below the ovary; large-flowered species of *Ipomoea* with narrow tubes are adapted for the visits of birds.

The largest genus, *Ipomoea,* has about 400 species distributed throughout the warmer parts of the earth. *Convolvulus* has about 150 species, mainly in temperate climates. *Cuscuta* contains nearly 100 species in the warmer and temperate regions; two are British.

The tuber-like roots of *Ipomoea batatas* are rich in starch and sugar, and, as the "sweet potato," form one of the most widely distributed foods in the warmer parts of the earth. Several species are used medicinally for the strong purging properties of the milky juice they contain; jalap is the product of the tubercles of *I. Purga,* a native of Mexico. The resinous cathartic scammony is obtained from the roots of *Convolvulus scammonia,* native to Asia Minor. Species of *Ipomoea* (morning glory) and *Convolvulus* are cultivated as ornamental plants. *Convolvulus sepium* and *C. arvensis* (bindweed) are pests in fields and gardens and many of the dodders (*Cuscuta*) cause damage to crops.

CONVOLVULUS, a genus of twining plants of the family Convolvulaceae (*q.v.*), commonly known as bindweeds or wild morning glories, comprising 200 or more species widely distributed in temperate and tropical regions. The genus consists of two distinct sections, *Calystegia,* with calyx inclosed in two broad leafy bracts, and *Strophocaulos,* with no bracts at or near the base of the calyx. *C. arvensis,* field bindweed (or creeping Jenny of the western United States), originally native to Europe but now widely introduced, is one of the most troublesome weeds of arable lands in the temperate zone. Its roots may penetrate the soil to a depth of more than 20 ft. *C. sepium,* hedge bindweed, native to both Europe and North America, is a common weed with shallow creeping rootstocks. It has been introduced as an ornamental vine is some places. Other well-known species include the Japanese bindweed, *C. japonicus,* with a double-flowered form, introduced from eastern Asia as an ornamental; and the seaside bindweed *C. soldanella,* widespread on beaches of the Atlantic and Pacific oceans. (W. C. M.)

CONVOY. Merchant vessels, transports, or naval auxiliaries assembled for passage together usually protected by combatant ships known as the escort. Also, a train of vehicles carrying troops or supplies. Obsolete, the escorting vessels or troops. In early days all merchantmen were more or less armed. Thus the ships of the Hanseatic league and of Venice were required to sail in convoy for mutual protection. Both these methods continued to be employed, until, with the advent of iron ships and steam power, merchantmen ceased to be armed. In the meantime many nations had entered into treaties for the purpose of exempting from visit and search (*q.v.*) ships under convoy, from which arose the so-called "right of convoy." This right Great Britain refused to recognize and the United States took the same view. It

BY COURTESY OF (1) THE IMPERIAL WAR MUSEUM; PHOTOGRAPHS, (2-5) BRITISH COMBINE

CONVOYS OF WORLD WARS I AND II

1. Allied convoy zigzagging in a danger zone during World War I. From 1914 to 1917 the use of convoys was restricted to troopships, but in the latter year intensified German submarine warfare compelled an extension of the service to merchant ships
2. Merchant vessels proceeding in single-line formation under the protection of British naval guns during World War II
3. Increased protection was provided for British convoys in World War II by the fleet air arm of the navy
4. An escort ship laying a smoke screen to cover a convoy
5. Depth charges exploding during an attack on a submerged German submarine in World War II. Notice the charges on the deck

was put to the test during the war between Great Britain and France, when a fleet of Swedish merchantmen with naval stores on board, under convoy of a Swedish frigate, resisted the exercise of visit and search by a British squadron. The merchantmen were captured, sent in for adjudication and condemned with their cargoes. Lord Stowell held that the right of visit and search could not be displaced by the intervention of the neutral sovereign or by the fact of the vessel being under convoy (see *The Maria,* 1 C., Rob. 340). At the Naval conference of 1908, however, in view of the general acceptance of the doctrine of the "right of convoy" Great Britain expressed her willingness to come into line. By Art. 61 of the Declaration of London "Neutral vessels under national convoy are exempt from search. The commander of a convoy gives in writing at the request of the commander of the belligerent warship, all information as to the character of the vessels and their cargoes, which could be obtained by search." By Art. 62, if the commander of the belligerent warship had reason to suspect the accuracy of the information furnished, he could demand further investigation by the convoy commander. The latter was required to withdraw his protection from any vessel if this investigation indicated that she was legally subject to capture. With the abandonment of the Declaration in 1916 Great Britain reverted to her former practice, and when the Dutch Government in 1918 declared that certain vessels would be convoyed by a Dutch warship to the East Indies, she refused to recognize the right of convoy and eventually agreed not to exercise the right of visit in this instance only upon terms agreed between the two governments (see *Parl. Papers* 1908 [Cd. 9028]). There has been no general agreement with the British viewpoint. The U.S.A. Naval Instructions, 1917 follow the Declaration of London. However, during the war of 1939, neutrals did not challenge the British practice. For the contrasting viewpoints, *see* Hyde, *International Law,* vol. 2, and Lauderpacht, *International Law,* vol. 2.

The use of belligerent convoy by neutral vessels is analogous to shipping neutral goods on an enemy armed vessel. On principle the use of belligerent convoy is a good ground for seizure, and resistance will justify condemnation. By the U.S.A. Naval Instructions, 1917, "any vessel under convoy of a vessel of the enemy is liable to capture." This is in accord with the British practice.

(H. H. L. B.; R. M. G.)

NAVAL CONVOY

Naval convoy is a term used in naval warfare to describe the system of defending merchant ships, whereby the vessels sail in groups "convoyed" by warships. The practice of sailing in convoy was common in the middle ages, because most ships, whether ostensibly warships or not, had some sort of armament, and they could thus afford each other some mutual protection.

The problem of mercantile convoy was fundamentally different in the War of 1914–18 from what it had been in the days of sailing ships. Merchant vessels in the 18th century made very few round voyages in the year, often only one. The length of each passage was uncertain, depending on wind and weather conditions, and the delays caused by assembly, awaiting escort and sailing in groups, were comparatively unimportant. The owners of fast sailing vessels might lose the profits to be gained by forestalling the market, but the nation suffered little. Hence trade could be carried on in time of war by a comparatively few convoys of great size. A homeward bound West Indian convoy might comprise 100 or 150 vessels; there are records of Baltic convoys during the Napoleonic wars of over 500 sail. Warships for escort could usually be provided from vessels of war returning home for refit, or returning to station after refit. Since those days, the greater frequency and certainty of voyages under steam has permitted the growth of massed industrial populations, depending for their very life, not merely on an immense volume of imported foodstuffs and raw materials, but on its arrival in a steady, continuous stream of cargoes. Throughout the World War the stocks of food, of munitions and of materials for civil industries were small in comparison with annual requirements, and had to be continually renewed. The holding back of supplies for a few months, or even for a few weeks, might entail irremediable disaster. Thus, if trade were to be run in convoy at all, it must be in numerous small convoys run to a regular schedule, not in a few large convoys at irregular intervals. The contrast may be illustrated by the fact that, during the first two years of the War of the Austrian Succession, 35 outward and 45 homeward convoys sufficed for the requirements of the ocean trades; in the summer of 1918, 40 outward and 42 homeward convoys were run in the ocean trades alone every 32 days. In these circumstances convoy called for a greater allocation of force and a far more elaborate organization than in the past. At the best, too, it entailed very serious delays to the faster ships, owing to the wide discrepancies in speed between steamers, even of similar type. Neither to the commercial nor to the naval mind was convoy a light matter.

Early Part of the World War.—During the first two and a half years of war, the use of convoy was restricted to the protection of troop movements. As the submarine campaign increased in intensity, escort was frequently given, within the danger zone, to tankers and vessels with important Government cargoes; but the introduction of organized mercantile convoy was delayed until 1917. So long as the attack on commerce was carried on by surface warships, the total effect, despite the notoriety attained by the "Emden" and other raiders, was comparatively trifling, and even the submarine campaign, in its earlier stages, produced an astonishingly small effect on the flow of commerce. Towards the end of 1916, however, the losses of neutral as well as of British and Allied shipping, became very serious, and the outbreak of unrestricted submarine warfare in Feb. 1917 compelled a reconsideration of the whole problem of trade protection. At this time the general run of opinion at the British Admiralty was strongly against convoy. It was condemned both as impracticable and undesirable; impracticable because there were not enough cruisers, destroyers and patrol craft to provide escorts for the trade, and because accurate station keeping would be impossible in a group of steamers of varied type and speed; undesirable because of the delays involved, and because any protection derived from escort would be outweighed by the disadvantage of offering a large target to torpedo attack.

Organized Convoys Begin.—The delays caused by the holding up of shipping and by deviation to avoid danger areas were now, in fact, so serious as to discount one of the chief objections to convoy, and the losses suffered during the first three months of unrestricted warfare (*see* SUBMARINE CAMPAIGNS) were so heavy as to threaten disastrous results to the supply system of the Allies. The existing methods of protection were clearly inadequate, and the advocates of convoy became insistent. In Feb. 1917 the French coal trade was organized in a system of controlled sailings which rapidly developed into regular convoys, and in April a Scandinavian convoy was introduced to protect the helpless, unarmed neutral, trading on Allied account, in the North sea. Meanwhile, the application of convoy to the ocean trades was being persistently urged both within and without the anti-submarine division of the Admiralty. A special committee was appointed at the Admiralty during May to draw up a detailed scheme of convoys for the ocean trades, and during the same month two experimental convoys were sailed from Gibraltar and Hampton Roads respectively. Both these experimental convoys arrived without loss, and the experience gained went far to dispose of the bogey of station keeping. Meanwhile, investigations had shown that the difficulty of providing escort had been magnified by an exaggeration of the number of voyages to be protected, and the arrival of United States destroyers at Queenstown (Cobh) increased the available force. Regular convoys from Hampton Roads were started in June; from Sydney (Cape Breton), New York and Gibraltar in July; in August the system was extended to the south Atlantic trades and the outward traffic.

The system adopted for convoys bound for England was for a group of steamers, collected at a port of assembly, to be escorted by a cruiser or armed merchant cruiser, giving protection against surface raiders, to a rendezvous outside the submarine danger zone, whence the convoy was brought in by a destroyer escort. Outward convoys, collected at assembly ports on the west and south coasts of England, were taken through the danger zone by a destroyer escort, to a point of dispersal outside the ordinary limits of submarine activity, whence the ships made their way individually to their ports of destination. In order to economize the forces used as destroyer escorts, which included destroyers, sloops and in some instances P-boats and trawlers, the escort, which had taken an outward convoy clear of the danger zone, was required to steam from the point of dispersal to the rendezvous with a homeward convoy, which it then brought in.

A seldom noted feature of the British mercantile convoy system, both of the wars of 1914 and 1939 and of earlier wars, was the containing of the main enemy fleets in their home waters by heavy concentrations of war vessels between them and the open sea, thus permitting the safeguarding of convoys with escorts sufficient only to deal with submarines and other weak raiders. When this part of the system failed the results were disastrous, as in 1693 when the French Fleet under Tourville left Brest with 71 vessels in May before the blockade was established, and destroyed 100 vessels of a convoy of four hundred. In 1918 when there was danger of German battle cruisers eluding the blockade, a division of American battleships was stationed at Berehaven, Ireland, to be in a position to reinforce the escorts quickly if necessary.

Work of the Convoys.—The merchant convoys were organized by the British Admiralty and escorted chiefly by the British Navy, with valuable assistance by the United States cruisers and destroyers in the Atlantic, Japanese destroyers in the Mediterranean and French vessels in the Bay of Biscay. There were 99,083 vessels convoyed with a loss of approximately 0·5%. Two million United States troops were carried to Europe, with the loss of only 637 soldiers, by special troop convoys organized and escorted by the United States Navy, augmented in the spring of 1918 by British convoys to Liverpool and London. United States vessels escorted 82% and transported 46·25%, British vessels transported 51·25%, and the remainder were transported by French and Italian ships.

Success of the System.—From the first the convoys proved a triumphant success, and conclusively refuted the arguments against the system. The grouping of the ships diminished the number of targets offered to the attack, and the convoys could be routed by wireless to evade areas of known submarine activity. When located by a submarine, they proved far less vulnerable than the opponents of the system had supposed. The threat of instant retaliation by the escort, and the menace presented to a submarine by a group of ships manoeuvring in concert on a broad front, hampered the movements of the assailant, and even when the attack was successful, there was no such wholesale havoc as had been feared.

In the North sea in the World War of 1914–18 there were two serious disasters, both due to attacks by surface vessels; but in the ocean trades, even when a successful attack was made on a comparatively large convoy, it was rarely that the submarine claimed more than one, or at most two victims. The total percentage of loss was as follows:—

Ships escorted safely in ocean convoy	16,539	99·08%
Torpedoed in convoy	102	0·61%
Lost by marine peril	16	0·09%
Lost after parting company, etc.	36	0·22%
Total sailings	16,693	100·00%

In the short sea convoys (Scandinavian, Dutch, British east coast, French coal trade and Mediterranean local) there were over 80,000 sailings, with a loss of less than 0·5%.

Delays, which were considerable at first, were subsequently reduced to acceptable proportions by grouping ships into fast and slow convoys, by adjusting sailings to the convoy programs and by better planning and co-operation.

War of 1939.—In 1939 convoy was instituted on the pattern of previous wars, with the main German fleet contained. The submarine was no longer such a serious menace due to the development of adequate counter measures. But meanwhile air power had developed, without a corresponding development of the defence, and, particularly after the German occupation of northern France, took a serious toll of shipping to British east coast ports. Due to the inability of Britain to contain the main German air fleet, East Coast and Channel convoys were subjected to the full force of its attack. (*See* also BLOCKADE and SUBMARINE CAMPAIGN.)

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CONVOY SLOOPS: *see* FLEET AUXILIARY VESSELS; also CONVOY: *Naval.*

CONVULSIONS, the pathological condition of body associated with abnormal, violent and spasmodic contractions and relaxations of the muscles, taking the form of a fit. Convulsions may be a symptom resulting from various diseases, *e.g.,* in uraemia, eclampsia, rabies, tetanus, hysteria, epilepsy, strychnine poisoning, cerebral tumour and diseases. They are usually, but not always, accompanied by loss of consciousness. Popularly, the term is commonly restricted to the infantile variety, occurring in association with teething, or other causes which upset the child's nervous system. The treatment (plunging into a hot bath, or administration of chloroform) must be prompt, as convulsions are responsible for a large part of infant mortality.

The name "Convulsionaries" (Fr. *Convulsionnaires*) was given to certain Jansenist fanatics in France in the 18th century, owing to the convulsions, regarded by them as proofs of divine inspiration, which were the result of their religious ecstasies (*see* JANSENISM). The term "Convulsionists" is sometimes applied to them, as also, more loosely, to other religious enthusiasts who exhibit the same symptoms.

CONWAY, HENRY SEYMOUR (1721–1795), British soldier and statesman, sat in the Irish parliament from 1741 to 1761 as member for Antrim, and in the British House of Commons from 1741 to 1784 for various constituencies. In 1755 he went to Ireland as secretary to the lord-lieutenant, but after returning to England in the following year he was brought into discredit by the complete failure of an abortive expedition he participated in against Rochfort. As lieutenant-general he served under Prince Ferdinand of Brunswick in the campaigns of 1761–63. His opposition in parliament to the views of the court on the Wilkes case led to his being deprived of his military command and of his appointment in the royal household.

In the Rockingham ministry of 1765 Conway took office as secretary of State, with the leadership of the House of Commons. In the dispute with the American colonies his sympathies were with the latter, and in 1766 he carried the repeal of the Stamp Act. In Jan. 1768, offended by the growing influence of the Bedford faction which joined the Government, Conway resigned the seals of office, though he was persuaded by the king to remain a member of the cabinet and "Minister of the House of Commons." When Lord North became premier in 1770, Conway resigned from the cabinet and was appointed to the command of the Royal Regiment of Horse Guards. In 1772 he became governor of Jersey. In 1781 his opposition to Lord North's American policy brought about the resignation of the premier, and in the Rockingham Government that followed, Gen. Conway became commander-in-chief with a seat in the cabinet. On Pitt's elevation to the premiership, Conway supported Fox in opposition; but after the dissolution of parliament in 1784 he retired from political life. He was made field-marshal in 1793, and died on July 9, 1795.

See Horace Walpole, *Letters,* ed. P. Cunningham (9 vols., 1857); the duke of Buckingham and Chandos, *Memoirs of the Court and Cabinets of George III.* (4 vols., 1853).

CONWAY, HUGH, the nom-de-plume of FREDERICK JOHN FARGUS (1847–1885), English novelist, who was born at Bristol on Dec. 26 1847, the son of an auctioneer. At the age of 13 he joined the training-ship "Conway" in the Mersey. In deference to his father's wishes, however, he abandoned the sea, and eventually, in 1868, took over the family business. In 1883 Fargus published through Arrowsmith his first long story, *Called Back,* of which over 350,000 copies were sold within four years. A dramatic version of this book was produced in London in 1884, and in this year Fargus published another story, *Dark Days.* He died at Monte Carlo on May 15 1885.

CONWAY, MONCURE DANIEL (1832–1907), American clergyman and author, was born of an old Virginia family in Stafford county, Va., on March 17, 1832. He graduated at Dickinson college in 1849, studied law for a year, and then became a Methodist minister in his native State. In 1853, owing largely to the influence of Ralph Waldo Emerson, he entered the Harvard Divinity school, where he graduated in 1854. His abolitionist views aroused the bitter hostility of his old neighbours, and brought his dismissal from a Unitarian church in Washington, D.C. From 1856 to 1861 he was a minister in the First Congregational Church in Cincinnati, O., at that time a centre of western culture, where, also, he edited a short-lived liberal periodical named after its eastern predecessor *The Dial.* Subsequently with F. B. Sanborn he was an editor of the *Commonwealth* in Boston, Mass. During the Civil War he lectured in England in behalf of the North. From 1863 to 1884 he was the minister of the South Place chapel, Finsbury, London. During this time he wrote frequently for the London press, and in 1884 he returned to the United States to devote himself to literary work. He died in Paris, on Nov. 15, 1907. His publications include *Tracts for To-day* (1858); *Republican Superstitions* (1872); *Idols and Ideals* (1871); *Demonology and Devil Lore* (1878); *A Necklace of Stories* (1879); *The Wandering Jew* (1881); *Pine and Palm* (1887); *The Life of Thomas Paine,* with an unpublished sketch of Paine by William Cobbett (1892); *Solomon and Solomonic Literature* (1899); and *My Pilgrimage to the Wise Men of the East* (1906). His *Autobiography* (1904) is especially valuable for its sketches of important figures in the 19th century by whom he was esteemed as a leader of liberal thought. *Moncure D. Conway, Addresses and Reprints* (1909) contains *The Golden Hour* (1862), *The Earthward Pilgrimage* (1870) and shorter pieces.

CONWAY, WILLIAM MARTIN CONWAY, 1ST Baron (1856–1937), English art critic and mountaineer, was born at Rochester on April 12, 1856, and educated at Repton and at Trinity college, Cambridge. In 1880 his interest in early printing and engraving led him to make a tour of the principal libraries of Europe, the result appearing in 1884 as a *History of the Woodcutters of the Netherlands in the Fifteenth Century.* His later works on art include *Reynolds and Gainsborough* (1886); *Early Flemish Artists* (1887); *The Literary Remains of Albrecht Dürer* (1889); *The Dawn of Art in the Ancient World* (1891), dealing with Chaldaean, Assyrian and Egyptian art; *Early Tuscan Artists* (1902); *The Sport of Collecting* (1914); *The Van Eycks and their Followers* (1921); *Art Treasures of Soviet Russia* (1925). From 1884 to 1887 he was professor of art at University college, Liverpool; and from 1901 to 1904 Slade professor of the fine arts at Cambridge. He was knighted in 1895.

Sir Martin Conway began mountaineering in the Alps at the age of 16 and after devoting several years to the mountains about Zermatt he published a guide-book to them for climbers, entitled *The Zermatt Pocket Book.* This was reissued as one of the series of Climbers' Guides, which he edited in conjunction with the Rev. A. B. Coolidge, and these in form and arrangement were the original of scores of imitations issued in many languages and dealing with mountain ranges in four continents. He was president of the Alpine club 1902 to 1904. In 1892 he made the first complete ascent of any of the great Himalayan peaks, reaching a height of 23,000ft., in the course of the first scientific mountaineering expedition undertaken in any part of the snow region of the Himalayas, and supported by the Royal Society, the Royal Geographical Society and the British Association. In 1896–97 he explored the interior of Spitsbergen and crossed the main island for the first time; in the next year he explored and surveyed the Bolivian Andes, making the first ascent of the highest mountain of the group, Illimani (21,200ft.). He also ascended Aconcagua (23,080ft.) and explored Tierra del Fuego, making the first and almost successful attempt to climb Mt. Sarmiento, being driven down when near the summit by a terrific gale. At the Paris exhibition of 1900 he received the gold medal for mountain surveys, and in 1905 the founder's medal of the Royal Geographical Society, of which he was vice-president. His expeditions are described in his *Climbing and Exploration in the Kara-Koram Himalayas* (1894), *The Alps from End to End* (1895), *The First Crossing of Spitsbergen* (1897), *With Ski and Sledge over Arctic Glaciers* (1898), *The Bolivian Andes* (1901), *Aconcagua in Tierra del Fuego* (1902), and *Mountain Memories* (1920). *No Man's Land, a History of Spitsbergen from . . . 1596 . . .*, was published in 1906.

In 1902 he began the acquisition and chronological classification of photographic and other reproductions of works of art of all kinds from the Stone Age down to the 18th century, now some 250,000 in number. In 1905 he purchased the extensive ruins of Allington castle, near Maidstone, and proceeded to bring them back into a habitable condition, a work which has been continuously carried on for 21 years and is still in progress. He was vice-president of the Society of Antiquaries. From 1917 he was director-general of the Imperial War Museum. In 1918 he entered the House of Commons as member for the combined English universities, and urged the reform of the passport system. In 1931 he was created a baron. He died Apr. 19, 1937.

CONWAY, CONWY or **ABERCONWY,** municipal borough, Caernarvonshire, Wales, 14 mi. by the L.M.S.R. from Bangor. Pop. (est. 1938) 8,989. Area, 7.4 sq.mi. The river on the North Wales coastal route has always been important. Caerhun, 4½ mi. from the present town, is on the high road from London to Holyhead and is the *Canovium* of the Romans. The site was excavated in 1926–27 revealing a Roman fort occupied down to Antonine times (see *Arch. Camb.,* 1926–27 *seq.*). Diganhwy (Dyganwy, Deganwy) is mentioned in the *Mabinogion* (*Geraint and Enid*), if the reading is sound; it is certainly mentioned in the *Annales Cambriae* (years 812–822), and in the *Black Book of Carmarthen,* xxiii, 1. The town is enclosed by a high wall, roughly triangular, about 1 mi. round, with 21 dilapidated round towers and their gateways. The castle in the south-east angle, built in 1284 by Edward I, was, in 1389, the scene of Richard II's agreement to abdicate. There are ruins of the Cistercian abbey (1185), whose site is occupied by the Gothic church of St. Mary (13th century and later). The castle was held for Charles I by Archbishop Williams and taken by Gen. Mytton in 1646. It was later dismantled. Pearl fisheries existed at Conway for centuries, dating back to the Roman occupation. Two bridges, a tubular one for the railway and a suspension one, designed by Stephenson (1846–48) and Telford (1822–26) respectively, cross the Conwy. The Elizabethan Plâs Mawr is the *locale* of the Royal Cambrian Academy of Art. Conway is in the Caernarvon Boroughs parliamentary division. In 1937 the corporation acquired the Bodlondeb hall estate, now a public park with the mansion for municipal offices.

CONWAY, a city in central Arkansas, U.S.A., 30 mi. N.W. of Little Rock, on the Missouri Pacific railroad; the county seat of Faulkner county. The population in 1940 was 5,782. It is the trading and shipping centre of a rich cotton-growing, farming and dairying country, and the seat of Central college (Baptist), Hendrix college (Methodist) and the State teachers college. The city was settled about 1871, and incorporated in 1875.

CONY or **CONEY,** a name originally applied to the rabbit and still sometimes used for it, notably in the fur trade. The cony of the Bible is a different beast (*see* HYRACOIDEA), which, although superficially rodent-like, is a hoofed animal of dubious affinities, and is better termed the hyrax (*q.v.*). It is a small, stocky animal, living among rocks in deserts, hills and mountains.

CONYNGHAM, GUSTAVUS (*c.* 1747–1819), U.S. naval officer, was born in County Donegal, Ireland, about 1747. He was taken to the U.S. in his youth, and apprenticed to a captain in the West Indian trade. Advancing to shipmaster, he was employed to bring gunpowder from Holland at the outbreak of the American Revolution, but became stranded in Holland. The American commissioners in France supplied him with a commission dated March 1, 1777, and sent him forth from Dunkirk in May in an armed lugger. He captured a packet plying with mail between England and Holland, and brought it and another prize back to Dunkirk. Upon British protest, Conyngham and his crew were imprisoned, the prizes restored and the captain's commission confiscated. The commissioners secured his release, supplied him with a new commission and the cutter "Revenge," and sent him again on a cruise out of Dunkirk. Sailing around the British Isles and operating off Spain and in the West Indies, he took 29 prizes in the ensuing two years, but was finally captured, carried to England, and threatened with death as a pirate. Amid threatened reprisals on the part of the Continental congress, Conyngham escaped to Holland, where, in 1780, he joined John Paul Jones in a cruise in the frigate "Alliance." From the end of the war until his death in Philadelphia on Nov. 27, 1819, he waged a hopeless fight to gain recognition by congress of his rank in the navy. Almost a century after his death the commission the French had confiscated and which could have substantiated his claim, was found in the collection of a Parisian autograph dealer. (W. B. Ck.)

COOCH BEHAR or **KUCH BEHAR,** a state of India, in Bengal, consisting of a submontane tract entirely surrounded by British territory. Area, 1,321 sq.mi. Population (1941) 640,842; estimated revenue 3,867,000 rupees. The state forms a level plain of triangular shape, intersected by numerous rivers. The greater portion is fertile and well cultivated, but tracts of jungle are to be seen in the northeast corner, which abuts upon Assam. The rivers, of which the most important are the Tista and Sankosh, all pass through the state from north to south, to join the main stream of the Brahmaputra. Rice is grown on three-fourths of the cultivated area. Jute and tobacco are also largely grown for export. The state is connected with the Eastern Bengal State railway by the Cooch Behar State railway.

The Koch or Rajbansi, from whom the name of the state is derived, were a widely spread tribe akin to the Indo-Chinese races of the northeast frontier, and were the masters of northeastern Bengal and lower Assam till they were overcome by the Mohammedans and Ahoms. They have now become largely Hinduized, especially in their own home, where the appellation "Koch" has come to be a term of reproach.

Cooch Behar at the dawn of its history formed part of Kamarupa. In the 15th century it was held by Khen kings, and early in the next century became the centre of the kingdom of the Koch king Biswa Singh. The greatest monarch of the dynasty was Nar Narayan, the son of Biswa Singh, who extended his power over a large part of Assam and southward over what is now part of the British district of Rangpur. His son became tributary to the Mogul empire. In 1772 the country was invaded by the Bhutanese and an appeal for assistance was made to Warren Hastings. A detachment of sepoys drove out the Bhutanese who were forced to sue for peace through the mediation of the Tashi Lama of Tibet. By the resulting treaty the raja acknowledged subjection to the East India company, and made over to it one-half of his annual revenues. The administration of the state was for some years under a regent, H.H. the Maharani of Cooch Behar, on behalf of her son, H.H. Jagaddipendra Narayan Bhup Bahadur, who succeeded at the age of seven in 1922. There was a regency council, the vice-president of which was an officer lent by the British government. The governor of Bengal acted as the agent of the governor general for the purpose of superintending the administration. The town of Cooch Behar is situated on the river Torsa, and has a railway station. Pop. (1941) 16,000. It has a college affiliated with the Calcutta university.

COODE, SIR JOHN (1816–1892), English engineer, was born at Bodmin, Cornwall, on Nov. 11, 1816, the son of a solicitor. In 1847 he was appointed resident engineer at the national harbour works at Portland then in progress, and in 1856 engineer-in-chief, a post which he occupied till the completion of the works in 1872. After the Portland harbour his best-known work is the harbour of Colombo, Ceylon. He was made a K.C.M.G. in 1886. From 1884 till his death he was a member of the Suez Canal commission, and was president (1889–91) of the Institution of Civil Engineers. He died at Brighton on Mar. 2, 1892.

COOK, ARTHUR JAMES (1884–1931), English socialist and labour leader, was born at Wookey in Somerset, the son of a soldier. He was educated at the elementary schools and at the London Labour college, and worked as a miner in the pits, especially in the Rhondda area. In 1924 he was elected general secretary of the Miners' Federation of Great Britain. He took a prominent part in the events leading up to the threatened general strike of 1925 and the actual strike and coal lockout of 1926.

COOK, SIR EDWARD TYAS (1857–1919), British journalist and author, was born at Brighton and educated at Winchester and New college, Oxford. Cook was connected with the *Pall Mall Gazette* under John Morley, and then under W. T. Stead, whom he succeeded as editor (1890–92). He was the first editor (1893–96) of the *Westminster Gazette,* then editor of the *Daily News* (1896–1901) and leader writer on the *Daily Chronicle* (1901–12). He was knighted in 1912. His strong political convictions led to his resignation from the *Pall Mall Gazette* when it changed hands, and from the *Daily News* on account of its attitude on the Boer War.

Among Cook's publications are *Studies in Ruskin* (1890); *Rights and Wrongs of the Transvaal War* (1901); *The Life of John Ruskin* (1911); *Life of Florence Nightingale* (1913); *Delane of "The Times"* (1915); *Literary Recreations* (1918); and *More Literary Recreations* (1919). He also edited, in collaboration with A. Wedderburn, the standard edition of the works of Ruskin (1903–07). *See* J. Saxon Mills, *Sir Edward Cook* (1921).

COOK, ELIZA (1818–1889), English author, was born on Dec. 24, 1818, in Southwark, the daughter of a local tradesman. She was self-taught, and began when a girl to write poetry for the *Weekly Dispatch* and *New Monthly.* From 1849 to 1854 she conducted a paper for family reading called *Eliza Cook's Journal.* She also published *Jottings from my Journal* (1860), and *New Echoes* (1864); and in 1863 she was given a civil list pension. As the author of a single poem, "The Old Armchair," Eliza Cook's name was for a generation after 1838 a household word in England and in America. She died at Wimbledon on Sept. 23, 1889.

COOK, JAMES (1728–1779), English naval captain and explorer, was born on Oct. 28, 1728, at Marton village, Cleveland, Yorkshire, where his father was first an agricultural labourer and then a farm bailiff. At 12 years of age he was apprenticed to a haberdasher at Staithes, near Whitby, and afterward to Messrs. Walker, shipowners, of Whitby, whom he served for years in the Norway, Baltic and Newcastle trades.

In 1755, having risen to be a mate, Cook joined the royal navy, and after four years' service was, on the recommendation of Sir Hugh Palliser, his commander, appointed master successively of the sloop "Grampus," of the "Garland" and of the "Solebay," in the last of which he served in the St. Lawrence. He was employed also in sounding and surveying the river, and he published a chart of the channel from Quebec to the sea. In 1762 he was present at the recapture of Newfoundland, and was employed in surveying portions of this coast (especially Placentia harbour); in 1763, on Palliser becoming governor of Newfoundland, Cook was appointed "marine surveyor of the coast of Newfoundland and Labrador"; this office he held till 1767; and the volumes of sailing directions he now brought out (1766–68) showed remarkable abilities. At the same time he began to make his reputation as a mathematician and astronomer by his observation of the solar eclipse of Aug. 5, 1766, at one of the Burgeo Islands, near Cape Ray, and by his account of the same in the *Philosophical Transactions* (vol. lvii, pp. 215–216).

In 1768 Cook was appointed to conduct an expedition, suggested by the revival of geographical interest now noticeable, and resolved on by the English admiralty at the instance of the Royal society, for observing the impending transit of Venus, and prosecuting geographical researches in the South Pacific ocean. For these purposes he received a commission as lieutenant (May 25), and set sail in the "Endeavour," of 370 tons, accompanied by several men of science, including Sir Joseph Banks (Aug. 25). On April 13, 1769, he reached Tahiti, where he observed the transit on June 3. From Tahiti he sailed in quest of the great continent then supposed to exist in the South Pacific, explored the Society Islands, and thence struck to New Zealand, whose coasts he circumnavigated and examined with great care for six months, charting them for the first time with fair accuracy, and especially observing the channel ("Cook Strait") which divided the north and south islands. His attempts to penetrate to the interior, however, were thwarted by native hostility. From New Zealand he proceeded to "New Holland" or Australia, and surveyed with the same minuteness and accuracy the whole east coast. New South Wales he named after a supposed resemblance to Glamorganshire; Botany bay, sighted on April 28, 1770, was so called by the naturalists of the expedition. On account of the hostility of the natives his discoveries here also were confined to the coast, of which he took possession for Great Britain. From Australia Cook sailed to Batavia, satisfying himself upon the way that (as Torres had first shown in 1607) New Guinea was in no way an outlying part of the greater land mass to the south.

Arriving in England, by way of the Cape of Good Hope, on June 12, 1771, Cook was made a commander, and after was appointed to command another expedition for examining and determining once for all the question of the supposed great southern continent. With the "Resolution" of 462 tons, the "Adventure" (Captain Furneaux) of 330 tons, and 193 men, he sailed from Plymouth on July 13, 1772; he touched at the Cape of Good Hope, and striking thence south-east (Nov. 22) passed the Antarctic Circle (Jan. 16, 1773), repassed the same, and made his way to New Zealand (March 26) without discovering land. From New Zealand he resumed his "search for a continent," working up and down across the South Pacific, and penetrating to 67° 31′ and again to 71° 10′ S., with imminent risk of destruction from floating ice, but with the satisfaction of disproving the possibility of the disputed continent in the seas south-eastward of New Zealand. He made for Easter Island, the exact position of which he determined, for the first time, with accuracy; noticing and describing the gigantic statues which Roggewein, the first discoverer of the island, had made known. In the same manner he accomplished a better determination and examination of the Marquesas, as well as of the Tonga or Friendly Islands, than had yet been made; and after a stay at Tahiti to rest and refit, crossed the central Pacific to the "New Hebrides," as he renamed Quiros's "Southern Land of the Holy Spirit" (a name preserved in the modern island of *Espiritu Santo*), called by Bougainville the "Great Cyclades" (*Grandes Cyclades*), whose position, extent, divisions and character were now verified as never before. Next followed the wholly new discoveries of New Caledonia, Norfolk Island, and the Isle of Pines. Another visit to New Zealand, and yet another examination of the far southern Pacific, which was crossed from west to east through the whole of its extent, from south Australia to Tierra del Fuego, were now undertaken by Cook before he finally closed his work in refutation of the Antarctic continent, as previously understood, on this side of the world. The voyage closed with a rapid survey of the "Land of Fire," the rounding of Cape Horn, the rediscovery of the island now named Southern Georgia, the discovery of Sandwich Land, the crossing of the South Atlantic (here also exploding the great *Terra Australis* delusion), and visits to the Cape of Good Hope, St. Helena, Ascension, Fernando Noronha and the Azores. The voyage (reckoning only from the Cape of Good Hope and back to the same) had covered considerably more than 20,000 leagues, nearly three times the equatorial circumference of the earth; it left the main outlines of the southern portions of the globe substantially as they are known to-day; and it showed a possibility of keeping a number of men for years at sea without a heavy toll of lives. Cook only lost one man out of 118 in more than 1,000 days; he had conquered scurvy.

The discoverer reached Plymouth on July 25, 1775, and his achievements were promptly, if meanly, rewarded. He was immediately raised to the rank of post-captain, appointed a captain in Greenwich hospital, and soon afterwards unanimously elected a member of the Royal Society, from which he received the Copley gold medal for the best experimental paper which had appeared during the year.

Cook's third and last voyage was primarily to settle the question of the north-west passage, practically abandoned since before the middle of the 17th century, but now taken up again, as a matter of scientific interest, by the British government. The explorer, who had volunteered for this service, was instructed to sail first into the Pacific through the chain of the newly discovered islands which he had recently visited, and on reaching New Albion to proceed northward as far as latitude 65° and endeavour to find a passage to the Atlantic. Several ships were at the same time fitted out to attempt a passage on the other side from the Atlantic to the Pacific. Sailing from the Nore on June 25, 1776 (Plymouth, July 12), with the "Resolution" and "Discovery," and touching at the Cape of Good Hope, which he left on Nov. 30, Cook next made Tasmania and thence passed on to New Zealand and the Tonga and Society Islands, discovering on his way several of the larger members of the Hervey or Cook Archipelago, especially Mangaia and Aitutaki (March 30–April 4, 1777); some smaller isles of this group he had already sighted on his second voyage, Sept. 23, 1773. From Tahiti, as he moved north towards the main object of his expedition, he made a far more important discovery, or rather rediscovery, that of the Hawaiian or Sandwich Islands, the greatest and most remarkable of the Polynesian archipelagos (early Feb. 1778). These had perhaps first been seen by the Spanish navigator Gaetano in 1555; but their existence had been kept a close secret by Spain at the time, and had long been forgotten. Striking the west American coast in 44° 55′ N. on March 7 following, he made an almost continuous survey of the same up to Bering Straits and beyond, as far as 70° 41′, where he found the passage barred by a wall, or rather continent, of ice, rising 12 ft. above water, and stretching as far as the eye could reach. The farthest point visible on the American shore (in the extreme north-west of Alaska) he called Icy Cape. On his way towards Bering Straits he discovered and named King George's ("Nootka") and Prince William's Sound, as well as Cape Prince of Wales, the westernmost extremity of North America, never yet seen by English navigators, but well known to Russian explorers, who probably first sighted it in 1648; he also penetrated into the bay afterwards known as Cook's Inlet or River, which at first seemed to promise a passage to the Arctic Seas, to the south-east of the Alaska peninsula. Cook next visited the Asiatic shores of Bering Straits (the extreme north-east of Siberia); returning to America, he explored Norton Sound, north of the Yukon; touched at (Aleutian) Unalaska, where he met with some Russian-American settlers; and thence made his way back to the Hawaiian group, which he had christened after his friend and patron Lord Sandwich, then head of the British admiralty (Jan. 17, 1779). Here he visited Maui and Hawaii itself, whose size and importance he now first realized, and in one of whose bays (Kealakekua) he met his death early in the morning of Feb. 14, 1779. During the night of the 13th, one of the "Discovery's" boats was stolen by the natives; and Cook, in order to recover it, made trial of his favourite expedient of seizing the king's person until reparation should be made. Having landed on the following day with some marines, a scuffle ensued which compelled the party to retreat to their boats. Cook was the last to retire; and as he was nearing the shore he received a blow from behind which felled him to the ground. He rose immediately, and vigorously resisted the crowds that pressed upon him, but was soon overpowered.

Had Cook returned from his third voyage, there is ground for believing King George would have made him a baronet. Distinguished honours were paid to his memory, both at home and by foreign courts, and a pension was settled upon his widow. But in his life a very inadequate share of official reward was dealt out to the man who not only may be placed first among British maritime discoverers, but also gave his country her title, and so her colonies, in Australasia. As a commander, an observer and a practical physician, his merits were equally great. Reference has been made to his survey work and to his victory over scurvy; it must not be forgotten that along with a commanding personal presence, and with sagacity, decision and perseverance quite extraordinary, went other qualities not less useful to his work. He won the affection of those who served under him by sympathy, kindness and unselfish care of others as noteworthy as his gifts of intellect.

See the *Account of a Voyage round the World in 1769–1771, by Lieut. James Cook,* in vols. ii. and iii. of Hawkesworth's Voyages (1773); the *Voyage towards the South Pole and round the World . . . in . . . 1772–1775, written by James Cook . . .* (1777); a *Voyage to the Pacific Ocean . . . in 1776–1780,* vols. i. and ii. written by Cook (1784); also the *Narrative of the Voyages round the World performed by Captain James Cook,* by A. Kippis, D.D., F.R.S. (1788), long the standard life of the navigator, but now superseded by Arthur Kitson's *Captain James Cook, the Circumnavigator* (1907). *See* also E. S. Hodgson, *Captain Cook's Voyages* (1910); Y. G. Rowe, *Captain Cook, Explorer and Navigator* (1928). (C. R. B.)

COOK, SIR JOSEPH (1860–), Australian politician, was born at Silverdale, Staffs., and at the age of nine started life in a coal-mine. In 1885 he went to Australia and, six years later, entered the New South Wales Legislature, holding office as postmaster-general 1894–98 and minister of mines and agriculture 1898–99. He was elected to the Commonwealth Parliament for Parramatta as a free trader in 1901 and became minister for defence under Deakin 1909–10. In 1913, after the defeat of the Labour party, he became Premier and retained office until immediately after the outbreak of the World War. He did not take office again until 1917, when he was minister for the navy in W. M. Hughes's second ministry. From 1921 to 1927 he was high commissioner in London for the Commonwealth. In 1922 he was senior Australian delegate to the third Assembly of the League of Nations. He was created G.C.M.G. in 1918.

COOK, THOMAS (1808–1892), English travelling agent, was born at Melbourne in Derbyshire on Nov. 22, 1808. Beginning work at the age of ten, he was successively a gardener's help and a wood-turner at Melbourne, and a printer at Loughborough. At the age of 20 he became a Bible-reader and village missionary for the county of Rutland; but in 1832, on his marriage, combined his wood-turning business with that occupation. Cook persuaded the Midland Counties Railway Company to run a special train from Leicester to Loughborough and back at a shilling a head for a temperance meeting on July 5, 1841, and this is believed to be the first publicly-advertised excursion train ever run in England. In 1844 he entered into a permanent arrangement with the Midland Railway Company to place trains at his disposal, for which he should provide the passengers. At the Great Exhibition of 1851 Cook helped 165,000 visitors to attend. On the occasion of the Paris exhibition of 1855 there was a Cook's excursion from Leicester to Calais and back for £1 10s. The following year saw the first grand circular tour in Europe. "Cook's tourists" were at first personally conducted, but in the early '60s he began to be an agent for the sale of English and foreign tickets, the holders of which travelled independently. Switzerland was the first foreign country accessible under these conditions, and in 1865 nearly the whole of Europe was included in the scheme. Its extension to the United States followed in 1866. In the same year he began his system of "hotel-coupons," providing accommodation at a fixed charge. In 1882, on the outbreak of Arabi Pasha's rebellion, Thomas Cook & Son were commissioned to convey Sir Garnet Wolseley and his suite to Egypt, and to transport the wounded and sick up the Nile by water, for which they received the thanks of the war office. The firm was again employed in 1884 to convey General Gordon to the Sudan, and the men (18,000) and stores necessary for the expedition afterwards sent to relieve him. In 1889 Thomas Cook & Son acquired the exclusive right of carrying the mails, specie, soldiers and officials of the Egyptian Government along the Nile. In 1891 the firm celebrated its jubilee, and on July 19 of the following year Thomas Cook died.

COOKE, JAY (1821–1905), American financier, was born at Sandusky (O.), on Aug. 10, 1821. At the age of 18 he entered the Philadelphia house of E. W. Clark and Co., private bankers. Three years later he was admitted to membership in the firm. In 1858 he retired from the firm, and devoted himself to reorganizing some of the abandoned Pennsylvania railways and canals. On Jan. 1, 1861 he opened in Philadelphia the private banking house of Jay Cooke and Co., and floated at par a war loan of $3,000,000 for the State of Pennsylvania. In 1862 Salmon P. Chase, secretary of the Treasury, engaged him as special agent for the sale of the $500,000,000 of so-called "five-twenty" bonds. Cooke secured the influence of the American press, appointed 2,500 subagents, and before the machinery he set in motion could be stopped he had sold $11,000,000 more of bonds than had been authorized, an excess which Congress immediately sanctioned. At the same time he used all his influence in favour of the establishment of national banks, and organized a national bank at Washington and another at Philadelphia almost as soon as such institutions were authorized by Congress. In the early months of 1865, when the needs of the government were pressing, and the sale of the new "seven-thirty" notes by the national banks had been very disappointing, Cooke's services were again secured. As a result, between Feb. and July 1865 he had disposed of three series of the notes, reaching a total of $830,000,000.

After the Civil War Cooke became interested in the development of the north-west, and in 1870 his firm undertook to finance the construction of the Northern Pacific railway, but failed at the approach of the financial crisis of 1873. By 1880 Cooke had discharged all his obligations, and had again become wealthy. He died at Ogontz (Pa.) on Feb. 18, 1905. Cooke was noted for his piety. His estate at Ogontz became a school for girls.

See E. P. Oberholtzer, *Jay Cooke, Financier of the Civil War* (Philadelphia, 1907).

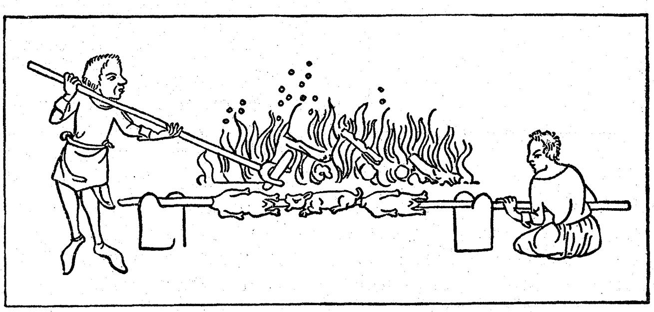
COOKE, ROSE TERRY (1827–1892), American writer, *née* Terry, was born at West Hartford (Conn.), Feb. 17, 1827, was educated at the Hartford Female seminary, and then found employment as a teacher. Her intense nature soon found vent in writing, however, and before she was 20 she had contributed to many magazines. She published in 1860 a volume of *Poems,* but after her marriage in 1873 to Rollin H. Cooke she was best known for her fresh and realistic stories, though in 1888 she published more verse in her *Complete Poems.* Her chief volumes of fiction, dealing mainly with New England country life, were *Happy Dodd* (1878), *Somebody's Neighbors* (1881), *Root-bound and Other Sketches* (1885), *The Sphinx's Children and Other People's* (1886), *Steadfast,* a novel (1889) and *Huckleberries Gathered from New England Hills* (1891). She died at Pittsfield (Mass.), on July 18, 1892.

COOKE, THOMAS (1703?–1756), English author, was born at Braintree, Essex, probably on Dec. 16, 1703. He went to London at an early age and in 1725 published his first important work, *The Battle of the Poets,* a poem which attacked some of the leading authors of the day, most notably Pope and Swift. Pope later retaliated by mentioning Cooke unfavourably in his *Dunciad.* Cooke wrote a number of other original works but he is best known for his translation of Hesiod into rhymed couplets, a work which gave him the nickname of "Hesiod" Cooke. He also translated some of the works of Terence, Plautus and Cicero. He died Dec. 29, 1756, at Lambeth.

COOKE, SIR WILLIAM FOTHERGILL (1806–1879), English inventor, was born at Ealing, Middlesex, May 4, 1806. He attended the University of Edinburgh and in 1826 joined the East Indian army, returning to England in 1832. In 1836 he attended at Heidelberg a demonstration of an experiment in transmitting messages by wire. Cooke at once began to experiment with the construction of an electric telegraph. Early in 1837, having returned to England, he was introduced to Charles Wheatstone, who had also been working with the telegraph and the two determined to form a partnership. In June of that year they were granted their first patent and subsequently made a number of tests of their new apparatus, but in that early model it proved too expensive for practicality. It was about this time that the quarrel between the two men arose over which should have the principal credit for their invention. Cooke alleged that Wheatstone was taking full credit undeservedly, while Wheatstone said that Cooke's invention had been impractical and that the patented telegraph was largely, if not wholly, his (Wheatstone's) work. In 1841 the dispute was submitted for settlement to Sir Marc Isambard Brunel, engineer of the Thames tunnel and a partisan of Cooke and Professor J. F. Daniell, King's college, a partisan of Wheatstone. On April 27, 1841, they published the statement that "Whilst Mr. Cooke is entitled to stand alone as the gentleman to whom this country is indebted for having practically introduced and carried out the Electric Telegraph . . . Professor Wheatstone is acknowledged as the scientific man, whose profound and successful researches had already prepared the public to receive it as a project capable of practical application . . ." This apparently settled the quarrel, for Cooke and Wheatstone issued a joint statement expressing their satisfaction with the decision, but in a few years the dispute flared again. There is, actually, little doubt that Wheatstone was the more important of the two in the history of the telegraph, but Cooke at least contributed his superior business skill to the partnership and his scientific contribution was not negligible. In 1845 the two men were issued the patent for their most important joint invention, an electric telegraph employing only a single needle. Cooke, who was knighted in 1869, died in Surrey, June 25, 1879.

COOKERY. The art of preparing and dressing food of all sorts for human consumption, of converting the raw materials, by the application of heat or otherwise, into a digestible and pleasing condition, and generally ministering to the satisfaction of the appetite and the delight of the palate.

Ancient Cookery.—It is obvious that opportunity has dominated its history, for the art of cookery is to some extent the product of an increased refinement of taste, consequent on culture and increase of wealth. To this extent it is a decadent art, ministering to the luxury of man, and to his progressive inclination to be pampered and have his appetite tickled. The Greeks learned by contact with Asia to increase the sumptuous character of their banquets, but we know little enough of their ideas of gastronomy. Athens was the centre of luxury. According to our chief authority, Athenaeus, Archestratus of Gela, the friend of the son of Pericles, the guide of Epicurus, and author of the *Heduphagetica,* was a great traveller, and took pains to get information as to how the delicacies of the table were prepared in different parts. His lost work was versified by Ennius. Other connoisseurs seem to have been Numenius of Heraclea, Hegemon of Thasos, Philogenes of



MEDIAEVAL COOKING IN ENGLAND (AFTER THE LOUTERELL PSALTER)

Leucas, Simonaclides of Chios and Tyndarides of Sicyon. The Romans, emerging from their pristine simplicity, borrowed from the Greeks their achievements in gastronomic pleasure. We read of this or that Roman gourmet, such as Lucullus, his extravagances and his luxury. The name of the connoisseur Apicius, after whom a work of the time of Heliogabalus is called, comes down to us in association with a manual of cookery. And from Macrobius and Petronius we can gather very interesting glimpses of the Roman idea of a menu. In the later empire, tradition still centred round the Roman cookery favoured by the geographical position of Italy; while the customs and natural products of the remoter parts of Europe gradually begin to assert themselves as the middle ages progress.

The Renaissance.—It is, however, not till the Renaissance, and then too with Italy as the starting-point, that the history of modern cookery really begins.

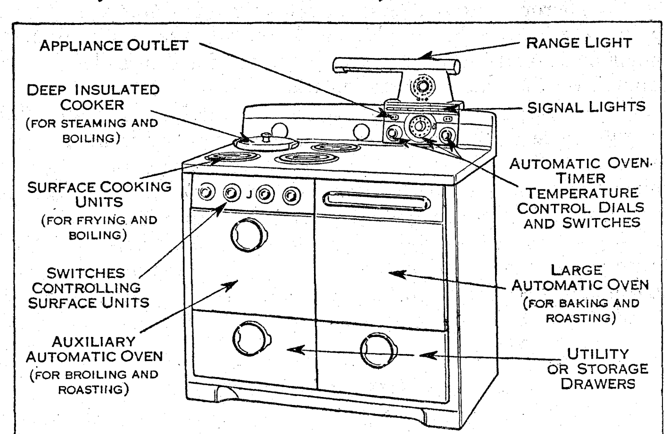
Montaigne's references to the revival of cookery in France by Catherine de Medici indicates that the new attention paid to the art was really novel. She brought Italian cooks to Paris and introduced there a cultured simplicity which was unknown in France before. It is to the Italians apparently that later developments are originally due. It is clearly established, for instance (says Abraham Hayward in his *Art of Dining*), that the Italians introduced ices into France. Fricandeaus were invented by the chef of Leo X. And Coryate in his *Crudities,* writing in the time of James I, says that he was called "furcifer" (evidently in contemptuous jest) by his friends, from his using those "Italian neatnesses called forks." The use of the fork and spoon marked an epoch in the progress of dining, and consequently of cookery.

Under Louis XIV further advances were made. His *maître d'hôtel,* Béchamel, is famous for his sauce; and Vatel, the great Condé's cook, was a celebrated artist, of whose suicide in despair at the tardy arrival of the fish which he had ordered Madame de Sévigné relates a moving story. The prince de Soubise, immortalized by his onion sauce, also had a famous chef.

In England, the names of certain cookery books may be noted, such as Sir J. Elliott's (1539), Abraham Veale's (1575), and the *Widdowe's Treasure* (1625). The *Accomplisht Cook,* by Robert May, appeared in 1665, and from its preface we learn that the author (who speaks disparagingly of French cookery, but more gratefully of Italian and Spanish) was the son of a cook, and had studied abroad and under his father (*c.* 1610) at Lady Dormer's, and he speaks of that time as "the days wherein were produced the triumphs and trophies of cookery." From his description they consisted of most fantastic and elaborately built-up dishes intended to amuse and startle, no less than to satisfy the appetite and palate.

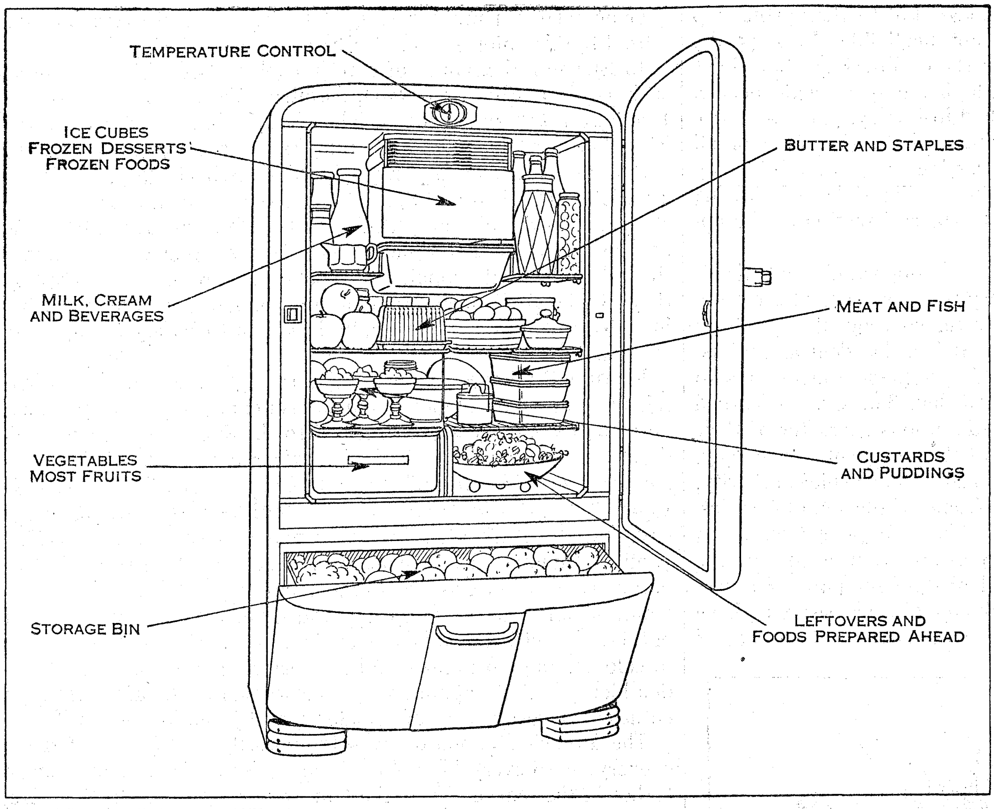
French Cookery.—Louis XV was a great gourmet; and his reign saw many developments in the culinary art. The mayonnaise (originally *mahonnaise*) is ascribed to the duc de Richelieu. Such dishes as *"potage à la Xavier," "cailles à la Mirepoix," "chartreuses à la Mauconseil," "poulets à la Villeroy," "potage à la Condé," "gigot à la Mailly"* owe their titles to celebrities of the day, and the Pompadour gave her name to various others. The Jesuits, Brunoy and Bougeant, who wrote a preface to a contemporary treatise on cookery (1739), described the modern art as "more simple, more appropriate and more cunning, than that of old days," giving the ingredients the same union as painters give to colours, and harmonizing all the tastes. The very phrase "cordon bleu" (strictly applied only to a woman cook) arose from an enthusiastic recognition of female merit by the king himself.

The French Revolution was temporarily a blow to Parisian cookery, as to everything else of the *ancien régime.* "Not a single turbot in the market," was the lament of Grimod de la Reynière, the great gourmet, and author of the *Manuel des amphitryons* (1808). But while it fell heavily on the class of noble amphitryons it had one remarkable effect on the art which was epoch-making. It is from that time that we notice the rise of the Parisian restaurants. To 1770 is ascribed the first of these, the *Champ d'oiseau* in the rue des Poulies. In 1789 there were 100. In 1804 (when the *Almanach des gourmands,* the first sustained effort at investing gastronomy with the dignity of an art, was started) there were between 500 and 600. And in 1814, to such an extent had the restaurants attracted the culinary talent of Paris, that the allied monarchs, on arriving there, had to contract with the two brothers Véry for the supply of their table. Among the great gastronomic names of Napoleon's day was that of his chancellor Cambacérès, of whose dinners many stories are told. Robert (the eponym of the *sauce Robert*), Rechaud, and Mérillion were at this period esteemed the Raphael, Michelangelo and Rubens of cookery; while A. Beauvilliers (author of *Art des cuisines*) and Carême (author of the *Maître d'hôtel français,* and chef at different times to the tsar Alexander I, Talleyrand, George IV and Baron Rothschild) were no less celebrated. Perhaps the greatest name of all in the history of the literature of cookery is that of Anthelme Brillat-



COURTESY OF BOSTON EDISON COMPANY

Fig. 1.—Modern electric range with automatic timer and temperature control. Range has two ovens and storage space



COURTESY OF BOSTON EDISON COMPANY

Fig. 2.—Modern automatic electric refrigerator

Savarin (1755–1826), the French judge and author of the *Physiologie du Goût* (1825), the classic of gastronomy.

Later History.—In England, Louis Eustache Ude, Charles Elmé Francatelli and Alexis Soyer carried on the tradition, all being not only cooks but authors of treatises on the art. The *Original* (1835) of Thomas Walker, the Lambeth police magistrate, is another work which has inspired later pens. Like the *Physiologie du Goût,* it is no mere cookery book, but a compound of observation and philosophy. Among simple hand-books, Mrs. Glasse's, Dr. Kitchener's, and Mrs. Rundell's were standard English works in the 18th and early 19th centuries; and in France the *Cuisinière de la Campagne* (1818) went through edition after edition. An interesting old English work is Dr. Pegge's *Forme of Cury* (1780), which includes some historical reflections on the subject. "We have some good families in England," he says, "of the name of Cook or Coke. . . . Depend upon it, they all originally sprang from real professional cooks, and they need not be ashamed of their extraction any more than Porters, Butlers, etc." He points out that cooks in early days were of some importance; William the Conqueror bestowed land on his *coquorum praepositus* and *coquus regius;* and Domesday Book records the bestowal of a manor on Robert Argyllon, by the service of a dish called "de la Groute" on the king's coronation day.

At the present time, whatever the local varieties of cooking, and the difference of national custom, French cooking is admittedly the ideal of the culinary art, directly we leave the plain roast and boiled. And the spread of cosmopolitan hotels and restaurants over England, America and the European continent has largely accustomed the whole civilized world to the Parisian type. The improvements in the appliances and appurtenances of the kitchen have made the whole world kin in the arts of dining, but the French chef remains the typical master of his craft. *See* GASTRONOMY, MODERN. (E. G. C.)

EARLY AMERICAN COOKERY

Early American cookery was very simple. A primitive method was to build a fire on stones, to heat them, rake off the ashes and coals, lay the food on the stones, and cover it to steam cook. Another method was to roast food in the hot ashes. Both of these survive in the New England clam bake, for which the clams, as well as lobsters, chickens, sweet potatoes, corn or other foods, are put on the hot stones, covered with seaweed and then with canvas, and left an hour or more. Hunters still cook birds by coating them with clay, feathers and all, and roasting in hot ashes. The name, if not the method, still survives in the south, in the hoe cake, originally cooked in the fields on a hoe blade thrust into the ashes.

Open fireplaces followed the Indian method of fire on the floor in the centre of the tepee. With the open fire, a large three-legged iron kettle, an iron frying pan, also with three short legs, wooden spoons or pudding sticks with long handles, and ladles often made of hollowed out gourds, sufficed for the preparation of cornmeal mush, stews made of wild game, including rabbits and woodchucks, and for frying bannocks or pancakes, fish and tender cuts of meat. Roasting was done on a spit before the open fire and baking in a Dutch oven before the fire. Most of the food eaten on the farm was raised there or found in woods and streams, and most of the people lived in the "country." Very few foods had to be purchased. The accounts in the cash book kept in 1801 in a country store within 50 mi. of Boston include only:

Molasses	Salt
Sugar	Chocolate and
Coffee	Biscuit
Tea	

For equipment they bought:

Earthen pots	Sugar bowls
Milk pans	Teapot
Platters	Cake pans, etc.

Many more entries in this book were for:

Tobacco	Brandy and
Rum	other liquors

Butter, cheese and veal were sometimes brought in to be exchanged for one of the above.

Following the open fireplace, a large brick oven was popular, built above and at one side of the fireplace so as to use the large chimney, on the other sides of which were the fireplaces to warm the living rooms. A fire was built inside this oven, usually only once a week, and in it was cooked enough baked food to last through the week. First, pies which were often served at every meal. Mince pies, after baking, were sometimes frozen then reheated during the winter, as needed, a precursor of modern quick-frozen cooked foods.

Bread was then baked, made light with liquid yeast to which more water, potato, sugar, salt, cornmeal, etc., were added from week to week, often making it last for years. If the yeast gave out, more was borrowed from a neighbour. Next, gingerbread, the hard thin kind that kept well, or for special occasions a pound cake would go in the oven, and always baked beans, brown bread and Indian pudding as the fire died down.

EQUIPMENT

Stoves.—About 1830 the first cook stoves were marketed. They were built to burn wood, of which there was an abundance. They had built-in ovens and a tank at the end for heating water. Then the coal stove came, and with the advent of city water, a coil of pipe was built into the range and running hot water was available. The kerosene oil stove was a boon for quick cooking and then came the range that used natural or artificial gas, and a separate gas-heated water boiler was installed in kitchen or cellar. Since about 1904 constant improvements have been made in gas ranges, and electric ranges now seem almost perfect (fig. 1). The oven heat of these ranges is controlled by a thermostat. The regulator is set for the temperature desired and the gas flame or electricity is automatically reduced when that temperature is reached and the heat is held there until shut off. Many ranges have electric clocks that can be set to turn on and shut off the electric current. Thermostats are also used to control the temperature of large fry kettles in which are cooked potatoes, fish, doughnuts, etc., in institutions, restaurants and hotels, and for many other pieces of large equipment.

Refrigerators.—With the perfected ranges have come gas and electric refrigerators (fig. 2) for the preservation of food, so that we no longer have to cool our food in the well or in the cellar or by means of huge cakes of ice. Units for the quick freezing and storage of fresh foods, commercially and in the home, are gaining in popularity.

Small Equipment.—Much small electric equipment has made cooking easier and pleasanter. Coffee percolators, toasters and orange juicers are used in preparing the typical American breakfast. Many toasters are automatic. Sliced bread is inserted, upright, and heat is turned off as soon as the bread is a golden brown. Egg cookers, waffle irons, chafing dishes, broilers and other electric gadgets have their uses.

Labour-saving electric equipment for the preparation of many kinds of food for large numbers of people is used in institutions, hospitals, hotels, restaurants and factories. Equipment with smaller motors is used in the home for beating and mixing, grating and chopping and grinding, extracting fruit juice, freezing ice cream and sherbets, and even shelling peas and shredding green beans.

Black iron utensils for cooking have practically disappeared. Frying pans, saucepans and double boilers are made of aluminum, steel, stainless, chromium plated or with enamel coating, and heat-proof glass. Large kettles and steamers are of aluminum to save weight. Tin, sheet-iron and aluminum are used for bread, cake and roasting pans and cookie sheets. Oven glass is very popular for all kinds of baking. Covered dishes, called casseroles, are used for stews, scalloped dishes and baked desserts. Oven platters of glass or chromium-plated steel and heavy oak planks go directly from the oven to the table.

Pressure cookers (fig. 3) or canners are kettles made of cast or sheet aluminum, porcelain-enamelled steel, or tinned steel. Each has a cover held on with screws or other device, and some type of pressure gauge, pet cock, safety valve and closure.

The stores are full of small gadgets some of which are a great help in saving time and labour. Knives and flexible spatulas are made of stainless steel which needs little scouring. The rotary eggbeater is superseded, for many purposes, by the electric mixer, the chopping bowl and knife by the food chopper, etc.

Thermometers.—Cookery is becoming more and more a matter of using thermometers to get the best results in keeping and cooking food. Candy thermometers are used in sugar cookery and candy making. They register up to 400° F.

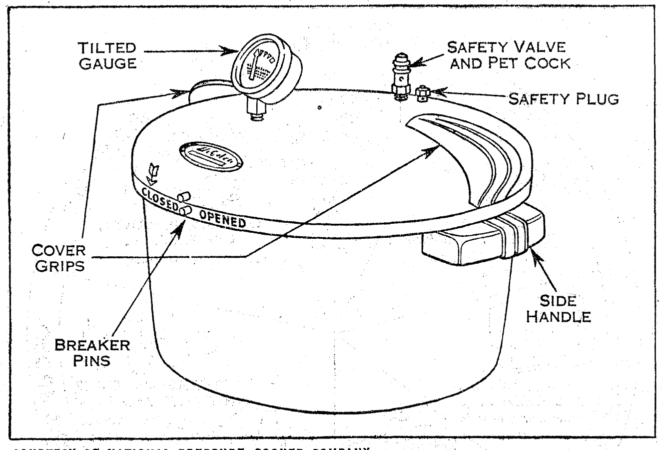
Fat thermometers are used to test fat for deep-fat frying and register up to 600° F.

Oven thermometers register the temperature of the oven and are used to test the accuracy of thermostat control or when there is no thermostat.

Meat thermometers thrust into the centre of a piece of meat or poultry show when the roast is cooked rare, medium or well done.

Refrigerator thermometers show the temperature in any part of a refrigerator. The temperature should not go above 40°–45° F.

Milk thermometers are used in testing the temperature of milk in bread and cheese making and for the baby's formula.



COURTESY OF NATIONAL PRESSURE COOKER COMPANY

Fig. 3.—Modern pressure cooker, used for the preparation of meals and for canning

Tables showing the temperatures that are best for baking, frying, candy making, etc., are found in modern cook books.

The teaching of cookery commenced in the United States about 1870. It is now taught in most public schools, and many colleges have home economics departments in which the preparation of foodstuffs and especially the nutritive value of foods is taught most scientifically. The composition of food has received increasingly more attention since about 1890.

NUTRITION

Since the discovery of factors in food, unknown until about 1914 and now called vitamins, millions of dollars have been spent in scientific food investigations in the laboratories of universities and food and equipment factories. In 1942 a national nutrition council of leading doctors, dietitians and nutritionists was called in Washington, D.C., U.S.A., to consider the best methods by which to acquaint the public with the necessity for a wiser daily choice of foods in order to promote better general health.

While food values had been stressed for years in schools, hospitals and dispensaries and by home demonstration agents and many others, this had not prevented a large number of men from being unfit for military service.

The chart shown in fig. 4 has been used on posters, in books, magazines and advertisements to acquaint the public with what they should eat. In thousands of classes women have been taught the best way to prepare these foods to conserve vitamins and minerals, and cooking today, 1944, is based on laboratory findings that show how to retain the greatest amount of nourishment in the food.

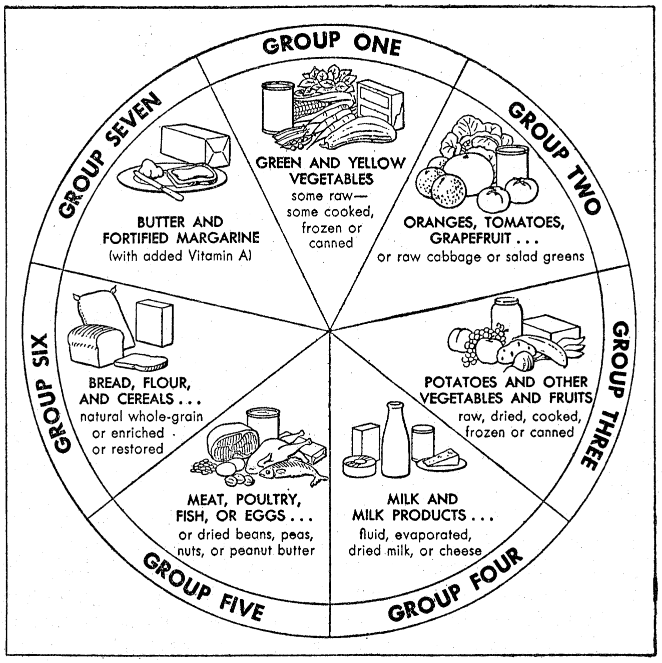
Dietitians.—Since 1900 more and more women trained in nutrition and in the purchase, preparation and serving of food, have taken charge of the feeding of groups of people in hospitals, schools and institutions and in many hotels, restaurants and factories. More people eat away from home every year, and they are getting better food, better prepared and in better planned meals, because of the educated women who are in charge of the cooks.

PROCESSING FOOD

From the time when nearly every family took its own corn to be ground, and slaughtered its own pig, to the present time, enormous strides have been made in the processing, in quantity, of almost every kind of food. Less and less raw food is being cooked in the home. The necessities of feeding the soldiers and Allies during World War II brought about the development of many new methods of processing food to conserve vitamins and minerals and make it keep without spoiling in any climate, under every adverse condition and to occupy the smallest possible space.

Smoking is used not only for the preservation of ham and bacon, but for many kinds of sausages and for turkeys, haddock and salmon.

Drying in the sun or under controlled conditions is used for codfish and for prunes, raisins, dates and figs, and all kinds of beans and peas. Modern machinery is used to remove the moisture



COURTESY OF U.S. WAR FOOD ADMINISTRATION

Fig. 4.—Chart showing the Seven Basic Foods as advocated by the U.S. government for the promotion of health

from milk, eggs, fresh vegetables, fruits, fruit juices, soups, baked beans and meat so that they will keep a long time and occupy little space. In most cases this is done with very little loss of food value.

Canning.—Nearly every kind of food can be purchased in a can of glass or tin, ready to be eaten either hot or cold.

The homemaker with a victory garden in 1944 is canning millions of pints, and quarts of fruit, vegetables, meat, poultry and fish, to replace that which is being sent all over the world.

Freezing.—Since 1930 quick freezing of foods has become very popular, and many kinds of fruit and berries, vegetables, poultry, meat and fish are available in this form. The food is prepared for cooking, wrapped and packaged in 1-lb. and larger cartons and frozen very rapidly. As long as they remain frozen these foods are just as good as though freshly picked or killed or caught. Frozen foods should remain frozen until they are put to cook, or if to be used without cooking, defrosted as short a time as possible before being used. Frozen food may be put directly into boiling water or into a steamer, pressure cooker, oven or broiler.

Enriching.—Because much of the food value of wheat is removed in the process of milling, the U.S. government decreed that this nourishment should be returned to white flour and to white bread and bakery products, and beginning early in 1944, vitamins and minerals were being added to wheat products including cereals, to make them of equal value with the whole grain. Vitamin A is added to most brands of margarine to make it compare favourably with butter of which there is not always a sufficient amount to supply the demands of the public. Vitamin D is produced in much of the evaporated milk that is sold. It is called irradiated milk.

Packaging.—Methods of packaging have made it possible to take from the shelves of the modern food shop almost every kind of food. Fresh fruits and vegetables are exposed where the customer can select them and meat, fish and poultry are shown in glass-topped refrigerated cabinets where one can see and select just what one wishes.

Many packages show their contents through glass or cellophane, and all packaged and canned goods for interstate shipment must tell on the label what the package or can contains.

METHODS OF COOKING

Baking is cooking in an oven. Best results are obtained by having a thermostatic control or using an oven thermometer.

Kind of Oven	*Temperature*
Very slow	220° F.
Slow	250° F.
Moderate	350° F.
Hot	400° F.
Very hot	450°–500° F.

Casserole cookery is baking in the oven in a covered dish of glass or pottery.

Roasting, originally applied to meat cooked on a spit before an open fire, is now applied to food, usually meat, baked in an oven. A meat thermometer is a great help in serving roast meats done as they should be.

Braising is cooking in a small amount of liquid, below boiling point, on top of the stove or in the oven. The meat is first browned in a small amount of added fat, then covered and cooked slowly in the juices from the meat, or in a small amount of added liquid. This is usually water but may be meat stock, milk, cream, dilute vinegar or juices from vegetables. Vegetables and seasonings are usually cooked with the meat for additional flavour.

Boiling is the term applied to water when in a state of ebullition or when it has reached a temperature of 212° F. at sea level. At high altitudes the boiling point is appreciably lower, and food takes longer to cook. The pressure cooker is of advantage at high altitudes as it raises the temperature of the water and makes for more rapid cooking. Boiling water is used in making beverages as tea and coffee, and in cooking vegetables, cereals, macaroni and other pastes. Boiling water is used in the under part of double boilers, in bains-marie and pressure cookers, and in processing canned foods. Most top-of-the-stove cooking is done at boiling point or a few degrees below.

Blanching is achieved by dipping food in boiling water to assist in removing skin, or to bleach.

Parboiling is to partly boil or partially cook, in water or (for shellfish) in their own juices.

Water and sugar, molasses or syrups are boiled for candy, frostings, etc. Fruit or fruit juices and sugar are boiled in making jams and jellies. The candy thermometer is a help in these types of cooking.

Sauces made with fat, flour and liquid are brought to the boiling point with frequent stirring or cooked in a double boiler, with boiling water underneath, until thickened.

Scalding is to heat just below boiling point, usually in the top of a double boiler. Milk is scalded at 196° F.

Simmering is cooking in water a little below the boiling point or at 185° F. This is the best temperature for "boiled" meat and eggs. Stock is made by cooking meat, poultry, fish, vegetables and seasonings in water at simmering temperature.

Stewing is cooking in water, preferably at 185° F. on the stove or in the oven.

Steaming.—When water boils it goes off as steam. Steaming is cooking food in the steam from boiling water. Fish and most vegetables may be cooked in this way in a covered perforated steamer over boiling water or in a covered saucepan or other utensil with less water than will cover the food. Many foods are cooked in covered moulds or tins or in double boilers surrounded by boiling water and steam.

Pasteurizing is cooking food in bottles or jars surrounded by water at a temperature of 140° F. to 145° F., or sufficient to kill any possible germs. City milk is usually pasteurized before being delivered.

Broiling or **grilling** is cooking food on a broiler or gridiron over hot coals or under or over a gas or electric unit. Food is seared first on one side and then on the other, then cooked more slowly to the desired condition. This has always been considered the best method for cooking tender cuts of meat and slices of fish. Tomatoes, some fruits and sliced cooked vegetables may be prepared in this way. Fireplaces in parks and backyards are frequently used in the summer for broiling. Bread is toasted or browned by broiling. Two slices of bread or split buns "broiled" with meat or other sandwich filling between are popular as toasted sandwiches.

Pan-broiling is cooking in a heated pan on top of the range with only enough fat to prevent sticking.

Sautéing is cooking in a pan on top of the range, in a small quantity of fat.

Frying in a small amount of fat is really sautéing—sometimes called pan-frying. Frying in deep fat or French frying is cooking in fat or oil deep enough to cover the object to be fried. Most articles, except potatoes, that are fried in deep fat contain egg or are coated with egg. A fat thermometer that registers up to 600° F. is best for testing the fat.

The best temperature for:

Uncooked mixtures—doughnuts, fritters, etc.	370° F.
Croquettes and other cooked mixtures	390° F.
Potatoes, raw	370–395° F.
Breaded chops	360–400° F.
Fish, small, whole or fillets	370° F.

Fricasseeing is browning meat or poultry in a small amount of fat and simmering in or serving with a sauce. Food is usually pre-cooked but tender cuts may be fricasseed without previous cooking.

FOOD PREPARATION

Beverages.—Glass and china are best for coffee and tea pots. The flavour is better than when they are brewed in metal. Coffee is made in a drip or percolator pot or by boiling for from one to three minutes.

Tea is made by pouring fresh boiling water over tea leaves or tea bags and straining off after five minutes.

Cocoa and chocolate are usually boiled with a small amount of water and added to milk heated in a double boiler.

Fruit drinks and punches are made of fruit juices, fresh or canned, diluted with plain or carbonated water, sweetened to taste and served iced.

Appetizers.—The Swedish smorgasbord, the Italian antipasto and the French hors d'oeuvre tray are popular in the United States. Many dainty tidbits, served as a first course, make a party meal of a simple luncheon, dinner or tea.

Small crackers and thin pieces of toast spread with highly seasoned cheese, fish pastes, devilled meat, etc., are called canapés. Fruit or shellfish in small pieces with a sauce are called cocktails, as are fruit and vegetable juices and liquors served in small glasses.

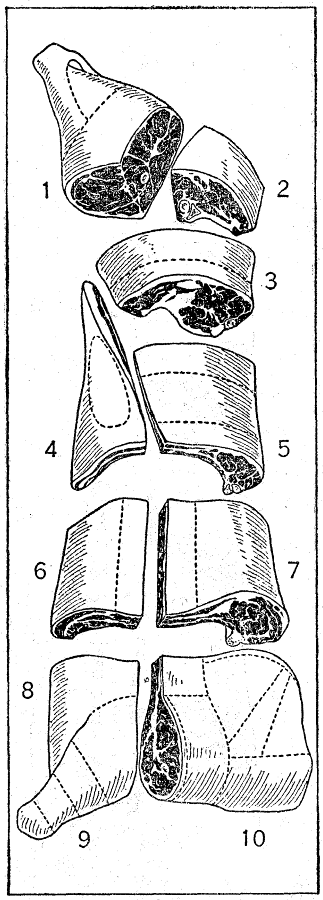
Fish, eggs, vegetables, fruit and cheese in various shapes and combinations are used as appetizers or hors d'oeuvres.

Fresh Fruits.—Many kinds are served without cooking. Citrus fruits and juices are especially popular at breakfast since they are the best source of vitamin C. A fruit cup or cocktail is a mixture of fruits, cut in small pieces, chilled and served in a cocktail glass. Many fruits are stewed or canned in a syrup of sugar and water. Apples, bananas, pears and quinces are baked with sugar and little or no water. Prunes, apricots and other dried fruits are usually soaked in water to cover before being boiled or simmered.

Yeast breads are made light with compressed or dry yeast. Most bread is made in 1944 from enriched white wheat flour with salt, sugar, fat and water or milk. Whole-wheat flour, rye flour, soybean flour, corn meal, rolled oats, bran and other cereals, or cooked potato may replace part of the wheat flour. In a dark bread, molasses is used instead of sugar. Orange juice, or tomato juice may replace other liquid. Eggs, raisins, prunes, nuts, cheese, cinnamon and other spices, cardamom and caraway seeds are sometimes added.

Rolls and biscuits in many shapes and sizes are made from yeast mixtures. After mixing, yeast dough is kept covered in a warm place until it has become light and full of bubbles of CO_2 gas, it is then cut down, shaped, put in pans and left to rise again before being baked. Bread needs a 375° F. to 425° F. oven. Rolls and biscuits a 425° F. to 450° F. oven. More bread and rolls are probably baked in commercial bakeries than in the American home.

Sandwiches are made of two slices of bread, usually spread with butter, put together with a filling of meat, chicken, eggs, fish, cheese, nuts, jam, etc. Fillings should be smooth and well flavoured. For lunch boxes these are cut in two and wrapped in wax paper. For teas and parties the bread is thinner and sandwiches are in small fancy shapes. Sandwiches are often toasted.



COURTESY, NATIONAL LIVE STOCK AND MEAT BOARD

Fig. 5.—Chart showing the wholesale cuts of beef: 1, round; 2, rump; 3, loin end; 4, flank; 5, short loin; 6, plate; 7, rib; 8, brisket; 9, shank; 10, chuck

Toast is crisp or soft, used plain with butter, jam or marmalade, in sandwiches and as a base for serving all kinds of meat, fish, eggs and vegetables in a sauce, and with milk plain or thickened as milk toast. Melba toast is made of very thin slices of bread, dried and browned in a slow oven. Stale bread may be cut in slices, buttered and cut in strips or dice, browned in moderate oven and served with salad or soup. As an accompaniment to soup these cubes are called croutons. Dry bread is forced through a food chopper or grater and as bread crumbs is used for coating food to be fried. When mixed with one-fourth as much melted fat, these are called buttered crumbs and used as a coating on baked dishes.

Stale bread with fat, seasoning and water or other liquid is used for stuffing veal, lamb, poultry and fish. Oysters, mushrooms, sausage meat and many other ingredients are often added. Soft bread crumbs are used in many made dishes.

Quick bread and biscuits are made light with baking powder or with soda, and cream of tartar, sour milk or molasses. These mixtures may be made of the same ingredients as suggested for bread. After mixing they are put in bread or cake pans or shaped and placed on cookie sheets and baked at once, usually in a 450° F. oven, except Boston brown bread which is put in a tightly covered tin and steamed, surrounded with boiling water.

Biscuit mixtures, in packages, needing only milk or water to be added are on the market.

Griddle cakes and waffles are cooked on top of the stove or in a waffle iron. A soft mixture, or batter, made of flour, milk and eggs, with baking powder, salt and shortening is used. Other ingredients, suggested under bread, may be added. Many packaged mixtures are on the market, some requiring the addition of liquid only.

Doughnuts are made of a similar but stiffer mixture. Shaped in rings or braids they are fried in deep fat at 370° F.

Batters are thin mixtures of flour, milk and egg. Fish, tripe, and many vegetables and fruits are dipped in or coated with batter and fried in deep fat heated to 370° F.

Cereals are made from different grains left whole, cracked, rolled or ground coarse or fine. Some are entirely cooked and served as they come from the package. Some are partially cooked so that five minutes cooking in boiling water with salt is sufficient. A double boiler is used to prevent burning. Whole grains and coarse cereals require one to three hours. Cereals which lose vitamins and minerals in being milled often have them restored before being packaged. Cooked cereals, especially corn products, are moulded, sliced and pan-fried.

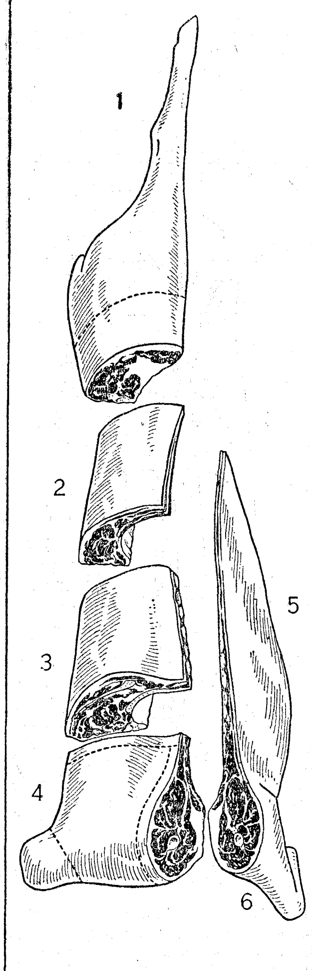
Rice is boiled or steamed or baked, in water, milk or tomato juice.

Macaroni is boiled until tender in plenty of salted water, drained and combined with white or tomato sauce, with cheese, meat or mushrooms. Noodles and spaghetti are cooked in the same way. Many of these pastes are made with soybean flour added to the wheat flour.

Eggs are soft or hard cooked in the shell, or poached out of the shell in salted water just below the boiling point. They may be combined with a sauce or used in salad. Eggs are baked, scrambled, pan-fried, used in custards, soufflés and French and puffy omelets, and are a necessity in many desserts, in cakes and most cookies.

Cheese is obtainable in many varieties. It is used without cooking as an accompaniment to many foods or in sandwiches. Cream, cottage and Roquefort cheese are extensively used in salads, especially with fruit. Firm cheese is often grated and used with vegetables and eggs. Cheese is added to bland dishes made with bread, macaroni, cereals and potatoes. Cheese mixtures, like rarebits and sauces, and in other combinations, should be cooked below boiling point or in a double boiler. Care should be taken that it is never over-cooked.

Soups are made from stock to which salt, pepper, onion, herbs and other seasonings are added for flavour. Many varieties of soup may be purchased dehydrated, in cartons, or condensed in cans requiring only to be boiled with water for a few minutes.



COURTESY, NATIONAL LIVE STOCK AND MEAT BOARD

Fig. 6.—Chart showing the wholesale cuts of lamb: 1, leg; 2, loin; 3, rack; 4, shoulder; 5, breast; 6, shank

Brown stock is the water in which beef has been cooked.

White stock is the water in which chicken, fowl or veal has been cooked.

The water in which ham or pork bones have been cooked is often used for pea and bean soups.

Fish stock is the water in which fish and fish bones have been cooked.

Vegetable stock is the water in which vegetables have been cooked.

Broth is made from beef, lamb or chicken cut in small pieces. Cooking is started in cold water and completed by simmering. Rice or barley are frequently added.

Bouillon is beef stock cleared with egg white. Bouillon cubes, powders and pastes with beef or chicken flavour, largely replace meat stock in home cooking. Clam bouillon is made from clams in the shell.

Consommé is soup made of beef, chicken or veal, vegetables and other seasoning, and cleared with egg whites.

Cream soups are made of white stock, fish stock, or vegetable stock with milk or cream and seasonings, and slight thickening of flour and fat. Any vegetable stock and cooked vegetable rubbed through a sieve may be used.

Bisque is made from shellfish or tomato with milk and seasonings.

Vegetable soups are made with stock or water and one or more vegetables in small pieces.

Chowders are made from fish, fresh or canned, or shellfish or from corn or other vegetable with salt pork, onion, potato dice, milk or tomato and seasonings.

Sauces for meat, fish and vegetables are made of liquid thickened usually with fat and flour, called roux, and well seasoned.

White sauce is made of milk, or a combination of milk or cream and white stock for the liquid.

Fish sauce is made like white sauce, using fish stock or hot water for the liquid.

Brown sauce is made from brown stock or water. The fat and flour are well browned before the liquid is added.

Gravy is made from the fat in the roasting pan. Flour is browned in the fat and liquid added.

Tomato sauces are made with strained tomato or tomato juice as all or part of the liquid called for.

Cheese, eggs, egg yolks, green and red peppers, celery, onion, mushrooms and other vegetables, when added, give their own name to these sauces.

Hollandaise sauce is made of egg yolks, butter, lemon juice and seasonings, and has many variations. Other sauces that add variety to meat, fish, egg and vegetable dishes include raisin sauce, orange sauce, and butter creamed with lemon juice, chopped parsley, etc.

Fish.—There are many edible varieties of salt-water fish, and of fresh-water fish and many kinds of shellfish. Fish is purchased whole; in slices; in thick portions from the centre of large fish; or skinned and boned as fresh or frozen fillets. Fish should be kept covered closely in a cool place and used as soon as possible. Fish is at its best when very fresh, served free of skin and bones, and with butter, lemon, or a suitable sauce. Quick-frozen fish, canned fish, especially salmon and tuna, and salt and smoked fish are available far from ocean, lake or river.

Broiled Fish.—Small or medium-sized fish, steaks or fillets are seasoned with salt and pepper, brushed with melted fat and broiled until brown first on one side then on the other (see *Broiling*).

Fried Fish.—Small fish, fillets or steaks are seasoned, coated with corn meal, flour or crumbs and sautéed in a small amount of fat; or coated with egg and crumbs, or dipped in batter, and fried in deep fat.

Baked Fish.—Whole, medium-sized fish, steaks and fillets are baked until nicely browned and tender. Fish are often stuffed before baking or stuffing may be put between two fillets. If fish are not fat, salt pork or other fat should be placed on top of the fish. Fish is often baked in milk, tomato, brown sauce, cheese sauce or wine.

Boiled Fish.—Medium-sized fish or thick pieces of fish are placed on a plate, wrapped in a square of cheesecloth and plunged into boiling water with salt and vinegar, then cooked below boiling point until flesh leaves the bone. Onion and other seasonings are usually added to the water. A sauce is always served with boiled or steamed fish.

Steamed Fish.—Steaming is preferable to boiling as more flavour is retained in the fish.

Creamed Fish.—Fish cooked, canned, including shellfish, salt or smoked are separated in flakes, free from skin and bones, and reheated in white sauce in a double boiler, or in the oven with buttered crumbs on top.

Fish Hash.—Cooked fish, or freshened shredded salt fish, is mixed with twice as much cooked and mashed potato, and pan-fried in pork fat.

Fish Balls.—The mixture for fish hash is shaped in flat cakes before pan-frying, or with an egg added is cooked in deep fat at 385° F. for one minute or until brown.

The most commonly used shellfish are clams, crabs, including soft-shelled and oyster crabs, lobsters, oysters, scallops and shrimps. Oysters and clams are often served raw with cocktail sauce. All are used in soups and chowders. Clams are steamed and served in their shells. Live lobsters are split and baked or broiled. Clams, oysters and scallops are fried. Crabs, lobsters and shrimps are boiled and the meat used, as are the other shellfish, in salads, with sauces and in many other ways.

Meat.—The wholesale cutting of the carcasses of live stock is uniform throughout the United States (see figs. 5–8). Local butchers separate the large cuts into the many smaller pieces listed in Tables I-IV.

Meat Cookery.—Since 1929 a vast amount of research has been sponsored by the National Live Stock and Meat Board, and the U.S. department of agriculture, bureau of home economics, and in universities and colleges, with the following conclusions:

Roast Meat.—Tender cuts of meat are placed in the roasting pan, fat side up, and cooked in a 300°–350° F. oven. At this temperature the roast is uniformly done throughout, cooking losses are less than with higher temperatures, the meat is more palatable, and bones and fat are not charred. Searing in a hot oven and basting are not necessary, no cover is used on the pan, and no water is needed in the pan. This method requires little attention, not much fuel, and there is little spattering of fat in the oven. An oven thermometer or thermostat is necessary and a meat thermometer thrust into the thickest part of the roast registers rare, medium and well done for beef, and well done for other meats. The time for roasting meat depends on the oven temperature, the weight and the shape of the roast, the degree of doneness desired and the proportion of lean and fat in the meat.

TABLE I.—*Meat Cuts for Roasting*

Beef	Veal	Pork	Lamb
Rib	Leg	Ham	Leg
Standing	Loin	Fresh	Loin
Rolled	Shoulder	Smoked	Shoulder
Chuck ribs	Boned and	Loin	Boned and
(of good quality)	rolled	Picnic shoulder	rolled
Tenderloin	Boned and	Fresh	Boned and
Rump	stuffed	Smoked	stuffed
Top round		Boston butt	Ribs
(of good quality)		Crown roast	Crown roast

TABLE II.—*Meat Cuts for Broiling*

Beef	Lamb	Pork
Sirloin steaks	Shoulder chops	Ham slice
Pin-bone	Rib chops	Bacon
Round-bone	Loin chops	Sausage
Wedge-bone	English lamb chops	
Double-bone	Steaks from the leg	
Porterhouse steak	Ground lamb patties	
Club steak		
Rib steak		
Tenderloin (filet mignon)		
Chuck steak		
(of good quality)		
Ground beef patties		

Broiled Meat.—Experiments in broiling steaks have shown that a moderately low broiling temperature is best. The temperature at the top of the steak (or about three inches below the broiling unit) is about 350° F. during all or most of the cooking. Steak may first be seared at a higher temperature if a very brown, crisp exterior is preferred, then the heat can be decreased. Broiled meat is seasoned with salt and pepper and spread with butter. Beef steaks and lamb chops, one to two inches thick, are best

TABLE III.—*Cuts Cooked by Braising*

Beef	Pork	Lamb	Veal
Neck	Rib chops	Breast	Breast
Fore shank	Loin chops	Neck slices	Steak
Chuck	Shoulder steaks	Shank	Rib chops
Brisket	Tenderloin	Shoulder	Loin chops
Plate	Steaks from leg	Shoulder chops	Shoulder chops
Short ribs	Heart	Heart	Shoulder
Flank steak	Kidney	Kidney	Cuts from leg
Heel of round	Liver	Liver	Heart
Round steak			Kidney
Rump			Liver
Oxtails			
Heart			
Kidney			
Liver			

and it is desirable that a meat thermometer be inserted horizontally to test the doneness.

Pan-broiled Meat.—Steaks and chops that are less than one inch thick may be pan-broiled. Hamburg, minute and cube steaks are pan-broiled.

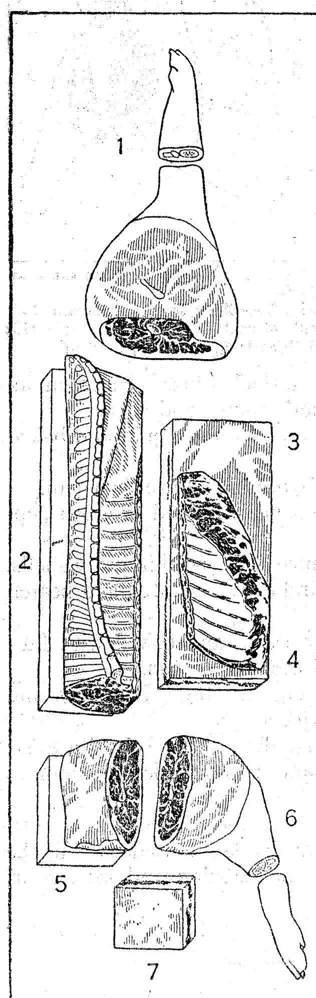
Braising is used in the preparation of those cuts of meat that are not quite tender enough for roasting or broiling, and for pork and veal steaks and chops, which usually become too dry when broiled. Meat is cooked by low heat on top of the stove, or in a slow oven until it is tender. As with roast meats, the time depends on the size, shape and tenderness of the meat, and varies from 45 minutes to four hours.

Pot-roast is the name applied to a large piece of beef that is braised. A piece weighing three to four pounds requires 40 to 50 minutes per pound.

Meats Cooked in Water.—This is a moist heat method and

TABLE IV.—*Cuts Used for Stews*

Beef	Lamb	Veal
Fore shank	Neck	Neck
Neck	Breast	Breast
Brisket	Shoulder	Shoulder
Plate	Flank	Flank
Short ribs	Kidney	Kidney
Chuck		
Flank		
Heel of round		
Kidney		



COURTESY, NATIONAL LIVE STOCK AND MEAT BOARD

Fig. 7.—Chart showing the wholesale cuts of pork: 1, ham; 2, loin; 3, side; 4, spareribs; 5, butt; 6, picnic; 7, jowl

used in the preparation of the less tender cuts, in small or in large pieces.

Stews.—A stew is made of small uniform pieces of meat, simmered in liquid in a heavy covered kettle, with or without vegetables. For a brown stew the meat is browned before water is added; for a light stew the meat is not browned. Almost any vegetable or combination of vegetables may be added, with due regard to uniform shapes and pleasing colour and flavour.

Large Cuts Cooked in Water.—Corned beef and cured hams, shoulders and spareribs, neck and shank of veal, and tongues and hearts are the chief large cuts cooked in water, although other pieces may be so cooked. The meat is completely covered with water and simmered until tender. The time varies according to the weight and method of processing. In a pressure cooker two cups of water is sufficient. The pressure is kept at 10 lb. and meat cooks more quickly than when simmered.

Variety Meats.—During World War II emphasis was placed on the nutritive value, economy and many uses of brains, hearts, kidneys, liver, sweetbreads, tongue and tripe, and also of oxtails and pigs' feet. These are prepared by various methods; most of them are first simmered in water and then served with a sauce. Calf's liver is often pan-fried or broiled or baked with bacon.

Sausages.— Those made of fresh pork are cooked slowly, first in a little water then browned. Smoked sausages require reheating only. Bologna needs no cooking. Dry or summer sausages are ready to serve.

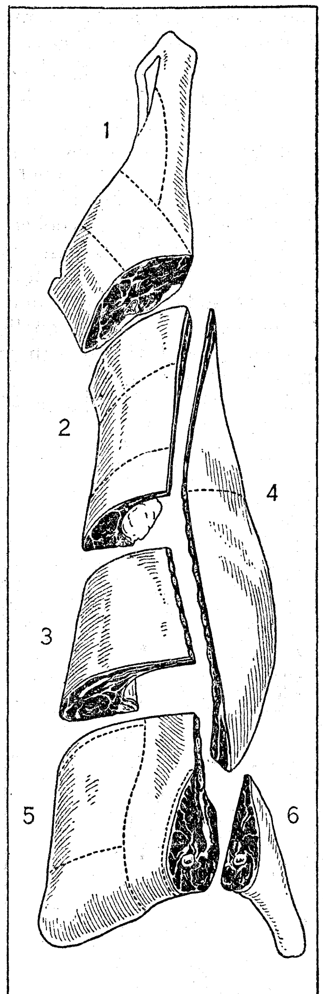
Cooked specialties or prepared meat products of many kinds in cans, loaves and casings need no cooking.

Cooked meat is used in hash, meat pies, scallops, sandwiches and other entrees.

Poultry and Game.—Poultry includes all domestic birds suitable for food, as chickens, fowl, guinea fowl, turkey, duck, geese, pigeons and squab. Rabbits and Belgian hares are raised for the market.

Game includes all wild animals and birds suitable for food, such as quail, partridge, plover, wild duck, deer, reindeer and moose.

Chicken, turkey and duck are first cleaned and dressed and then most of them may be baked or roasted, braised, broiled, fried, stewed or fricasseed. After cooking they may be creamed and used in other made dishes, salads and sandwiches, and served in a great variety of ways.



COURTESY, NATIONAL LIVE STOCK AND MEAT BOARD

Fig. 8.—Chart showing the wholesale cuts of veal: 1, round; 2, loin; 3, rib; 4, breast; 5, shoulder; 6, shank

Entrees.—Entrees are served as a special course at very formal dinners or as a main course at informal lunches, dinners and suppers. They are dishes made from cooked meat, poultry, fish, eggs or cheese and vegetables. These are called:

Croquettes when combined with a thick sauce, shaped in individual portions, coated with egg and crumbs and fried.

Timbales when mixed with eggs, crumbs and liquid and baked in small moulds.

Loaves when made of timbale mixture baked in a loaf pan.

A la king when added to a white sauce with red or green pepper and mushrooms.

Patties when mixed with a rich sauce and served in patty shells.

Soufflés when mixed with sauce and eggs separated and beaten very light, and baked.

Au gratin when combined with a sauce and baked with buttered crumbs, or grated cheese and crumbs, on top.

Many menus include among the entrees stews, fricassees and other meat dishes that are served with a sauce.

Vegetables.—The cooking of vegetables has received a great deal of attention in many food laboratories in order to conserve vitamin values.

The United States bureau of home economics offers the following suggestions as a summary of all available knowledge about the conservation of vitamin values in the cooking and serving of foods in the home:

Buy firm, fresh vegetables.

Don't let vegetables soak before cooking.

Don't stir air into foods while cooking.

Don't put them through a sieve while still hot.

Don't use soda in cooking green vegetables.

In boiling foods, raise the temperature to the boiling point as rapidly as possible.

Use as little water as possible.

Don't use long cooking processes such as stewing when shorter methods are feasible.

Don't throw away the water in which vegetables have been cooked. Use it in making gravies, sauces and soups.

Prepare chopped fruit and vegetable salads just before serving.

Start cooking frozen foods while they are still frozen.

Serve raw frozen foods immediately after thawing.

Green and yellow vegetables and tomatoes stand at the head of the list, being especially rich in vitamins.

Most vegetables may be eaten raw. Vegetable juices, especially tomato juice, retain most of their vitamins, and are popular served as cocktails, plain, or with additional seasoning, and are easy to use for sauces, jellied salads and in made dishes.

Boiled Vegetables.—Most vegetables are boiled or steamed, then dressed in various ways with sauces, chopped parsley, etc. Pressure cookers reduce the time for boiling vegetables; asparagus tips for instance cook in one to two minutes and even whole beets take only 15 to 18 minutes.

Baked Vegetables.—Vegetables that are good baked include:

American artichokes	Onions
Beets	Potatoes and
Acorn squash, halved	Sweet potatoes
Marrow squash in strips	

Cooked vegetables are used in soups and salads, reheated in a sauce, broiled or pan-fried.

Potatoes are served almost daily. Boiled in their skins until tender they retain most of their vitamins. Baked in their jackets is the next best way to conserve vitamins. They are fried in deep fat. After boiling they are browned in the oven with roast meat, pan-fried, mashed, served with a sauce, or used in soup or salad. One cook book has directions for serving potatoes in 224 different ways.

Sweet potatoes are baked or boiled, then may be served mashed, candied, creamed, etc.

Dried vegetables, including beans of many varieties, peas, green and yellow, whole and split, lentils and peanuts, which belong to the same family, are all used as meat substitutes. Ordinarily dried beans, peas and lentils are soaked in water overnight or for several hours, then baked or simmered until tender, or used in soup or with a sauce. Soybeans are being used more extensively since 1943 than ever before in the United States. They are purchased whole, tenderized, as grits, as flour and as nuts. The grits are used in sausages and other meat preparations. The flour is used in the manufacture of macaroni and other pastes and in prepared flours, as well as in the home to replace about one-fourth the wheat flour in many recipes. The protein of soybeans being more nearly like meat protein than that of other kinds of beans makes them especially valuable.

Baked beans, canned or quick frozen, require only to be heated.

Nuts.—Almonds, Brazilnuts, cashew nuts, filberts, pecans and walnuts are roasted and salted, or used in salads, cakes, cookies, candy, etc.

Peanuts are roasted or baked before being eaten and are much used in cooking. As peanut butter they are used in sandwiches and added to many dishes, as muffins, cakes, soup, sauces, candy, etc., for flavour and food value.

Salads are served as a first course, as a main course, with or following the main course, and as desserts. The suggestion to eat something raw every day has caused a great increase in the use of salads in the United States.

Salads usually have a base of something raw and green, like lettuce, romaine, chicory, escarole or watercress, or white and crisp like cabbage, Chinese cabbage, endive and celery. These are served with a salad dressing in which the leaves are tossed about until marinated. Almost all kinds of fruits and vegetables, raw or cooked; meat, poultry, fish, cooked or canned, eggs, cheese of many kinds and nuts alone or in combination, may be mixed with the greens or arranged attractively on them. Some salads are combined with gelatin and liquids and jelled, some containing cream are frozen. All are arranged to appeal to the eye as well as the palate. The simplest or French dressing is a combination of oil and vinegar, or lemon juice, seasoned with salt and pepper, and just before serving, beaten or shaken well. Many variations are possible. Mayonnaise dressing is a thick, smooth combination of oil and vinegar, beaten with egg yolks and seasoning. Cooked dressings usually are made with milk and butter, to replace the oil, and may be thickened with flour as well as egg. Many dressings are made with cream, lemon juice and other fruit juices.

Desserts.—Most luncheons and dinners conclude with something sweet, called a dessert. These are usually classified as hot, cold and frozen, cakes and pies. Desserts also include fruit, raw, cooked and canned, with or without cookies.

Hot Desserts.—Baking powder biscuit mixtures combined with fruit include cobblers, dumplings, shortcakes and steamed puddings.

Baked mixtures of milk, with or without eggs, include bread puddings in variety, cereal puddings, as rice and Indian pudding, tapioca puddings with milk or with fruit. Bread crumb and fruit "betties" are baked with neither milk nor eggs.

Soufflés are sweet mixtures of eggs separated and beaten light combined with a white sauce and flavour, or with fruit.

Steamed puddings are made of flour or bread crumbs, and with little or much fruit, with and without suet.

Cottage or castle puddings are like plain cake served with a sauce. Upside-down cakes are cottage puddings baked on top of fruit.

Dutch apple, peach or apricot cakes are cottage puddings with fruit baked on the top.

Fritters.—Batters made light with yeast, baking powder or eggs, enclosing pieces of fruit, fried in deep fat and served with a sauce.

Cream Puffs and Eclairs.—Crisp cakes with open space in the centre are made with choux paste, a cooked mixture of flour, shortening and water, beaten with eggs, then baked or fried, served with a filling, and sometimes frosting or sauce.

Many other mixtures that do not come under any particular heading and served with or without a sauce are listed as hot desserts.

Desserts served hot *or* cold include cream puffs and tarts and tortes, or thin layer cakes, chiefly eggs and sugar, served with whipped cream.

Cold Desserts.—These may be made and chilled before being served.

Soft custard is made with milk, egg yolks and sugar, cooked and stirred over hot water until a coating is formed on the spoon. With many different flavours, added ingredients, and baked instead of cooked in double boiler, at least 1,001 different desserts are possible. Gelatin added to soft custard poses as Spanish cream, or with whipped cream added as Bavarian cream. When cooked in custard cups or a mould in a pan of hot water in a 350° F. oven, this becomes baked custard. Some tapioca and rice puddings are in this class.

Cornstarch pudding or blancmange is milk thickened with cornstarch. Mixtures for these puddings come in packages requiring only to be cooked with milk.

Rennet custards are made of milk thickened with rennet.

Gelatin with fruit juice, coffee or wine makes jellies that may contain fruit, nuts and marshmallows, in great variety. (Many packaged jellies are flavoured synthetically and require the addition of hot water only.) Egg whites beaten light with fruit and sugar make snows and whips. Gelatin added to whipped cream with lady fingers or sponge cake becomes charlotte russe.

Icebox or refrigerator puddings are moulded with several layers of cake or cookies with a rich sweet mixture between.

Frozen desserts include: Ices or sherbets, generally made of fruit juices, sweetened, combined with water, milk or cream, and frozen until firm.

Frappé or sorbet are the same mixtures frozen to a mush only.

Ice cream is cream sweetened, flavoured and frozen. Many varieties contain milk thickened with flour, tapioca, eggs or gelatin. The above mixtures are placed in a metal container with a dasher and a cover, surrounded with ice and salt and churned by hand, or mechanically, until frozen, or they are put in an ice cube pan in freezing compartment of a mechanical refrigerator and left until frozen. Usually they are stirred or beaten once or twice to make them less icy.

Mousse.—A whipped cream mixture usually containing gelatin, frozen without stirring.

Parfait.—A whipped cream, syrup and egg mixture frozen without stirring.

Bombe.—A dessert made by lining a mould with a frozen mixture, filling centre with a different mixture and freezing until centre is firm.

Coupes and Sundaes.—An ice or ice cream served in a glass with a sauce, a fruit or a combination of fruits.

Dessert Sauces.—Some sauces are made of sugar and water, flavoured usually with chocolate or coffee or lemon or other fruit juice, and sometimes with a thickening of flour or cornstarch. They are served, hot and cold, on desserts and ice cream.

Butter and sugar creamed together with flavour added make hard sauce. Adding liquids, beaten eggs or whipped cream provides many variations. Eggs, separated and beaten very light, with sugar and flavour, make sauces with various names.

Whipped cream is used extensively as a sauce, a garnish or a cake filling.

Pastry, including dishes made with plain paste or puff paste, requires flour, salt, water and shortening, as lard, vegetable shortening or butter. Lightness depends on the amount of air enclosed while mixing or rolling, and the expansion of that air during baking. Chilling before baking is desirable, especially for puff paste.

Pies.—Plain paste of fat and flour (with salt), usually one part fat to three parts flour, mixed to a firm dough with water and rolled thin, is used to line a plate and to cover a filling of sweetened fruit. Sometimes a bottom crust only is used with a custard filling; sometimes only a top crust is preferred. Small pies, tarts, turnovers and many other combinations of pastry and filling provide a great variety of desserts. In the United States apple pie is the most popular pie. Pies are baked in a 450° F. oven at first, then at 350° F.

Cracker crumbs or ready to eat cereals, sugar and melted butter mixed and pressed into a pie plate make a bottom crust for many kinds of pies.

Ice Cream Pies.—Baked pie shells, holding a layer of fruit and a layer of ice cream, covered with meringue and browned quickly before serving.

Puff Paste.—A mixture of equal parts, by weight, of flour and fat, with water to make a firm dough, is rolled out and folded several times to enclose air which makes the paste rise with as many as 1,000 paper-thin layers. This is used for patties, vol-au-vent, and many small desserts. Puff paste requires a hot oven, 450° to 500° F. for the first five minutes, then 350° F.

Choux Paste. (See *Cream Puffs.*)

Cakes.—Sponge cakes are made of sugar, eggs, wheat flour, salt and flavour. Butter cakes require, in addition, butter, margarine or other shortening, milk or water, and baking powder or soda, except in pound cakes.

Sponge cakes are made by separating the eggs and beating whites until stiff and yolks until very light. Sugar and flavouring are beaten in. Flour and salt are sifted in and mixtures are cut and folded together. Angel cakes require egg whites only.

Butter cakes are usually made by creaming butter and sugar together, adding beaten eggs, then flour, sifted with other dry ingredients, alternately with the liquid. Chocolate cakes have melted chocolate or cocoa added to the mixture. Fruit cakes have raisins, currants, dates or figs added to the mixture. Molasses cakes have molasses instead of, or in addition to, part of the sugar. Ginger is added for gingerbread. Spices give flavour to many cakes.

Loaf, Layer and Cup Cakes.—Cake mixtures are baked in loaf pans, layer cake pans, angel cake pans, muffin pans and others.

Angel and sponge cakes require a 325° F. oven.

Butter cakes in loaves require a 350° F. oven.

Thin layer cakes and cup cakes require a 375° F. oven.

Chocolate or molasses cakes require a 325° F. oven.

Fruit and pound cakes require a 250–325° F. oven.

Frostings are made of sugar and liquid combinations of a consistency that can be spread on cakes. Vanilla or other flavour is needed in the frostings mentioned below:

Confectioners' frosting is made of sifted confectioners' sugar with egg white, water, coffee, fruit juice or other liquid. Many flavours and colours are possible.

Butter frosting is made by creaming butter and confectioners' sugar together with sufficient liquid to make it of the right consistency to spread.

Plain frosting is made by adding to beaten egg white, sugar and water syrup boiled to 240° F., or until it spins a long thread.

Seven-minute frosting is made by beating sugar, water, egg white and flavour over hot water until it holds its shape.

Fudge frostings are made by boiling sugar, milk or water, and chocolate to 234° F., cooling to 100° F. and beating to right consistency.

Brown sugar and maple sugar may be used in cooked frostings.

Frosted Cakes.—Many loaf cakes are covered with frosting. Layer cakes may have frosting between and on top, or jam or cream filling between and sugar on top. Cup cakes are usually frosted. Pound cakes and other firm cakes may be cut in small shapes and covered with melted fondant or frosting.

Decorations.—Nuts, candies and frosting forced through a pastry bag, with a tiny tube in the end, are the principal decorations used on cakes.

Cake Filling.—A great variety of sweet mixtures is used between layers of cake and in cream puffs. Cream filling is made with milk, sugar, flour and eggs, cooked over hot water until thick, and flavoured with chocolate, vanilla, etc. Fruit juice may be used instead of milk. Whipped cream may be added, or nuts, raisins, figs, etc.

Cookies are made of the same ingredients used for cake, but with less liquid so that they will hold their shape when dropped from a spoon onto a greased cookie sheet, forced through a cookie press, or chilled and sliced, or rolled out and shaped with cookie cutters before baking. Nuts, spices, fruit, flavour and shapes make hundreds of kinds of cookies possible. Some cookies are frosted and decorated for special occasions, or put together with a filling between.

Meringues.—Egg whites beaten stiff, with sugar beaten in, are shaped on a tin sheet and baked in a 250° F. oven.

Macaroons.—Combinations of sugar and egg whites, with almond paste, chopped nuts, cornflakes or other cereals, shaped in small balls and baked in 300° F. oven.

Candy.—Most candy is made in factories where conditions of cooking, coating and storing are accurately controlled. Many kinds can be made in the home from sugar, fruit, nuts, chocolate, etc. Uncooked candies require confectioners' sugar combined with egg white or fruit juice.

Chocolate-coated bonbons have centres of fondant, nuts, etc.

Fudges are made by cooking white, brown or maple sugar with milk or cream to from 234° F. to 238° F., cooling, and beating or working to a smooth creamy consistency that holds its shape. Chocolate, nuts, etc., may be added.

Fondant is made of sugar and water cooked and worked like fudge. Cream of tartar or corn syrup are usually added to prevent the formation of large crystals. Fondant is used for mints, and for the centres and coatings of many candies.

Caramels and nougatines are made of sugar, corn syrup and cream cooked to a firm ball.

Taffy is usually made of a molasses mixture, cooked to 256° F., cooled and pulled until porous and light in colour.

Hard candies include butterscotch, made of brown sugar, butter and water cooked to 290° F.; nut brittle, cooked to about 295° F.; and glacéed fruits and nuts, dipped in syrup cooked to 310° F.

Marshmallows contain gelatin.

Turkish paste contains agar agar.

Gumdrops require gum arabic.

Most cook books contain some candy recipes, as well as recipes for all the things suggested above.

Canning may be divided into six steps.

1. Preparation as for immediate table use.
2. Blanching of some vegetables and fruits.
3. Packing in jars or tins with water or syrup.
4. Sealing, entirely or partially, according to type of jar and contents.
5. Processing of jar and contents, according to timetables for different products, which must be followed exactly.
6. Storing, preferably in a cool dry space.

To prevent botulinus poisoning it is recommended that home canned vegetables (except tomatoes), meat, poultry and fish be processed in a pressure cooker.

Jams, jellies, marmalades, conserves and preserves, and relishes of many kinds are made of fruit or fruit juice and sugar, cooked to the desired consistency. Different fruits, combinations of fruits, and the addition of nuts make for a great variety of sweets that will keep indefinitely and can be used at any meal. Pickles are made from both fruits and vegetables with vinegar, and often with sugar and spices, added.

Jam of every kind can be purchased ready to serve but many are still prepared in the home. Some are made from recipes that have been in the family for generations, others are made firm very quickly by adding to the fruit and sugar mixture, pectin prepared commercially from certain fruits.

It must appear from the foregoing that in its modern aspect cookery is both an art and a science. It is an art because it requires special manipulative skill, and colour, design and attractive form and service are essential, especially in the higher grades. It is a science because exact knowledge is necessary in determining the correct time and amount of heat needed by the food material to be cooked to make it palatable and digestible, of food values so that the preparation may conserve vitamins and minerals and a rightly proportioned diet may be given, and of all food stuffs so that they may be combined suitably, satisfactorily and in definite and correct proportions.

Cook Books.—The first cook book published in the United States, called the *Compleat Housewife, or Accomplished Gentlewoman's Companion,* was printed in Williamsburg, Va., in 1742. A bibliography of American cookery books lists 490 books published from that time up to 1860. These were written for the housewife, not the chef. Cook books have continued to come from the press until it is said that books on foods and beverages rank second only to the Bible in the number printed. There has been a constant evolution in cookery, food preservation and cooking equipment. In the United States there is found, at least in the large cities, foods of every kind from all over the world, and in the book stores, books of recipes for dishes that are common in every civilized country. In the United States with its population made up from many different countries, housewives may retain their own recipes but, so far as funds allow, everybody uses the most modern equipment.

Probably the book that has had the greatest influence in raising the standard of American cookery is *The Boston Cooking School Cook Book,* written by Fannie Merritt Farmer in 1896. This book featured for the first time level measurements in cups and spoons and stressed the use of standard $\frac{1}{2}$ pint cups, divided in quarters and thirds, tablespoons holding $\frac{1}{16}$ of a cup and teaspoons holding $\frac{1}{3}$ of a tablespoon. More than 2,000,000 copies have been printed as the book has gone into edition after edition with frequent revisions that keep it up to date. Unnumbered cook books, large and small, pamphlets, magazine articles and newspaper columns appear every year, but this book continues to set the standard for all of them. (A. By.)

COOKING APPARATUS: *see* HOUSEHOLD APPLIANCES.

COOK ISLANDS: *see* PACIFIC ISLANDS.

COOKSTOWN, market town and urban district, Co. Tyrone, Northern Ireland, $53\frac{1}{2}$ mi. N.W. of Belfast on the Northern Counties (L.M.S.) and Great Northern railways. Pop. (1937) 3,369. Area 263 ac. It was founded in 1609 by the landlord, Allan Cook. Linen manufacturing and pork curing are the chief industries.

COOKTOWN, a seaport of Banks county, Queensland, Australia, opposite a gap in the eastern highlands at the mouth of the

Endeavour river, about 1,050 mi. N.N.W. of Brisbane. In 1770 Captain Cook here beached his ship the "Endeavour," to repair the damage caused by striking a reef 25 mi. to the S.E. Cooktown became a municipality in 1876. Pop. (1933 census) 504.

It is visited by ocean steamers and is a centre of the bêche-de-mer and pearl fishery. Tin and gold are mined and coffee and rice are grown. Cooktown is the port of the Palmer goldfields. A railway runs to Laura on the goldfield. It is the chief port of Queensland for the New Guinea trade; and is also the seat of a Roman Catholic vicariate whose bishop has jurisdiction over Queensland north of lat. 18° 50′.

COOKWORTHY, WILLIAM (1705–1780), English potter, famous for his discovery of china-clay and china-stone in Cornwall, and as the first manufacturer from English materials of a porcelain similar to the Chinese, was born at Kingsbridge, Devon, of Quaker parents. At 14 he was apprenticed to a London apothecary named Bevans, and afterwards carried on business at Plymouth with his master, under the title of Bevans & Cookworthy. The manufacture of porcelain was at the time attracting great attention in England, and while the factories at Bow, Chelsea, Worcester and Derby were introducing the artificial glassy porcelain, Cookworthy spent many years in searching for English materials similar to those used by the Chinese. From 1745 onwards he travelled over the greater portion of Cornwall and Devon in search of these minerals until he located them near to St. Austell. With some financial assistance from Mr. Thomas Pitt of Boconnoc he established the Plymouth China Factory at least as early as 1768.

But Cookworthy is remembered for his discovery of those supplies of clay and rocks which form the foundation of English porcelain and fine earthenware (*see* POTTERY AND PORCELAIN).

COOLIDGE, CALVIN (1872–1933), 30th president of the United States, was born at Plymouth, Vt., on July 4, 1872, the son of John C. Coolidge and Victoria J. Moor. He was descended from a long line of typical New England farmers and storekeepers, living in Puritan simplicity and taking a characteristic interest in local civic affairs. His father, like others in the ancestral line, was selectman and moderator of the town meeting; he held the office of town constable for many years, and became a member of each House of the State Legislature.

It is possible that much of the younger Coolidge's flair for practical politics was developed at an early age as he listened to the conversation that passed in his father's country store, where the Yankee democracy settled political issues over the nail and cracker barrels. His early education was characteristic of the region; he was first sent to the rural school-house, later to Black River academy and to St. Johnsbury academy, where he was prepared for Amherst college, which he entered in 1891. There he displayed the qualities which were to distinguish his later career, a dislike of ostentation, a capacity for hard work and clear thought, an ability to express his ideas in phrases that were frequently humorous and invariably terse. Such qualities did not make him a leader in his class (1895), either as scholar, social light or athlete; they did capture the admiration of a small group of the stronger men, and in senior year he was chosen "Grove Orator" for the class commencement. His interest in history had led him to prepare an essay on "Principles fought for in the War of the American Revolution," which was awarded the prize by the Sons of the Revolution in a national competition of college students.

As Lawyer and Legislator.—Upon graduation, Coolidge studied law with a Northampton firm, Hammond and Field, and two years later, in 1897, began its practice. The members of the firm were interested in local politics, and he himself soon found opportunity to follow his natural inclination. He was elected a councilman of Northampton in 1899, city solicitor in 1900, and was appointed clerk of the courts, a county office, in 1904. He was a member of the Republican city committee. In 1907 and 1908 he served as a member of the general court of Massachusetts, the legislative body of the State, winning the reputation of a hard-working committeeman; he returned to Northampton to become mayor for two terms in 1910 and 1911. At the close of his second term he secured the Republican nomination for State Senator, which in his district was tantamount to election. From that time his political career in the State progressed by regular steps. In 1914 and 1915 he was chosen president of the Senate; he was elected lieutenant-governor of Massachusetts for three terms, 1916, 1917, 1918 and governor of Massachusetts for two terms, 1919 and 1920. In each case of re-election he was returned to office by an increased majority.

His success was not achieved by conventional electoral methods, for he avoided ostentatious advertising and was regarded personally as a poor "mixer," shy, taciturn and apparently cold. Coolidge himself expressed in a characteristic phrase his conviction that electoral success ought to depend upon the candidate's devotion to official duty. "Let men in public office," he said, "substitute the light that comes from the midnight oil for the limelight." And again, "We need more of the office desk and less of the show window in politics." He translated his epigram into action, and the success he achieved as mayor of Northampton and as governor of Massachusetts, in securing both economy and efficiency, explains much of his consequent recognition at the polls. At all times he displayed a political shrewdness which saved him from mistakes, and a dry common-sense, skilfully expressed in trenchant phrases that caught the imagination of his auditors.

Governor of Massachusetts.—Coolidge, as governor of Massachusetts, proved himself an expert administrator; he was the first governor of the State to submit an executive budget for legislation and he pushed through various laws providing for the reduction in the number of administrative agencies in the State. But it is likely that his name would not have become nationally prominent if it had not been for his handling of the strike of the Boston policemen. The Boston charter provided that the police department should be under the direction of a commissioner appointed by the governor (in this case the commissioner had been chosen by Coolidge's predecessor); the mayor of Boston, however, may in certain contingencies take control of the police, and in "case of tumult, riot or mob," may call out such part of the State guard as is within the city of Boston; if the situation passes beyond his control he may call upon the governor to mobilize the remaining State militia.

The Boston Police.—During the first week of Sept. 1919, the Boston police threatened to go on strike because of the refusal of the commissioner to permit affiliation with the American Federation of Labor; the commissioner was steadily supported in his position by Gov. Coolidge. On the afternoon of Sept. 9, about three-fourths of the policemen left their posts; disorder in the streets commenced during the night, which became riotous the following morning. The mayor, who had been previously informed by the commissioner that he did not need the State guard, on the morning of Sept. 10 called out the State guard in Boston and requested the governor to send at least three regiments of infantry. Coolidge immediately issued the order. It is possible that, thus reinforced and with the aid of young college graduates, the local authorities might have handled the situation successfully. In view, however, of a threatened general strike calculated to disorganize transportation and business activities, as well as the danger of continued rioting, Coolidge called out the entire State guard, and on Sept. 11 took charge of the police department. The strike was broken and order restored. Coolidge steadfastly supported the commissioner in his refusal to reinstate the striking policemen, and in a public reply to an appeal of Samuel Gompers clarified the issues involved: "The right of the police of Boston to affiliate has always been questioned, never granted, is now prohibited. . . . There is no right to strike against the public safety by anybody, anywhere, at any time." Warned that organized labour would prevent his election to any office in the future, he replied, "It does not matter."

As Vice-President.—The action and words of Coolidge in this crisis were eminently characteristic. He took no step until it seemed necessary, but then he took it decisively. The effect upon the popular mind was impressive. In the election of Nov. 1919, standing for re-election as governor, he received a majority of 125,000. His name was at once included in the list of possible presidential nominees for the following year. Already mentioned in 1916 by a few supporters, he might have received the nomination in 1920 if he had been given the solid backing of politicians from his own State. But at the National Republican Convention, where the senatorial group in control did not approve him, the Massachusetts delegation was divided and he did not have the support of the senior senator, Henry Cabot Lodge. He failed thus to profit by the deadlock, which was finally broken in favour of Warren G. Harding. But when it came to a call for vice-presidential nominees, a wave of enthusiasm for Coolidge caught the convention which, with 674½ votes, nominated him on the first ballot. He was elected Vice-president of the United States in the following November, receiving with Senator Harding 404 electoral votes.

As Vice-president, Coolidge was the first who attended meetings of the Cabinet, but he made no attempt to enlarge the functions of his office. He attended faithfully to the routine duties that went with the presidency of the Senate, consistently supported the policies of the Harding administration, and did nothing to bring himself before the public eye. Early in the morning of Aug. 3, 1923, in his father's house at Plymouth, Vt., he learned of the death of President Harding. The oath of office was administered by his father, a justice of the peace, and he immediately left for Washington.

Becomes President.—Characteristically, President Coolidge's first interest was to assure the efficiency of the public administration, his second not to weaken his future position by any false step. Following four months' silence, his first presidential message, in Dec. 1923, commanded universal attention. It was brief and categorical. In it he made plain his opinion on the major problems before the country. He approved the maintenance of the tariff without frequent revision, a reduction of taxes; he disapproved the soldiers' bonus as well as any complicated scheme of Government relief for the farmers. As regards foreign policy, he advocated co-operation without entanglement, opposing entrance into the League of Nations, but approving adherence to the World Court. The message was courageous in its lack of equivocation and attractive in its emphasis upon economic common-sense.

With its delivery Coolidge caught the admiration and confidence of the ordinary citizen of the United States as a whole, as he had previously in Massachusetts. None the less, he faced a difficult situation in Washington. The Republican Party in Congress was broken into *blocs,* disinclined to accept his leadership, torn by factional struggles to secure advantage in the coming National Convention. Congress sustained the veto of Coolidge of the Postal Salaries bill by only one vote, and passed the Bonus bill over his veto. In the spring the disclosures of the Teapot Dome leases threatened to involve his Cabinet and discredit the Republican Party. The President met the demands for wholesale purification of the Administration with discretion and restraint; he immediately appointed special counsel to prosecute an investigation, but refused to satisfy popular clamour by hasty dismissal of accused officials: "I do not propose to sacrifice any innocent man for my own welfare, nor do I propose to maintain in office any unfit man for my own welfare." At the Republican Convention, largely because of popular feeling in his favour, his control was unthreatened and he was nominated with ease; the vote of the convention was in many cases an unwilling tribute by the party leaders to the overwhelming power of public opinion "back home."

Coolidge did not take an active part in the 1924 campaign, staying for the most part in Washington and dealing with current problems of administration. In the few speeches which he made he reiterated the basic principles which he had already stated: economy in public affairs, efficiency of public service, abstention from the League of Nations, adherence to the World Court. He made slight effort to answer the bitter criticism passed on the Republican Party for the scandals and its reactionary attitude, by the Democratic and Third Party nominees; he relied upon the increasing prosperity of the country under his administration and the widespread feeling that he embodied a shrewd common-sense in which the nation might trust. He was vindicated by the result of the election, which gave him 382 electoral votes against 136 for Davis and 13 for La Follette. The popular vote was 15,700,000 for Coolidge, 8,400,000 for Davis, 4,800,000 for La Follette.

Presidential Administration.—On March 4, 1925, Coolidge was inaugurated President by virtue of election. His position in the country and the party was strong. He still met difficulties with the old Congress, in which the insurgent senators combined on occasion with the Democrats to oppose his wishes; but the back of the insurgent-radical movement seemed broken, and his control of the new Congress became solidified. Rarely has a President fulfilled so exactly the predictions that were made of Coolidge. Indeed, his popularity with business elements and the warm admiration felt for him by the common citizen largely resulted from the fact that he was "predictable." His administration was characterized by no striking development apart from the continued maintenance of unparalleled national prosperity. In matters of policy the President depended upon the three outstanding figures in his cabinet, Mellon, Hoover and Frank B. Kellogg, who on Jan. 10, 1925 succeeded Charles E. Hughes as Secretary of State. His other cabinet appointments were sound rather than brilliant: William M. Jardine as Secretary of Agriculture, John G. Sargent as Attorney-General, Dwight F. Davis as Secretary of War, Curtis D. Wilbur as Secretary of the Navy, Dr. Hubert Work as Secretary of the Interior. For the first time in more than 50 years, the Senate refused to confirm a presidential nomination to a cabinet position, in the case of Mr. Charles Warren, whom Coolidge had named Attorney-General; the President avoided a constitutional issue by sending in the name of Mr. Sargent.

In domestic affairs Coolidge, relying chiefly upon Mellon and Hoover, continued the policy already laid down in his year and a half of office: economy of administration, reduction of taxation, non-interference in industrial affairs. "Economy," he said, "is idealism in its most practical form." He demanded the reduction of the national budget and constantly supported the principle of the retirement of national indebtedness as a means of employing Treasury surplus. In his message of Dec. 1926 he approved the plan to reduce the income tax payments of March 15 and June 15 following, as a refund on taxes in excess of Treasury needs; but he opposed definitive tax reduction. In the case of Mississippi flood control he refused to be hurried into calling an extra session of Congress for the purpose of making special appropriations, but awaited the report of the engineers, without whose expert advice he felt that no wise action could be taken. He insistently opposed the McNary-Haugen Farm Relief Bill (*see* under "Becomes President"), as partly unconstitutional, but chiefly because he looked upon its price-fixing stipulations as economically unsound. His own solution of the farmers' problem was found in the application of the principle of co-operative marketing. His invariable conviction that the Government should not interfere in business lay behind his refusal to take action in the coal strike of 1927.

In the field of foreign relations President Coolidge laid constant emphasis upon the traditional principles of U.S. foreign policy, especially control of the Caribbean and the devising of mechanism for settling differences between the powers by peaceful methods. He urged the desirability of American adhesion to the World Court and the necessity of progressive and reciprocal limitation of armaments. His policy in these respects was not crowned with success. On Jan. 27, 1926, the Senate voted in favour of participation in the World Court but with reservations which did not prove acceptable to the participating powers; the President thereupon announced in his Armistice Day speech at Kansas City that he did not intend to ask the Senate to modify its reservations in any further attempt to make participation in the World Court possible. In 1927 the conference of Great Britain, Japan and the United States called at Geneva for the purpose of securing further limitation of naval armaments, was unable to reach any decision because of a deadlock on the problem of cruiser tonnage. In view of this failure the President approved a programme for the increase of U.S. naval armament. The administration of foreign policy and the conduct of negotiations he left to Secretary Kellogg. Although President Coolidge showed his interest in settling differences with Mexico by the appointment of his close friend, Dwight Morrow, as Ambassador to Mexico, responsibility for negotiations with President Calles as well as for the sending back of American marines into Nicaragua, rested upon the Secretary of State. Mr. Kellogg also conducted the important negotiations which followed upon M. Briand's proposal, in 1927, that the United States and France sign a treaty renouncing war as an instrument of national policy; through the diplomacy of Mr. Kellogg this proposal was extended to cover a plan for a multilateral treaty of similar intent, which was accepted by all the great and most of the small States of the world. Negotiations *re* the debts of foreign Governments to the United States were left to Secretary Mellon. In the case of Italy, Belgium, Yugoslavia and Greece, the arrangements made by Mr. Mellon were ratified; the agreement which he negotiated with the French Ambassador was not ratified by the French Chamber, although France agreed on March 1, 1927, to pay provisionally at the rate of $10,000,000 a year.

Although his name was not connected with any positive policy, except perhaps that of thrift, Coolidge's prestige among the American people increased each year. The economic prosperity of the nation, combined with his refusal to embark upon any imaginative policy which people did not understand, doubtless accounts in large degree for the confidence generally placed in him. Lacking many of the conventional traits of the orator, President Coolidge proved himself a political preacher second only to Roosevelt, and the public addresses in which he set forth his views systematically, made a strong popular appeal. His speeches on economy, better local Government, the need of the spiritual element in politics, obedience to law, religious toleration and the like, were readily understood and warmly approved by the average citizen. Whatever the cause, his prestige was such that it was generally assumed that the Republican Party would disregard the third-term tradition and renominate him for the presidency. With characteristic simplicity and without any warning, President Coolidge, on Aug. 2, 1927, stated: "I do not choose to run for President in 1928." The phrase, used in the New England sense, connoted a determination that could not be broken, regardless of any wealth of reason that might be brought to bear. All efforts to "draft Coolidge for President," which were continued up to the time of the Republican Convention in June 1928, proved fruitless. The President exercised no clear influence at the Convention, but the nomination of Herbert Hoover was looked upon as an endorsement of the Coolidge administration. Upon the record of that administration the Republicans rested their case most successfully in the election of 1928. President Coolidge retired on Mar. 4, 1929, and in that year published *The Autobiography of Calvin Coolidge.* He died, Jan. 5, 1933, at Northampton, Mass.

On Oct. 4, 1905, Coolidge married Grace Anne Goodhue, of Burlington, Vt. Two sons, John and Calvin, were born on Sept. 7, 1906, and April 13, 1908, respectively. The younger died on July 7, 1924, as a result of blood poisoning. (C. Sey.)

COOLIDGE, WILLIAM AUGUSTUS BREVOORT (1850–1926), American alpinist and writer on alpine subjects, was born on Aug. 28, 1850, near New York, and educated at St. Paul's school, Concord, New Hampshire, Elizabeth college, Guernsey and Exeter college, Oxford, where he became modern history tutor. From 1880 to 1881 he was professor of English history at St. David's college, Lampeter, and from 1881 to 1885 modern history tutor at Magdalen college, Oxford. During the period 1883 to 1895 he was curate at South Hinksey, near Oxford. Climbing and alpine literature were always his main interests, and in 1909 he went to Switzerland, and settled at Grindelwald. His chief ascents were made, during vacations, between 1865 (Col du Géant) and 1898 (Ortler), and he made the first winter ascent of the Wetterhorn (1874) and the Schreckhorn (1879). His guide was the famous Christian Almer, and later Almer's son. Coolidge made altogether over a thousand ascents in the French, Swiss and Italian Alps, but the Dauphiné was his favourite district. His most notable books are *Swiss Travel and Swiss Guide-books* (1889), and *The Alps in Nature and History* (1908). He edited the first volume of Ball's *Alpine Guide,* and two issues of Murray's *Handbook for Switzerland.* He was the sole author of several volumes in the *Climbers' Guide* series, and contributed to the *Encyclopædia Britannica.* He died at Grindelwald on May 6, 1926.

COOLIDGE TUBE, an X-ray tube with a hot cathode (*q.v.*) (*see* also X-Rays, Nature of).

COOLIE, a term applied generally to Asiatic unskilled labourers and specially to Indian or Chinese emigrants of this class. In many tropical countries, where the needs of the existing population were few and simple, and there was an abundance of fertile land open to its use, it was found impossible, after the abolition of slavery, to obtain an adequate supply of steady labour for the planting industry from local sources. The emancipated negroes were able to obtain land on easy terms, and had no incentive to work for regular hours on the estates of the planters. The deficiency was remedied by promoting the immigration of a fresh labouring population drawn from the industrious inhabitants of India and China.

Indian Indentured Emigration.—The needs of the British sugar-producing colonies after the abolition of slavery in 1834 gave the first great impetus to the emigration of coolies from India. Labourers were recruited under "indenture," a contract enforceable by penal sanctions, to serve for a term of years, usually five, in return for their wages and certain benefits and the cost of their passage. A considerable number of Indians had been introduced into Mauritius, and a few into British Guiana, by 1838 when the recruitment was stopped pending enquiry into abuses. In 1842 indentured emigration to Mauritius was re-opened under proper safeguards; in 1844 it was allowed to Jamaica, Trinidad and British Guiana, in 1860 to Natal and in 1885 to Fiji. Emigration to certain French colonies was regularized by a convention of 1861, but was suspended about 1890, and not subsequently renewed. After 1872 emigration was allowed to Surinam under a convention with the Netherlands Government. The system of indentured emigration to distant colonies was strictly regulated by Indian legislation, which was progressively amended to remedy such abuses as came to light from time to time. The object was three-fold: first, to prevent kidnapping or any kind of coercion or fraud, and to ensure that the recruited labourers properly understood the terms of their contracts before they left India; secondly, to secure their well-being prior to embarkation and during the voyage; thirdly, to insist, as a condition of permitting emigration, on adequate provision being made in the colonies for the equitable treatment of the immigrants.

Colonial Governments made themselves responsible for recruitment through their agents in India; these agents employed recruiters approved by the Indian Government's protector of emigrants; persons recruited were taken before the magistrates, who registered their engagements, and were then conveyed to Calcutta, Madras or Bombay and housed in depots, licensed by the protector, pending embarkation on vessels which were also licensed and required to be equipped in every respect with what was needed to ensure the safety and welfare of the passengers on their long voyage. On arrival in the colony the labourers were distributed among the estates on which they were to work. The employer was responsible for the welfare of his indentured labour force. Under the colonial laws he was bound to provide regular but not excessive work, at fair wages, and to house his labourers and their families. Rations at less than cost price were sometimes supplied. Medical care and inspection were provided by the employers and the Government. Special officials were appointed for the protection of immigrants. The labourer on his side was bound to give regular work, and penalties, of fine or imprisonment, were provided by law for offences such as refusal to work or desertion.

At the expiry of his contract the labourer was free either to re-indenture for a further period or to seek other employment or occupation; he frequently became a peasant proprietor; after a minimum period of residence in the colony he had the option of a free or assisted return passage to India, but many ex-indentured coolies settled permanently in the colonies, where their descendants form a large and, for the most part, flourishing population. In 1926 the approximate Indian population, mostly of this origin, was 277,000 in Mauritius, 125,000 in British Guiana, 126,000 in Trinidad, 17,000 in Jamaica, 130,000 in Natal and 68,000 in Fiji. In British East Africa Indian labourers were supplied under Government auspices for the construction of the Uganda railway, which commenced in 1895; they were engaged on three-year contracts with the right of a return passage to India. At one time there were as many as 18,000 Indians thus employed; but only a few of them remained permanently in the country, and the bulk of the present Indian population in Kenya has a different origin.


BY COURTESY OF THE NATIONAL BOARD OF THE Y.W.C.A.
TYPICAL CHINESE COOLIE

Cessation of Indenture System.—The Indian Government neither encouraged nor discouraged indentured emigration but confined itself to the neutral rôle of an honest broker between two parties to a commercial transaction, the colonial Government and planters on the one side and the Indian labourer on the other; the elaborate regulation of the system was no more than was necessary to avoid risk of the ignorance and weakness of the coolie class being imposed upon or exploited. In 1875 the late Lord Salisbury, as secretary of State for India, suggested that coolie emigration should be actively encouraged with a view to relieving congestion in India and promoting prosperous Indian settlements in the under-populated colonies. The Government of India, however, declined to change their policy, considering that any probable flow of emigration would be negligible in proportion to the vast population of India, and that its promotion would cause misunderstanding and suspicion and would lay on themselves an embarrassing degree of responsibility for the prosperity of the emigrants and the quality of the labour supplied to the colonies. As time went on, the Government of India's attitude was affected by two further considerations; firstly, it was felt in India that her labour supply was not in excess of her growing industrial requirements; secondly, the treatment of ex-indentured Indians in Natal led to acute political difficulty after the colony obtained self-government, and encouragement of Indian settlement in other colonies might sow the seeds of similar trouble. Recruitment for Mauritius ceased in 1911 because the large Indian population rendered further immigration unnecessary. Meanwhile the grievances in Natal were one of several factors which were making the whole system unpopular in India; others were the penal clauses of the colonial labour laws in general, and evils resulting from the small number of women who emigrated; but above all it was felt that indenture attached a stigma of inferiority to the Indian race, and that the diffusion of coolies spread abroad a false estimation of India's cultural development by giving the impression that she was merely a reservoir of unskilled labour; the term "coolie," for example, had come to be mistakenly used in the West Indies as synonymous with "Indian," and in South Africa with "Hindu." In 1910, Gokhale, in the Indian legislative council proposed that further indentured emigration to Natal should be forbidden, and this was done in the following year; in 1912 he urged that all recruitment under indenture should be abolished. During the war the system was suspended and the Government of India proposed its final abolition; the British Government agreed, and the decision not to revive it was announced in 1917. The conventions with the Netherlands and France were formally terminated in 1919 and 1921. In the colonies outstanding indentures have come to an end either through cancellation, as in Fiji and British Guiana (1920) and Mauritius (1923), or through time expiry, save in a few cases of labourers who have entered into successive re-indentures.

Modern Regulations.—After the abolition of indentured recruitment the way was open for the consideration of other methods of attracting labour to the colonies with a view to eventual settlement of the labourers as colonists. Memories of the indentured system, however, made unpopular any scheme based solely on the labour requirements of distant countries. The Government of India's policy in regard to all forms of labour emigration has been embodied in the Indian Emigration act, 1922. No restrictions are placed on unassisted emigration, but the act applies to persons who receive financial assistance to leave India for the purpose of working for hire or engaging in agriculture; the assisted emigration of skilled workers may be permitted under adequate safeguards, but that of unskilled workers, including agriculturists, is prohibited except to such countries and on such conditions as may be specified by the Government of India with the concurrence of the Indian legislature; any scheme of assisted emigration would be examined by these authorities in respect of the conditions of work and wages offered, medical and educational facilities, the cost of living, the terms of repatriation and the provisions of the labour laws in the country of emigration, as well as the political status of Indian immigrants and their opportunities for economic and social advancement. The act provides minutely for the protection of assisted emigrants against abuses in recruitment and hardships in transit, and for securing that a due proportion of women accompany their male relatives. Under the act emigration to Mauritius was again permitted for one year in 1923, but was then discontinued as enquiry showed that the Indian population in the colony had reached saturation point. An attractive scheme for the settlement of a small number of families as colonists in British Guiana was approved in 1926 but lapsed owing to the difficulty of financing it.

Indian Non-contract Labour in Ceylon and Malaya.—There is a large movement of Indian labour from the Madras Presidency to Ceylon and Malaya, especially for work on the tea and rubber estates. The estimated Indian estate population in Ceylon was over 700,000 in 1926. The total Indian population of Malaya was about 470,000 in 1921, of which more than half was on the estates, and is rapidly increasing, the estimate for 1926 being 660,000. In Malaya prior to 1910 there was a certain number of indentured immigrants; otherwise emigration to these neighbouring countries, which has taken place from an early date, has been a natural and largely a spontaneous process. Recruitment is effected through *kanganies* (labour headmen), originally the senior members of emigrant families, who return home and persuade other relatives and friends to join them, financing the transaction with funds supplied by their employers. Recruitment for Ceylon was supervised by a labour commission set up by the planters in 1904; that for Malaya is financed by an Indian immigration fund established in 1907, which is officially managed and is maintained by a levy on employers. But this emigration was not regulated by the Indian Government till 1922; absence of long-term contracts, ease of communication with India and the patriarchal organization of the labour force made the system immune from the abuses to which emigration under indenture was liable, though it had defects of its own in Ceylon, such as the initial indebtedness of the coolie to his *kangani,* from which the former might never escape, and the consequent power possessed by the latter, in times of labour shortage, to barter the transfer of his gang from one estate to another in consideration of receiving advances which he pocketed himself.

This assisted emigration became subject to regulation by the act of 1922. It was temporarily allowed to continue, and in 1923 was definitely legalized under certain rules and conditions; the Governments of Ceylon and Malaya each appoint an emigration commissioner in India who is responsible for the organization of recruitment; the *kanganies* are licensed by the colonial authorities; each recruit must be examined by his village headman, in the presence of the *kangani,* to ascertain that he understands the conditions attaching to his emigration and that his family agrees to his departure; engagements are limited to one month's duration; the Government of India has its agents in Ceylon and Malaya to assist and advise Indian residents; free repatriation is granted within one year of an immigrant's arrival when considered desirable by the agent; in the case of Ceylon it is provided that no payment made by a *kangani* to enable a coolie to liquidate his debts in India before emigrating shall be recoverable. Besides agreeing to these conditions the colonial Governments abolished penalties for labour offences and made a number of amendments in their labour laws affecting Indians; a minimum age has been prescribed for the employment of children on estates, and machinery has been set up for fixing standard wages sufficient to maintain a labourer and his family comfortably, and provide a margin for savings for sickness and old age. Emigrants to Malaya are accompanied on the voyage (of five to ten days' duration) by travelling inspectors appointed by the colonial authorities.

Assam.—In the Assam tea gardens there is a large immigrant population drawn from other parts of India to make up the deficiency of the local labour supply; in the year ending June, 1927, the number of new immigrants was over 45,000; recruitment under careful official safeguards is carried on by *sardars* (labour headmen) who have themselves worked in the gardens; previously the labourers often entered into contracts which could be enforced by penal sanctions under the Assam Labour and Emigration act, or the Indian Workmen's Breach of Contract act; but more recently the penal provisions of the former act have been withdrawn, and the latter was repealed in 1925.

Chinese Indentured Emigration.—Indentured emigration from China commenced about 1845. It was nominally prohibited before 1859, but owing to the weakness and corruption of the Chinese officials the prohibition was not effective; at the same time the refusal of legal recognition made it impossible to regulate recruitment and it was accompanied by all kinds of abuses. European firms employing Chinese recruiters were engaged in the traffic. Many coolies were actually kidnapped or decoyed; the ships were badly equipped and overcrowded, and many died on the voyage. Their principal destinations were Cuba and Peru; on arrival the contracts, which ran for seven or eight years, were sold by auction, and the coolies frequently found themselves in a position virtually little better than slavery, owing to the absence or non-enforcement of laws for their protection. So far as British ships were concerned, the traffic was checked by the Chinese Passengers act, 1855; under this the certificate of an emigration officer was required for all vessels clearing from Hongkong, or British vessels clearing from Chinese ports, which carried more than 20 passengers on a voyage of more than seven days, and the certificate was to be withheld unless the coolies understood the terms of their contracts, and the vessel satisfied minimum requirements as to space and provisions.

In 1859 the British Government obtained the co-operation of the Chinese authorities at Canton in establishing a legal and regulated system of emigration to the British West Indies on five-year contracts; the system was applied also to emigration to the territories of other powers. In the following year the Imperial Chinese Government by the Anglo-Chinese convention of 1860 formally sanctioned contract emigration to British territory under regulation. Similar conventions were concluded by other powers. Henceforward it became possible to control recruitment. The system adopted in 1859 continued in force till 1866, when British, French and Chinese representatives signed a convention which provided for the grant of a free return passage to the coolies at the expiry of their five-year contracts. This convention was not ratified by Great Britain and France, but the Chinese Government refused to continue countenancing emigration on other terms; the trade at Chinese ports was thus diverted to the Portuguese settlement of Macao, where its abuses had largely continued unchecked.

In Hongkong the law was strengthened in 1868, 1870 and 1873, and contract emigration to places outside the British empire was prohibited. In 1874 Macao was closed to the traffic, and, after an enquiry into the treatment of the coolies in Cuba, the Chinese Government was more than ever averse to allowing it through the treaty ports. Throughout this period the Chinese emigrants to the British West Indies went chiefly to British Guiana; about 14,000 landed there between 1853 and 1879, and a few more in the course of the next generation, but the majority subsequently re-emigrated, and the Chinese population in 1921 was only about 2,000. Indentured emigration to British territory was legalized afresh by the Anglo-Chinese convention of 1904 in order to enable Chinese to emigrate under three-year contracts for unskilled work in the Transvaal gold mines (*see* TRANSVAAL). More recently Chinese contract labourers were introduced by the Germans into Western Samoa. In 1920 the New Zealand Government adopted similar arrangements for the territory, but in 1923 they abolished the indenture system and replaced it by one of free labour.

Chinese in Malaya.—From early times there has been a large spontaneous immigration of Chinese into Malaya. In the 19th century it was supplemented by assisted immigration organized on a "credit-ticket" system; passages were paid by Chinese agents who recouped themselves from the immigrants or their prospective employers. From 1877 onwards this system was brought under strict regulation by the British Government with a view to preventing abuse and ensuring that immigration was voluntary; a protector of Chinese was appointed and registration of contracts was compulsory. In 1914 (1916 in the state of Kelantan) the system was abolished and immigrants could no longer be compelled to enter into any particular employment as security for repayment of passage money or any advance. The labour codes make special provision for the protection of Chinese. The law provides for the proper equipment of coolie ships and the comfortable accommodation of their passengers. Vessels carrying more than 20 immigrants must have a qualified medical practitioner on board. Specially appointed protectors examine the coolies on arrival, particularly in regard to the existence of any engagements to undertake labour or repay debts; their financial liability is limited to sums fixed by the protectors; immigrants under 16, or over 45, years of age, or physically unfit, and any who have been induced to travel by fraud or misrepresentation may be repatriated at the expense of their creditors; any indebted immigrant who has obtained assistance by promising to enter into a labour contract may also be repatriated at his creditor's expense, or released from his obligation, at the discretion of the protector. Penalties for labour offences have been abolished, and, apart from the special protection of Chinese, the laws in their general application provide amply for the well-being of labourers and their dependants on the estates, for housing, water supply, sanitation, medical treatment, hospital accommodation, maternity benefits, nurseries for infants and education of children. The popularity of work in Malaya is shown by the increase in the Chinese population of the Straits Settlements and Federated Malay States from 583,000 in 1901 to 993,000 in 1921. The total Chinese population in the whole of Malaya was about 1,174,000 in 1921, of whom 257,000 were born in the country; it includes many independent agriculturists, merchants and mine-owners, as well as labourers in the tin mines and on the estates.

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(J. C. W.)

COOLING EFFECT, the drop in temperature of a system whose internal potential energy is increased without heat being absorbed from outside is the Joule-Thomson cooling effect. (*See* ADIABATIC CHANGE; ENERGY; THERMODYNAMICS.)

COOLING SYSTEMS. In certain industrial processes cooling has to be effected to render the working of an engine or machine practicable. All the internal-combustion engines generate such heat in the cylinder that unless cooled the lubricating oil would burn up, pistons and other parts would seize, and unequal expansions would create difficulties. Air cooling by means of *fins,* though adopted in motor-cycles and some aero-engines, has as yet been adopted by only a few motor-cars.

In the water cooling, the most suitable system, a jacket is cast around the cylinders, or made separately from thin sheet in aero-engines. Two systems, the thermo-syphon and the pump are in use for passing the water through a radiator, which exposes it to large cooling surfaces, past which air is drawn by a fan. In the thermo-syphon method, the hot water from the jacket rises to the top of the radiator and, becoming cooled, sinks to the bottom and flows again to the jacket as illustrated in fig. 1. Refinements which assist in maintaining the required temperature in spite of weather and running conditions are the radiator shutter, adjusted over part of the radiator and the thermostat, which automatically operates the shutter. In large gas and Diesel engines the piston cannot sufficiently be cooled by the transmission of heat into the cylinder walls, consequently a hollow water-cooled piston is used. Either pump or thermo-syphon flow is employed for these engines. Among other machinery that requires cooling are the cylinders for compressing air or ammonia, and parts of furnaces, such as tuyeres and hearth-jackets, which would otherwise rapidly burn away. Shaft and other bearings may have a much increased flow of oil, beyond that actually necessary for lubrication, if the speed is high or the shafts are big, or they may have water-cooling passages in the bearings. When a cooler deals with the oil in its course of circulation it may be of air-cooled pattern for aero-engines, or water-cooled in other instances. The condenser is a specimen of cooling apparatus for steam, gas, ammonia, or carbon dioxide, and there are also the cold air and brine circulating systems around cold stores. Water has to be cooled in large volumes in several classes of plant, including condensing equipments and large internal-combustion engines. There are three methods employing, severally, a large reservoir, into which the water goes and

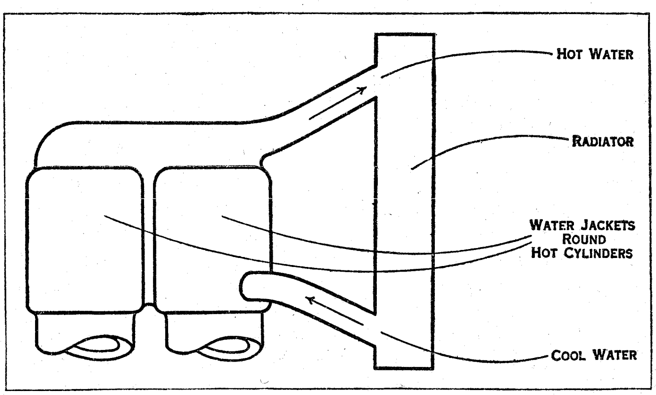


FIG. 1.—THERMO-SYPHON COOLING SYSTEM USED IN MODERN MOTOR CAR
Cool water, after being heated by contact with cylinders, rises and passes through the radiator to be cooled again, before circulating once more through the jacket

cools by the surface area, a smaller pond with spraying devices, and a cooling tower filled with a framing of laths, up which air flows by natural or forced draught and meets the water falling in a finely divided state as shown in fig. 2. The spray pond has the water sprayed through a series of nozzles out over the water, the cooling effect being due to the water going up in the air in a finely atomized state.

Several schemes for cooling are to be found in electrical apparatus to check injurious rises in temperature. In motors, generators, transformers, etc., care is taken to provide paths for free circulation of either air or oil as near as possible to the points where the heat is generated. Small transformers depend on natural air circulation, while others are mounted in tanks filled with insulating oil and are self cooling by means of tubes or radiators. Forced cooling is essential for large transformers, with air supplied by a fan, or water passed through piping in the oil, or the oil itself being cooled. Small and medium sizes of motors and gener-

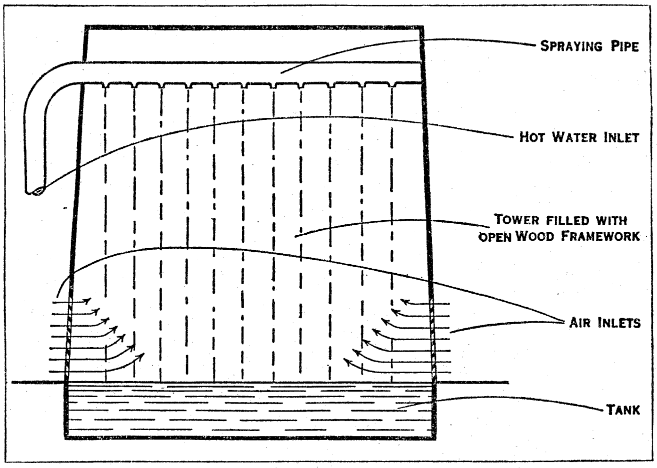


FIG. 2.—WATER COOLING TOWER WITH NATURAL DRAUGHT, THE SYSTEM USED WHERE LARGE VOLUMES OF WATER MUST BE COOLED
The cooling tower is fitted with a framing of laths, up which air flows by natural or forced draught, and meets water falling in a spray

ators are cooled by a fan. For large units a closed system of cooling is preferable, as it avoids the dust present in supplies of air drawn from outside.

Heat generated in metal-working processes, such as turning, drilling, milling and grinding, must be dealt with by copious flooding with oil, water or compound, otherwise the tools would not endure and the work would be roughened and warped.

COOLUS, ROMAIN, known as RENÉ WEIL (1868–), French dramatist, born at Rennes on May 25, 1868. His first popular success seems to have been *Les Amants de Sazy* (1901), a daring play full of biting irony, which has not yet lost its appeal. Among the plays which definitely made Coolus' reputation are *Antoinette Sabrier* (1903), *L'Enfant Chérie* (1906), *Coeur à Coeur* (1907), and *Une Femme passe* (1910). Since the World War he has tended to abandon serious comedy in favour of vaudeville: *L'Autruche* (1923) and *Né un Dimanche* (1924). The distinguishing features of Coolus' more important works are an extremely lucid analysis of human character under the stress of passion, and an endeavour to show that in questions of love we ought to judge with an indulgence founded on understanding and sympathy, and in that spirit of broad humanity which alone can avert tragedy in individual lives. *L'Enfant Chérie* and *Coeur à Coeur* are particularly characteristic in this respect. Coolus has sometimes been accused of an immoral tendency, but he has always claimed that, on the contrary, he defends the rights of conscience against the blind cruelty of convention. Since the death of Robert de Flers, Coolus has been president of the Society of Dramatic Authors and Composers. He was also one of the founders of the C.T.I. (Confederation of Intellectual Workers).

COOMA: *see* ALPS, AUSTRALIAN.

COON-CAN is an adaptation of the old Spanish game of Conquian—derived from the Spanish word Conquién, "with whom." The game was taken over by the Spaniards to Mexico, where it is played at the present time under the slightly altered name of "Conquain."

There is no record as to when, or by whom, Coon-Can was introduced into England. It was first heard of at the Bath club in Dover street in the early years of the twentieth century. The Bath club has been the nursery of various new card games. It was played for a time at the Portland club for high points, but the committee stepped in and decided that it was a gambling game and opposed to the rules of the club, and it was promptly forbidden. It was also played at the Travellers' club in Paris for a short time, but it soon died a natural death there. It has no real pretensions to rank as a scientific card game, but it makes an excellent family game, easy to learn, and requiring no great card skill.

The game can be played by any number of players up to seven, but five is the best number. Two full packs of fifty-two cards are used, with the addition of two jokers. If proper joker cards are not available, it is usual to consider the twos of spades as jokers. A joker may be made to assume the place of any card which the holder of it chooses.

The dealer deals ten cards, one at a time, to each player. He then places the remaining cards, in a pack, face downwards in the middle of the table, turning up the top card and placing it by the side of the pack.

The object of the game is to dispose of all the cards in one's hand by forming combinations of three or more of a kind, such as three knaves, or four eights, or into sequences of three or more cards of the same suit, such as seven, eight, nine of hearts, or king, queen, knave, ten of spades, and placing them, face upwards, on the table. This is called "showing down." For the purpose of forming sequences an ace can be reckoned as the highest or lowest card, *e.g.*, ace, two, three or ace, king, queen, but the cards must be of the same suit, it must be a "straight flush" in poker parlance.

When the deal is completed, and the top card exposed, the player on the dealer's left must take into his hand either the exposed card, or the top unexposed card from the pack. If the exposed card is likely to be of use to him in forming any of the above mentioned combinations he will naturally take it. If it is of no use to him he leaves it on the table and takes the top card from the pack. He must take one or the other. After taking in a card, he may at once, if he wishes, show down on the table in front of him any combination, or combinations, such as have been described, that is, any sequence of three or more cards of the same suit, or three of a kind. Lastly, he must discard a card from his hand, placing it, face upwards, on the top of the exposed card, or, if he has taken the exposed card, in place of it. His proceedings must be in the specified order. He must first take in a card, then show down anything that he may wish to, and last of all, discard a card from his hand. After he has made his discard he can do nothing further until his turn comes round again. Each player, in turn, proceeds as described, first taking in either the exposed card or the top card from the pack, then showing down if he can do so, and if he wishes to, and lastly discarding a card, which must always cover up the last card exposed.

In addition to this, any player, in his proper turn, may add to a sequence already shown down by himself or anybody else, any card, or cards, which will continue the sequence at either end, or he may add to three or more of a kind any cards of the same kind which he may happen to hold. If a sequence is shown down with a joker at either end of it, any player, in his proper turn, may move the joker to the other end of the sequence, if so doing will enable him to add any cards to it, but when once a joker has been so moved, its position becomes fixed, it cannot be moved back again.

The game continues round and round in regular rotation, until one player is able to show down all his cards. The game is then over. The player who has got rid of all his cards wins from each of the others the value of the cards which they still hold in their hands, *i.e.* which have not been shown down.

A joker counts 15 points, an ace counts 11 points, each court card counts 10 points, other cards count their face value. There is only one winner in each game. Losers do not pay the balance of points to one another.

There are many variations of the game, principally turning on the question of "ratting." "Ratting" is when a player shows down some of his cards, possibly only three of them, with a view to decrease his liability, before he is prepared to show down his whole hand. One variation is to allow no ratting at all. Another variation is that no one is allowed to show down less than six cards. Another variation, and probably a better one is that a player may rat at any time, but if he fails to win the game he must add 30 points to his losing score. When one player has ratted, anyone else may show down without penalty. This is the game as played in England. It was popular for a time, and it is still played in parts of the country. (*See* also RUMMY.)

See W. Dalton, *Coon-Can* (1913).

COOPER, ALEXANDER (d. 1660), English miniature painter. His works are of great rarity, and the chief are a series representing the king and queen of Bohemia and their children, some very remarkable portraits belonging to the queen of Holland, and others in the possession of the king of Sweden and in various Swedish galleries. He came to Sweden in 1646, and the Swedish documents declare that he was a Jew, and that his full name was Abraham Alexander Cooper. He had previously been residing in Holland, but on reaching Sweden entered the service of Queen Christina, and continued to be her miniature painter until 1654, when she resigned the Crown. Two years later Cooper was in Denmark, carrying out some commissions for Christian IV., but in 1657 was back again in Stockholm, where he died in the early part of 1660. The date of his birth is not known, but he is believed to have been born in London. He was the brother of Samuel Cooper (*q.v.*).

For full information regarding his career, and for various documents bearing his signature, see *The History of Portrait Miniatures*, by G. C. Williamson, ch. vi. 78, and the *Nineteenth Century*, Oct. 1905.

(G. C. W.)

COOPER, SIR ASTLEY PASTON (1768–1841), English surgeon, was born at Brooke, Norfolk, on Aug. 23, 1768, the son of a clergyman. He studied under Henry Cline, surgeon at St. Thomas's Hospital, London, and attended the lectures of John Hunter. He was connected with St. Thomas's as demonstrator in anatomy (1789–91), joint lecturer with Cline on anatomy and surgery (1791–1800), and then went to Guy's as surgeon. In 1813 he became professor of comparative anatomy to the Royal College of Surgeons, of which body he was president in 1827 and 1836. He was vice-president of the Royal Society in 1830, and received a baronetcy in 1820. He died in London on Feb. 12, 1841.

Sir Astley Cooper was a great surgeon and his operation (1817) of tying the abdominal aorta for aneurism is historic; the achievement can only be appreciated when it is borne in mind that the operation was accomplished before the days of antiseptic surgery. In the first volume of the *Transactions* of the Chirurgical Society, of which he was one of the founders, he published (1805) an account of an attempt to tie the carotid artery. Of his numerous works the most important is *The Anatomy and Surgical Treatment of Hernia*.

See *Life of Sir Astley Cooper*, by his son, B. B. Cooper (1843).

COOPER, CHARLES HENRY (1808–1866), English antiquary, was born at Great Marlow, on March 20 1808, and died at Cambridge on March 21 1866. He was borough coroner and then town clerk of Cambridge. His earliest production, *A New Guide to the University and Town of Cambridge*, was published anonymously in 1831. *The Annals of Cambridge* (1842–53) contained a chronological history of the university and town from the earliest period to 1853. His most important work, the *Athenae Cantabrigienses* (1858, 1861), a companion work to the famous *Athenae Oxonienses* of Anthony à Wood, contains biographical memoirs of alumni of the university from 1500 to 1609. He left an immense collection of ms. materials for a biographical history of Great Britain and Ireland.

COOPER, JAMES FENIMORE (1789–1851), American author, was born at Burlington, N.J., Sept. 15, 1789. In the next year, the family moved to the lake region of central New York. He entered Yale college in the class of 1806; a silhouette taken of him in his undergraduate days shows a profile chiefly marked by determination. A boy of 14, he was old enough to display that pugnacity which was later to be one of his chief characteristics; he showed insubordination, and the faculty expelled him, unaware of the fact that he was to be the most important man of letters ever connected with Yale. He went before the mast on a merchant vessel, and saw Europe for the first time. On Jan. 1, 1808, he became a midshipman in the U.S. navy. He resigned in 1811, was happily married and retired to the beautiful family estate at Cooperstown, where he died Sept. 14, 1851.

In 1826 he took his family to Europe and lived abroad seven years. From 1833 until his death he lived in Cooperstown. The later years were clouded by continual quarrels with the newspapers, and by the suits for libel that he brought against them. The echoes of this fight were heard across the ocean, and the London journals joined with those of New York in brutal attacks upon Cooper the controversialist. They never succeeded in frightening or quieting him, but they took up his time—the time that he might have more profitably employed in writing novels.

Cooper's ideals in literature were not shaken, and his letter to the editor of a new magazine in 1841 is characteristic. The editor had written in boastful terms about the size of the periodical, and the large sums that would be paid to distinguished contributors. "I never asked or took a dollar in my life, for any personal service, except as an officer in the navy, and for full-grown books. . . . Do you think size as important in a journal as quality? We have so much mediocrity in this country that, excuse me for saying it, I think distinction might better now be sought in excellence."

Cooper was prolific. He wrote more than 30 novels, many books of travel and several tons of polemics. The wonder is that he survived such a mass of production. He came to the gates of immortality with a vast amount of excess baggage. He himself, however, is on the right side of the gates, although only a small portion of his works followed him.

His happiest years were from 1821 to 1831. He was internationally famous and the clear sky of domestic happiness and literary fame had not been stained by clouds of hostility. He was welcomed everywhere in Europe as a distinguished man of letters; he revisited as a luxurious traveller the scenes he had first witnessed as a common seaman. During this decade, moreover, he composed masterpieces with fluent ease. Very few authors can show in so short a period so splendid an output. In 1821 appeared *The Spy,* in 1823 *The Pioneers* and *The Pilot* (both germinal works), in 1825 *Lionel Lincoln,* in 1826 *The Last of the Mohicans,* in 1827 *The Prairie* and in 1828 *The Red Rover.*

Cooper never refused a challenge; and it is possible that if he had not been challenged, he would have remained in obscurity. He had reached the age of 30 without any apparent desire to write, when after reading aloud to his wife a novel of English society, he said, "I believe I could write a better story myself." Mrs. Cooper dared him to try. The result was *Precaution,* one of the worst novels in history, hopelessly bad in style, structure and characters, and disfigured by typographical errors.

If this book had been a success, it is possible that he might never have written another. His temperament was encouraged by success, but inspired by failure. In Browning's phrase, he made the stumbling-block a stepping-stone. The dates are significant: *Precaution,* 1820; *The Spy,* 1821. John Jay had told Cooper the story of a spy, and Cooper turned it into one of the most successful novels in literature. Never was a work written with such contemptuous carelessness. The publisher became alarmed at the increasing size of the manuscript as it reached him in instalments, and expressed his misgivings. Cooper immediately wrote the last chapter, told the publisher to have it set up, printed and the pages numbered, so that he might know the extreme limit of the book. Then Cooper filled the intervening space. The novel scored a prodigious success and deserved it.

From 1821 to the present moment Cooper has been a "household word." Russian and Polish children are as familiar with the Leather-stocking Tales as are the boys and girls of America. Morse, the inventor of the electric telegraph, wrote (1833): "I have visited, in Europe, many countries, and what I have asserted of the fame of Mr. Cooper I assert from personal knowledge. In every city of Europe that I visited, the works of Cooper were conspicuously placed in the windows of every bookshop. They are published as soon as he produces them in 34 different places in Europe. They have been seen by American travellers in the languages of Turkey and Persia, in Constantinople, in Egypt, at Jerusalem, at Ispahan."

Probably no writer ever showed greater inequalities in his work than Cooper. When he attempted "society" novels, he fell beneath criticism; on the high seas or in the forest primeval, he is impressive. He could not make ladies and gentlemen seem real; but his men of the wood and of the wave are gloriously alive. His failure was not due to unfamiliarity with the material; he was a gentleman by birth and breeding, and knew the manners of aristocratic society. Why, then, could he not make them seem real? Perhaps because in that field he had no sympathetic imagination. In the forest and on the ocean he lived with his characters; they were more real to him than his neighbours; but apparently he could not visualize the children of fashion.

One reason for Cooper's enormous popularity in foreign countries is that his tales lend themselves easily to translation. It is not the style but the narrative that gives them distinction. Not only do Cooper's novels lose nothing in translation, they positively gain. Every time they were translated they were improved. French, German, Spanish, Italian, Russian, Polish, Turkish and Japanese children hold in their little hands a better book than the original.

American literature began like a child learning to talk, imitating its British parents. Cooper suffers from the same drawback in his novels of social life. But in his masterpieces he was, of all early American writers, the most truly and consistently American. We can see this more clearly than it was perceived by his contemporaries. He created an American literature out of American materials. It had in its robust tones no echoes of Europe. He was less influenced by foreign authors and foreign topics than any other American writer of his time. He was a path-maker.

Apart from the excellence of his best works, he deserves credit as the founder of two great schools of fiction. He was apparently the only man in America who thought a sea story could be made interesting. While he was engaged in the composition of *The Pilot,* he talked it over with many men and women, and received not one favourable opinion. In a preface to the later edition, dated Aug. 10, 1849, Cooper gave an account of the inception of this work and the constantly discouraging comments he had from all sides. "Not a single individual among all those who discussed the merits of the project, within the range of the author's knowledge, either spoke or looked encouragingly. It is probable that all these persons anticipated a signal failure." The book appeared in 1823. Its success was immediate. It founded a new school in fiction, which has flourished and will flourish indefinitely. One of Cooper's friends declared that the sea could not be made "interesting," but Cooper's followers, Marryat, Melville, Clark Russell, Stevenson and Conrad have had no difficulties in engaging the attention of readers. Seventeen years after *The Pilot* appeared Richard Henry Dana's *Two Years Before the Mast,* which resembled Cooper's work in its accidental entrance into immortality.

Cooper was, is, and will be best known for the Leather-stocking Tales. They have often been called a drama in five acts. There is an orderly development in the character of the hero; the incidents have a regular and disciplined march; hence it is surprising that no two of the novels appeared in their logical order. *Deerslayer,* which comes first, was written last; *Mohicans,* the second, was written after *Pioneers,* the fourth; *Pathfinder,* the third, was written fourth; *Pioneers* was written first, and the series concluded with *Prairie,* which was written third. They were published in this order: *Pioneers,* 1823; *Mohicans,* 1826; *Prairie,* 1827; *Pathfinder,* 1840; *Deerslayer,* 1841.

When Cooper wrote *The Pioneers,* he apparently had no thought of continuation. It was a chance remark by a friend on an excursion to Lake George, that emboldened him to make the risky experiment of reviving the hero. *The Last of the Mohicans* justified the adventure. Then he produced *The Prairie,* and left his scout dead and buried. But the popularity of Hawkeye called for a resurrection; and after 13 years he brought him back in *Pathfinder,* and then crowned the series by the most difficult feat of all—he wrote *Deerslayer* and gave the immortal scout not only a new lease of life, but the freshness and glory of early youth.

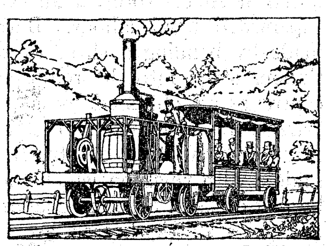
Cooper's powers developed with his hero. Natty Bumppo, in

Pioneers, is an ignorant and almost peevish elderly man, who regrets the advance of civilization. The ideal side is missing. But Hawkeye is alert, adroit, strong, resourceful, rejoicing in the plenitude of his powers. He is an addition to the population of immortals. He will live with D'Artagnan and Cyrano de Bergerac. His is essentially a romantic character; so that attacks on his "naturalness" are of no moment. Cooper knew perfectly well what he was about. He said, "In a moral sense this man of the forest is purely a creation. A leading character in a work of fiction has a fair right to the aid which can be obtained from a poetical view of the subject." Cooper's "noble red man" has often been matter for laughter, but those who know most laugh least. If one will read Franklin's *Remarks Concerning the Savages of North America,* he will find that the great realist drew as favourable a picture of these people as the great romanticist.

Cooper's chief faults are faults of style; his English is chronically bad. His powers of characterization did not include subtlety. But he is a master of action; and his books have in them the principle of life. Balzac said, "If Cooper had succeeded in the painting of character to the same extent that he did in the painting of the phenomena of nature, he would have uttered the last word of our art."

Bibliography.—The chief authorities for the life of Cooper are the biography by T. R. Lounsbury, in the "American Men of Letters" series, the letters in two volumes, edited by James Fenimore Cooper, his grandson; and *Le Roman de Bas-de-Cuir,* by Margaret Murray Gibb, published at Paris in 1927. (W. L. P.)

COOPER, PETER (1791–1883), American manufacturer, inventor and philanthropist, was born in New York city on Feb. 12, 1791. He received practically no schooling, but worked with his father at various trades. At 17 he was apprenticed to a coach-builder in New York city. On coming of age he got employment at Hempstead (L.I.), making machines for shearing cloth; three years afterwards he set up in this business for himself. After the war of 1812 he turned his shop into a furniture factory; soon sold this and for a short time was engaged in the grocery business on the site of the Bible house, opposite Cooper Union; and then invested in a glue and isinglass factory. About 1828 he built the Canton ironworks in Baltimore, Md., the foundation of his great fortune. In 1830 he designed and constructed the first steam locomotive built in America, the "Tom Thumb," which was about the size of a modern hand-car. He built, in 1836, a rolling mill in New York; in 1845 he removed it to Trenton, N.J., where iron structural beams were first made in 1854 and the Bessemer process first tried in America in 1856; and at Philippsburg, N.J., he built the largest blast furnace in the country at that time. He built other foundries at Ringwood (N.J.), and at Durham (Pa.), bought iron mines in northern New Jersey and carried the ore thence by railways to his mills. Actively interested with Cyrus Field in the laying of the first Atlantic cable, he was president of the New York, Newfoundland and London Telegraph Company, and his frequent cash advances made the success of the company possible; he was also president of the North American Telegraph Company, which controlled more than one-half of the telegraph lines of the United States. For his work in advancing the iron trade he received the Bessemer gold medal from the Iron and Steel Institute of Great Britain in 1879. He took a prominent part in educational affairs, and conducted the campaign of the Free School Society to its successful issue in 1842, when a State law was passed forbidding the support from public funds of any "religious sectarian doctrine." He is probably best known, however, as the founder of the Cooper Union (*q.v.*). Though he had been a hard-money Democrat, he joined the Greenback Party after the Civil War, and in 1876 was its candidate for the presidency. He died in New York city on April 4, 1883. He published *The Political and Financial Opinions of Peter Cooper, with an Autobiography of his Early Life* (1877), and *Ideas for a Science of Good Government, in Addresses, Letters and Articles on a Strictly National Currency, Tariff and Civil Service* (1883).



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THE "TOM THUMB," FIRST STEAM LOCOMOTIVE IN AMERICA, BUILT BY PETER COOPER IN 1829–30, AND RUN ON THE BALTIMORE & OHIO R.R.

There is a brief biography by R. W. Raymond, *Peter Cooper* (Boston, 1900).

COOPER, SIR RICHARD POWELL, 1st Bart. (1847–1913), English agriculturist, was born on Sept. 21, 1847. He became a member of the firm of Cooper and Nephews, chemical manufacturers and exporters of pedigree live stock, and achieved a great reputation as a breeder of shorthorn cattle and Shropshire sheep. He rendered great service to the Argentine republic by supplying it with British live stock. He died at Berkhampstead on July 30, 1913, being succeeded as second baronet by his son Richard (b. 1874), M.P. for Walsall from 1910 to 1922.

COOPER, SAMUEL (1609–1672), English miniature painter. This artist was undoubtedly the greatest painter of miniatures who ever lived. He is believed to have been born in London, and was a nephew of John Hoskins, the miniature painter, by whom he was educated. He lived in Henrietta St., Covent Garden, and frequented the Covent Garden coffee-house. Pepys, who makes many references to him, tells us he was an excellent musician, playing well upon the lute, and also a good linguist, speaking French with ease. According to other contemporary writers, he was a short, stout man, of a ruddy countenance. He married one Christiana, whose portrait is at Welbeck Abbey, and he had one daughter. In 1668 he was instructed by Pepys to paint a portrait of Mrs. Pepys, for which he charged £30. He is known to have painted also the portrait of John Aubrey, which was presented in 1691 to the Ashmolean museum, as we learn from his correspondence with John Ray, the naturalist. Evelyn refers to him in 1662, when, on the occasion of the visit that the diarist paid to the king, Cooper was drawing the royal face and head for the new coinage.

Magnificent examples of his work are to be found at Windsor Castle, Belvoir Castle, Montague House, Welbeck Abbey, Ham House, the Rijks Museum at Amsterdam and in the collection of the late Mr. J. Pierpont Morgan. His largest miniature is in the possession of the duke of Richmond and Gordon at Goodwood. A piece of the artist's handwriting is to be seen at the back of one of his miniatures in the Welbeck Abbey collection, and one of his drawings in black chalk is in the University gallery at Oxford. His own portrait of himself is in the collection of J. Pierpont Morgan.

For a fuller account *see* the *History of Portrait Miniatures,* by G. C. Williamson, vol. i., p. 64. (G. C. W.)

COOPER or COUPER, THOMAS (*c.* 1517–1594), English bishop and writer, was born in Oxford, where he was educated. He became master of Magdalen college school, and afterwards practised as a physician in Oxford. In 1565 appeared the first edition of his greatest work, *Thesaurus Linguae Romanae et Britannicae,* followed by three other editions.

Queen Elizabeth was greatly pleased with the *Thesaurus,* generally known as *Cooper's Dictionary;* and its author, who had been ordained about 1559, was made dean of Christ Church, Oxford, in 1567. Two years later he became dean of Gloucester, in 1571 bishop of Lincoln and in 1584 bishop of Winchester. Cooper defended the practice and precept of the Church of England against the Roman Catholics on the one hand and against the Martin Marprelate writings and the Puritans on the other. He died at Winchester April 29 1594.

Cooper's *Admonition against Martin Marprelate* was reprinted in 1847, and his *Answer in Defence of the Truth against the Apology of Private Mass* in 1850.

COOPER, THOMAS (1759–1840), American educator and political philosopher, was born in London, Oct. 22, 1759, and studied at Oxford. Because of his active sympathy with the French Revolution he emigrated to the United States about 1793 and began the practice of law, becoming president-judge of the 4th District of Pennsylvania in 1806–11. Like his friend Joseph Priestley, Cooper was very highly esteemed by Thomas Jefferson, who secured for him the appointment as first professor of natural science and law in the University of Virginia, a position which Cooper was forced to resign under the fierce attack made upon him by the Virginia clergy. After filling the chair of chemistry in Dickinson College, Carlisle (Pa.), and in the University of Pennsylvania, in 1819 he went to South Carolina college, Columbia, where he taught chemistry and political economy.

In 1820 he became acting president of that institution, and was president from 1821 until 1833, when he resigned his presidency and, in the following year, his professorship, owing to the opposition within the State to his liberal religious views. He was a born agitator: John Adams described him as "a learned, ingenious, scientific, and talented madcap." Before his college classes, in public lectures, and in numerous pamphlets he constantly preached the doctrine of free trade and tried to show that the protective system was especially burdensome to the South. His remedy was State action. Each State, he contended, was a sovereign power and was in duty bound to protest against the tyrannical acts of the Federal Government. He exercised considerable influence in preparing the people of South Carolina for nullification and secession. The last years of his life were spent in preparing an edition of the Statutes at Large of the State. Dr. Cooper died in Columbia on May 11, 1840. As a philosopher he was a follower of Hartley, Erasmus Darwin, Priestley, and Broussais; he was a physiological materialist and a severe critic of Scottish metaphysics.

Among his publications are *Some Information Respecting America* (1794); *Political Essays* (1800); *Lectures on the Elements of Political Economy* (1826); *A Treatise on the Law of Libel and the Liberty of the Press* (1830); and a translation of Broussais' *On Irritation and Insanity* (1831), with which were printed several of his own essays.

See I. Woodbridge Riley, *American Philosophy: The Early Schools* (1907); E. F. Smith, *Chemistry in America* (1914); and "The Possible Origin of a Lincoln Phrase" in the *Review of Reviews* (Feb., 1901).

COOPER, THOMAS (1805–1892), English Chartist and writer, the son of a working dyer, was born at Leicester on March 20, 1805, and was apprenticed to a shoemaker. He had a passion for knowledge; studied Greek, Latin and Hebrew in his spare time; and in 1827 gave up cobbling to become a schoolmaster, and, later, a Methodist preacher. His affairs did not prosper, and in 1840 he joined the staff of the *Leicestershire Mercury*. Here he was converted to Chartism and became one of the most ardent supporters of Feargus O'Connor (*q.v.*). He organized the most poverty-stricken Leicester workers into an "army" devoted to Chartist propaganda and the study of literature, assuming himself the title of "the Shaksperean General." He edited the *Midland Counties Illuminator* for the Chartists and took a prominent part in the general strike of 1842, making an organizing tour in the Potteries. For this he was imprisoned in Stafford gaol for two years, where he produced *The Purgatory of Suicides,* a political epic in ten books. After his release from prison he became disillusioned in Feargus O'Connor, and his political enthusiasm waned. After 1848 historical and educational subjects predominated in his lectures, and from 1856 he lectured in defence of Christianity. He died at Lincoln on July 15, 1892. *See* the *Life of Thomas Cooper, written by Himself* (1872).

COOPER, THOMAS SIDNEY (1803–1902), English painter, was born at Canterbury on September 26, 1803. At the age of 20 he went to London and was admitted as a student of the Royal Academy. He then returned to Canterbury, where he was able to earn a living as a drawing-master and by the sale of sketches and drawings. By showing his first picture at the Royal Academy (1833) he began an unprecedentedly prolonged career as an exhibitor. Cooper's name is mainly associated with pictures of cattle or sheep, of which he produced many hundreds. He was elected A.R.A. in 1845 and R.A. in 1867. He presented to his native place, in 1882, the Sidney Cooper art gallery. He wrote his reminiscences, under the title of *My Life,* in 1890, and died on Feb. 7, 1902.

COOPERAGE. The trade of making casks of staves and hoops. The term is also applied to the factory where casks are made. The word is from "cooper," a maker of casks, derived from such forms as Mid. Dutch *cuper,* Ger. *Küfer,* Lat. *cuparius;* the same root is seen in various Teutonic words for a basket, such as Dutch *kuip* and Eng. "kipe" and "coop," but cooper is apparently not formed directly from "coop," which never means a "cask" but always a basket-cage for poultry, etc. Cooperage is of great antiquity; Pliny ascribes its invention to the inhabitants of the Alpine valleys.

The trade is one in which there are numerous subdivisions, the chief of which are tight or wet and dry or slack cask manufacture. To these may be added white cooperage, a department which embraces the construction of wooden tubs, pails, churns and other even-staved vessels. Of all departments, the manufacture of tight casks or barrels for holding liquids is that which demands the greatest care and skill since, in addition to being perfectly tight when filled with liquid, the vessels must bear the strain of transportation to great distances, and in many cases have to resist considerable internal pressure when they contain fermenting liquors.

The staves are best made of well-seasoned oak. Since a cask is a double conoid, usually having its greatest diameter (technically the bulge or belly) at the centre, each stave must be properly curved to form a segment of the whole, and must be so cut as to have a suitable bilge or increase of width from the ends to the middle; it must also have its edges bevelled to such an angle that it will form tight joints with its neighbours.

Setting up the Barrel.—The staves being prepared, the next operation is to set up or raise the barrel. For this purpose as many staves as are necessary are arranged upright in a circular frame, and round their lower halves are fitted truss hoops which serve to keep them together for the permanent hooping. The upper ends are then drawn together by means of a rope which is passed round them and tightened by a windlass, and other truss hoops are dropped over them, the wood being steamed or heated to enable it to bend freely to shape. The two ends of the cask are next finished to receive the heads by forming the chime, or bevel on the extremity of the staves, and the croze or groove into which the heads fit. Finally the heads and permanent hoops are put in place. The heads, when made of two or more pieces, are jointed by wooden dowel pins, and after being cut to size are chamfered or bevelled round the edge to fit into the croze grooves. The hoops are generally of iron. The manufacture of slack casks proceeds on the same general lines, but is simpler in various respects, both because less accurate workmanship is required, and because softer woods, largely fir, may be employed.

Machinery of the most elaborate and specialized character has been devised to perform most of the operations in making both slack and tight casks, and though it involves considerable capital outlay it effects so great an economy of time that it has largely superseded hand labour. Barrels without separate staves are made by bending a sheet of wood, sawn from a log in a continuous strip, into the required circular shape, the bulge at the centre being obtained by cutting out V gores from the ends. Barrels are also made of steel, either of the ordinary bulging form or consisting of straight-sided drums provided near the middle with rings on which they may be rolled. Immense numbers of casks of different shapes and sizes are employed in various industries. Tight barrels are a necessity to the wine and cider maker, brewer and distiller, and are largely used for the transport of oils and liquid chemicals, while slack barrels are utilized by the million for packing cement, alkali, china, fruit, fish and numerous other products.

CO-OPERATION. Co-operation in the sense of working together for a common result is as old as human nature. When primitive men hunted and their womenfolk prepared the meat there was elementary co-operation. In this sense Dr. Johnson wrote, of the larger and infinitely more varied economic order of his time, that "the business of life is carried on by a general co-operation." Despite an obvious lack of intention, different activities did, in fact, work to one end. But that, at best, is unconscious co-operation; even in its general sense the word usually is reserved for a designed common effort. Wishes are expressed that political parties should co-operate for some national object, or that there should be co-operation of labour and capital. These bodies or interests are conceived as equal, and free each to take its own course. They are then asked to proceed together to a mutual end—to co-operate.

The same implication of agents equal and free underlies the particular sense of the word in co-operation and the co-operative movement. Galley slaves pulled together; but they did not co-operate. In the gilds amongst the freemen of the English villages of the 15th century, as in the *mujins* or mutual-aid societies of Japan, and in the *fruitières* of Switzerland, it was different. In these countries, as elsewhere, such bodies were voluntary, and they arose amongst groups of people roughly on an equality. Of the two principles the voluntary element is even more necessary: in the Russia of 1920, when co-operative membership was compulsory and State control complete, the name "co-operative" lost all meaning. Free association is essential. In Britain this spirit of association, in which each seeks his own benefit through that of the whole, is shared by friendly societies, clubs, trade unions and other bodies. From these kindred movements co-operation diverges by applying itself to businesses such as usually are conducted for profit. A co-operative society thus becomes a voluntary union of persons, on a democratic basis, to supply its members with goods and services, or to employ its members in producing for sale, or to sell its members' produce, or to finance its members, or to combine all these aims in one, and at the same time to distribute surpluses in a manner agreed upon by the members as fair to each and all.

Building societies may also come within the terms of this definition, but have never been included with co-operative societies in Great Britain. (*See* BUILDING SOCIETIES.)

Co-operation under any of these forms has roots which go back far into the past; but it is the modern world which has both created the need and given opportunity for the modern co-operative movement. This world came into existence when domestic hand labour, for domestic needs, was replaced by production in factories, for markets; when the peoples of Europe began to mass together in industrial towns; and when virgin continents became new factors in the world's life. At first, in Britain, the threatened workers co-operated in self-defence and to get for themselves the benefits of the new machinery. Then, gradually, a newer co-operation came into effect, namely, combination (on the same mutual lines) of the consumers massed in the spreading towns, to possess a larger share of the riches of the new production. Later, under the disturbing influence of new American food exports, there came the peasant co-operation of Ireland and Europe, again in self-defence. Last of all, there followed a somewhat similar movement of exporting farmers, equally to benefit each individual member while pursuing the gain of the whole number. These different movements we may now survey in detail, remembering, however, a factor sometimes overlooked. The success of "all for each and each for all" is seen to depend very considerably on the degree of knowledge and intelligence, of honesty and loyalty and of active self-direction and self-reliance possessed by each. Thus writers on co-operation in Asiatic countries have pointed out how illiteracy, dependence on others, unpunctuality, inertia and the spirit of faction have checked or prevented the spread of the movement in the East; while elsewhere the zeal for education of the Rochdale pioneers is perceived to have been well-inspired. (For Co-operation in the United States *see* page 389.)

CO-OPERATION IN GREAT BRITAIN

Primitive Efforts and Failures.—Great Britain is the classic home of co-operation as a movement, and of consumers' co-operation in particular. As early as 1761 a Fenwick weavers society in Ayrshire, Scotland, supplied its members with weavers' reeds, and also oatmeal for home consumption; and this was not the only Scottish effort. In England 1,400 inhabitants of Hull, to protect themselves "from the invasions of covetous and merciless men," managed in 1795 to establish the Hull Anti-Mill society, whose flour mill continued for 100 years. Again, in the dockyard towns of Devonport and Sheerness the high prices of the period of the Napoleonic wars quickened the more responsible workers into devising societies to supply themselves at least with the most urgent necessaries.

But these spontaneous beginnings did not constitute a concerted movement. That came after 1820, with Robert Owen. By that time capitalist large-scale manufacture had so developed in Great Britain as to destroy much of the old domestic handwork. The new system had separated thousands of workers from the purchasers of the products they handled; it had also assembled working populations in new industrial towns as massed consumers dependent on new and unfamiliar sources of supply. Meanwhile England had escaped the direct effects of war and revolution, and devoted religious and secular teachers had created a capacity in many workers to be something better than industrial machines. Robert Owen, himself a capitalist, but fresh from his famous pioneer welfare work at New Lanark, found an immediate response to his teaching that livelihood and security could be gained through forming self-employing co-operative communities. In London in 1821 the Co-operative and Economical Society set out to create a community of families buying at cost price through its own co-operative store, employing (gradually) its own members, and providing for both education and recreation.

The London society ended; but its aims were born again in 1827, at Brighton, with active and wise support from Dr. King, a Brighton physician. Dr. King emphasized the store as a means to employing members in producing for the assured market of its organized consumers. Other propagandists were busy, and, though statistics are lacking, by 1830 there were perhaps two to three hundred co-operative societies, two or more journals, and several paid co-operative missionaries. And co-operative congresses held in Manchester and Birmingham projected a wholesale society—in this case against Owen's advice. In 1831 the North-west of England United Co-operative Company was established in Liverpool. Yet within three years all this effort and enthusiasm had faded like a rainy sunset. The societies aimed at capitalizing profits, in order to buy land and settle thereon communally. If they enjoyed any success (as at Brighton) in view of the distance to the communal ideal, it became tempting to divide the capital. But success was rare. Co-operators found then, as many times since, that when shopkeeping (or other business) is made secondary to creating employment, on the principle that economic value inheres in labour and production independently of serviceableness, then even the simplest shopkeeping fails.

The Rochdale Pioneers.—At Rochdale this truth was soon to be proved in a happier way. There, in 1844, a simple idea was applied which revolutionized co-operation, and gave it a place in a world very rapidly outgrowing the pioneers' localized hope of an Owenite "self-supporting home colony of united interests." Two societies had failed in Rochdale; and to tread another path the Rochdale pioneers (the idea is attributed to Charles Howarth) proposed neither to sell at cost nor to capitalize profits, but to charge the accustomed market prices and credit each member personally with his share of the surplus in precise proportion to his general purchases at the society's store. The idea was not entirely new. Scotland (Lennoxtown) and Yorkshire (Meltham) had harboured it (with Lyons in France); but by opening membership to all householders at the cost of only a shilling entrance fee, and by permitting members to withdraw accrued profits down to £1, as well as through systematic and commonsense capacity, combined with missionary zeal, the pioneers established their society and made its example infectious. Cash sales, liberal depreciation, the limited interest on capital (5%) and the educational grant from profits (2½%) further commended the Rochdale system.

Enabling Acts and Expansion.—Four years later, in 1848, Maurice and Kingsley were joined by Ludlow, already afire with the idea of co-operative workshops, and the raising of the Christian Socialist banner attracted Hughes and Neale. The last three, especially, supported the northern co-operators, not only by advocacy, but by legal and parliamentary help, both unsparing and unpaid. Enabling Acts for friendly societies had developed since 1793 and for building societies since 1836. In 1852 the first Industrial and Provident Societies Act extended the area of sanction, and expressly legalized dividends on purchases. In 1862 a further act, amongst other changes, allowed the autonomous societies increasing in the northern towns to federate, and so form a wholesale society related to the retail societies exactly as the latter were to their individual members. The co-operators immediately made good their project for the trading federation afterwards known as the Co-operative Wholesale Society. A similar federation was established for Scotland, and separate British federations for insurance and for publishing; while the Co-operative Union of Great Britain and Ireland came into being as a general protective, legal, propagandist and educational association. George Jacob Holyoake, a prince of co-operative propagandists, and Dr. Watts, of Manchester, shared vigorously in this work with the Christian Socialists.

Yet the change which the pioneers had made, empirically, in shifting the practical co-operative appeal from the man in the workshop to the domestic consumer—the woman in the home—remained unperceived. The veteran Dr. King disliked the new dividend. Holyoake, Hughes and Neale supported it, but they limited pure Rochdale co-operation to "distributive" societies. "Production," they held, should be differently organized, in workshops supplying the retail stores but self-governing; and the "productive" workers should share the profits with the customers and with the providers of capital. It was J. T. W. Mitchell, a late-comer to the Rochdale band, who saw new principles in the Rochdale practices. He, for the first time, distinctly taught a consumers' co-operation. Consumers were everybody. Consumers' needs were the reason for existence of all industry; industry prospered as it served use and enjoyment. Consumers paid for all profits, distributive or productive; it was the consumers who were entitled through co-operative control to reduce their cost of living, and abolish poverty, by possessing and sharing all surpluses arising throughout industry. On this basis Mitchell looked forward to a universal co-operation based on the common needs of mankind, without distinction of class or race.

Emergence of Consumers' Co-operation.—Holyoake, Hughes and Neale (the latter becoming the self-sacrificing, honorary, working secretary of the Co-operative Union) opposed Mitchell with a sincerity equal to his own, with much superior literary and oratorical powers, and with all the support of the educated onlookers, until, in 1891, Miss Potter (Mrs. Sidney Webb) wrote her *Co-operative Movement in Great Britain.* But as the indefatigable chairman of the English C.W.S. for 21 years, Mitchell saw "The Wholesale" succeed as distributor, as banker, and in industry after industry, as manufacturer for its organized market, while productive societies rose and fell. By its financial success rather than through any theoretical comprehension, his view triumphed. In bootmaking, printing and industries similarly open at the time to small-scale effort, a group of productive societies remained as an alternative source of supply for the retail stores and, in bootmaking, a participator in Government contracts and export trade. These societies formed their own Co-operative Productive Federation and remained influential, especially in the English midlands, as a partner in the Co-operative Union. But the tide flowed with the consumers movement. Societies modelled on the Rochdale success extended over Europe and gained a footing in the Dominions and in the United States. And where populations were too scattered for consumers' societies, and the large, common economic interest which is essential to co-operation was found instead in farming communities widely interested in a staple product like wheat, fruit or butter, the Rochdale system was adapted to serve the whole in a manner as equitable to each participator.

War-time and Later Extensions.—Britain, curiously, though the mother of co-operation, has continued to call her offspring by other names. The law, as further amended in 1867, 1876, 1893 and 1913, speaks officially of "industrial and provident societies." Consumers' societies are classed as "distributive," and the title "consumers" remains officially unknown. But in Europe "societies for consumption" carry that name from France to Russia; and in the United States the title "consumers" is also used. And in Britain as in France, Germany, Austria and elsewhere, the World War brought the basis of consumers' service to the front. The different governments found themselves obliged to work with the societies in recognizing the necessities of their nationals as consumers, and in doing justice equitably to their hungry populations. Thus the importance of organized consumption was emphasized, while high prices the world over drove consumers into co-operative membership. In Great Britain the number increased from 2,878,648 consumer members in 1913, to 3,788,490 in 1917 and 4,548,557 in 1921. In 1927 the figure had increased to over five millions. This British increase was typical of the growth in other lands; and though many European societies had to strike off lapsed members, later on, there remained a large net increase.

After 1921 the falling food prices which benefited consumers created a crisis in agriculture and stimulated ideas of co-operation there. Themselves farming 64,000 acres, the consumers societies were not unaware of what the fall meant. Relations were established in Britain with the National Farmers' Union, and though in matters of general supply it proved difficult and sometimes impossible to reconcile special functional societies—farmers and labourers—with general societies of consumers covering the same areas, the existing movement for bringing agricultural societies into trading membership with the C.W.S. was considerably quickened. In 1922, for example, the C.W.S. created a precedent by successfully extending to an agricultural society in difficulties exactly the same financial and administrative service which had re-established many subsequently prosperous consumers' societies. Through the same agency, the British consumers entered into new relations with Dominion farmers' societies, and with Russian co-operators and English capitalists in respect to Russian grain and other exports. When in 1927 an outcry arose because the Co-operative Party agreed to facilitate its work by avoiding competition with the Labour Party, it was not quite realized how wide in other directions the contacts of the co-operative movement were becoming.

Their history has proved British co-operators true to type. Theorizing has rarely guided them or misguided. Oblivious to merely logical consequences, they have travelled in whatever direction promised success, provided the path approved itself to the instincts and common sense of their movement as a whole.

RETAIL DISTRIBUTIVE OR CONSUMERS' SOCIETIES

Extent and Character.—Consumers' co-operation in Britain has spread far beyond the industrial regions of the Midlands and the North. From Penzance to Wick and Thurso there extends a network of between 1,200 and 1,300 independent, self-governing, territorial societies, the number decreasing through amalgamations while the societies enlarge. Some have grown enormously, like the London Co-operative Society, which covers an area north of the Thames from Hounslow to Southend-on-Sea, and includes 230,000 members. Others continue as tiny village societies with perhaps less than 100 adherents. In agricultural areas, as around Lincoln and Peterboro, Shrewsbury and Hereford, the society at the centre has branched out over hundreds of square miles. Elsewhere, as in parts of Lancashire, West Yorkshire or Durham, societies, perhaps too independent, are crowded together. All are equal in their complete autonomy. Their membership is by no means purely industrial. With factory workers, miners and railwaymen, they include clerks and professional men, farmers and rural labourers; while the revenues of the peerage have been known to benefit by dividend on purchases. By the older rules, either husband or wife holds the share book. In the newer practice all adults are accepted. It is the C.W.S. of which people hear; but it is these local societies which form the basis, and are the chief owners, of the federal institutions.

At the Co-operative Congress of 1928 it was recognized that the societies were too numerous for modern ideas of efficiency, and steps for hastening amalgamations were recommended from the chair; while by a small majority the C.W.S. was authorized to start retail stores from its wholesale centres rather than leave the localities to attempt to create more small societies. All such steps, however, remain subject to the will of the present local societies as composing the governing bodies.

Practically all the consumers' societies have begun with a public meeting, an enrolment of members subscribing capital, the election of a committee of management, and the subsequent purchase or tenanting of a shop by the committee, and the appointment of a paid manager. From selling plain groceries—just as any shopkeeper, except for the dividend-check given with every purchase—they have extended to universal supply and to baking, boot-repairing, tailoring, coal and milk delivery, laundering, dairy-farming and meat production. On the educational and recreative side, the societies maintain libraries, arrange lectures and week-end schools, entertain conferences, distribute their own periodicals, give concerts, dances and entertainments in their own halls, establish choirs, hold mammoth "field days" for their members' children, conduct rambles and motor tours and organize travel guilds. They have outstanding between six and seven millions advanced for house purchase by members, and they own houses worth over three millions. Such services are not all found in every place; for one society will be a "live" one, and another seem content with a rather dull-minded routine shopkeeping. This variation, like the sometimes varying prices of the societies for the same article, is felt nationally to be an obstacle. But all these activities widely exist. In general, the societies in Great Britain do not supply intoxicants, and avoid overlapping with their own national institutions in manufacture and insurance. Otherwise they recognize no barriers in the field open to local voluntary association.

Government—Trade—Taxation.—The government of all the distributive societies is entirely democratic, following usually the model rules of the Co-operative Union. Each member has one vote and only one. Membership rules, and not capital. The newcomer with £1 invested ranks equally with the holder of shares to the legal limit of £200. For the committee of management, as for other selected positions, all are equally eligible, except for varying qualifications in respect to the management committee, and these are as likely to be concerned with purchases as with the holding of capital. The Royal Arsenal Society in South London, with 180,000 members, has a salaried executive, but the usual payment is a small fee for each meeting. Control may be through a group of departmental managers or (the newer practice) a general manager or managing-secretary. Employees as consumers may be members, and the more progressive societies do not debar them from election to the boards of management; joint advisory councils of the management committee and the employees exist in certain societies and are officially recommended. Trade union wages and conditions are all but universal, and, since the World War, pension schemes have come into existence. Interest on capital is limited generally to 5% or less, and rules are found that further limit the interest paid to non-purchasing members. Much of the members' capital represents dividends on past purchases, allowed to accumulate with the society. Cash sales in respect to groceries is the general rule; in other departments practices vary, many societies having introduced instalment clubs and hire-purchase for furniture. In 1926, a sum of four million pounds, or 16/ per member, was due to the societies for goods at the end of the year. It is widely believed that the societies are privileged in being excused income tax; but they are, in fact, taxed on their land and numerous buildings, while taxable members are liable to income tax on their share interest. The only untaxed money is the "disposable surplus," and, whether paid or reserved, this is legally regarded as a deferred discount—a saving through buying practically at cost price. A new kind of "income" would need to be defined, a "wage" of the consumer, earned whenever his pocket benefited by economy in self-supply, in order to bring within the limits of any income tax the excess payments revealed in co-operative transactions at each accounting.

Prosperity and Its Problems.—That nothing succeeds like success is not always true. The consumers' societies have by no means ousted multiple shops or individual traders. But they have so far prospered as to incur the danger of affluence. Amongst the thousands of members in each locality only hundreds at most attend the local business meetings. With millions passing through the coffers, many people prefer to befriend causes deemed to be more needy, and voluntary help becomes apt to depend on a few. Employees in turn develop the disposition which led to the short but determined struggle for special wages which occurred between societies and the National Union of Distributive Workers in Lancashire in 1924; or their co-operative loyalty is overcome by their class loyalty, as in certain areas during the general strike of May, 1926. Yet to infer decadence from these signs would be as idle as for co-operators to see the millennium in a congress vote. What is more important is the really astonishing fact that having begun in 1844 from nothing but tiny incomes and pressing needs, the British retail co-operative societies founded and continued by the "rude unlettered mass" should, for the troubled year of 1926, be able to show members' purchases of £184,000,000, a surplus of £17,000,000 returned on these purchases, a capital held by members of over £87,000,000, and a body of workers numbering 147,000[1]. In a world deemed to be incurably selfish these figures still constitute a revelation of new social forces.

The Guilds.—The Women's Co-operative Guild, founded in England in 1883, with later-born sisters in Scotland and Ireland; the National Co-operative Men's Guild, dating from 1911, and the more recently founded mixed guild, form a core of activity within the consumers' movement. The women's guild, having 58,000 members, and holding an important annual congress, is a self-governing organization mainly of married women, intent on stimulating and organizing the ideas and abilities of the woman in the home, both as a co-operator and a citizen.

THE NATIONAL (FEDERAL) CO-OPERATIVE ORGANIZATIONS

The Co-operative Wholesale Societies.—The wholesale societies have grown from the retail as naturally as a tree from its roots. It would not be inapt to speak of their relationship to their members as resembling that of the Federal Government in America to the States of the Union. The original English (and Welsh) C.W.S. came into being during the American Civil War, and the Lancashire promoters of the society were influenced by that struggle for federal unity. Unity is the note of the wholesale society, as diversity is of the retail. What would be a medley of local units competing against one another for supplies is transformed by a C.W.S. into an organized body, buying and selling together. Where the larger local societies would each be setting up rival wholesale departments, the national wholesale pools the strength of all, and supplies all, on open terms strictly equal toward all society-members. On the other hand a C.W.S. has no monopoly of the co-operative market. It is a wholesale department, which the retail society may or may not elect to use. Only corporate bodies are members; for no individual in his own right holds any "wholesale" shares or enjoys any C.W.S. control.

The society-members provide capital in the ratio of one £5 share for every two members; and these shares, also, may accumulate out of the dividend of 3d. or 4d. in the £ on wholesale purchases. Once a quarter, on Saturday afternoons, several hundred delegates from the society-members attend regional meetings, and the general meetings subsequently held at its Manchester headquarters by the C.W.S., and at Glasgow by the S.C.W.S. The voting power is based on membership qualified by purchases. Salaried full-time directors are elected, 32 by the societies in England and Wales for the C.W.S., 12 by Scottish societies for the S.C.W.S. Independent auditors are similarly chosen. The federations are so far servants that, except by consent, they cannot fix retail prices—maximum prices, and not minima, being desired. On the other hand they possess very great influence. All the directors have been elected from well-known and trusted local leaders. With their officials they represent the knowledge and power of a world-wide business. They can match their national oversight against the strength of local independence. The C.W.S. Bank with its annual turnover of six or seven hundred millions is a giant in co-operative finance. In addition there are the accountants and auditors appointed by the C.W.S., and the managers and travellers, all without any compulsory powers, yet constituting a body of vigilance, while themselves subject to the criticism of the local managers and executives, and of the C.W.S. directors elected by those executives.

Along these lines the C.W.S. conducts a trade that—from semi-failure and derision in the days when, literally, the federation employed two men and a boy—has grown to over seventy-five

[1]Retail societies employees. The total number of employees of all societies in 1927 was 209,616.

millions yearly. From solicitors to artists, from bankers and tailors to land workers, miners and seamen, it employs at home and abroad, approximately, 50,000 workers. In its own workshops, wholly or in part, it manufactures goods to the value (at wholesale prices) of over twenty-five millions, these being supplied only to its corporate members. Besides its depots scattered over the world, in partnership with the S.C.W.S. it cultivates tea estates in India and Ceylon. The Co-operative Insurance Society is jointly held by itself and the S.C.W.S.; and it is also represented on the board of the Manchester Ship Canal and of a colliery company. Apart from its own 31,000ac. of English land, held as a consumers' federation, it has dealings with 160 agricultural societies, 100 of which are members. In its relations with employees, by resolution of the delegate meetings, it has to insist on trade-union membership, however oddly that action may seem to come from an employer; and though it has no immunity from strikes, no stoppage has been of long duration. Welfare work for employees is carried on, with a thrift fund, and a pension scheme is in view; while with other responsibilities toward the millions who are its ultimate customers and owners, it maintains a convalescent home, subsidizes and conducts publications, and subscribes to co-operative and guild education and propaganda. The tendency is to enlarge rather than to narrow the scope and responsibilities of the most powerful and most experienced co-operative organization in the world.

Other Federations.—Since the period when the co-operative idea was one function, one organization, amalgamation has reduced the number of separate federations. Of those which remain, the National Publishing Society, the United Baking Society, of Glasgow, and the Co-operative Printing Society, of Manchester, are the most important. The two first, like the C.W.S., are limited to society-members, and come definitely within the consumers' movement. The third includes trade unions and individuals. The *Co-operative News* and the *Scottish Co-operator* are both issued (weekly) by the publishing society. Local federations of consumers' societies for laundering are found chiefly in Lancashire and Yorkshire, one of these claiming to possess the largest laundry in the world. Federations for milk supply form the newest development along the same local lines.

The Productive Societies.—To meet with a picturesque name like "guild of cricket-ball" makers is to have one's sympathies enlisted at once on the side of productive independence. Shoemaking, printing and the clothing trades, however, are those which engage most of the societies representing partnerships in the co-operative movement between consumers, workers and individual small capitalists. Consumers' societies take employees into membership as consumers. The productive societies seek to make their employees direct participants in workshop gains and control. Membership confers no right to work; but employment, for the adult, does carry a right to membership. The Co-operative Productive Federation, of Leicester, which secures joint invoicing and joint exhibiting, but not joint selling, includes 41 societies with 5,700 employees, and sales reaching two and a quarter millions yearly. In 1926, amongst these societies, 22 shared profit with their workers in ratios of from $1\frac{3}{4}$d. to 2s. 8d. in the £ on wages. Altogether, of a surplus of £107,000 just over 5% (in addition to share interest) was distributed to capital, 25% to labour and 35% to purchasers. The societies' copartnerships thus vary from private forms of copartnership in recognizing the consumer and not regarding their industry as simply the possession of capital and labour. On the other hand, the consumers' average share in control is only 21%, the remainder being divided between the trade union and individual holders of capital (40%), and employees (39%). In post-war years the societies have not increased in number, and in the favourable field of bootmaking, for example, their sales have fallen behind those of the consumers' factories; but they hold their ground in the counsels of the movement, and with educational and social committees, and provident or pension schemes, maintain the co-operative spirit.

The Co-operative Union.—The defensive, educational and propagandist union of the British co-operative movement exists as the necessary means to those ends, and may be said to have outgrown the moralist and copartnership aims inherited from its Christian Socialist co-founders in the form in which these aims are still expressed. It is a comprehensive body, including the consumers' movement, local and national, the productive societies and their federation, some farmers' societies, and tenants', building and recreational societies. There is also an Irish section, and altogether 1,300 societies are affiliated. There is no salaried executive, but a complex control of sectional boards forming a central board which delegates work to smaller bodies. The union organizes co-operative opinion through district and regional conferences, especially through its great annual three-day congress of 1,700 delegates. Much of its work is done with the other national organizations through joint committees, particularly the joint parliamentary committee. The central education committee is another important arm, having control of a co-operative college and a teaching staff, conducting classes and summer schools, and sharing in an international school. Amongst the co-operative millions it is surprising to find the union's yearly subscription revenue no more than £41,000—a quarter of what the societies subscribe to hospitals and charities. The local character of the movement largely accounts for this, while there might be added the value of the regular hospitality given to union conferences by the local societies.

The Co-operative Party.—Political co-operation is relatively a new force, born during the World War, when the congress of 1917 turned from a traditional neutrality to organize a political party that should be the co-operators' and consumers' own. One member of Parliament was elected from ten candidates in 1918; four in 1922; six in 1923 (one of whom held office in the first British Labour Government); and five in 1924. In Parliament the group keeps general touch with the Labour Party, which contains many co-operative members, but with its own leader and whips it concentrates on the innumerable issues in modern legislation affecting the mass of consumers. It also stands for the support of voluntary co-operation against any policy, from any quarter, which might fail in understanding and considering co-operative public interests. Municipal trading proposals it aims at reconciling with co-operative commitments, to prevent any clash. Two million out of nearly five million co-operators are collectively affiliated to the party, with a great majority in support in the South and Midlands. Through a relationship rather like that of the Established Church to Parliament, the party is under the authority of the Co-operative Union and the congress.

Agricultural Co-operation in Great Britain and Ireland.—Before the British farmer is assailed for not co-operating in his business affairs as the Danish farmers do, it should be remembered that he does not live by exporting two or three staple products, but by supplying variously a varied home market, often close at hand. The national conditions in general prevent or discourage both large-scale production and mass selling. But it has been estimated that one in every five English farmers is associated for the purchase of requisites; and in England and Wales societies with 60,000 members, dealing mainly in requisites, show a turnover of eight millions yearly. Societies for marketing dairy produce, eggs and poultry are found throughout Great Britain. In the eastern and southern counties of England organized farmers possess large bacon factories; and auction marts, slaughter-houses, butter factories and retail shops are similarly held. Yet it is difficult either to classify or to generalize about British agricultural co-operation. In scattered areas, as in Wales, many societies become general distributors; and the manager has to hold the scales between member-producers who want a good price for pigs, poultry or eggs, and member-consumers who quote the price at which they could buy in the market town. Everywhere the associations tend to do business, not by system, but as circumstances demand; while the problem of specially federating for national trading so many varied and often conflicting aims proves insoluble. In England different attempts have failed; but the National Farmers' Union undertakes the duty of promoting co-operation, and the Co-operative Wholesale Society, as already stated, invites farmers' societies into membership on equal terms with all other members. Generally, British agricultural co-operation is a business rather than a movement. (For details about farmers' co-operative effort *see* AGRICULTURAL CO-OPERATION.)

Co-operation in Ireland.—In 1906 in a little cabin amongst the barren hills of Donegal, a few Irish peasants conducted in turn, every evening, a tiny co-operative store. Under the leadership of one "Paddy the Cope" this Templecrone society has become a peasant consumers' and producers' co-operative, employing 70 persons and possessing several branches, a bakery, a hosiery factory and a local hall. Templecrone is an outstanding example of an Irish co-operation which in Belfast and in a few cities and towns is urban and wholly consumers', like the British, but elsewhere is represented by some hundreds of rural societies supplying farmers' requisites along with domestic needs. In the Free State the rural societies are federated for such purchases in the Irish Agricultural Wholesale Society. Since the disturbances and losses of the Irish political conflicts, the I.A.W.S. has been brought back to a sound position with assistance from the English C.W.S. Of the two other main forms of co-operation which in the pre-war years inspired poetic hopes of a new social Ireland, the farmers' creameries again are prospering under Government supervision, but the credit movement has been merged in commercial banking. In joining a creamery the farmers take shares in proportion to their cows, guarantee milk supplies, and receive payment monthly, or oftener, in proportion to the butter fat from each supplier (less the value of separated milk returned), with the surplus on working costs divided in the same way at each year end. The principle is the simple Rochdale idea adapted; and in abolishing profiteering, distributing material benefit, and removing the sense of being exploited, is in this form almost as far-reaching. The Agricultural Organization Society in the Free State, as a non-trading, propaganda body, represents over 150,000 farmers.

CO-OPERATION IN CONTINENTAL EUROPE, INDIA, JAPAN AND ELSEWHERE

The Two Types: Peasants' and Consumers'.—That the world is so full of a number of things becomes quite an imposing truth when one glances at co-operation as it extends through Europe to Palestine, India and Japan. Socialist, Christian and Liberal societies, credit unions and land banks, distilleries, oil-pressing, horse-breeding, cattle-insurance and land-renting societies, school and army societies—many unfamiliar forms convey, perhaps, a more confused than a happy sense of plenty. But the full picture can be put into simple outline. In the main, these all represent two types of co-operation. One is the Rochdale consumers' type, found throughout the world; but strongest in North-western and Central Europe. The other is the co-operation of peasant farmers.

In Britain the proportion of consumers' societies' members to population is one in nine—the figure would be one in three if families were wholly included. Finland, Denmark, Switzerland, adding the families, show approximately the same ratio of one in three. Germany, Austria, Estonia, Sweden (including families, one in four to five) are not far behind; and France, Belgium and Czechoslovakia follow—one in five to six. On the Danube, in Hungary, there is a change. The proportion of co-operators is high (one in three), but that is due to the farmers; and the national wholesale society, the "Hangya" is first agricultural and then general. Eastward, consumers' societies diminish until few but peasant societies are found. In India there are some 3,000,000 co-operative members—perhaps more than one in 20—but they are lightly organized in loan and supply groups which are less societies than clubs. And in Japan, though more developed, the character of the movement is not dissimilar.

The two types are distinct. Socialist or Christian (Roman Catholic), the consumers, by conserving for themselves the value of their customs, in effect seek a reduction in the cost of living for an unlimited number of members. The farmers, also hard pressed, aim at increasing the wages of production by saving for themselves the gains made at their expense by usurers, merchants caring only to take advantage of markets and even consumers. Issues such as those of food taxes would, if raised, divide type from type. Yet both bodies work to prevent exploitation by middlemen. And all are co-operative, in so far as they represent free association, and in each association a government based on equality in membership, and not on unequal capital holdings. The persons rule, and not the money.

Western Europe.—In Continental Europe, France was first in co-operative effort. While Owen appealed to Britain, St. Simon and Fourier laboured in France. In 1835 two disciples, Derrion and Reynier, started a store-keeping co-operative society in Lyons, the *Commerce Veridique et Social,* as a monument there attests. But French energy turned from the store to the workshop, and founded workers' societies, from which Ludlow took to England the idea of workshop self-government. Neither this eventually State-aided movement nor the paternal Familistere of Guise has led to any considerable result in modern France; but the consumers' movement—which began again at Nimes in 1885, derived strength from union in 1912, was conspicuous during the war, and is developing regional societies—has attained a membership of over 2,000,000. Equally successful are the farmers' butter-making and casein societies of Poitou and west-central France.

In Belgium, with its *maisons du peuple,* co-operation has been developed by the Socialist movement as providing incidentally a party servant of great value; and this has very naturally led to separate Catholic and Liberal societies, with the result of weakening co-operation as a purely economic power, especially in the smaller centres of population. The peasant movement, including butter and cheese production and rural supply, is almost wholly Catholic, with the clergy taking an active part. In Holland an amalgamation of the neutral and workers' movements has helped to overcome a similar weakness.

Belgian rural co-operation, derived from Germany, where, about 1849, Professor Huber made known the new success of co-operation in England, and where Schulze-Delitzsch and Raiffeisen adapted the Rochdale idea to the more primitive economic conditions then found in Germany. The loan societies of Schulze-Delitzsch for the town craftsmen and artisans, and the land banks of Raiffeisen for small farmers, became very successful, and created new movements for co-operative credit in other countries. The rural co-operation extended to the purchase of requisites and the provision of threshing and other machines; while building societies and consumers' societies grew up under the shelter of the General Union established by Schulze-Delitzsch. Following their improved legal position from 1889 onwards, and following, also, a new co-operative enthusiasm amongst German workers previously hostile, and an exclusion of consumers' societies by the General Union, a new Central Union was established in 1903 for consumers' societies only. This federation represented over 3,000,000 members in 1927; while 750,000 were affiliated to the National Union—Catholic—at Dusseldorf-Reiszholz. German societies distinguish between management and supervision. Boards of management are composed of a few appointed officials, co-operating with elected boards of supervision and both with the general membership. Large societies like that in Berlin, or the progressive Hamburg "Produktion," replace general meetings of members by councils elected from the membership, and these are the final authority. (Comparisons with England, however, show that differences of organizations count for less than the general quality and spirit of a movement.) Joint committees for co-ordinating consumers, farmers and all other forms of co-operation are established in Germany, Denmark and Estonia. Denmark, avowing her debt to Rochdale, exhibits a rural population using its double power as producers and consumers to attain a very complete co-operative welfare. Copenhagen, besides its big consumers' society, has a remarkable Workers' Co-operative Building Association. Scandinavia is also notable for the young and vigorous movement in Sweden, which in 1926 ended a rubber shoe monopoly. The Scandinavian C.W.S., established by the trading federations of the three countries, is regarded as a possible model for a general international inter-trading association. In Iceland, also, the movement is well-established.

From Switzerland Eastward.—Switzerland, amongst its equally advanced developments, can point to the creation of a co-operative village at Freidorf, Basle. Austria has the large Vienna society, and the land settlement societies. Poland, with nearly 2,000,000 consumer and peasant co-operators, since 1924 had led in unity by the amalgamation of civil service, labour and Christian workers' co-operative federations. Finland, followed by the Baltic countries generally, shows an active co-operative development perhaps superior to that of Denmark. In the heart of Central Europe racial divisions weaken co-operation, Czech and German members in Czechoslovakia being separately organized. But in Silesia the friendly inter-relations of German, Czech or Polish societies have helped to ease the friction of frontiers. Passing to Asia, a similar reconciling influence is found in the credit societies of India, where members of different castes, and even "untouchable" Regars and Chamars, serve together on the committees.[1] In India, however, as in Japan, peasant co-operation has been initiated and furthered from above, by governmental power. Consumers' co-operation in Japan mainly represents employers' benevolence, like Owen's at New Lanark, though the Christian social movement led by Mr. Kagawa has created independent societies.

Russia and Italy.—Russia is the most co-operative of all countries in Europe, the consumers' societies—apart from the Ukraine—including 15,000,000 shareholding members, and conducting 48% of the country's retail trade. The consumers' societies buy from State factories and also market rural members' produce; and their trade with the English C.W.S. easily outdistances any other in Europe. Yet, measured by employing power, the Centrosoyus falls much below the level of either of the British wholesale societies; while notwithstanding the restored freedom of 1924, it remains difficult to say how far voluntary co-operation, in a State under a class dictatorship, can be itself. The same question arises more acutely in Italy, where the National Union of Co-operative Societies was suppressed in Nov. 1925, Fascist organizations having been set up instead. In Jan. 1927, the board of management of the large consumers' society at Trieste was similarly dismissed, and a Fascist commissioner installed. Under such conditions the roots of co-operation die. What remains is State machinery.

Consumers' Societies in the Newer Lands.—But farmers—to say nothing of the farm labourers, so far omitted—are themselves important consumers; and in 1927 the then premier of Alberta (Mr. Brownlee) declared that, with the pools successful, the next step would be the consolidation and extension of co-operative purchasing. In Saskatchewan the important community hall movement, as part of the farmers' co-operation, shows a spirit at work very like that which built the co-operative halls of Lancashire; while the Co-operative Union in Ontario, representing the few thousand co-operative consumers between Cape Breton island and the West, enjoys direct relations with the prairie grain growers. Apart from the latent rural power, consumers' co-operation in the newer countries is naturally weak. It is found in New Zealand and in the Australian capitals, and in South Africa chiefly amongst dockyard and railway employees. In South America, the Workers' Household Credit Building and Consumers' Society, at Buenos Aires had, in 1927, over 7,000 members.

Meanwhile, the U. S. Bureau of Labour Statistics, reporting in 1926, found 700,000 co-operative consumers throughout the United States. These co-operative societies are curious in being organized frequently amongst immigrant races, especially Finns, Scandinavians, Germans and Russians, so that a group of societies possessing their own wholesale federation may conduct a very considerable business while using almost entirely a language foreign to America. This segregation, with the American distances and the consequent difficulties for united and trustworthy efforts amongst a population much more restless, economically, than in European cities, must long delay a powerful consumers' movement. But cafeterias and housing societies in New York—where the forward movement of consumers' co-operative services is notable—loan societies in the Eastern States, and general consumers' societies in the Middle West (including the Franklin Creamery Association of Minneapolis), have laid solid foundations. There are also negro societies amongst negro students from New York to Colorado. Since 1915 the Co-operative League of America, with New York headquarters, has federated for all non-trading purposes American societies genuinely conforming with Rochdale principles, and has also linked up American co-operation with the international movement.

[1] B. L. Mahtur, *Wheatsheaf*, June 1926.

International Co-operation.—Because of its million-fold memberships, its roots in home, farm and workshop, its forward possibilities and its everyday constructive work, the co-operative movement is imposing in a way hardly to be guessed from co-operative store windows and advertisements of goods. The International Co-operative Alliance, first suggested by the French pioneer, de Boyve, and constituted in 1895, is a minor league of nations, representing 85,000 societies in 36 countries. Kept in being formally during the World War, the alliance resumed its triennial international congresses in 1921. It has headquarters in London, issues a monthly *Bulletin* in English, French and German, and at Stockholm in 1927 found it necessary to promise to consider a wider lingual basis. The International Co-operative Wholesale Society, based on the C.W.S. headquarters at Manchester, solidly represents 26 national trading federations, covering 28,000,000 individual members, and since 1924 it has explored the possibilities of international co-operative trade. The International Co-operative Women's Guild, pioneered in 1921, and established in 1924, speaks for the new place and new interests which women are finding through consumers' co-operation in Europe and America, as well as in Britain. An international co-operative summer school (held annually) and a students' fellowship, are fresh evidences of growth. All were active at Stockholm in 1927; and they look to Vienna for 1930.

The Future.—The question of the future of co-operation is of particular interest. The movement never was more vigorous. In Great Britain its recovery from industrial depression has filled its supporters with confidence. Where numbers of its own members once anticipated its supersession in trade after trade by the "larger co-operation" of the municipalities, the Congress of 1928 showed a unanimous belief in the power of voluntary co-operation to perform the services required. What might be a source of weakness in the division of the societies into political and non-political, appears to be proving, instead, a stimulus to healthy rivalry, since both wings remain united through the general federations, while vying with one another in producing results. And the extension of credit trading in the form of "mutuality clubs" was in 1928 too successful to create forebodings.

The case is not dissimilar with consumers' co-operation abroad. In Germany, especially, not only industrial depression but the more disastrous inflation had to be surmounted; in 1928 success in both tasks inspired the German co-operators. In Sweden, recent co-operation has encouraged its supporters by enlisting a higher artistic skill than that which co-operative societies often command. Yet there, as throughout Europe, the movement still has far to go in supplying those articles into which individual taste and skill in design (as well as fashion) enter: In Great Britain 80% of the societies' trade is in groceries; and the Continent has advanced less than Great Britain. Meanwhile the strike of employees in the model Finnish Society, Elanti, in May, 1928, together with the challenge of the Russian conception of co-operation as a workers' instrument for the socialism of a class, constituted a warning of the task that lies before co-operation in leading its whole membership to understand and respond to the common interests of the millions and to bring over sectional and individual interests into serviceable relation to the whole.

These underlying issues of the individual and the mass, the section and the whole, the class and the community, form the real problem of co-operation's future. Avowedly neutral in religion and politics, the international movement does not regard itself as excluded from pursuing—although on a vaster, world-wide scale—the original aim of a co-operative community proposed by the co-operative fathers, the pioneers of Rochdale. How far is that aim practicable? It does not stand as the design of a theorist; to any friendly constant observer it must appear as arising from the social instincts of the masses. But amongst the masses themselves, there are multitudes bound to the co-operative movement only by self-interest and monetary ties. To make economic democracy widely effective, the co-operators evidently need to find profounder means than those yet employed for arousing disinterested human enthusiasm.

Furthermore, to have great effect in life's varied field, a movement must be complex, as well as extensive. Conscious mass power is a new thing, tremendous and far-extending, but it is not everything. Individual and personal integrity and skill will not be submerged; the side which enlists this latter power will also be hard to defeat. As a free movement, neither class-bound nor State-bound, co-operation appears to have before it a magnificent opportunity. Both producers' and consumers' co-operation present, it is urged by co-operators, a solution of the industrial problem by showing capital as a hired yet contented servant. Consumers' co-operation further offers the outline of a new economic society in which the workshop is related to the home and economic surplus to human needs, and where industry begins to look to its human ends instead of simply to profits and money wages. Whether the movement can lead a stubborn world decisively along this co-operative road, probably will depend more and more not only on its numbers, but also on its power to enlist intelligence, and develop in all ranks a leadership capable both of creating enthusiasm and producing everyday conviction amongst the masses of mankind.

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CO-OPERATION IN THE UNITED STATES

Speaking generally, the co-operative movement in America is far less developed than in Europe. It came into prominence at the beginning of this century and reached its zenith about 1920, when the instability of economic conditions caused the failure of many co-operative stores; those which did survive have prospered. Co-operative organizations are most developed in the Middle West, the majority being in towns of less than 2,500. They operate retail and wholesale stores, gasolene (petrol) filling stations, bakeries, laundries, restaurants, creameries, etc. The capital for such stores is raised through non-returnable entrance fees, the issue of non-assessable capital stock and money borrowed from members and others. The entrance fee, usually ranging from 25 cents to $2, covers the cost of organization work; any balance forms a reserve fund. Most stores sell at current prices to avoid the antagonism of competitors. From the profits, a fixed rate of interest is paid on the share capital after which a percentage is put in reserve for losses, etc. The remainder of the profits is then returned to the members in proportion to their patronage. Co-operative stores tend to check profiteering in local merchants, to raise the quality of goods sold and to encourage fair wages for clerks. The system purports to apply the principles of democracy to business enterprises.

CO-OPERATION, AGRICULTURAL: *see* Agricultural Co-operation.

CO-OPERATIVE INSURANCE: *see* Agricultural Insurance.

COOPERING, or Copering. A system of traffic in spirituous liquors, tobacco and other articles amongst the fishermen in the North Sea. The practice began in the middle of the 19th century, when Flemish and Dutch *koopers* (traders) frequented the fishing fleets for the purpose of barter. Trading first in tobacco, they extended their operations, and soon became practically floating grog-shops.

The demoralizing nature of the traffic was brought to the public notice in 1881, and a convention was held at The Hague in 1882 to consider means of remedying the abuses. In 1887 Great Britain, Germany, Belgium, Denmark, France and the Netherlands signed an agreement to prevent the sale or purchase of spirituous liquors among fishermen at sea. In Great Britain an act (the North Sea Fisheries Act, 1888) was passed to carry into effect the terms of the convention. The act (now repealed and replaced by the North Sea Fisheries Act, 1893, with which it is identical but for some slight verbal modifications) imposes a fine not exceeding £50 or a term of imprisonment not exceeding three months for supplying, exchanging or otherwise selling spirits. It imposes a like penalty for purchasing spirits by exchange or otherwise, and requires every British vessel dealing in provisions or other articles to have a licence and to carry a special flag.

See E. J. Mather, *Nor'ard of the Dogger* (1888), and publications of the Royal National Mission to Deep-Sea Fishermen.

COOPERSTOWN, a village of New York, U.S.A., 70 mi. W. of Albany, at the foot of Otsego lake, where the Susquehanna river emerges from it, 1,200 ft. above sea level; the county seat of Otsego county. It is served by the Delaware and Hudson and several bus lines. The population in 1940 (federal census) was 2,599.

The charming village, with many quaint old houses, is in the midst of the romantic scenes of J. Fenimore Cooper's "Leather-stocking Tales," now a prosperous dairying region. The shores of the lovely lake (9 mi. long and from $\frac{1}{4}$ to 2 mi. wide), Cooper's "Glimmerglass," are now lined, as he predicted in 1838 they would be, with beautiful estates and modest cottages. The village is the site of the National Baseball museum and Doubleday field, the game having been invented at Cooperstown in 1839 by General Abner Doubleday. There also is the museum headquarters of the New York State Historical association.

In 1785 Judge William Cooper, of Burlington (N.J.), acquired large tracts of land in this region, and in 1788 laid out the village, which was incorporated in 1807. The Cooper home, Otsego hall, was for many years the largest private residence in the State. It was burned in 1852, and its site is now a public park. Cooperstown was the home also of Erastus F. Beadle (d. 1894), who originated the "dime novel," and of Samuel A. Nelson, a justice of the supreme court. *See* J. Fenimore Cooper, *The Chronicles of Cooperstown* (Cooperstown, 1838).

COOPER UNION, a unique educational institution "for the advancement of science and art" in New York city, founded in 1859 by Peter Cooper. It is housed in two buildings on Cooper square at the northern terminus of the Bowery, Third avenue, and Seventh street. In a letter to the trustees accompanying the trust-deed to the property, Cooper said that he wished the endowment to be "forever devoted to the advancement of science and art, in their application to the varied and useful purposes of life." Cooper's most efficient assistants in establishing and developing the Union were his son, Edward Cooper, and his son-in-law, Abram S. Hewitt. In 1900 Andrew Carnegie increased the financial resources of the Union by generous gifts.

The instructing staff, laboratories and studios are excellent. All instruction is free and is open to all who meet the entrance requirements irrespective of race, creed, colour, or place of residence. The library contains full files of current journals and magazines, and in 1939–40 had 71,000 volumes; the number of readers per year averages 250,000. There is a museum for the arts of decoration, which opened in 1897, containing the famous J. Pierpont Morgan collection of textiles, the Decloux collection of 17th and 18th century drawings of ornaments and decoration, the Winslow Homer sketches, an outstanding collection of wallpapers, and an encyclopaedic picture reference library of 500,000 classified clippings and photographs relating to the decorative arts. Apart from evening lecture courses, the principal departments of the Union, with their attendance in 1939–40 were: a day school of engineering offering standard four-year day college courses in civil, electrical, mechanical and chemical engineering, 336; a night school of engineering offering co-ordinated courses of six years' duration in civil, electrical, mechanical and chemical engineering, and awarding degrees identical with those granted in the day school, 961; a day school of art offering a four-year course in art and its industrial applications, which includes drawing, painting, decorative design, architecture, plastic design and advanced study in painting, sculpture, fashion illustration and costume design, graphic design, advertising design and architecture, 200; a night school of art also offering a four-year course in art and its industrial applications, 480; making a total enrolment of 1,977. All courses are of college grade. Admission is restricted to graduates of recognized secondary schools who have qualified in rigorous intelligence and aptitude tests. Free lectures for the public are given throughout the winter under the auspices of the Department of Social Philosophy, in the Great Hall of the Union, where on Feb. 27, 1860, Abraham Lincoln gave before an audience of notables the famous "Cooper Union Address" which was largely instrumental in securing his nomination for the presidency. Since that eventful winter, thousands of lectures and addresses have been heard there, including those of John Tyndall, the English physicist, who gave the lectures on light, which stimulated the building of scientific laboratories in American universities. It was there that Robert G. Ingersoll gave one of his earliest addresses on religion and Victoria Woodhull defended rights for women. Gano Dunn succeeded to the presidency of Cooper Union following the death of R. Fulton Cutting in 1934. With the installation of Dr. Edwin Sharp Burdell as director in 1938, a policy of scientific humanism, which aims to accomplish an intellectual synthesis of the natural sciences and the humanities, was inaugurated. A Department of Humanities, functioning as an integral part of the Institute of Technology, was established in 1939.

CO-OPTATION, the election to vacancies on a legislative, administrative or other body by the votes of the existing members of the body instead of by an outside constituency (Lat. *co-optare*). Such bodies may be purely co-optative like the Royal Academy, or elective with power to add to the numbers by co-optation. An example of the latter are the municipal corporations in England.

CO-ORDINATES in the widest sense are class characteristics (in mathematics, primarily magnitudes) that serve to distinguish and arrange the elements or units of an assemblage, specifically of a continuum. More particularly, in geometry they determine the position of each point, line, plane or other extent in a total of such. Co-ordinates of the simplest and principal type are called *Cartesian* from René Descartes in whose *Géométrie* (1637) they first made a somewhat disguised and informal appearance, though vague hints may be found much earlier, as in Nicole Oresme's Latin *Treatise on the Latitudes of Forms* (*c.* 1361). Perhaps with exacter justice they might be named "Fermatian," as invented by Pierre de Fermat (1601–65) in his study of maxima and minima (1629), who communicated his idea to M. Despagnet of Bordeaux, according to Fermat's letter to Roberval (Sept. 22, 1636). Immediately following the appearance of the *Géométrie*, Fermat wrote to Descartes (Jan. 10, 1638) setting forth his own conceptions, first published, however, in his *Varia Opera* in 1679—ideas and methods far in advance of Descartes' and nearer to the modern form, range and system. Indeed, it may be said that they almost distinguish him as the "sole founder of analytic geometry" (H. Wieleitner, 1927), if not of modern mathematics.

Parallel Co-ordinates.—The *Cartesians* are the two distances (x, y) of a point $P(x, y)$ from two axes (OX, OY) in its plane, that meet (commonly at right angles) in the origin O. A fitting name is *parallel co-ordinates* (fig. 1). Suppose the plane filled completely with each of two systems of parallel lines, the two intersecting at any angle. Suppose also that the lines are all numbered, from a base line in each system, along the base line in the other (OX, OY); then through each point of the plane passes one and only one line of each system, and each line bears a number representing the length it cuts off from O on the other axis, and is given by an equation as $x=3$, $y=4$; these lengths, numbers and equations are called co-ordinates of the point of intersection $P(x, y)$, *rectangular* or *oblique* according to angle XOY, but in both cases *parallel* (or rectilinear).

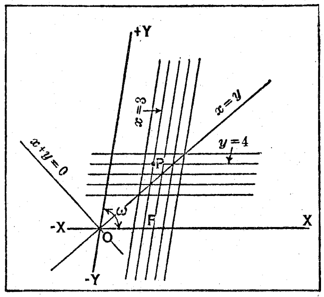

FIG. 1

The co-ordinate y is often called the *ordinate*, a term reproducing the Latin adverb *ordinatē* or *ordinatim* (arrangedly), long used with the participle *applicata*, in translating Apollonius, for the Greek τεταγμένος, especially of parallel chords (in a conic) bisected by their conjugate diameter. *Applicata* itself furnished an equivalent for "ordinate," as in Fermat's *appliquée*. *Abscissa* (abscisse), "off-cut" (Gr. ἀποτομή) explains itself, as segment cut off from an axis, or diameter (reckoned either from vertex or centre) by a conjugate chord (or ordinate). Both ordinate and co-ordinate, as nouns, were slow in being recognized, being first used in their present sense by Leibniz (1692).

Equations. The whole system of points forming the plane may now be indicated by a symbol (x, y), both x and y "real" and arbitrary, ranging from zero (0) both ways to infinity (from $-\infty$ to $+\infty$), each point corresponding to one and only one pair of values (x, y), and conversely. But if x and y be subjected to some condition, as $x-y=0$, the points (x, y) cannot be just anywhere in the plane, but only in a certain region of value, viz., on the line bisecting the angle XOY (ω); hence $x-y=0$ (fig. 1) or $x=y$ is called the equation of the bisector. To each of its points corresponds a value-pair (x, y) satisfying its equation, and conversely. The equation symbolizes a system of value-pairs (all that satisfy it), all depicted together by all the points on the line and, conversely, a one-to-one correspondence of point and value-pair. Likewise the system of value-pairs $x^2+y^2=25$ symbolizes an assemblage of points, a circle about O, of radius 5; conversely, such a circle depicts such a system of value-pairs. So for any curve and its symbolizing equation, and for any equation and its depicting curve.

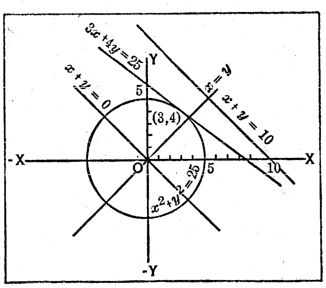

FIG. 2

Degrees. All equations of the first degree in point co-ordinates (as $lx+my+n=0$) are depicted by lines, and hence are called *linear*, and conversely; all of the second degree (as $ax^2+2hxy+by^2+2jx+2fy+c=0$) by *conics* (*see* CONIC SECTION), of which both circles and line-pairs are limiting cases, and conversely; equations of a higher degree, by higher curves, and conversely; the numerical fact of degree corresponding to the geometric fact of intersection by a line. A curve of the nth order (its equation being of the nth degree in x and y) meets a line in exactly n points, some perhaps coincident, or even *nul*, non-existent in the plane of real x and y. Thus $3x+4y=25$ meets $x^2+y^2=25$ in the double tangent-point (3, 4), while $x+y=10$ meets it in the imaginary points $x=5\pm\frac{5}{2}\sqrt{-2}$, $y=5\mp\frac{5}{2}\sqrt{-2}$ (fig. 2). Concentric circles, as $x^2+y^2=36$, $x^2+y^2=100$, meet only in imaginary points at ∞.

Transformation. There is often occasion to change the axes of reference. In the simplest change of origin only, OX, OY are pushed, without turning, into new positions $O'X'$, $O'Y'$: if O' be (a', b'), plainly $x=x'+a'$, $y=y'+b'$ (fig. 3). If OX, OY be not pushed, but only turned round O, say counter-clockwise through the angle a, then clearly $x=x' \cos\alpha - y' \sin\alpha$, $y=x'\sin\alpha+y'\cos\alpha$ (fig. 4). For both changes at once, the formulae are combined. This is the case for rectangular axes; for oblique axes we have similar processes with more complex results.

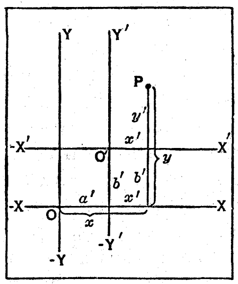

FIG. 3

Polar Co-ordinates.—The second primitive type of co-ordinates is the *polar*, used by Jakob (Jacques) Bernoulli in 1694; a length or distance $\rho(OP)$ radius vector, inclined θ, direction angle, to an initial direction OD (fig. 5). The co-ordinate net-work consists of all concentric circles about O, with all their radii, each radius meeting each circle in one point only, and conversely. Rectangular co-ordinates are readily expressed by polar co-ordinates, thus $x=\rho\cos\theta$, $y=\rho\sin\theta$; conversely, $\rho=\sqrt{x^2+y^2}$, $\theta=\tan^{-1}y/x$.

Threefold and Fourfold Space.—Rectangular co-ordinates are easily extended to spaces of three or more dimensions. Imagine three planes mutually perpendicular, meeting by twos in OX, OY, OZ, like the walls of a room and the edges at a corner. Then the co-ordinates of P are its three distances a, b, c, from the planes YOZ, ZOX, XOY, parallel to OX, OY, OZ. Or imagine space filled with each of three sets of parallel planes, OX, OY, OZ, being three intersections taken as axes. Then for all points of a plane upright on OX, parallel to YOZ, the distance x to YOZ, parallel to OX, is the same—say $x=a$; and similarly for $y=b$, $z=c$. Hence these three lengths (fig. 6) or their numbers a, b, c, or the three planes through P, or their equations are co-ordinates of P. Clearly any equation of the first degree in x, y, z, as $lx+my+nz+c=0$, is depicted by a plane, with axial intercepts $-c/l$, $-c/m$, $-c/n$, and conversely. Also an equation of the second degree in x, y, z, symbolized by

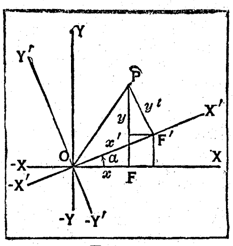

FIG. 4

$$(a, h \cdots)(x, y, z)^2=0,$$

is depicted by a quadric (ellipsoid, paraboloid, hyperboloid), and so on for higher degrees and surfaces.

If there be four such independents (x, y, z, u), any set of values named will specify an element in a manifold of four dimensions, and all such would constitute the total fourfold extent. Any single equation binding together the four would be depicted by a threefold extent, a section of the fourfold, as a curve is a section of a surface, and a surface a section of a solid. Similarly for any number of co-ordinates or values determining elements. Although no logical difficulty arises, the geometric representation offers a serious one; for the constructive power of our space sense does not reach beyond three dimensions, and so we cannot envisage a fourfold, although the assemblage of musical notes appears to be such, since we distinguish a note by four marks high, loud, long, rich (timbre), that is by four co-ordinates. But we do not imagine a fourth axis U perpendicular to X, Y, Z, to the whole XYZ space, as Z is to XOY, to the XY-plane. In spite of this difficulty, however, the abstract reasoning is undisturbed. Thus, in transforming to polar co-ordinates, consider this example: in XOY draw OP or ρ_1 to P (x, y), inclined ϕ_1 to Y, so that $x=\rho_1\sin\phi_1$, $y=\rho_1\cos\phi_1$. So in $O-XYZ$ draw OP or ρ_2 to $P(x, y, z)$, inclined ϕ_2 to Z, $90°-\phi_2$ to the XY-plane, on which its orthogonal projection is $\rho_2\sin\phi_2$; *i.e.*, a ρ_1 inclined as above, so that,

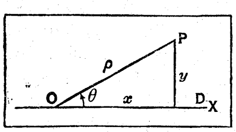

FIG. 5

on putting $\rho_3\sin\phi_2$ for ρ_1 we have $x=\rho_2\sin\phi_2\sin\phi_1$, $y=\rho_2\sin\phi_2\cos\phi_1$, and besides $z=\rho_2\cos\phi_2$. Quite similarly, in four dimensions, $x=\rho_2\sin\phi_3\sin\phi_2\sin\phi_1$, $y=\rho_3\sin\phi_3\sin\phi_2\cos\phi_1$, $z=\rho_3\sin\phi_3\cos\phi_2$, $u=\rho_3\cos\phi_3$; and so on for other dimensions.

Triangular Co-ordinates.—Thus far only parallel (especially rectangular) and polar co-ordinates have been considered. During the past century, there have been devised many others both linear and curvilinear. The first are *linear combinations of parallel co-ordinates* introduced by Möbius (1827) in *Der barycentrische Calcül*, and then by Plücker (1828) in his *Analytisch-geometrische Entwicklungen*—of signal importance in projective geometry. Möbius imagined three masses (p_1, p_2, p_3) at the vertices of a $\triangle\ ABC$, as co-ordinates of their own mass centre P. Of course, only the ratios $p_1:p_2:p_3$ are significant. If h_1, h_2, h_3 be (fig. 7) the altitudes of ABC, and d_1, d_2, d_3 the distances of P from BC, CA, AB, we have the static equalities: $p_1h_1=(p_1+p_2+p_3)d_1$, and so for the indices 2, 3; whence at once

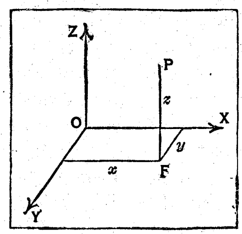

FIG. 6

$$p_1:p_2:p_3=d_1/h_1:d_2/h_2=d_3/h_3,$$

that is, the p's vary as the d's multiplied by the height-reciprocals, a special case of general *trilinear co-ordinates* in which the assumed three lines must form a triangle. In any $\triangle\ ABC$ (fig. 7) take CA, CB as OX, OY, and any point $P(x, y)$. Then $d_1=\alpha=x\sin C$, $\beta=y\sin C$, and

$$a\alpha+b\beta+c\gamma = 2\triangle. \qquad \text{(i)}$$

If P lie beyond any side, as at P', the corresponding distance is negative. We may now take α, β, γ strictly $\alpha:\beta:\gamma$ as trilinear or trimetric co-ordinates of P, under condition (i). The quotient $(a\alpha+b\beta+c\gamma)/2\triangle=1$ and may serve as multiplier to make all terms of an equation explicitly homogeneous in α, β, γ. If for $a\alpha/2\triangle$, $b\beta/2\triangle$, $c\gamma/2\triangle$ we put x, y, z, called *areal co-ordinates* the quotient becomes $x+y+z=1$ and serves to make such equations homogeneous, x, y, z being any numbers rightly signed and proportioned. The advantages of trilinear co-ordinates lie in homogeneity, adaptability, and the treatment of infinity (Klein).

Extensions.—Epoch-making were the works of J. Plücker (1828, 1831, 1835, 1839, 1846, 1868–69), broadening the notion not only of point-co-ordinates but also of co-ordinates in general, by regarding any geometric (or algebraic) form as a co-ordinate base and reckoning with the co-ordinates so defined. Thus he regarded any rational integral combination of point-co-ordinates denoted by a single letter, as itself a co-ordinate. Hence geometrically the most general co-ordinates of a point in three-space would be any three definite surfaces (of three surface-systems) meeting in the point. "The most general system of co-ordinates of a point consists of three sets of surfaces, on one of each of which it lies." (Thompson and Tait, *Nat. Philos.*, ii. 202.)

Curvilinear Co-ordinates.—We now reach the type of *curvilinear co-ordinates*, as especially treated by Lamé in the period from 1830 to 1860. Any surface-systems $U_i=C_i$ $(i=1, 2, 3)$, the C's being constants, whose functional-determinant Ux, y, z does not equal 0, by their intersections (in twos of two systems) determine points in space just as do three systems of parallel planes in three-space (or two systems of parallel lines in two-space, the plane). But this they do only within a region free from singularities of any such co-ordinate surface, which hardly affects their availability in mathematical physics. Of these curvilinear systems the *elliptic* (announced in 1839 by both Lamé in *Liouville's Journal* and Jacobi in *Crelle's Journal*) are of note as applicable throughout three-space, unhemmed by singularities. They are in a sense the three roots λ_1, λ_2, λ_3 of the cubic in,

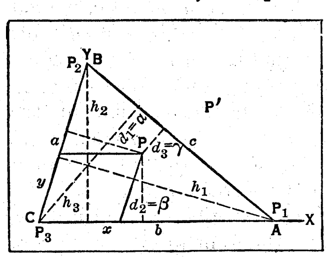

FIG. 7

$$\lambda x^2/(a-\lambda)+y^2/(b-\lambda)+z^2/(c-\lambda)=1.$$

symbolizing three confocal quadrics (for the three roots) through the point (x, y, z). For $-\infty<\lambda<c>0$, an ellipsoid E; for $c<\lambda<b$, an hyperboloid H_1 of one nappe; for $b<\lambda<a$, an hyperboloid H_2 of two nappes; for $a<\lambda$, a nullibi (nullteilig) quadric without real points. Such confocals intersect at right angles, forming an orthogonal system. So through each point P there pass three such surfaces (E, H_1, H_2), all intersecting by twos in P, and by Dupin's theorem each two meet on *curvature-curves* common to the two-space-curves of the fourth order, each in general of two branches.

Specially useful in the study of spheres are *pentaspheric co-ordinates*, in which five spheres are assumed—one always a (nullibi) sphere without real points, if the five are all to meet at right angles, forming an orthogonal system. If $S_i (i=1, 2, 3, 4, 5)$ be the five powers (squared tangent-lengths from point to spheres) of a point P as to the five spheres, then the five-sphere co-ordinates (strictly, their four independent ratios, which alone count) are fixed by $\sigma x_i=k_iS_i$ there σ denotes the proportionality-factor and k_i the arbitrary constants. These five are homogeneous, and since three-space has only a fourfold of spheres (an assemblage around each point as centre), some homogeneous equation of the second degree must connect the five; it is written $\Omega=0$. Just here emerges a notable distinction. Hitherto, in point-and-plane geometry, the co-ordinates used in determining an element of space have been quite independent of each other, wherefore the space as so constituted is called a *linear manifold;* but in the point-geometry of pentaspheric co-ordinates as in various other types, there appear *supernumerary co-ordinates* which must satisfy a quadratic equation, wherefore the space so constituted is known as a *quadratic manifold.* Made generally known by Darboux (1873), but already used since 1869, pentaspherics have been studied and developed mainly by Sophus Lie and Felix Klein.

Other Elements.—Thus far the *point P* has been treated as the only geometric irreducible, but others are often useful. If $lx+my+1=0$ be a line L, then its intercepts $\left(-\frac{1}{l}, -\frac{1}{m}\right)$ on OX, OY fix it and are constant for any one line, while x and y vary from point to point. But now suppose $P(x, y)$ fixed (as 3, 4) and let l, m vary; then as the intercepts $\left(-\frac{1}{l}, -\frac{1}{m}\right)$ change, the line will swing round $P(x, y)$. Hence the equation no longer symbolizes a *row* or *range* of points all on the same line L, but a *sheaf* or *pencil* of all lines in the plane on (through) the same point P. Thus the notions of P and L are interchanged, giving lines on a point instead of points on a line, the equation remaining unchanged; hence l and m are *line co-ordinates;* that is, co-ordinates of the lines on (or *flat pencil* through) the point (x, y). So in $lx+my+nz+1=0$, on holding l, m, n fixed and letting x, y, z change, we get the twofold of value-triplets depicted by all points $P(x, y, z)$ of the plane; but on holding P fast (say 2, 3, 6) and letting l, m, n loose, we get the twofold of value-triplets correlated with the (*bundle* of) planes on (through) the point $P(2, 3, 6)$. So l, m, n become *plane co-ordinates*, specifying all planes lying on a point (x, y, z).

Duality.—This discussion leads to the recognition of the principle of *duality* (Gergonne, 1771–1859) or *reciprocity.* An equation is understood in two ways, as a symbol both (1) of a line (or plane) total of points, in point co-ordinates, and (2) of a point-total of lines (or planes) in line (or plane) co-ordinates. And so on prolifically; to every such theorem in either type of co-ordinates corresponds the *dual* or *reciprocal* in the other; proving either proves both, as in the theorems of Pascal and Brianchon. (*See* CONIC SECTION.) But the theorem must be *such, i.e.*, concerning *positional* relations, and not *metrical*, as lengths or sizes of angles. *Order* (number of intersections by a line) in the point-co-ordinate *locus* corresponds to *class* (number of tangents from a point) in the line (or plane) co-ordinates. In the line (or plane) co-ordinate *envelop,* each number being given by the degree of the equation in the respective co-ordinates; these latter co-ordinates are also called *tangential*, since they are tangent to the forms they envelop and thus determine.

Thus there appear as many lines as points in a plane, and as many planes as points in space. This is not strange, since there are infinitely more circles in the plane and spheres in space than points in either; in fact, around each point as centre a countless number of circles and spheres. It is no question of room or of crowding, but only of definition, of distinction one from another. Equations in point-co-ordinates (x, y, z) symbolize forms as aggregates of points (P) co-ordinated in specific ways; equations in line or plane-co-ordinates symbolize such forms themselves as units co-ordinated into other aggregates, each individual in which is specified by a special set of values (l, m, n). The mind makes space of more dimensions in complexes than in simples. In the line geometry proper of Plücker (1868–69), the line displaces the point as "space-element." But it is fixed by four co-ordinates (not three), as in two projections on co-ordinate planes (traces of two planes through the line and perpendicular to the co-ordinate planes), which are (say) $x=az+\alpha$, $y=bz+\beta$; hence a, α, b, β are the line's four co-ordinates, though the preferred line-co-ordinates are *six homogeneous* co-ordinates connected by one quadratic equation. Hence, as an aggregate of lines our three-space is fourfold. According as these four independents are joined by 1, 2, 3 equations, there result three configurations: (1) a triple *complex*, as the total of tangents to a surface, a plane or sheaf of tangents at each point of the twofold surface of points; (2) a double *congruence*, as the total of common tangents to two surfaces, as quadrics; (3) a simple *regulus* (or *skew*), as the system of tangents to H, H_1, an hyperboloid of one sheet, whichever half of the total be regarded.

The query will at once arise, may not still other geometric wholes, as circle, conic or quadric, be taken as space-elements, raising still higher the dimensionality of our triple space of points? The answer is that this is possible and that it has been done, in a way, with the *circle* (by C. Stephanos, 1881), the aggregate of circles in space appearing as a sixfold extended domain of the fifth order in a ninefold extent. If the quadric be taken as space-element, our three-space attains nine dimensions, and so on. These brief hints may suggest the range and significance of the concept co-ordinates, and how the mind develops the notion of space, constituted at will of forms differing endlessly in complexity and degree, but all obeying the same logical laws and all united into one self-consistent whole. (*See* also ANALYTIC GEOMETRY; NOMOGRAPHY.)

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CO-ORDINATION, in chemistry, denotes a mode of linking between atoms first recognized by Alfred Werner in 1893. In accordance with the co-ordination theory, which affords a simple and comprehensive explanation of the chemical constitutions of complex salts, amines (*q.v.*) and mordant dyes, certain salts of boron, beryllium, chromium, cobalt, copper and many other elements should exist in optically active forms. This prediction has since been verified experimentally in many instances. (*See* STEREOCHEMISTRY.)

An electronic interpretation of co-ordination was provided by N. V. Sidgwick in 1923, thus bringing this chemical conception into line with modern views of the constitution of matter. (*See* VALENCY.)

COORG, a province of India, administered by a commissioner, subordinate to the governor-general through the resident of Mysore, who is officially also chief commissioner of Coorg. A legislative council with five nominated and fifteen elected members, was set up in 1923. Coorg (an anglicized corruption of *Kodagu,* said to be derived from the Kanarese *Kudu,* "steep," "hilly"), lies in the south of the peninsula, on the plateau of the Western Ghats, sloping inland towards Mysore. It is the chief coffee-producing state after Mysore, coffee cultivation having held its own in the face of severe competition. The administrative headquarters are at Mercara. There is no railway. Coorg is the smallest province in India, its area being only 1,593 sq.mi. It was constituted a province on account of its isolation. It lies at the top of the Western Ghats, and is cut off by them from easy communication with the British districts of South Kanara and Malabar, which form its western and southern boundaries, while on its other sides it is bordered by the native state of Mysore. It is a mountainous land of wooded hills, the lowest 3,000 ft. high, and deep valleys; the loftiest peak, Tadiandamol, has an altitude of 5,729 ft. The principal river is the Cauvery, which rises on the eastern side of the Western Ghats, and with its tributaries drains the greater part of Coorg. During the rainy season, from June to the end of September, the rivers are very rapid. Coorg has a rainfall which may exceed 160 in. yearly, particularly heavy in the jungle tract, but the climate is on the whole healthy. The hottest time is April and May. In the undergrowth are cardamom, areca, plantain, canes, wild pepper, tree and other ferns, and arums. In the forest of the less thickly-wooded bamboo country in the west of Coorg the trees most common are blackwood, kino, mutti, acacia, etc., with teak and sandalwood in the eastern part. Elephants, tigers, cheetahs, wild boar, deer and buffalo are found. The most interesting antiquities of Coorg are the earth redoubts or war-trenches (*kadangas*) with a linear extent of between 500 and 600 m. They are mentioned in inscriptions of the 9th and 10th centuries. Rice is the staple product and the chief export. Coffee growing is the main industry, rubber and some tea are grown and there are sandalwood works.

In 1941, the population, which is mainly agricultural, was 168,-726. Of the various tribes inhabiting Coorg, the Coorgs proper, or Kodagas, and the Yeravas, both special to the country, are the most numerous. The Kodagas, a light-coloured race of unknown origin, constitute a highland clan of independent spirit and free from the trammels of caste. Their religion consists of ancestor- and demon-worship, with a certain admixture of Brahman cults. The men are by tradition warriors and hunters, and while they will plough the fields and reap the rice, they leave all menial work to the women and servants. They speak Kodagu. The Yeravas are an inferior race, dark-skinned and thick-lipped. Though now nominally free, they were, before the establishment of British rule, the hereditary praedial slaves of the Kodagas. They are demon-worshippers. Their language, a dialect of Malayalam, is peculiar to them. Among the other tribes or castes special to Coorg are the Heggades, cultivators from Malabar, the Ayiri, who constitute the artisan caste and the Medas. There are several other tribes peculiar to Coorg. Of those not special to the country, the Holeyas, from Mysore, Malabar and South Kanara, are the most numerous. They were formerly the slaves of the Kodagas and now act as their menials. Of the Tulu (farmer) class the Gaudas, who live principally along the western boundary, are the most important; they speak Tulu and wear the Coorg dress. The official language of Coorg, which is that spoken by nearly half of the population, is Kanarese, the Coorg language (Kodagu) coming next. There are three secondary schools in the state, but no college.

History.—Early accounts of Coorg are purely legendary, and it was not till the 9th and 10th centuries that its history became the subject of authentic record. At this period, according to inscriptions, the country was ruled by the Gangas of Talakād, under whom the Changalvas, kings of Changa-nād, held the east and part of the north of Coorg. After the overthrow, in the 11th century, of the Ganga power, the Changalvas became tributary to the Cholas, the Hoysalas and the Vijayanagar empire in turn. On the fall of the last-named empire a prince of the Ikkeri or Bednur family brought Coorg under his sway, his descendants continuing to be rajas of Coorg till 1834. Hyder Ali of Mysore occupied the country in 1780 but was expelled in 1782. Two years later Tippoo Sahib reduced the country; but the Coorgs having again rebelled in 1785 he vowed their destruction. Having secured some 70,000 of them by treachery, he drove them to Seringapatam, where he had them circumcised by force. Coorg was partitioned among Muslim proprietors; but in 1788 Vira Raja succeeded in driving the forces of Tippoo out of the country. The British, who were about to enter on the struggle with Tippoo, concluded a treaty with Vira Raja; and during the war that followed the Coorgs proved invaluable allies. By the treaty of peace, Coorg, though not adjacent to the East India Company's territories, was included in the cessions forced from Tippoo. On the spot where he had first met the British commander, the raja founded the city of Virarajendrapet.

Vira Raja (d. 1809) was guilty towards the end of his reign of hideous atrocities, rivalled by his nephew, Vira Raja, a monster of sensuality and cruelty, who ascended the throne in 1820, at the age of 20. Among his victims were all the members of the families of his predecessors. In 1832, evidence of treasonable designs on the raja's part led to inquiries by the British resident at Mysore, and a British force marched into Coorg in 1834. On April 11 the raja was deposed by Colonel Fraser, the political agent with the force, and on May 7 the state was annexed to the East India Company's territory.

The "Coorg rebellion" of 1837 was really a rising of the Gaudas, due to a grievance at having to pay taxes in money instead of in kind. A man named Virappa, who pretended to have escaped from the massacre of 1820, tried to take advantage of this to assert his claim to be raja, but the Coorgs remained loyal to the British and the attempt failed. In 1861, after the Mutiny, the loyalty of the Coorgs was rewarded by their being exempted from the Disarmament Act.

See Rev. G. Richter, *Castes and Tribes found in the Province of Coorg* (Bangalore, 1887); *Imperial Gazetteer of India* (Oxford, 1908) vol. xi. *s.v.* where, besides an admirable account of the country and its inhabitants, the history of Coorg is dealt with in some detail. *The Cambridge History of India,* ed. Prof. E. J. Rapson (1922); Vincent Smith, *Early History of India,* revised by S. M. Edwardes (1924).

COORNHERT, DIRCK VOLCKERTSZOON (1522–1590), Dutch politician and theologian, was born at Amsterdam. He settled in Haarlem, as engraver on copper, and produced works which retain high values. He published Dutch translations from Cicero, Seneca and Boethius. He was appointed secretary to the city (1562) and secretary to the burgomasters (1564). Throwing himself into the struggle with Spanish rule, he drew up the manifesto of William of Orange (1566). Imprisoned at The Hague (1568), he escaped to Cleves, where he maintained himself by his art. Recalled in 1572, he was secretary of State for a short time; his aversion to warfare led him back to Cleves, where William continued to employ his services and his pen. He stood for toleration and against capital punishment for heretics. He had no party views; the Heidelberg catechism, authoritative in Holland, he criticized. The great Arminius, employed to refute him, was won over by his arguments. He died at Gouda on Oct. 29, 1590. His Dutch version of the New Testament, following the Latin of Erasmus, was never completed. His works, in prose and verse, were published in 1630, 3 vols.

See F. D. J. Moorrees, *Dirck Volckertszoon Coornhert* (1887); N. Delvenne, *Biog. des Pays-Bas* (1829); A. J. van der Aa, *Biog. Woordenboek der Nederlanden* (1855).

COOT, a bird of the genus *Fulica,* belonging to the family *Rallidae* or rails. The European coot (*Fulica atra*) breeds abundantly in many of the larger inland waters of the northern parts of the Old World, in winter resorting to river mouths or shallow bays of the sea. Hunted in winter, at other times it is comparatively unmolested. The nest is a large mass of flags, reeds or sedge, among rushes in the water or on the margin, and frequently contains as many as ten eggs. The young are beautiful little creatures, clothed in jet-black down, with heads of a bright orange-scarlet, varied with purplish-blue. This brilliant colouring is soon lost, and they assume the sooty-black plumage which is worn for the rest of their lives; a characteristic of the adult is a bare white patch or callosity on the forehead. The coot is about 18 in. in length, and sometimes more than 2 lb. in weight. Though its wings appear to be short and it seems to rise with difficulty from the water, it is capable of long-sustained and rapid flight. It swims buoyantly, and dives with ease. When wounded it is said to clutch the weeds at the bottom. It is not often found on dry land. The feet of the coot are remarkable, the toes being fringed by a lobed membrane, to facilitate swimming and walking over the ooze.

The coot is found throughout the palaearctic region and in most other parts of the world is represented by nearly allied species, having almost the same habits. An African species (*F. cristata*) is distinguished by two red knobs on its forehead. The Australian and North American species (*F. australis* and *F. americana*) closely resemble the English bird; in South America half a dozen species are found, one (*F. gigantea*) being of considerable size. The remains of a large extinct species (*F. newtoni*) were discovered in Mauritius.

COOTE, SIR EYRE (1726–1783), British soldier, the son of a clergyman, was born near Limerick, and entered the 27th regiment. He saw active service in the Jacobite rising of 1745, and some years later obtained a captaincy in the 39th regiment, which was the first British regiment sent to India. In 1756 a part of the regiment, then quartered at Madras, was sent forward to join Clive in his operations against Calcutta, and Coote was soon given the local rank of major. After the battle of Plassy he led a detachment in pursuit of the French for 400m. under extraordinary difficulties. His conduct won him the rank of lieutenant-colonel and the command of the 84th regiment, newly-raised for Indian service. In Oct. 1759 Coote's regiment arrived to take part in the decisive struggle between French and English in the Carnatic; in 1760 he led them in the decisive victory of Wandiwash (Jan. 22). Coote loyally supported Monson in the siege and capture of Pondicherry, and soon afterwards (1761) was given the command of the East India Company's forces in Bengal. In 1762 he returned to England, receiving from the Company rewards for his great services. In 1771 he was made a K.B. In 1779 he returned to India as lieutenant-general commanding in chief. Following generally the policy of Warren Hastings, he nevertheless refused to take sides in the quarrels of the council, and made a firm stand in all matters affecting the forces. Hyder Ali's progress in southern India called him again into the field, but his difficulties were very great and it was not until June 1, 1781, that the crushing and decisive defeat of Porto Novo struck the first heavy blow at Hyder's schemes. The battle was won under most unfavourable conditions against odds of five to one, and is justly ranked as one of the greatest feats of the British in India. It was followed up by another hard-fought battle at Pollilur and by the rout of the Mysore troops at Sholingarh a month later. His last service was the arduous campaign of 1782. Sir Eyre Coote died at Madras on April 28, 1783.

COPAIBA or **COPAIVA,** an oleo-resin—sometimes termed a balsam—obtained from the trunk of the *Copaifera langsdorfii* (family Leguminosae) and from other species of *Copaifera* in the West Indies and Amazon valley. It is a viscous transparent liquid, occasionally fluorescent and light yellow to pale golden in colour. The odour is aromatic and characteristic, the taste acrid and bitter. It is insoluble in water, but soluble in absolute alcohol, ether and oils.

COPAL, a hard lustrous resin, varying in hue from an almost colourless transparent mass to a bright yellowish-brown, having a conchoidal fracture, and, when dissolved in alcohol, spirit of turpentine, or other suitable menstruum, forming a valuable varnish. Copal is obtained from a variety of sources; the term is vaguely used for resins which, though similar in physical properties, differ in their constitution, and are altogether distinct as to their source. In Brazil and other South American countries, copal is obtained from *Hymenaea courbaril,* and other species, while the dammar resins and the piney varnish of India are occasionally spoken of as copal. By far the most important from a commercial point of view is the Zanzibar or East African copal, yielded by *Trachylobium verrucosum.* The resin is found in two distinct conditions: (1) raw or recent ("jackass" copal); and (2) ripe or true copal. The raw copal obtained direct from the trees, or found at their roots or near the surface of the ground, does not enter into European commerce. It is sent to India and China, where it is manufactured into a coarse varnish. The true or fossil copal is found embedded in the earth over a wide belt of the mainland coast of Zanzibar, on tracts where not a single tree is now visible. It is not found at a greater depth than 4ft., and occurs in pieces varying from the size of small pebbles up to masses of several ounces in weight, and occasionally lumps weighing 4 or 5lb. have been obtained. Kauri copal is found in New Zealand, which exports large quantities. It is derived from the Kauri pine (*Agathis australis*), and like the East African copal is found in the earth often far from living trees of this pine.

COPALITE or **COPALINE,** also termed "fossil resin" and "Highgate resin," a naturally occurring organic substance found as irregular pieces of pale-yellow colour in the London clay at Highgate hill. It has a resinous aromatic odour when freshly broken, volatilizes at a moderate temperature, and burns readily with a yellow, smoky flame, leaving scarcely any ash.

COPAL VARNISH: *see* VARNISH.

COPÁN, a ruined city of Honduras, located near the Guatemalan border and on the Copán river, a tributary of the Motagua. The ancient city, buried under vegetation and alluvial deposits, is cut through by the river, so that the banks give a vertical section of centuries of life and building under the ancient Maya Indians. The ruins are named after a nearby modern town; this was captured by the Spaniards in 1530.

COPARCENARY, in law, the descent of lands of inheritance from an ancestor to two or more persons possessing an equal title to them. It arose either by common law, as where an ancestor died intestate, leaving two or more females as his co-heiresses, who then took as coparceners or parceners; or, by particular custom, as in the case of gavelkind lands, which descend to all males in equal degrees, or in default of males, to all the daughters equally. All such special forms of descent were abolished by the Law of Property Act 1922 and the Administration of Estates Act 1925.

The term "coparcenary" is not in use in the United States, joint heirship being considered as *tenancy in common.*

CO-PARTNERSHIP, a term used (often with the prefix "Labour" or "Industrial" added) to denote (1) the ideal that workers should enjoy full participation in the profits and administration of industry, and (2) a specialized type of business organization (more or less embodying this ideal) introduced into the fabric of the existing economic order.

As an ideal it has a history as old as that of the co-operative movement (*see* CO-OPERATION), and like the latter it drew its inspiration in the second quarter of the 19th century from a refusal to recognise that the divorce between productive labour and the ownership and control of capital was either just or inevitable. During the period of the Chartist movement, John Stuart Mill was not alone among economists in setting great store by co-partnership as a solvent of industrial discontent, and even as late as 1862 one finds him predicting that "the relationship of masters and workpeople will be gradually superseded by partnership in one of two forms: in some cases association of the labourers with the capitalist, in others, and perhaps finally in all, association of labourers among themselves."

Already in the 'forties efforts to achieve co-partnership in the forms to which Mill refers had met with wide support. The first form was held in view by the advocates of the limited partnership, legalisation of which would, it was hoped, put capital, protected by limited liability, at the disposal of the capital-less worker. The second form found expression in the starting of numerous societies for co-operative production. In neither of these directions can it be said that the course of economic development since 1850 has confirmed the accuracy of Mill's prediction. The introduction (1855–62) of the registered limited liability company swamped the more modest proposal for the limited partnership. And though the reorganization of industry and trade on joint-stock lines has steadily developed (quite overshadowing even the ordinary partnership) that event has not *in itself* contributed much to bring about co-partnership between capital and labour. Only in one respect, and that indirectly, have the British

Companies Acts favoured employee membership of companies. As the result of legislation, 1907–13, the restriction of the membership of private companies to 50 has been waived in the case of employee or ex-employee shareholders.

Nor again were the high hopes placed by Robert Owen (*q.v.*), and later by the Christian Socialists, in the "self-governing workshop" form of co-partnership destined to be realised. The English co-operative movement, while always ready to encourage employee-membership, has won its main victories on the side of consumers' control rather than of producers' or of workers' control. The Scottish co-operative movement, however, has had notable success in giving the employee as such a joint share in control with the ordinary consumer-member.

Closely connected though it was in the 'eighties with the co-operative movement and drawing part of its inspiration from the ideals of the Christian Socialists (*see* CHRISTIAN SOCIALISM), the organised movement has tended, especially in the present century, to develop on lines of its own and to put forward on behalf of labour claims more moderate than those advocated, for example, by the Guild Socialists (*see* GUILD SOCIALISM). These claims as formulated by the Industrial Co-partnership Association (the present title of the propagandist body founded in 1884) are that all workers "shall share to some extent in the profits, capital, and control of the business in which they are employed." By share in profits is meant an arrangement whereby as a matter of fixed rules the worker is entitled to receive, in addition to the standard wages of the trade, some share in the final profit (if any) of the business. By share in capital is meant the accumulation by the worker of his share of profit, or part thereof, in the capital of the business. Share in control is to be acquired in one or both of two ways:

(a) by acquiring share capital, and thus gaining the ordinary rights and responsibilities of a shareholder.

(b) by the formation of a co-partnership committee of workers having a voice in the internal management.

It is obvious that even these fairly precise definitions leave considerable latitude in the planning of individual schemes, while the extent to which the ideal of co-partnership is in any case realizable depends not only on the amount of the share (in net profits, capital and control) to which the employees of an undertaking are to become entitled but also on the *kind* of share contemplated under each head.

Workers and Profit-Sharing.—On account of this element of uncertainty the annual statistics of the Ministry of Labour on "Profit-sharing and Labour Co-partnership" do not furnish a complete guide either to the success which co-partnership has already won or to the rôle which it is likely to play in the future. The latest official figures show that at the end of 1926 there were in Great Britain 280 schemes (the survivors of 554 launched during the past 50 years), one-half dating after the World War. These schemes were operated by 274 firms, employing 400,000 people of whom approximately one-half were eligible to participate in the benefits conferred. But at least 50% of these existing schemes contemplate nothing more than a distribution of part of the net profits in cash (*see* PROFIT-SHARING). On the other hand, the official figures are far from being comprehensive—(1) as regards capital ownership by employees, (2) as regards schemes which provide for their participation in internal management. Under the former head the Committee on Industry and Trade had to record (in 1926) that "no information is available as to the extent to which employees own capital at the present time in the undertakings by which they are employed." But there is little doubt that the amount (*e.g.,* in certain sections of the cotton industry) must be large. Under the latter head must be reckoned the extensive movement (stimulated by the Whitley Report) in favour of setting up joint works councils representing the management and the workpeople employed in a particular establishment. In some industries provision for joint consultation has been organised nationally as well as locally, and a tendency is observable—*e.g.,* among railway companies—to use the machinery for administrative purposes. Whitleyism, though it does not approach co-partnership from the profit-sharing angle, has yet contributed much towards the rationalisation of industry on co-partnership lines by insisting that collective bargaining is not the only matter in which joint consultation between employer and employee is desirable.

Apart from these two developments there is little doubt that profit-sharing has up to the present been the basis of most of the experiments in co-partnership in Great Britain. Three types may be distinguished: (1) that in which either a specified proportion of the net profits or a bonus rising or falling with the rate of dividend is divisible among the employees; (2) that in which the bonus or part of it must be left with the firm either on deposit or in the form of special "co-partnership shares" to earn interest varying with the rate of dividend; (3) that in which the profit is given indirectly through the offer of share or stock purchase facilities not available to the outside public or to non-employee shareholders. These facilities may take the form of opportunity to purchase by small instalments (a full dividend being payable before the last instalment is due), opportunity to buy shares below the current price offered, or a right to receive an extra bonus on dividend. In any case the arrangement does not, like the second type, involve the creation of a special, new class of share.

Practical British Schemes.—This third type of scheme comes nearest to satisfying the three conditions laid down by the I.C.A. It is, however, a type better suited for adoption by the large public company than by the small concern whose shares do not command a ready market. In the gas industry, where in combination with direct profit-sharing it has stood the test of years, 44 English gas companies (60% of the total number) have adopted with slight variations the scheme originally launched by the South Metropolitan Gas Company in 1889. This scheme, under which the employees have, since 1894, been given the opportunity of investing in the company's ordinary stock and, since 1896, of appointing their own directors to the board, was made statutory in 1920 on the basis of a division of profits (after payment of standard dividends) among consumers, shareholders, and employees in the proportions of three-fourths, one-eighth, and one-eighth respectively.

Although the economic conditions in the gas industry (standardized product, local monopoly, statutory limitation of dividend) are no doubt favourable to co-partnership, the fact remains that in Great Britain, as in America, employee stock or share ownership has received recently marked encouragement by some of the larger British companies, more often than not in connection with schemes to give employees security of tenure and a direct voice in the control of the conditions under which they work. Viewed as an integral part of these larger administrative changes the co-partnership scheme of Imperial Chemical Industries Ltd., one of the largest British combines with a pay-roll of over 40,000, is of special interest. Under this scheme facilities are given to all employees to purchase ordinary shares in the company at 2s. 6d. below the mean market price, while employees earning less than £200 p.a. are entitled to a bonus of one free share for every four shares purchased. It is also provided that the payment of all instalments outstanding on his shares are cancelled by the death of the employee-holder. The objection often urged against a scheme of this type, that it is unwise to encourage people of small means to invest their savings in the industry in which they are employed, can hardly be sustained in regard to a company controlling the production of necessaries under conditions of virtual monopoly.

Another interesting variety of scheme (which avoids this particular objection without entailing the issue of shares carrying restricted rights of ownership) is that of the Brush Electrical Engineering Company Ltd. Under this scheme the employees collectively are entitled to take their share of the surplus profits either in cash or in shares in the company.

Of schemes in general it may be said that wherever the employers or directors show (as in the case of the two schemes just mentioned) a sincere desire to adopt co-partnership in a form and for objects which are acceptable to organized labour outside as well as inside their particular businesses the prospects of successful working will be fair. Much, too, depends upon the possibility (of which there are many signs) that the traditionally lukewarm attitude of Labour towards co-partnership may change to one of acceptance when it is realized that co-partnership (in the broad sense of the term) is an essential ingredient in the scientific rationalisation of industry.

Movement outside Great Britain.—In the United States, as a recent investigation by Princeton university shows, the "acquisition by employees of stock in the companies they work for has reached the proportions of a comprehensive movement." Though there is no doubt that this movement, fostered by instalment-purchase arrangements, has stimulated a similar development in other countries it is difficult to say whether co-partnership is likely to result from it as a permanent factor in the organization of American industries. It must be borne in mind that a large and increasing proportion of stock issued by American corporations is of the non-voting variety, that economic conditions have in themselves for many years past been favourable to investors, and that the investment capacity of the average American employee has been considerably greater than the employee in any other part of the world. He has had both the capacity and the opportunity to invest. Even then, of the total stock, the amount held by employee-investors is only something like 2 per cent.

In New Zealand an act known as the Companies Empowering act was passed in 1924 which enables any company registered under the general company laws to issue labour shares to its employees, these shares to be of no-par value and not to form part of the share capital. Voting rights, however, as well as rights to a share in the profits are to attach to these "shares" according to the regulations made by the company.

In France a somewhat similar arrangement was authorized by an act in 1917 for Sociétés Anonymes that choose to adopt it. Under this act, however, the "labour shares" (actions de travail) become the collective property of the employees organized in a "Société commerciale co-operative de main d'oeuvre" with voting powers at the company's meetings. (*See* PROFIT-SHARING.)

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COPE, EDWARD MEREDITH (1818–1873), English classical scholar, was born in Birmingham on July 28 1818, and died on Aug. 5 1873. He was a sound scholar, with perhaps a tendency to over-minuteness. He was the author of *An Introduction to Aristotle's Rhetoric* (1867), a standard work; *The Rhetoric of Aristotle,* with a commentary, revised and edited by J. E. Sandys (1877); translations of Plato's *Gorgias* (2nd ed., 1884) and *Phaedo* (revised by H. Jackson, 1875).

The chief authority for the facts of Cope's life is the memoir prefixed to vol. i. of his edition of *The Rhetoric of Aristotle.*

COPE [Med. Lat. *cappa*], a liturgical vestment of the Western Church. The word "cope," now confined to this sense, was in its origin identical with "cape" and "cap," and was used until comparatively modern times also for an outdoor cloak, whether worn by clergy or laity. This, indeed, was its original meaning, the *cappa* having been an outer garment common to men and women whether clerical or lay. The word *pluviale* (rain-cloak), which the cope bears in the Roman Catholic Church, is exactly parallel so far as change of meaning is concerned. In both words the etymology reveals the origin of the vestment, which is but a glorified survival of a garment worn by all and sundry in ordinary life. When spread out the cope forms an almost complete semicircle. Along the straight edge there is usually a broad band, and at the neck is attached the "hood" (in Latin, the *clypeus* or shield); *i.e.,* a shield-shaped piece of stuff which hangs down over the back. The vestment is secured in front by a broad tab sewn on to one side and fastening to the other with hooks, sometimes also by a brooch (called the morse, Lat. *morsus*).

The cope thus preserves the essential shape of its secular original, and even the hood, though now a mere ornamental appendage, is a survival of an actual hood. The evolution of this latter into its present form was gradual; first the hood became too small for use, then it was transformed into a small triangular piece of stuff (13th century), which in its turn grew (14th and 15th centuries) into the shape of a shield, and this again, losing its pointed tip in the 17th century, expanded in the 18th into a flap which was sometimes enlarged so as to cover the whole back down to the waist. In its general effect, however, a cope no longer suggests a "waterproof." It is sometimes elaborately embroidered all over; more usually it is of some rich material, with the borders in front and the hood embroidered, while the morse has given occasion for some of the most beautiful examples of the goldsmith's and jeweller's craft.

The use of the cope as a liturgical vestment can be traced to the end of the 8th century. Before this the so-called *cappa choralis,* a black, bell-shaped, hooded vestment with no liturgical significance, had been worn by the secular and regular clergy at choir services, processions, etc. This was in its origin identical with the chasuble, and if, as Father Braun seems to prove, the cope developed out of this, cope and chasuble have a common source. In the 10th century, partly under the influence of the splendour-loving community of Cluny, the use of the cope became widespread; in the 11th century it was universally worn, though the rules for its ritual use had not yet been fixed. It was at this time, however, *par excellence* the vestment proper to the cantors, choirmaster, and singers.

By the beginning of the 13th century the liturgical use of the cope had become finally fixed. The substitution of the cope for the chasuble in many of the functions for which the latter had been formerly used was primarily due to the comparative convenience of a vestment opened at the front, and so leaving the arms free. A natural conservatism preserved the chasuble (q.v.) as the vestment proper to the celebration of Mass; but the cope took its place in lesser functions; *i.e.,* the censing of the altar during the Magnificat and at matins (whence the German name *Rauchmantel,* smoke-mantel), processions, solemn consecrations, and as the dress of bishops attending synods. It is clear from this that the cope, though a liturgical, was never a sacerdotal vestment. If it was worn by priests, it could also be worn by laymen, and it was never worn by priests in their sacerdotal, *i.e.,* their sacrificial, capacity. For this reason it was not rejected with the "Mass vestments" by the English Church at the Reformation, in spite of the fact that it was in no ecclesiastical sense "primitive." A cope was worn by the prelate who consecrated Archbishop Parker, and by the "gentlemen" as well as the priests of Queen Elizabeth's chapel; and, finally, by the 24th canon (of 1603) a "decent cope" was prescribed for the "principal minister" at the celebration of Holy Communion in cathedral churches as well as for the "gospeller and epistler." Except at royal coronations, however, the use of the cope, even in cathedrals, had practically ceased in England before the ritual revival of the 19th century restored its popularity.

It will be convenient here to note other vestments that have developed out of the *cappa.* The *cappa choralis* has already been mentioned; it survived as a choir vestment that in winter took the place of the surplice, rochet (q.v.) or almuce (q.v.).

The Cappa Magna.—From the hood of the *cappa* was developed the almuce. At what date the *cappa choralis* developed into the *cappa magna,* a non-liturgical vestment peculiar to the pope, cardinals, bishops, and certain privileged prelates, is not known; but mention of it is found as early as the 15th century. This vestment is a loose robe, with a large hood (lined with fur in winter and red silk in summer) and a long train, which is carried by a cleric called the *caudatarius.* Its colour varies with the hierarchical rank of the wearer.

The Mozzetta.—Lastly, from the *cappa* is probably derived the *mozzetta,* a short cape with a miniature hood, fastened down the front with buttons. The name is derived from the Italian *mozzare,* to cut off, and points to its being an abbreviated *cappa,* as the episcopal "apron" is a shortened cassock. By the pope, cardinals, bishops, and prelates, it is worn over the rochet, the colours varying as in the case of the *cappa magna.*

See J. Braun, S.J., *Die liturgische Gewandung* (1907); also the bibliography to the article VESTMENTS.

COPELAND, HENRY, an 18th century English cabinet-maker and furniture designer. The dates of his birth and death are unknown but he was still living in 1768. He appears to have been the first manufacturing cabinet-maker who published designs for furniture. *A New Book of Ornaments* appeared in 1746, but a few of the plates are all that are known to exist. Between 1752 and 1769 several collections of designs were produced by Copeland in conjunction with Matthias Lock; in one of them Copeland is described as of Cheapside. Some of the original drawings are in the library at the Victoria and Albert Museum, London. Copeland was probably the originator of a peculiar type of chair-back, popular for a few years in the middle of the 18th century, consisting of a series of interlaced circles.

COPENHAGEN, the capital of Denmark (Danish *Kjøbenhavn*), on the east coast of the island of Zealand (*Sjaelland*) at the southern end of the Sound, in 55° 41′ N., 12° 35′ E. Pop. (1940) 890,130, including Frederiksberg (113,208) and Gentofte (76,457). The nucleus of the city is on low-lying ground between the sea and a series of small freshwater lakes, known as St. Jørgens Sø, Peblings Sø and Sortedams Sø, a southern portion occupying the northern part of the island of Amager. An excellent harbour is furnished by the natural channel between the two islands; and communication from one division to the other is afforded by two bridges—the Langebro and the Knippelsbro, which replaced the wooden drawbridge built by Christian IV. in 1620. The fertile island of Amager produces vegetables for the capital; it was peopled by a Dutch colony planted in 1516, and many peculiarities of dress and language are retained. The older city, including both the Zealand and Amager portions, was formerly surrounded by ramparts and moats; but boulevards and gardens now occupy the landward site of fortifications. Outside the lines of the original city (about 5 mi. in circuit), there are extensive suburbs, especially on the Zealand side (Østerbro, Nørrebro and Vesterbro or Østersøgade, etc.) and Frederiksberg and Amagerbro to the south of Christianshavn.

Copenhagen (*i.e.,* Merchant's Harbour, originally simply Havn, Latinized as *Hafnia*), first mentioned in 1043, remained a mere fishing village until the 12th century, when Valdemar I. presented that part of the island to Axel Hvide, renowned in Danish history as Absalon (*q.v.*) bishop of Roskilde, and afterwards archbishop of Lund. In 1167 he erected a castle on the spot where the Christiansborg palace now stands, and the building was called after him Axel-huus. The settlement gradually became a great resort for merchants, and thus acquired the name of Kaupmannahöfn or Kjøbmannshavn, corrupted to Kjøbenhavn. In 1186, Bishop Absalon bestowed the castle and village, with the lands of Amager, on the see of Roskilde; but the Danish kings became anxious to regain it, and in 1245 King Eric IV. drove out Bishop Niels Stigson. On the king's death (1250), however, Bishop Jacob Erlandsen obtained the town, and, in 1254, gave to the burghers their first municipal privileges, confirmed by Pope Urban III. in 1286. Trade or craft gilds were expressly prohibited in the later charter of Bishop Johann Kvag (1294); and the distinctive character of the constitution of mediaeval Copenhagen consisted in the absence of the free gild system, and the right of any burgher to pursue a craft under licence from the *Vogt* (*advocatus*) of the overlord. Later on, though gilds were established they were strictly subordinate to the town authorities. Copenhagen was attacked by Lübeck in 1248, and by Prince Jaromir of Rügen in 1259. In 1306 it repelled the Norwegians, but in 1362, and again in 1368, it was captured by the opponents of Valdemar Atterdag. In the following century a new enemy appeared in the Hanseatic league, which was jealous of its rivalry, but their invasion was frustrated by Queen Philippa. Various attempts were made to obtain the town from the see of Roskilde, as the most suitable for the royal residence; but it was not till 1443 that Copenhagen became the capital of the kingdom. From 1523 to 1524 it held out for Christian II. against Frederick I., who captured it at length and strengthened its defensive works; and it was only after a year's siege that it yielded in 1536 to Christian III. From 1658 to 1660 it resisted Charles Gustavus of Sweden, and was rewarded by various privileges for its defence. In 1660 it gave its name to the treaty which concluded the Swedish war of Frederick III. In 1700 it was bombarded by the united fleets of England, Holland and Sweden. In 1801 the Danish fleet was destroyed in the roadstead by the English and in 1807 the city was bombarded by the British when the university buildings and its principal church were destroyed.

The area occupied by the inner city is known as Gammelsholm (old island). The main artery is the Gothersgade, running from Kongens Nytorv to the western boulevards, and separating a district of rectangular blocks to the north from one of irregular, narrow streets to the south. The Kongens Nytorv, the focus of the life of the city and the centre of road communications, is an irregular open space at the head of a narrow arm of the harbour (Nyhavn). The Palace of Charlottenborg (1672) on the east side, takes its name from Charlotte, the wife of Christian V., and was granted by Frederick V. to the Academy of Arts, which holds its annual exhibition of paintings and sculpture in the adjacent *Kunstudstilling* (1883). On the south is the Royal theatre. Other buildings in Kongens Nytorv are the Foreign Office, several great commercial houses, the commercial bank and the Thotts Palais of *c.* 1685. The quays of the Nyhavn are lined with old gabled houses.

From the south end of Kongens Nytorv, a street called Holmens Kanal winds past the National Bank to the Holmens Kirke, or church for the royal navy, originally erected as an anchor-smithy by Frederick II., but consecrated by Christian IV., with a chapel containing the tombs of the great admirals Niels Juel and Peder Tordenskjold, the wood-carving of the 17th century. The street then crosses a bridge on to the Slottsholm, an island divided from the mainland by a narrow arm of the harbour, occupied mainly by the Christiansborg, originally built (1731–1745) by Christian VI. Twice destroyed by fire, in 1794 and 1884, the royal palace was rebuilt after 1903 for use on occasions of state. After 1918 it was occupied by parliament, the supreme court and the foreign office. The Thorvaldsen bronze statues which stood over the portal of the palace before the fire, and the palace chapel, adorned with works by Thorvaldsen and Bissen, were saved from the fire.

The exchange (Børsen), on the quay to the east, is an ornate gabled building erected in 1619–1640, surmounted by a remarkable spire. To the south is the arsenal (Tøjhus) with a collection of ancient armour. The Thorvaldsen museum (1839–1848) has an open court, containing the artist's tomb. Most of the original works of the famous sculptor are housed here.

On the mainland, immediately west of the Slottsholm, is the Prinsens Palais, once the residence of Christian V. and Frederick VI. when crown princes, containing the national museum. This consists of six sections, the prehistoric collections, the Danish historical and Folk museums, the ethnographical and the numismatic collections and the collection of classical antiquities. It was founded in 1807 by Professor Nyerup, and extended between 1815 and 1885 by C. J. Thomsen and J. J. A. Worsaae. The prehistoric Danish finds, in particular those of the Bronze Age, constitute one of the most remarkable collections in existence. From this point the Raadhusgade leads north-west to the combined Nytorv-og-Gammeltorv, where is the old town hall (*Raadhus,* 1815), and continues as the Nørregade, to the Vor Frue Kirke (Church of Our Lady), the cathedral church of Copenhagen. This church, on a 12th century site, was almost completely rebuilt after the bombardment of 1807. The façade is surmounted by a group of 16 figures, one of Thorvaldsen's masterpieces, representing John the Baptist preaching.

Just north of Vor Frue Kirke is the university, until 1933 the only one in Denmark, founded by Christian I. in 1479, though its constitution dates from 1788. The building dates from 1836. There were some 5,000 students in 1940. In connection with the university are the observatory, the surgical academy in Bredgade, founded in 1786, and the botanic garden. The university library, incorporated in 1867 with the Classen library, collected by the famous merchants of that name, contains about 430,000 volumes, besides some 180,000 theses. Rask's famous Persian manuscripts and the Arnamagnaean collection of old Norse-Icelandic documents are housed here. It shares with the royal library the right of receiving a copy of every book published in Denmark. Adjacent is St. Peter's church, built in a quasi-Gothic style, with a spire 256 ft. high, and appropriated since 1585 as a parish church for the German residents in the city. A short distance along the Krystalgade is Trinity church. Its round tower (111 ft.), considered to be unique in Europe, was formerly used as an observatory. It is ascended by a broad inclined spiral way, up which Peter the Great is said to have driven in a carriage and four. The Høibro-plads has an equestrian statue of Bishop Absalon. The quarter north-east of Kongens Nytorv and Gothersgaden extending to the strong moated citadel (1662–63) which guards the harbour on the north-east, includes the palaces of Amalienborg, the castle and gardens of Rosenborg, etc. The Frederikskirke or Marble church was begun in the reign of Frederick V. (1749), but was left unfinished, until 1874, when it was purchased by a wealthy banker, M. Tietgen, who added the conspicuous dome. The four palaces, of uniform design, encircling the neighbouring Amalienborg-plads, became, on the destruction of Christiansborg in 1794, the residence of the king and court till 1848. One of the four is inhabited by the king, the second and third by the crown prince and other members of the royal family, while the fourth is occupied by the coronation and state rooms.

South-west from the citadel extends a line of gardens on the site of former landward fortifications, skirted on the inner side by three wide boulevards, Østervold, Nørrevold and Vestervold Gade. The botanical gardens (1874) contain an observatory with a statue of Tycho Brahe. On the inner side of Østervold Gade is Rosenborg Park, with the palace of Rosenborg (1608–1617), an irregular building in Gothic style, with a high pointed roof, flanked by four unequal towers. It contains a museum, including fine collections of Venetian glass and oriental tapestry, the famous silver drinking-horn of Oldenburg (1474) and the crown jewels. Noteworthy among modern buildings is the Renaissance town hall (1901) with a tower at the eastern angle. Here is also the museum of industrial art, and the Ny-Carlsberg Glyptotek, with its collection of sculpture, is on this boulevard, which skirts the Tivoli pleasure garden.

The western (residential) quarter contains the park of Frederiksborg, with its palace erected under Frederick IV. (d. 1730) used as a military school. The park contains a zoological garden and is continued south in the Søndermarken. The quarter of Christianshavn skirts the harbour to the south, and lies within the fortifications. It contains the Vor Frelsers Kirke (Church of Our Saviour) dedicated in 1696, with a curious steeple 282 ft. high.

The railway along the coast northward passes the seaside resorts of Klampenborg (6 mi.) and Skodsborg (10 mi.). Near Klampenborg is the Dyrehave (Deer park) or Skoven (the forest), a beautiful forest of beeches. The Zealand Northern railway passes Lyngby, on the lake of the same name, and Hillerød (21 mi.), a considerable town close to the palace of Frederiksborg, erected in 1602–1620 by Christian IV., embodying two towers of an earlier building, and partly occupying islands in a small lake. It was restored as a national historical museum after a fire in 1859. The palace church is an interesting medley of Gothic and Renaissance detail.

The city is the centre of several important learned societies including the Royal Danish Academy of Sciences and Letters, founded in 1742, for the advancement of mathematics, astronomy, natural philosophy, etc., by the publication of scientific works, and by the endowment of research; and the Royal Antiquarian Society (1825) for diffusing a knowledge of Northern and Icelandic archaeology. The Academy of Arts was founded by Frederick V. in 1754. The Carlsberg foundation, established in 1876 by Captain J. C. Jacobsen, promotes research and publication and supports the Frederiksborg museum. Among educational institutions, other than the university, may be mentioned the veterinary and agricultural college, established in 1773 and adopted by the state in 1776. Technical instruction is provided by the technological institute (1908). A high school of commerce was founded in Copenhagen in 1924. Churches other than Lutheran include the Reformed church, founded in 1688, and rebuilt in 1731, the Catholic church of St. Ansgarius, consecrated in 1842, and the Jewish synagogue in Krystalgade, which dates from 1853. Of the monastic buildings of mediaeval Copenhagen traces are preserved in the present nomenclature of the streets. The Franciscan establishment gives its name to the Graabrødretorv or Grey Friars' market; and St. Clara's Monastery, the largest of all, which was founded by Queen Christina, is still commemorated by the Klareboder or Clara buildings, near the present postoffice. The Duebrodre Kloster occupied the site of the hospital of the Holy Ghost.

Copenhagen is by far the most important commercial town in Denmark. Most of the foreign trade passes through the capital, while its transit trade is considerable. It is further the headquarters of nearly all the steamship and motorship owners of Denmark. The harbour is mainly comprised in the narrow strait between the outer Sound and its inlet the Kalvebod or Kallebo Strand. The trading capabilities were aided by the construction in 1894 of the Frihavn (free port) at the northern extremity of the town, well supplied with warehouses. The area of the free port is ·14 sq.mi.; of the customs port, 1·4 sq.mi. Within the limits of the piers the harbour has a total water area of 6·8 sq.mi. The free port has contributed largely towards the position of Denmark as an emporium of Baltic trade. In 1937 ships arriving at Copenhagen numbered 20,051, with 7,121,000 net register tonnage. Danish neutrality in World War I brought a great increase of trade and general prosperity. After 1917, however, unemployment became serious. Copenhagen is not essentially a manufacturing town, though mention must be made of the Royal Copenhagen porcelain manufactory, employing about 1,000 hands, and celebrated for its models of Thorvaldsen's works in biscuit china. Hand-wrought silver, especially that of Georg Jensen, is internationally famous. Here also are great shipbuilding yards, such as that of Burmeister and Wain. Diesel engines are manufactured on a large scale. Mostly the manufacturing is for domestic consumption: chocolate, tobacco, leather goods, distilleries and breweries, etc. The machine shops became targets for British bombing in World War II, after the German occupation.

See O. Nielsen, *Københavns Historie og Beskrivelse* (Copenhagen, 1877–1892); C. Bruun and P. Munch, *København, Skrildring of dets Historie*, etc. (*ibid.* 1887–1901); Bering-Lüsberg, *København i gamle Dage* (*ibid.* 1898, *seq.*). (X.)

The Battle of Copenhagen.—The sending of a British Fleet to the Baltic Sea in 1801 was the outcome of the formation of an Armed Neutrality, consisting of Russia, Prussia, Denmark and Sweden, backed by France, to resist the British claim to right of search. The fleet included eighteen ships of the line, and was commanded by Sir Hyde Parker who was fortunate enough to have Nelson as his Second-in-Command. The naval forces at the disposal of the Neutrality Powers were, on paper, considerable, but they were scattered in various ports, and no apparent effort was made to concentrate them. Indeed, many of the Russian ships were frozen in at Reval.

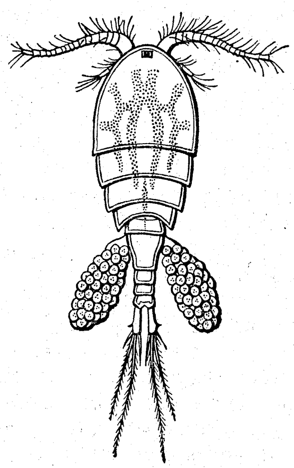
The British force was at the entrance to the Sound on March 21st. Here they heard that Denmark refused to come to any agreement and was putting Copenhagen into a state of defence. Nelson was in favour of immediately tackling Russia, which he rightly regarded as leader of the Armed Neutrality, but Parker declined to do this until Copenhagen had been reduced; neither would he approach that city by way of the Great Belt which would have enabled them to attack it from the South and also have cut off Denmark from Russian help. After long delay the fleet entered the Sound where they were at once engaged by the guns of Kronborg Castle. The Danish shot, however, fell short and the Swedes made no effort to second their attempts. Thus the British passed through successfully and in the afternoon of March 30th brought up under the lee of Hven Island, whence they began reconnoitring the approaches to Copenhagen.

Copenhagen lies on the islands of Zealand and Amag; the channel between them forms the harbour which was protected by the guns of the citadel, of the Trekroner forts situated on islands at the harbour mouth, and by several large ships placed at the entrance. The remainder of the Danish ships, 18 in number and of various types, were anchored along the sea-front of Amag Island, in a line stretching south from the Trekroner forts. They were on the edge of the shoals in front of the island and thus their position could not be turned, and it appeared to the Danes that any enemy attacking from the north—the situation of the British fleet—must pass the Trekroner to reach the line of battle. Parker thought likewise, but Nelson's unerring eye had already discovered the weakness in the Danish position. East of Amag lies the island of Saltholm; between them are two navigable passages, bisected by a shoal—the Middle Ground. Along the westernmost edge of the western passage—the King's Deep—lay the Danish fleet. On the other side of the Middle Ground lay the other passage—the Outer Deep. Nelson saw that, could he find that passage, he would be able to round the Middle Ground and approach the Danish force from the south, unhampered by the Trekroner. He offered to make the attempt with half the fleet. Parker, accepting, gave him ten sail of the line, two fifties and all the smaller vessels.

Throughout the night of March 31st–April 1st soundings were taken, and in the morning of April 1st the whole fleet proceeded to the northern end of the Middle Ground and from there Nelson's squadron successfully navigated the Outer Deep. During the night the wind, to Nelson's delight, changed to south and in the morning the signal was made to weather the shoal into the King's Deep. Nelson had ordered that his leading ship should anchor opposite the fifth Danish vessel and that each successive ship, passing on the disengaged side of those already at grips, should take her place ahead. The leading Danish vessels he hoped to destroy by the continuous fire of the English as they passed in succession. The "Agamemnon" failed to weather the shoal, and the "Bellona" and "Russell" went ashore in the King's Deep. This seriously depleted Nelson's force and compelled him to engage the Trekroner with only the light craft. The remainder were soon engaged in a stubbornly-contested action. At one o'clock Parker signalled to Nelson to withdraw, but the latter, putting his telescope to his blind eye, declined to obey. Anyhow withdrawal by the way they had come was impossible and by the Trekroner risky. An hour later the Danish fire slackened and Nelson tried to take possession of such Danish vessels as had struck, but the Danes, contrary to the usage of war, fired upon him as he did so. They agreed, however, to an armistice. Nelson collected his prizes and withdrew. All but three of the Danish ships had been taken or sunk.

Denmark eventually agreed to abandon the neutrality for 14 weeks, but the death of the Czar before Nelson reached Russia, and a consequent change in Russian policy, brought about its complete collapse.

See R. Southey, *Life of Nelson*, edited by G. A. R. Callender (1922) (Bibl.). (G. A. R. C.; J. G. B.)



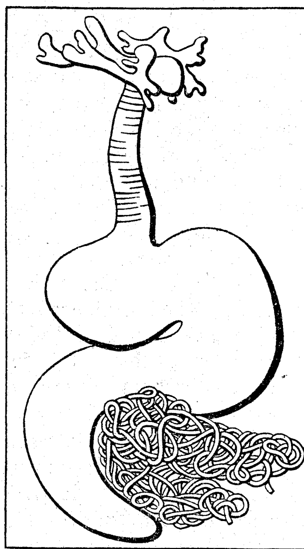
FROM SARS "CRUSTACEA OF NORWAY," BY PERMISSION OF THE BERGEN MUSEUM

FIG. 1.—CYCLOPS VULGARIS

Female, carrying a pair of egg masses

COPEPODA, one of the subclasses of the Crustacea (*q.v.*), the members of which, for the most part of microscopic size, are abundant in the sea and in fresh waters. They form one of the most important constituents of the plankton and it would be difficult to find a sample taken with the tow net in any part of the world which would not contain some representatives of the group. The bottom-living species, which have been less studied, are not so numerous as individuals but probably include more species than the pelagic forms. A ten-quart pail of wash water from the sand of Katama bay, Martha's Vineyard, yielded 800 sand-dwelling copepods distributed among 25 species, with one exception (Cyclopoida) all Harpacticoida. A large number of Copepoda are parasitic on other aquatic animals of all classes and these exhibit a wide range of modification in structure and life history. Copepods rank perhaps first as food for other animals, occurring in the sea in enormous numbers. Off Cape Cod, Mass., in 1916, between 2,000,000 and 3,000,000 (6 qt.) *Calanus* species, chiefly *C. finmarchicus,* were taken in a 15 minute tow of a fine-meshed net with an opening about a yard wide.

The typical free-swimming Copepoda have usually a somewhat pear-shaped body, divided into somites and narrowing behind to end in a "caudal fork." There is no distinct carapace, although one or two of the body somites are coalesced with the head. There are four or five pairs of two-branched, oarlike, swimming feet. The unbranched antennules are generally large and many-jointed, the antennae smaller, sometimes two-branched, and both are used in swimming. The mandibles are often of very primitive structure, the biramous palp retaining the form, and to some extent the function, of a two-branched swimming foot. The unpaired or "nauplius" eye is usually present but the paired eyes are not developed in the typical Copepoda. The eggs are usually carried by the female, cemented together into one or a pair of masses (ovisacs) attached to the genital openings. The young are hatched, as a rule, in the nauplius stage and attain the adult form by the successive addition of somites and appendages without any very sudden change. The antennules, antennae and mandibles may retain in the adult, more nearly than in any other Crustacea, the form they have in the nauplius stage.



BY COURTESY OF THE RAY SOCIETY FROM SCOTT "BRITISH PARASITIC COPEPODA"

FIG. 2.—LERNAEA BRANCHIALIS

One of the Lernaeopodoida, a parasite found on the gills of the cod and other fishes. Above are the branched rootlike processes of the head region, which are buried in the tissue of the host, and below the body proper are the two intertwined tubular egg masses.

The parasitic habit has been acquired in the evolution of many unrelated families of Copepoda and the modifications of structure and of life history to which it has led are correspondingly diversified. In some parasites the power of swimming has been retained and the general form does not differ greatly from that of free-living species, the mouth parts only becoming modified for sucking the juices of the host. In many other cases the male remains free-swimming and little modified while the adult female has a vermiform or distorted body and loses most of the appendages. In others again the minute and degenerate male is attached, like a secondary parasite, to the body of the much larger female. In all cases, probably, the earliest stages are free-swimming while the adults may be sedentary parasites. Some life histories are more complicated, as in the family Monstrillidae, in which only the later larval stages are endoparasitic, living in annelid worms, while the early larvae and the adults are free-swimming, the latter not feeding, neither mouth parts nor alimentary tract being developed; like the May flies, existing only for reproduction. In the Lernaeidae there are in the female two parasitic phases, passed on two different species of fishes, with a temporary free-swimming phase intervening. Some of the parasitic Copepoda are much larger than any of the free-living species. The largest are species of *Pennella* which are parasitic on whales, and sometimes exceed a foot in length.

A small group of Crustacea parasitic on fish, both fresh-water and marine, and heretofore known as the Branchiura or carp lice, have been renamed the Arguloida after the typical genus *Argulus* as the eighth order of the subclass by C. B. Wilson (1932) following the earlier suggestion of G. O. Sars. Some perhaps valid questions have been raised regarding their close affinity with the copepods because they have paired compound eyes which, however, are characteristic of many Crustacea though not possessed by other copepods; because there is no ovisac in the female and the eggs are deposited on some suitable surface (a few copepods shed their eggs directly into the water); and because the larvae, which after all much resemble a partly developed *Caligus,* are well developed when hatched. Generally speaking, their broad, flat, oval body is not unlike that of some other copepods. The segmentation of their body corresponds closely to that of the copepods; the appendages also are similar in number and grouping, but differ in having on some of the legs of some species an inward extension of the exopodite not found in the other Copepoda. On the under side of the head there is, in most of the species, a pair of suckers which are shown by their development to be modified maxillae. In front of the mouth in the genus *Argulus* is a sharp protrusible spine connected with a supposed poison gland. As the parasitic Copepoda do not constitute a single order and the details of the distribution of many of them among the free-living families have still to be worked out, the classification of the Copepoda is not yet settled. The system proposed by Wilson extending that of Sars recognizes eight orders:—the Calanoida, almost exclusively planktonic; the Harpacticoida, for the most part bottom-living; the Cyclopoida, both free-swimming and parasitic; and the Notodelphyoida, Monstrilloida, Caligoida, Lernaeopodoida and Arguloida, exclusively parasitic. (W. T. C.; W. L. St.)

COPERNICUS or **KOPPERNIGK, NICOLAUS** (1473–1543), Polish astronomer, was born Feb. 19, 1473, at Thorn in Prussian Poland, where his father, a native of Cracow, had settled as a wholesale trader. Nicolaus was virtually adopted by his uncle Lucas Watzelrode, later (1489) bishop of Ermeland. He studied mathematical science at the University of Cracow under Albert Brudzewski (1445–97), and incidentally acquired some skill in painting. At the age of 23 he repaired to Bologna, and there varied his studies of canon law by attending the astronomical lectures of Domenico Maria Novara (1454–1504). At Rome, in the Jubilee year 1500, he himself lectured with applause; but having been nominated in 1497 canon of the cathedral of Frauenburg, he recrossed the Alps in 1501 with the purpose of obtaining further leave of absence for the completion of his academic career. Late in 1501 he entered the medical school of Padua, where he remained until 1505, having taken a doctor's degree in canon law at Ferrara on May 31, 1503. After his return to Poland he resided at the episcopal palace of Heilsberg as his uncle's physician until the bishop's death on March 29, 1512. He then retired to Frauenburg, and attended to his capitular duties. He never took orders, but acted continually as the representative of the chapter under harassing conditions, administrative and political; he was besides commissary of the diocese of Ermeland; his medical skill, always at the service of the poor, was frequently in demand by the rich; and he laid a scheme for the reform of the currency before the Diet of Graudenz in 1522. Yet he found time to elaborate a new system of astronomy, by the adoption of which man's outlook on the universe was fundamentally changed.

The main lines of his great work were laid down at Heilsberg; at Frauenburg, from 1513, he sought, with scanty instrumental means, to test by observation the truth of the views it embodied (*see* ASTRONOMY: *History*). His dissatisfaction with Ptolemaic doctrines was of early date; and he returned from Italy, where so-called Pythagorean opinions were then freely discussed, in strong and irrevocable possession of the heliocentric theory. The treatise in which it was set forth, virtually finished in 1530, began to be known through the circulation in manuscript of a *Commentariolus,* or brief popular account of its purport, written by Copernicus in that year. Johann Albrecht Widmanstadt lectured upon it in Rome; Clement VII. approved, and Cardinal Schönberg transmitted to the author a formal demand for full publication. But his assent to this was only extracted from him in 1540 by the importunities of his friends, especially of his enthusiastic disciple George Joachim Rheticus (1514–76), who printed, in the *Narratio prima* (Danzig, 1540), a preliminary account of the Copernican theory, and simultaneously sent to the press at Nuremberg his master's complete exposition of it in the treatise entitled *De revolutionibus orbium coelestium* (1543). But the first printed copy reached Frauenburg barely in time to be laid on the writer's death-bed. Copernicus was seized with apoplexy and paralysis towards the close of 1542, and died on May 24, 1543, happily unconscious that the fine Epistle, in which he had dedicated his life's work to Paul III., was marred of its effect by an anonymous preface, slipt in by Andreas Osiander, with a view to disarming prejudice by insisting upon the purely hypothetical character of the reasonings it introduced. The trigonometrical section of the book had been issued as a separate treatise (Wittenberg, 1542) under the care of Rheticus. The only work published by Copernicus on his own initiative was a Latin version of the Greek epistles of Theophylact (Cracow, 1509). His treatise *De monetae cudendae ratione* (1526) (first printed in 1816), written by order of King Sigismund I., is an exposition of the principles on which it was proposed to reform the currency of the Prussian provinces of Poland.

BIBLIOGRAPHY.—Rheticus was the only contemporary biographer of Copernicus, and his narrative perished irretrievably. Gassendi's jejune Life (Paris, 1654) is thus the earliest extant of any note. It was supplemented, during the 19th century, by the various publications of J. Sniadecki (Warsaw, 1803–18); of J. H. W. Westphal, J. Czynski, M. Curtze, H. A. Wolynski, F. Hipler, and others, but their efforts were overshadowed by Dr. Leopold Prowe's exhaustive *Nicolaus Coppernicus* (Berlin, 1883–84), embodying the outcome of researches indefatigably prosecuted for over 30 years. The first volume (in two parts) is a detailed biography of the great astronomer; the second includes some of his minor writings and correspondence, family records, and historical documents of local interest. The effects of his Italian sojourn upon the nascent ideas of Copernicus may be studied in Domenico Berti's *Copernico e le vicende del sistema Copernicano in Italia* (Roma, 1876), and in G. V. Schiaparelli's *I Precursori del Copernico nell' antichità* (Milano, 1873). A centenary edition of *De revolutionibus orbium coelestium* was issued at Thorn in 1873, and a German translation by C. L. Menzzer in 1879. (A. M. C.)

COPIAPÓ, a city of northern Chile, capital of the province of Atacama, about 35m. from the coast on the Copiapó river. Pop. (1940) 15,877. The Caldera and Copiapó railway (built 1848–51 and one of the first in South America) extends beyond Copiapó to the Chañarcillo mines (50m.) and other mining districts. Copiapó stands 1,400ft. above sea-level and has a mean temperature of about 67° in summer and 51° in winter. Its port, Caldera, 50m. distant by rail, is situated about 6m. N. of the mouth of the Copiapó river. Copiapó is perhaps the best built and most attractive of the desert region cities. The river brings down from the mountains enough water to supply the town and irrigate a considerable area in its vicinity. Beyond the small fertile valley in which it stands is the barren desert, on which rain rarely falls and which has no economic value apart from its minerals (especially saline compounds). Copiapó was settled about 1540 and took its name from the Copayapu Indians who occupied that region. It was primarily a military station and transport post on the road to Peru, but after the discovery of the rich silver deposits near Chañarcillo by Juan Godoy in 1832 it became an important mining centre. It has a good mining school and reduction works, and is the supply station for an extensive mining district. For many years the Famatina mines of Argentina received supplies from this point by way of the Come-Caballo pass.

COPING, in architecture, a capping or covering for the top of a wall, to prevent the entrance of water. In those countries and times in which parapets are common, coping design becomes of great importance; especially in Gothic work, where copings are usually of stone with a steeply sloped, and sometimes moulded, profile. Copings may be made of stone, brick, tile, slate, metal, wood or thatch and are usually sloped so as not to hold water, and projected beyond the face of the wall they cover in order to prevent the wall below from becoming saturated.

COPLAND, ROBERT (fl. 1515), English printer and author, is said to have been a servant of William Caxton, and certainly worked for Wynkyn de Worde. The first book to which his name is affixed as a printer is *The Boke of Justices of Peace* (1515), at the sign of the Rose Garland, in Fleet street, London. His best known works are *The hye way to the Spyttell hous,* a dialogue in verse between Copland and the porter of St. Bartholomew's hospital, containing much information about the vagabonds who found their way there; and *Jyl of Breyntfords Testament.* He translated from the French the romances of *Kynge Appolyne of Thyre* (W. de Worde, 1510), *The History of Helyas Knyght of the Swanne* (W. de Worde, 1513) and *The Life of Ipomydon* (*Hue of Rotelande*), not dated. Among his other works is *The Complaynte of them that ben too late maryed,* an undated tract printed by W. de Worde.

William Copland, the printer, supposed to have been his brother, published three editions of *Howleglas,* perhaps by Robert, which in any case represent the earliest English version of *Till Eulenspiegel.*

Bibliography.—The *Knyght of the Swanne* was reprinted in Thom's *Early Prose Romances,* vol. iii., and by the Grolier Club (1901); the *Hye Way* in W. C. Hazlitt's *Remains of the Early Popular Poetry of England,* vol. iv. (1866). *See* further the "Forewords" to Dr. F. J. Furnivall's reprint of *Jyl of Breyntford* (for private circulation, 1871) and J. P. Collier, *Bibliographical and Critical Account of the Rarest Books in the English Language,* vol. i. p. 153 (1865). For the books issued from his press see *Hand-Lists of English Printers* (1501–56), printed for the Bibliographical Society in 1896.

COPLESTON, EDWARD (1776–1849), English bishop, was born on Feb. 2, 1776, at Offwell in Devonshire, and died on Oct. 14, 1849. He was elected to a tutorship at Oriel college in 1797, and in 1800 was appointed vicar of St. Mary's, Oxford. He was university professor of poetry (1802–12), dean of Oriel for some years, and succeeded to the provostship in 1814. The great prosperity of the college during the first quarter of the 19th century was partly due to Copleston. In 1826 he was appointed dean of Chester, and in the next year he was consecrated bishop of Llandaff.

Copleston's best known writings are on economic subjects. He wrote *Letters to the Rt. Hon. Robert Peel . . . on the pernicious effects of a Variable Standard of Value, especially as it regards the condition of the Lower Orders and the Poor Laws* (1819). In these two "letters" he did considerable service in drawing attention to the imperfect adaptation of wages and prices to currency depreciation.

See W. J. Copleston, *Memoir of E. Copleston, bishop of Llandaff* (1851), with selections from his diary and correspondence; Morley, *Reminiscences of Oriel College* (1883).

COPLEY, JOHN SINGLETON (1737–1815), English historical painter, was born of Irish parents at Boston, Massachusetts. He was self-educated, and commenced his career as a portrait-painter in his native city. The germ of his reputation in England was a little picture of a boy and squirrel, exhibited at the Society of Arts in 1760. In 1774, after a successful career as a portrait painter in Boston, he went to Rome, and thence in 1775 to England. In 1777 he was admitted associate of the Royal Academy; in 1783 he was made Academician on the exhibition of his most famous picture, the "Death of Chatham," popularized immediately by Bartolozzi's elaborate engraving; and in 1790 he was commissioned to paint a portrait picture of the defence of Gibraltar. The "Death of Major Pierson," in the National Gallery, also deserves mention. Copley's powers appear to greatest advantage in his portraits. The Boston museum of fine arts owns his portraits of Samuel Adams, John Quincy Adams, General Joseph Warren, Mrs. Warren and others. He was the father of Lord Chancellor Lyndhurst.

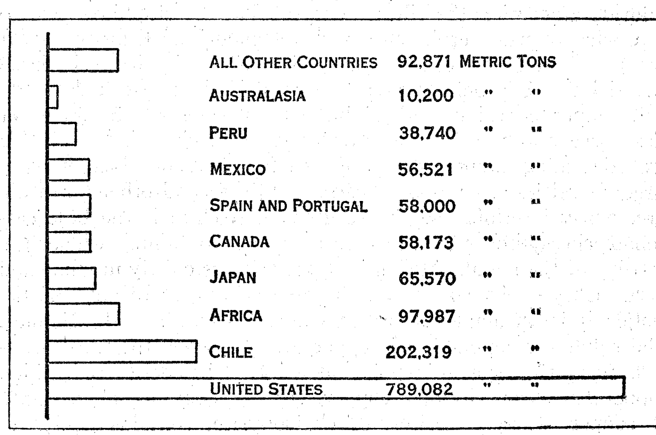
See M. Badcock Amory, *Life of Copley* (Boston, 1872).

COPPÉE, FRANÇOIS (1842–1908), French poet and novelist, was born in Paris on Jan. 12, 1842. After passing through the Lycée Saint-Louis he became a clerk in the ministry of war, and from 1878 to 1884 was archivist to the Comédie Française. Meanwhile he had made a reputation as a poet, and was admitted to the Académie Française in 1884. Coppée became known as the *poète des humbles* because he chose as subjects for his often exquisite verse the cares, loves and sorrows of the common people. The first of his many volumes of verse, *Le Reliquaire,* appeared in 1867; his first play, *Le Passant,* in 1869, and his first prose story, *Une Idylle pendant le siège,* in 1875. His plays include *Severo Torelli* (1883) and *Pour la couronne* (1895), the English translation of which, by John Davidson, was produced in 1896. His stories, describing with real insight the lives of simple people, had a great vogue, especially after his reconversion to religion, and the publication of his *La bonne Souffrance* (1898) made him popular with the *bien pensants.* After this he became a violent Nationalist, took a leading part against Dreyfus, and was one of the founders of the Ligue de la Patrie française. He died on May 23, 1908.

See M. de Lescure's *François Coppée, l'homme, la vie, l'oeuvre* (1889); G. Druilhet, *Un Poète français* (1902); Gauthier-Ferrières, *François Coppée et son oeuvre* (1908).

COPPER, a metal which has been known to and used by the human race from the most remote periods. Its alloy with tin (bronze) was the first metallic compound in common use by mankind, and so extensive and characteristic was its employment in prehistoric times that the epoch is known as the bronze age. By the Greeks and Romans both the metal and its alloys were indifferently known as χαλκός and *aes.* As, according to Pliny, the Roman supply was chiefly drawn from Cyprus, it came to be termed *aes cyprium,* which was gradually shortened to *cyprium,* and corrupted into *cuprum,* whence comes the English word copper, the French *cuivre* and the German *Kupfer.*

Copper is a brilliant metal (symbol Cu, atomic number 29, atomic weight 63·57) of a peculiar red colour which assumes a pinkish or yellowish tinge on a freshly fractured surface of the pure metal, and is purplish when the metal contains cuprous oxide. Its specific gravity varies between 8·91 and 8·95, according to the treatment to which it may have been subjected; J. F. W. Hampe gives 8·945 (0°/40) for perfectly pure, compact copper. Ordinary commercial copper is somewhat porous and has a specific gravity ranging from 8·4 to 8·9. It takes a brilliant polish, is in a high degree malleable and ductile, and in tenacity it only falls short of iron, exceeding in that quality both silver and gold. By different authorities its melting-point is stated at from 1,000° to 1,200° C; C. T. Heycock and F. H. Neville give 1,080·5°; P. Dejean gives 1,085° as the freezing point. Its boiling point is variously given as between 1,980° and 2,310° C. The molten metal is sea-green in colour, and at higher temperatures (in the electric arc) it vaporizes and burns with a green flame. G. W. A. Kahlbaum succeeded in subliming the metal in a vacuum, and H. Moissan (1905) distilled it in the electric furnace. Molten copper absorbs carbon monoxide, hydrogen and sulphur dioxide; in addition, to all appearances, it decomposes hydrocarbons (methane, ethane) in absorbing the hydrogen. These occluded gases are liberated when the copper cools, and so give rise to porous castings, unless special precautions are taken. The gases are also expelled from the molten metal by lead, carbon dioxide or water vapour. Its specific heat is 0·0899 at 0° C and 0·0942 at 100°; the coefficient of linear expansion per 1° C is 0·001869. In electric conductivity it stands next to silver; the conducting power of silver being equal to 100, that of perfectly pure copper is given by A. Matthiessen as 96·4 at 13° C.



GRAPH SHOWING SOURCES OF WORLD PRODUCTION OF COPPER IN 1926

Copper is not affected by exposure in dry air, but in a moist atmosphere, containing carbonic acid, it becomes coated with a green basic carbonate (verdigris). When heated or rubbed it emits a peculiar disagreeable odour. Sulphuric and hydrochloric acids have little or no action upon it at ordinary temperatures, even when in a fine state of division; but on heating, copper sulphate, cuprous sulphide and sulphur dioxide are formed in the first case, and cuprous chloride and hydrogen in the second. Concentrated nitric acid has also very little action, but with the dilute acid a vigorous action ensues. The first products of this reaction are copper nitrate and nitric oxide, but, as the concentration of the copper nitrate increases, nitrous oxide and, eventually, free nitrogen are liberated. Many colloidal solutions of copper have been obtained. A reddish-brown solution is obtained from solutions of copper chloride, stannous chloride and an alkaline tartrate.

Occurrence.—Copper is widely distributed in nature, occurring in most soils, ferruginous mineral waters and ores. It has been discovered in seaweed; in the blood of certain Cephalopoda and Ascidia as haemocyanin, a substance resembling the ferruginous haemoglobin, and of a species of *Limulus;* in straw, hay, eggs, cheese, meat and other foodstuffs; in the liver and kidneys and, in traces, in the blood of man and other animals; it has also been shown by A. H. Church to exist to the extent of 5·9% in turacin, the colouring-matter of the wing-feathers of the Turaco.

Native copper, sometimes termed by miners malleable or virgin copper, occurs as a mineral having all the properties of the smelted metal. It crystallizes in the cubic system, but the crystals are often flattened, elongated, rounded or otherwise distorted. Usually the metal is arborescent, dendritic, filiform, moss-like or laminar. Native copper is found in most copper-mines, usually in the upper workings, where the deposit has been exposed to atmospheric influences. The metal seems to have been reduced from solutions of its salts, and deposits may be formed around mine-timber or on iron objects. It is not infrequently found in serpentine and in basic eruptive rocks, where it occurs as veins and in amygdales. The largest known deposits are those in the Lake Superior region, near Keweenaw Point, Mich., where masses upwards of 400 tons in weight have been discovered. The metal was formerly worked by the Indians for implements and ornaments. It occurs in a series of amygdaloidal dolerites or diabases, and in the associated sandstones and conglomerates. Native silver occurs with the copper, in some cases embedded in it, like crystals in a porphyry. The copper is also accompanied by epidote, calcite, prehnite, analcite and other zeolitic minerals. Pseudomorphs after calcite are known and also after aragonite, the latter being found at Corocoro, in Bolivia.

Ores.—The principal ores of copper are the oxides cuprite and melaconite, the carbonates malachite and chessylite, the basic chloride atacamite, the silicate chrysocolla, the sulphides chalcocite, chalcopyrite, erubescite and tetrahedrite. Cuprite (*q.v.*) occurs in most cupriferous mines, but never by itself in large quantities. Melaconite was formerly extensively worked in the Lake Superior region, and is abundant in some of the mines of Tennessee and the Mississippi valley. Malachite is a valuable ore containing about 56% of the metal; it is obtained in very large quantities from South Australia, Siberia and other localities. Frequently intermixed with the green malachite is the blue carbonate chessylite or azurite (*q.v.*), an ore containing when pure 55·16% of the metal. Atacamite (*q.v.*) occurs chiefly in Chile and Peru. Chrysocolla (*q.v.*) contains in the pure state 30% of the metal; it is an abundant ore in Chile, Wisconsin and Missouri. The sulphur compounds of copper are, however, the most valuable from the economic point of view. Chalcocite, redruthite, copperglance or vitreous copper (Cu_2S) contains about 80% of copper. Copper pyrites, or chalcopyrite, contains 34·6% of copper when pure; but many of the ores, such as those worked specially by wet processes on account of the presence of a large proportion of iron sulphide, contain less than 5% of copper. Cornish ores are almost entirely pyritic; and indeed it is from such ores that by far the largest proportion of copper is extracted throughout the world. In Cornwall copper lodes usually run east and west. They occur both in the "killas" or clay-slate, and in the "growan" or granite. Erubescite, bornite (*q.v.*), or horseflesh ore is much richer in copper than the ordinary pyrites, and contains 56 or 57% of copper. Tetrahedrite (*q.v.*), fahlore (fahlerz), or grey copper, contains from 30 to 48% of copper, with arsenic, antimony, iron and sometimes zinc, silver or mercury.

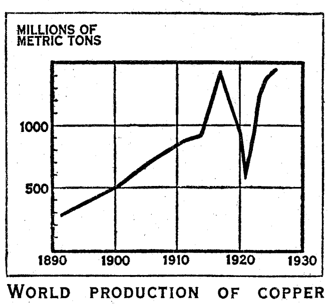
Alloys.—Copper unites with almost all other metals, and a large number of its alloys are of importance in the arts. The principal alloys in which it forms a leading ingredient are brass, bronze and German or nickel silver; under these several heads their respective applications and qualities will be found.

COMPOUNDS

Oxides.—Copper forms two definite oxides, cuprous oxide, Cu_2O, and cupric oxide, CuO, both of which give rise to well-defined series of salts. The other less definite oxides, Cu_4O and Cu_3O, do not possess this property, as is also the case of the hydrated oxides, $Cu_3O_2 2H_2O$ and $Cu_4O_3 5H_2O$, described by M. Siewert.

Cuprous oxide, Cu_2O, occurring as the mineral cuprite (*q.v.*), may be prepared artificially by heating copper wire to a white heat, and afterwards at a red heat, by the atmospheric oxidation of copper reduced in hydrogen, or by the slow oxidation of the metal under water. It is obtained as a fine red crystalline precipitate by reducing an alkaline copper solution with sugar. In its finely divided form it is of a fine red colour. It colours glass a ruby-red. The property was known to the ancients and during the middle ages; it was then lost for several centuries, to be rediscovered in about 1827. Cuprous oxide is reduced by hydrogen, carbon monoxide, charcoal or iron, to the metal; it dissolves in hydrochloric acid, forming cuprous chloride, and in other mineral acids to form cupric salts, with the separation of copper. It dissolves in ammonia, forming a colourless solution which rapidly oxidizes and turns blue. A hydrated cuprous oxide, ($4Cu_2O$, H_2O), is obtained as a bright yellow powder from cuprous chloride and potash or soda. Cuprous salts are generally white, insoluble in water, and readily oxidized to cupric salts, but stable soluble cuprous salts, giving neutral aqueous solutions, are obtained by co-ordinating the cuprous radical with sulphur containing agenda such as thiourea or ethylenethiocarbamide (Morgan and Burstall, 1928).

Cupric oxide, CuO, occurs as the mineral melaconite, and can be obtained as a hygroscopic black powder by the gentle ignition of copper nitrate, carbonate or hydroxide; also by heating cuprous oxide. It oxidizes carbon compounds to carbon dioxide and water, and therefore finds extensive application in analytical organic chemistry (*q.v.*). It is also employed to colour glass, to which it imparts a light green colour. Cupric hydroxide, $Cu(OH)_2$, is obtained as a greenish-blue flocculent precipitate by mixing cold solutions of potash and a cupric salt. This precipitate always contains more or less potash, which cannot be entirely removed by washing. A purer product is obtained by adding ammonium chloride, filtering and washing with hot water. Both the oxide and hydroxide dissolve in ammonia to form a beautiful azure-blue solution (Schweizer's reagent), which dissolves cellulose, or perhaps holds it in suspension as water does starch; accordingly, the solution rapidly perforates paper or calico (*see* SYNTHETIC FIBRES). The salts derived from cupric oxide are generally white when anhydrous, but blue or green when hydrated.



WORLD PRODUCTION OF COPPER FOR THE YEARS 1891–1926

Copper quadrantoxide, Cu_4O, is an olive-green powder formed by mixing well-cooled solutions of copper sulphate and alkaline stannous chloride; the tritoxide, Cu_3O, is obtained when cupric oxide is heated to 1,500°–2,000° C. Both are of doubtful composition. Copper dioxide, CuO_2H_2O, is obtained as a yellowish-brown powder, by treating cupric hydrate with hydrogen peroxide. When moist, it decomposes at about 6° C, but when dry at about 180° (L. Moser, 1907).

Cuprous Hydride.—Cuprous hydride, $(CuH)_n$, was first obtained by A. Wurtz in 1844, who treated a solution of copper sulphate with hypophosphorous acid, at a temperature not exceeding 70° C. According to E. J. Bartlett and W. H. Merrill, it decomposes when heated and gives cupric hydride, CuH_2, which is a strong reducing agent.

Halides.—Cuprous fluoride, CuF, is a ruby-red crystalline mass, formed by heating cuprous chloride in an atmosphere of hydrofluoric acid at 1,100°–1,200° C. It is soluble in boiling hydrochloric acid, but it is not reprecipitated by water, as is the case with cuprous chloride. Cupric fluoride, CuF_2, is obtained by dissolving cupric oxide in hydrofluoric acid. The hydrated form ($CuF_2,2H_2O,5HF$), is obtained as blue crystals, sparingly soluble in cold water.

Cuprous chloride, CuCl or Cu_2Cl_2, was obtained by Robert Boyle by heating copper with mercuric chloride. It is also obtained by burning the metal in chlorine, by heating copper and cupric oxide with hydrochloric acid, or copper and cupric chloride with hydrochloric acid. It dissolves in the excess of acid, and is precipitated as a white crystalline powder on the addition of water. It melts at below red heat to a brown mass, and its vapour density at both red and white heat corresponds to the formula Cu_2Cl_2. Its solution in hydrochloric acid readily absorbs carbon monoxide and acetylene; hence it finds application in gas analysis. Its solution in ammonia absorbs acetylene, with the precipitation of red cuprous acetylide, Cu_2C_2, a very explosive compound. Cupric chloride, $CuCl_2$, is obtained by burning copper in an excess of chlorine, or by heating the hydrated chloride, obtained by dissolving the metal or cupric oxide in an excess of hydrochloric acid. It is a yellowish-brown deliquescent powder, which rapidly forms the green hydrated salt $CuCl_2,2H_2O$ on exposure. The oxychloride occurs in nature as the mineral atacamite $[Cu\{Cu(HO)_2\}_3]Cl_2$. It may be artificially prepared by heating salt with ammonium copper sulphate to 100°. "Brunswick green," a light green pigment, is obtained from copper sulphate and bleaching powder.

Cuprous iodide, Cu_2I_2, is obtained as a white powder by the direct union of its components or by mixing solutions of cuprous chloride in hydrochloric acid and potassium iodide; or, with liberation of iodine, by adding potassium iodide to a cupric salt. Cupric iodide is only known in combination, as in $CuI_2,4NH_3,H_2O$, which is obtained by exposing $Cu_2I_2,4NH_3$ to moist air, or in combination with ethylenediamine as $[Cu,2en,2H_2O]I_2$.

Sulphides and Sulphate.—Cuprous sulphide, Cu_2S, occurs in nature as the mineral chalcocite (*q.v.*) or copper-glance, and may be obtained as a black brittle mass by the direct combination of its constituents. Cupric sulphide, CuS, occurs in nature as the mineral covellite. It may be prepared by heating cuprous sulphide with sulphur, or as a dark brown precipitate by treating a copper solution with sulphuretted hydrogen. A cuproso-cupric sulphite, $Cu_2SO_3,CuSO_3,2H_2O$, is obtained by mixing solutions of cupric sulphate and acid sodium sulphite.

Cupric sulphate or "blue vitriol," $CuSO_4$, one of the most important salts of copper, occurs in cupriferous mine waters and as the minerals chalcanthite or cyanosite, $CuSO_4 \cdot 5H_2O$, and boothite, $CuSO_4 \cdot 7H_2O$. Cupric sulphate is obtained commercially by the oxidation of sulphuretted copper ores, or by dissolving cupric oxide in dilute sulphuric acid. It was obtained in 1644 by Van Helmont, who heated copper with sulphur and moistened the residue, and in 1648 by Glauber, who dissolved copper in strong sulphuric acid. It crystallizes with five molecules of water in large blue triclinic prisms. When heated to 100° C it loses four molecules of water and forms the bluish-white monohydrate, which, on further heating to 250°–260°, is converted into the white $CuSO_4$. The anhydrous salt is very hygroscopic, and hence finds application as a desiccating agent. It also absorbs gaseous hydrochloric acid. Copper sulphate is readily soluble in water, but insoluble in alcohol; it dissolves in hydrochloric acid with a considerable fall in temperature, cupric chloride being formed. The copper is readily replaced by iron, a knife-blade placed in an aqueous solution being covered immediately with a bright red deposit of copper. This was formerly regarded as a transmutation of iron into copper. Copper sulphate finds application in calico printing and in the preparation of the pigment Scheele's green.

Carbonates.—Normal cupric carbonate, $CuCO_3$, has only been obtained in the form of such complex salts as $[Cu(CO_3)_2]K_2$ (Reynolds, 1898) and $[Cu,2C_2H_4(NH_2)_2]CO_32H_2O$ (Morgan and Burstall, 1927), basic hydrated forms being formed when an alkaline carbonate is added to a cupric salt. Basic copper carbonates are of wide occurrence in the mineral kingdom, and constitute the valuable ores malachite, azurite and mountain or mineral green. Copper rust has the same composition as malachite; it results from the action of carbon dioxide and water on the metal. Basic copper carbonate is also the basis of the valuable blue to green pigments, verditer, Bremen blue and Bremen green.

Other Compounds.—A copper nitride, Cu_3N, is obtained by heating precipitated cuprous oxide in ammonia gas (A. Guntz and H. Bassett, 1906). A maroon-coloured powder, of composition $CuNO_2$, is formed when pure dry nitrogen dioxide is passed over finely-divided copper at 25°–30°. It decomposes when heated to 90°; with water it gives nitric oxide and cupric nitrate and nitrite. Cupric nitrate, $Cu(NO_3)_2$, is obtained by dissolving the metal or oxide in nitric acid. It forms dark blue prismatic crystals containing 3, 4 or 6 molecules of water according to the temperature of crystallization.

Copper combines directly with phosphorus to form several compounds. The phosphide obtained by heating cupric phosphate, $Cu_2H_2P_2O_8$, in hydrogen, when mixed with potassium and cuprous sulphides or levigated coke, constitutes "Abel's fuse," which is used as a primer. Basic copper phosphates occur frequently in the mineral kingdom:—libethenite, $Cu_2(OH)PO_4$; chalcosiderite, a basic copper iron phosphate; torbernite, a copper uranyl phosphate; andrewsite, a hydrated copper iron phosphate; and henwoodite, a hydrated copper aluminium phosphate.

Copper forms several arsenides occurring in the mineral kingdom:—whitneyite, Cu_9As, algodonite, Cu_6As, and domeykite, Cu_3As. Copper arsenate is similar to cupric phosphate, and the resemblance is to be observed in the naturally occurring copper arsenates, which are generally isomorphous with the corresponding phosphates. Copper arsenite forms the basis of a number of once valuable, but very poisonous, pigments. Scheele's green is a basic copper arsenite; Schweinfurt green, an aceto-arsenite; and Casselmann's green a compound of cupric sulphate with potassium or sodium acetate.

Copper silicates occur in the mineral kingdom, many minerals owing their colour to the presence of a cupriferous element. Dioptase (*q.v.*) and chrysocolla (*q.v.*) are the most important forms.

Detection.—Compounds of copper impart a bright green coloration to the flame of a Bunsen burner. Ammonia gives a characteristic blue coloration when added to a solution of a copper salt; potassium ferrocyanide gives a brown precipitate, and, if the solution be very dilute, a brown colour is produced. This latter reaction will detect one part of copper in 500,000 of water. For the borax beads and the qualitative separation of copper from other metals (*see* CHEMISTRY: *Analytical*). For the quantitative estimation (*see* ASSAYING: *Copper*).

Medicine.—In medicine copper sulphate is employed occasionally as a rapid emetic, but its employment is very rare, as it is exceedingly depressant and, if it fails to act, may seriously damage the gastric mucous membrane. It is, however, a useful superficial caustic and antiseptic. A colloidal copper lysalbuminate has been used tentatively in malignant disease. All copper compounds are poisonous.

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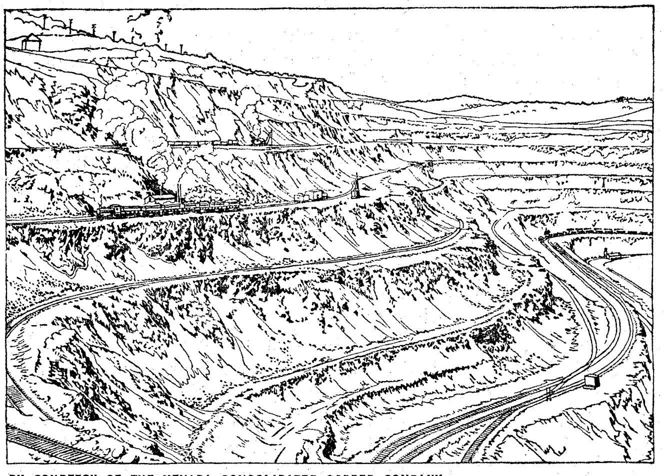
Copper was probably the first metal to be utilized by mankind, apart from gold and silver which were, no doubt, employed chiefly for ornamental purposes. In the native state, as metal, it is found in various parts of the world, and from these sources the first supplies are presumed to have been obtained, the metal in this state being malleable and requiring no metallurgical treatment prior to use. At some later date the more readily reducible oxide ores were treated by primitive peoples, ample evidence of this being obtained from time to time as new copper deposits are discovered and prehistoric workings are revealed. The extraction of the metal from the sulphide ores presented more difficulty than from the simpler oxide ores; in some districts the sulphides appear to have resisted satisfactory treatment, and were therefore neglected.

The development of the extraction processes until the middle ages was very gradual, and was confined mainly to obtaining



BY COURTESY OF THE NEVADA CONSOLIDATED COPPER COMPANY

AN OPEN CUT COPPER MINE AT RUTH, NEVADA, WHICH IS MINED BY STEAM SHOVELS AND YIELDS ABOUT 20 POUNDS OF COPPER PER TON OF ORE

greater recovery of metal from a given quantity of ore. By that time, however, the general principles which underlie the methods for the dry extraction of copper were appreciated, and they may be stated as follows. Since all sulphuretted copper ores (and these are of chief economic importance) are invariably contaminated with arsenic and antimony, it is necessary to eliminate these impurities as far as practicable at the earliest possible stage in the treatment. This is effected by calcination or roasting.

The roasted ore is then smelted to a mixture of copper and iron sulphides, known as "copper matte" or "coarse-metal," which contains little arsenic, antimony or silica. This coarse-metal is smelted with coke and siliceous fluxes (in order to slag away the iron) and the product, consisting of an impure copper sulphide, is variously known as "blue-metal" when more or less iron is still present, "pimple-metal" when richer in copper, or "fine" or "white-metal" which is a matte consisting of comparatively pure copper sulphide and containing approximately 75% of the metal. This product is re-smelted to form "coarse copper" or "blister copper" containing 95–97% of the metal, which is then refined.

Refining.—Blister or coarse copper contains numerous impurities. Sulphur, iron, lead, arsenic and antimony are almost invariably present. Silenium, tellurium, zinc, nickel and cobalt are also liable to occur, and in addition, silver and gold, which are frequently found in sufficient quantity to pay for their extraction. The object of refining is to remove these impurities as far as possible and to cast the copper into cakes and other forms suitable for mechanical treatment and conversion into rods, sheets, tubes, etc. The elimination of the impurities is effected by oxidation and removal either as slag or by volatilization. During the process the molten metal itself becomes partly oxidized, and this oxidation is continued and aided by the agitation of the bath with iron rabbles, or in more modern plants by means of compressed air blown either on the surface of the bath or below it. This operation is termed "flapping" and is continued until the metal contains approximately 6% of cuprous oxide. The iron, sulphur, zinc, tin and cobalt will have been almost completely eliminated. Arsenic, nickel and some other metals are not so completely removed, whilst the gold and silver and rarer metals still remain in the bath of metal. A sample ingot taken at this stage and allowed to solidify, contracts on solidification and exhibits a brick red surface when fractured.

The metal in this condition is known as "sett copper," and is relatively hard and easily fractured owing to the presence of the cuprous oxide. It is therefore necessary to reduce this oxide and reconvert it into metal. This is effected by "poling," which consists in forcing green trees or logs under the surface of the molten metal. The products which are evolved from the combustion and distillation of the wood reduce the oxide to metal, and if the operation be properly conducted, "touch-pitch" copper, soft, malleable and exhibiting a lustrous, silky fracture, is obtained. The progress of the reduction is checked from time to time by the removal of small test buttons which are hammered out hot, quenched and fractured. Fracture must only occur when the button is completely doubled over and flattened, and should show a silky texture and be of a salmon pink colour. Considerable skill is needed at this stage of refining, as if the poling be carried too far the metal again becomes brittle and porous owing to the absorption of furnace gases. Such metal is termed "over-poled," and on solidification the top surface of the ingot rises owing to the liberation of the absorbed gases during solidification. When the operation is carried out correctly, the castings solidify with a flat rippled surface but this appearance although essential to good "touch-pitch" copper is only indicative of good material when the furnace condition as regards temperature and atmosphere are known to have been satisfactory.

The "touch-pitch" condition is closely associated with the oxygen remaining in the metal and this is, in turn, influenced by a variety of factors, including the furnace conditions and temperature in addition to the collective effect of the various impurities present in the metal. Modern refining practice gives very close attention to all these factors and the larger furnaces and mechanical devices enable very close control of the oxygen content to be maintained.

The processes so far described are those developed to deal with a diversity of ore mixtures which were obtained from various sources and were treated on a relatively small scale both in Wales and in Germany. This position changed with the development of the enormous American ore bodies of comparatively uniform composition, whilst in addition, an immensely greater scale of operations was rendered possible by the increasing quantities of the metal required for the various forms of electrical development.

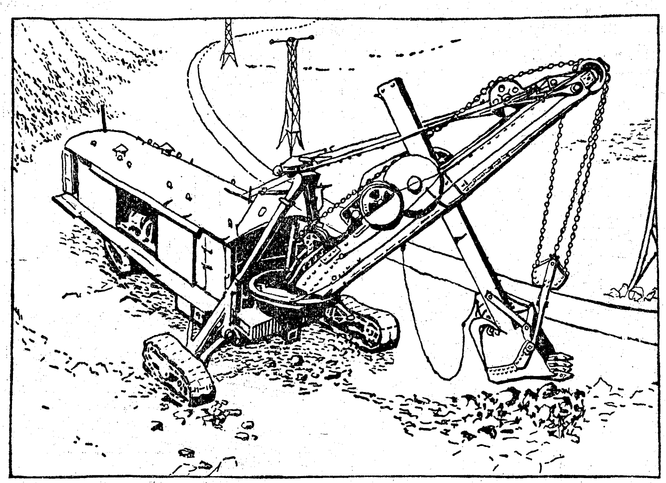
Towards the end of the 19th century, America rose very rapidly to be the world's greatest producer of copper, and in 1926 the United States produced 789,000 metric tons or over one-half of the world's total output. The fact that 86% of the total was produced by 35 companies shows the scale of the operations that have been in use.

The treatment methods have been continually modified to take full advantage of all modern metallurgical improvements, the direct result of which has been considerable simplification of the extraction process. In principle the operations are similar to those already described, and may be classified under three main headings:—(1) concentration, (2) furnace treatment, (3) electrolytic refining. In addition, some ores and residues are now treated by hydro-metallurgical extraction methods or leaching followed by electrolytic deposition.

Concentration.—Apart from the general development of ordinary crushing and dressing plant practice, the outstanding feature is the use of the oil flotation process and the high recoveries obtained from this method. Selective flotation is now applied to copper sulphide-pyrites ores so that there is an elimination of both silica and iron, leaving a high grade copper concentrate for smelting. In the case of mixed oxidized and sulphide ores it is still a question whether the oxide portion can be floated with the sulphide, although success is claimed by the use of potassium xanthanate. These improvements in dressing practice are permitting very poor ore bodies to be mined economically; for example, in 1926 the Miami Copper Company were working at a profit an ore body containing but 20 lb. copper per ton. Differential flotation is being applied on various plants, including Anaconda, and results in a much greater ratio of concentration which permits the smaller tonnage of richer concentrates obtained to be treated in reverberatory furnaces.

Furnace Treatment.—Prior to 1910 the blast furnace and the reverberatory furnace were in close competition for the ascendancy in the smelting of copper ore. With the increasing fineness of the ore to be smelted, resulting from the fine crushing necessary to obtain satisfactory recoveries from the poorer ores treated by the dressing plant, the leaning began to be definitely in favour of the reverberatory furnace. But with the advent of the Dwight-Lloyd and other sintering plants, which enabled fine ores to be agglomerated cheaply and efficiently, the blast furnace gained a new prestige. The recent developments of selective flotation enabling higher grade concentrates to be obtained, combined with the successful application of coal dust firing to reverberatory furnaces have again given this type of furnace an unquestioned predominance which it is likely to maintain. The modern copper smelting plant designed for the treatment of fine ore comprises roasting furnaces of the McDougall type and very large reverberatory furnaces. The process of extraction consists of (*a*) roasting in mechanical furnaces, (*b*) smelting to matte in reverberatory furnaces, (*c*) blowing the matte to blister in basic converters, (*d*) casting the blister into anodes either direct or after partial refining in reverberatory furnaces, and (*e*) electrolytic refining.

Roasting.—The McDougall type furnace is essentially a vertical cylinder with superimposed horizontal hearths and a central rotating shaft with radial arms for stirring the ore. The ore is fed in mechanically at the top of the furnace and is displaced by the rabble arms towards the periphery when it drops to the hearth beneath. The rabbles are here arranged to move the ore in the opposite direction, succeeding hearths being arranged alternately with slots provided for the ore to drop from one hearth to the next beneath. The central shaft and arms, water cooled in the original design, are now pressure air cooled as this offers several advantages, amongst which may be cited the absence of scaling and the possibility of returning the heated air to the bottom of the furnace for combustion purposes. Various other types of mechanical roasting furnaces were at one time used for copper ores but they have all been superseded by one of the several modifications of the McDougall furnace, variously known as Evans-Klepetko, Herreshoff or Wedge furnace. The modern practice is to treat this calcine or roasted material in reverberatory furnaces, which have been continuously increasing in size, although they now appear to have reached their maximum as regards length. The tendency in most recent construction is to make them approximately 100ft. in length and to increase the width, although constructional difficulties have hampered this development and few exceed 25ft. in width. All these modern furnaces use either pulverized coal or oil as a fuel, the choice depending on economic factors, great economy being effected by passing the flue gases through waste heat boilers to recover rather more than a third of the heating value of the fuel in the form of steam. The charging of the hot calcines is carried out along the sides of the furnace at frequent intervals, and this practice combined with the addition of highly siliceous ore for fettling purposes preserves the furnace sides. The furnace has two distinct functions, the first being the smelting of the charge, and the second the settling of the matte produced. The matte usually contains approximately 40% copper and is withdrawn intermittently as required for further treatment. The slag is withdrawn continuously from the far end of the furnace and flows into slag cars or granulating troughs. Such slags contain rather more copper than blast-furnace slag, and this is probably accounted for by dusting during the charging of such fine material. Special precautions are taken to collect the flue dust which is returned for further treatment. The next operation consists in the elimination of the sulphur from the matte and the production of blister copper in one operation.



BY COURTESY OF THE UTAH COPPER COMPANY

ELECTRIC SHOVEL, USED IN STRIP COPPER MINING, WITH A 4½ YD. DIPPER CAPABLE OF LOADING 9 TONS EACH TIME THE BUCKET IS FILLED

Converting.—The converting process consists in blowing thin streams of air under pressure through the molten matte retained in a suitable container. It was first used for copper by Manhés and David in France, and at a later date the process was introduced both at Butte, Montana, and in Wales. Originally the converters were lined with siliceous material, the lining furnishing the silica required to flux the iron oxide produced during the blowing. Numerous attempts were made to replace this lining by a basic lining owing to the short life of the acid linings, but not until 1910 was success achieved by Pierce and Smith in America. Subsequently it was found that the basic lining was not limited in its application to the horizontal converters originally used, but could be applied to other forms of both the horizontal and vertical types. Amongst the advantages of the basic lined converter, as compared with the acid lined type, are an increased life of the lining (one basic lining produces 2,500 tons copper as compared with ten tons from an acid lining), greater air efficiency, and ability to convert low grade matte. Modern basic lined converters are lined with magnesite, and the Pierce-Smith type, which is generally favoured, consists of a horizontal cylindrical shell of steel plate supported on cast steel rings, which can revolve on rollers. The converters are of varying dimensions, to meet the operating conditions in various plants. An ordinary large size converter measures 13ft. x 30ft. and the air is supplied through 41 $1\frac{3}{4}$in. tuyeres spaced at $6\frac{1}{2}$in. centres. In order to utilize the sulphurous gases for acid manufacture or SO_2, special arrangements are made in the form of hoods to prevent dilution with air. In converting 40% matte to blister copper, the daily capacity of such a converter varies from 110–125 tons. The method of operation is to charge in liquid matte and siliceous ore in given proportions and blow for 30 to 40 minutes. The slag formed is then poured off, and further additions of liquid matte, siliceous ore together with converter cleanings and cold matte, are added and help to lower the temperature of the bath. The charge is again blown, and the operation repeated until the converter is fully charged and the matte is enriched to "white-metal" (70–75% copper). The slag is then cleaned off as thoroughly as possible, scrap copper, cold white metal, etc., are added to reduce the temperature, and the final blow to blister copper is made. This blister copper is frequently tapped into ladles and transferred molten to reverberatory furnaces for partial refining and conversion into anodes for treatment in the electrolytic refining. In some instances the anodes are cast direct from the converter, and although in such cases, owing to their uneven thickness, the electrolytic treatment is less efficient, the expense saved by eliminating the reverberatory treatment may balance the smaller recovery. In preparing anodes in the reverberatory refining furnace the same care need not be taken as for finished copper, and it is usual to leave a larger proportion of cuprous oxide in the metal. The furnace can be of large capacity, and casting is carried out by means of a mechanical casting machine, the anodes passing to the electrolytic refining. The procedure described is applicable to fine ores such as sulphide concentrates, but for the smelting of coarse ore the blast-furnace operated on a pyritic or semi-pyritic principle still holds its place.

Pyritic Smelting.—In this process the oxidation of pyritic ores and the formation of the slag furnish the heat necessary to carry on the operation. Partial pyritic smelting is one in which the deficiency of sulphur in the charge is made up by the addition of some carbonaceous fuel. In both cases considerably more air is required than when carbon forms the fuel. This pyritic effect is utilized in some degree in practically all blast furnace practice and the modern blast furnaces have been designed to meet these requirements. They are oblong in shape, with vertical ends and sloping sides fitted with the necessary tuyeres. The discharge is continuous, the slag matte mixture running continuously over a raised spout trapping the blast. The matte and slag collect in a large fore-hearth settler where the matte settles and is tapped periodically for feeding to the converters. The slag is run off continuously, either into a slag car or into some granulating device. The large furnaces at Anaconda are 87ft. long by 56in. wide at the tuyeres. Increasing the length in this manner decreases the heat losses at the ends, giving greater regularity in operation with lower fuel and labour costs. In cases when a low grade matte is produced this is enriched sufficiently for converting by a second smelting, and is transferred molten or re-melted if the conditions are not favourable for immediate treatment.

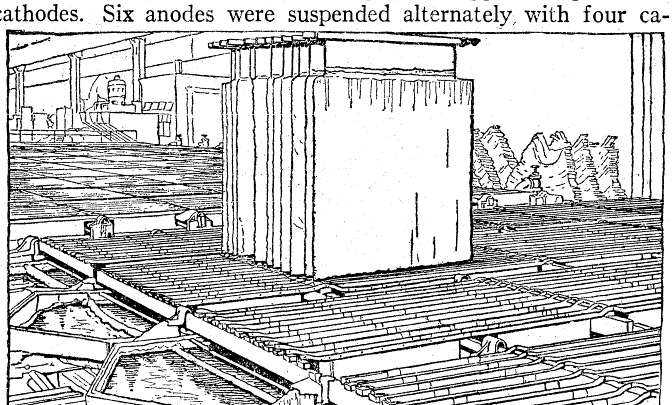
Hydro-metallurgical Treatment.—The development of this type of treatment has received considerable attention in certain cases where it is particularly applicable. It is eminently suited for low grade ores and residues with finely disseminated copper mineral and a gangue that is not attacked by the solvent. Leaching may be divided into three classes:—(1) leaching in place, (2) heap leaching, (3) confined leaching in vats, tanks or other vessels. The first is only applicable when the mineral in the natural state is in a form soluble in the solvent, with the gangue in such a condition that the solution can operate. It is in successful operation at the Ohio Copper Co.'s mine, Utah, where the rock is shattered, leaving the mineral exposed along cleavage planes. Water introduced on the surface emerges in the main haulage tunnel with little loss. The ore ranges between 0·3% and 1·3% copper, and natural ventilation aids oxidation and renders the mineral readily soluble. The copper in the solution pumped out is precipitated on de-tinned scrap, yielding a 90% copper precipitate, whilst one-third of the de-coppered liquor with two-thirds fresh water is returned to the mine.

Heap leaching was first practised at Rio Tinto, Spain, and is in successful operation there and at other mines in Spain and Portugal. At Rio Tinto weathering is used to render the mineral soluble, the ore being a sulphide mineral which is crushed and sorted into coarse and fine. The heaps are of large dimensions, and are made up of alternate layers of coarse and fines, the top layers consisting of fine ores to assist the distribution of the water. Whilst the heap is in course of formation, water is added to dissolve any copper sulphate already existent, and to hasten oxidation. The top of the heap is divided up with ridges for the even distribution of the water and the temperature during oxidation is adjusted by manipulating the outlets from the stacks which are built up through the heap. It is essential for the oxidation to be regular and gradual to produce the desired porous material suitable for wet extraction. When the heap is sufficiently oxidized, water and liquor from the depositing tanks are run on until the soluble copper has been extracted. At intervals of approximately one year the water distributing channels are changed in position, and it takes six to seven years with massive ore to reduce the heap of approximately 100,000 tons to 0·25–0·30% copper, which is the economic limit of extraction. The liquor obtained is first reduced by contact with freshly mined pyritic fines, and the copper is then precipitated with pig-iron in the usual manner.

Confined leaching in vats is the most general method of leaching in Chile. Thus at Chuquicamata a deposit of approximately 709,000 tons assaying 2% copper is being treated by such methods. The copper occurs in the ore as brochantite contaminated with chlorides. The process consists in crushing 90% of the mineral to pass a ⅜in. sieve, leaching with sulphuric acid, purification of the solution and deposition of the copper by electrolysis, using ferro-silicon anodes. The copper cathodes produced are cast into bars equal in grade to standard electrolytically refined copper.

Ammonia leaching has not found very general acceptance, but in one or two instances, under special conditions, it has been successfully instituted. Low grade carbonate ores and native copper tailings yield readily to this treatment, and successful plants are in operation in Alaska and at the Calumet and Hecla property, Michigan. At the latter plant, tailings from concentrating native copper are being treated, the solution used containing 3% copper, 6% NH_3 and 4% CO_2. The copper content of the solution is regulated by withdrawals for precipitation whilst losses of ammonia and CO_2 are replaced. In order to maintain the solution in an oxidized condition, it is circulated through towers with an upward air current, any ammonia passing away during this treatment being recovered in absorption towers. The copper is precipitated from the ammoniacal solutions by boiling in special evaporators and the ammonia is recovered. A further development of ammonia leaching is being applied in Africa at Bwana M'Kubwa. A process has been developed for obtaining satisfactory recoveries from silicate ores (such as chrysocolla) which have previously presented many difficulties. The ore is first crushed to about ½in. to 1in. and is then fed to a preheater, which is a cylindrical furnace of the rotary kiln type, where it is heated to 400–500° C. for about 30 minutes. The furnace de-hydrates the ore and heats it to the necessary temperature for a reaction to occur in the next furnace, to which it is transferred. The second furnace is maintained with a reducing atmosphere by a stream of producer gas, the heat of the reaction being sufficient to maintain the temperature. The reduction takes place rapidly, but the furnace has to be arranged with water cooling at the exit, so that the ore may be cooled down before passing into the air. The reduced ore is then crushed in rolls to the size necessary for successful extraction by leaching. The copper content of the ore is now readily soluble in ammonium carbonate in the presence of oxygen, and the usual methods are employed for the subsequent precipitation of the copper in the form of oxide. Tar and ammonia are both by-products in the manufacture of the producer gas required for the process. The tar is utilized by mixing with the oxide produced and aids reduction during the final refining, whilst the ammonia is stated to be sufficient in quantity to make up the losses during leaching.

Electrolytic Refining.—Copper made by this process contains a negligible quantity of impurities, and constitutes by far the greater portion of the world's production. The earliest attempt to refine copper electrolytically was made by Elkington, whose first patent is dated 1865. He cast crude copper into plates which were used as anodes, sheets of electro-deposited copper being used as cathodes. Six anodes were suspended alternately with four cathodes in a saturated solution of copper sulphate in a fireclay trough; all the anodes being connected in one parallel group and all the cathodes in another. A hundred or more troughs were coupled in series, the cathodes of the one to the anodes of the next, and they were so arranged that, with the aid of side pipes with leaden connections and India rubber joints, the electrolyte could be made to circulate once daily through them all from the top of one jar to the bottom of the next. The passage of current was continued until the anodes were of no further use and the cathodes, when thick enough, were removed and either cast into cakes and



BY COURTESY OF THE COPPER AND BRASS RESEARCH CORPORATION

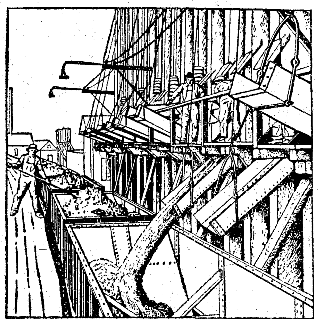
PURE COPPER SHEETS (CATHODES) BEING REMOVED FROM TANKS CONTAINING SULPHATE SOLUTION AND ANODE SHEETS. WHEN NEW CATHODES ARE LOWERED AND CURRENT IS PASSED, COPPER IS DEPOSITED BY ELECTROLYSIS

BY COURTESY OF ANACONDA COPPER MINING COMPANY

COPPER MINING, SMELTING AND REFINING

1. Miner operating pneumatic drill preparatory to blasting ore in a copper mine
2. Copper converters. The copper product of the reverberatory furnace, matte, is charged into the converters, where streams of air are blown under pressure into the molten mass, burning the sulphur and oxidizing the iron and other elements. This oxidized matte is poured off, leaving metallic "blister" copper—99% pure
3. Copper anodes are placed in tanks containing an electrolyte of copper sulphate solution. Then thin sheets of pure copper, or cathodes, are suspended between the anodes. With the passage of the current from the anodes through the electrolyte to the cathodes, copper dissolves from the anodes, and is deposited, more than 99.9% pure, on the cathodes. The impurities, which sometimes contain gold and silver, settle to the bottom of the tank and are recovered
4. Copper cathodes being removed from tanks. Copper refined by electrolysis comprises the bulk of production
5. After the cathode copper is removed from the tanks, it is melted and conditioned in furnaces. Then the pure molten copper, as shown here, is cast into shapes suitable for industrial use

rolled or disposed of as cathodes. Silver, gold and other insoluble impurities collected at the bottom of the tanks up to the level of the lower side tubes and were then run off as mud through plugs or holes in the bottom, and collected in settling tanks for further treatment. Elkington's method is now known as the multiple system; a second method of connecting up the tanks, known as the series system, being introduced in 1886. America produces the greater part of the electrolytic copper required and over 80% of this copper output is prepared in this manner. The efficiency of the process is dependent on the composition, character and temperature of the electrolyte, the current density and the voltage, all of which have to be carefully controlled.



BY COURTESY OF THE ANACONDA COPPER MINING COMPANY

LOADING COPPER ORE INTO ORE CARS AT ONE OF THE ANACONDA MINING COMPANY'S MINES IN BUTTE, MONTANA

The Multiple System.—This is now worked in oblong tanks with anodes made from copper partially refined after converting, and cathodes of pure copper. The usual composition of the electrolyte is 30% copper and 12% free sulphuric acid. The temperature of the bath ranges from 40 to 60° C and continuous circulation of the liquid is essential to correct variations in composition. The drop in potential between tanks ranges from 0·2 to 0·4 volts, and it was found at Anaconda that more than 20% of the drop was due to contact resistance and leakages. The current density in use ranges from 15 to 25 amperes per sq. ft., depending on the purity of the material to be treated and the power cost in relation to the increased output obtained. The anodes used should be as pure as possible, to avoid contamination of the electrolyte, and commonly average 99% copper, the precious metals recovered very largely defraying the cost of the process. In modern plants the anodes are usually cast about 3ft. square and may be up to 1½in. in thickness. Mechanical arrangements are provided for handling them in and out of the tanks in groups. The cathodes now used consist of thin sheets of deposited copper which are deposited on rolled sheet copper in special tanks arranged to form a slow deposit of sufficient strength to allow the starting sheet formed to carry the full weight of the finished cathode. These cathodes, after seven to 14 days depositing in the tanks, are removed, washed and transferred to the refining-furnace for remelting, poling to pitch and casting into marketable forms. The slime which collects in the bottom of the tanks carries the impurities, and from time to time certain tanks are thrown out of circuit for the collection of the mud, which is then treated for the extraction of the rare metals.

The Series System.—In the Hayden series system cast or rolled anodes are placed vertically in series in the tanks so as to fit closely along the sides, the electrolyte used being very similar to that of the multiple system. As the current passes, the electrodes other than those at the ends become negatively charged on one side and positively charged on the opposite or exit side. Copper is deposited on the negative side, and the anode dissolves away from the opposite side until it is only a few per cent of its original weight and the impurities have passed into the mud in the usual manner. Current connections are made through bus bars at the ends of the tanks, and the current density is approximately 22 amperes per sq. ft., with an E.M.F. of 22 volts for a tank containing 135 electrodes. The high voltage gives a large leakage of current, but the actual current carried is considerably less than in the multiple system, 500 amperes as compared with 10,000 amperes. In some instances rolled electrodes are used, in other cases refined cast anodes have given satisfaction, but it has been found that for this method the anode should be as high grade as possible. The two systems have been frequently compared. The multiple system has the advantage of being able to treat all grades of copper, whereas the series system requires relatively pure material. Owing to the fact that the electrodes can be placed much closer together, the power cost for the series system is lower, and, in addition, much less copper is required for conductors. These advantages are, however, counterbalanced in the multiple system by cheaper produced anodes and lower handling and operating costs. Both systems are being operated successfully on a large scale. (C. A. E.)

COPPER, OUTPUT AND MANUFACTURE. Before the World War, the world's production of copper had risen to about 1,000,000 tons per annum. From 1916–18 this rose to approximately 1,400,000 tons. For the next few years, owing to trade depression, production was restricted, but in 1926 the production exceeded the war-time maximum with 1,469,463 tons. Important new sources of the metal are being developed in Chili, Peru, Africa and Canada.

World's Production of Copper, 1920–1934

Year	Metric tons	Short tons
1920	953,177	1,050,687
1923	1,245,720	1,373,157
1925	1,434,716	1,581,479
1926	1,482,538	1,634,193
1927	1,525,586	1,681,643
1928	1,708,649	1,883,431
1929	1,921,639	2,104,110
1931	1,349,904	..
1933	1,031,665	..
1934	1,253,683	..

World's Copper Production by Countries
(In Metric Tons)

Country	1928	1931	1934
United States	848,413	475,945	210,742
Mexico	65,844	52,730	47,280
Canada	87,666	132,117	166,394
Chile	289,895	224,998	256,104
Peru	53,028	46,094	27,554
Spain-Portugal	49,537	36,301	34,788
Japan	68,233	75,848	59,966
Africa	128,034	153,618	265,378
Australasia	12,015	13,695	13,476
Other Countries	114,073	138,558	172,001
Total	1,716,738	1,349,904	1,253,683

Estimated Use of Copper in the United States
(In tons of 2,000 lb.)

Purpose	1928	1931	1934
Electrical manufactures (a)	213,000	162,000	101,000
Telephones and telegraphs	119,000	70,000	18,000
Light and power lines (b)	115,000	85,000	40,000
Wire cloth	7,100	4,900	4,600
Other rod and wire	87,100	55,000	40,000
Ammunition	8,200	5,000	12,200
Automobiles (c)	127,400	61,600	63,000
Buildings (e)	62,000	45,000	36,000
Castings, n.e.s. (d)	72,500	36,000	36,000
Clocks and watches	4,600	2,000	1,800
Coinage	800	100	900
Copper-bearing steel	1,600	1,200	2,100
Fire-fighting apparatus	2,300	1,300	1,000
Radiators, heating	1,100	1,700	2,400
Radio receiving sets	8,400	10,000	12,600
Railway equipment	6,000	1,800	2,600
Refrigerators	13,800	13,000	16,200
Shipbuilding	1,600	3,200	3,700
Washing machines	4,200	1,600	1,900
Water heaters, household	2,600	1,400	1,500
Other uses	65,800	40,000	42,000
Manufactures for export	66,600	48,200	25,500
Total	990,700	650,000	465,000
Use in pounds per person	16·53	10·43	7·36
Shipments by refineries	983,460	600,754	417,110

(a) Generators, motors, electric locomotives, switchboards, light bulbs, etc. (b) Transmission and distribution wire and bus bars. (c) Does not include starter, generator, and ignition equipment. (d) Bearings, bushings, lubricators, valves and fittings. (e) Excludes electrical work.

Copper in the Electrical Trade.—The major portion of the world's production of copper is utilized by the electrical industries, and of the remainder the greater part is finally used mixed with other metals in the form of alloys. This leaves a comparatively small portion of the total production to be absorbed for general purposes. The table on page 407 gives an approximate analysis of the consumption of copper in the United States and the purposes for which it was utilized.

Standard Electrolytic Copper.—Typical samples of electrolytic copper will contain from 99·92% to 99·96% copper, and of the remainder the major portion will consist of oxygen. A metal of this purity will show a conductivity of 99·8% to 100·3% as compared with the International Annealed Copper standard of 5,328 ohms at 20° C, this system of measurement being universally adopted for industrial purposes. The conductivity of commercial electrolytic copper is now expressed as a percentage of this value.

The specifications of the American Society for Testing Materials require a minimum value of 99·9% for wire bars and cakes, and 97·5% for ingots, the determinations to be made on annealed samples. The average copper produced to-day is fully up to this standard, and much of it will possess a conductivity exceeding 100% owing to the great improvement in purity since the time when the standard was fixed. The majority of electrolytic copper is supplied in the form of wire bars which are mainly of American origin. In order to facilitate mass production the sizes of these have been standardized, the several standard sizes varying in weight from 135 to 500 pounds. Wire bars vary in length from 3 ft. to 5 ft., and in cross-section they are approximately 4 in. square.

As a result of the large outputs to be handled, rolling mills for dealing with wire bars have reached a very high state of development, and modern mills are capable of dealing with the two bars simultaneously. The wire bars are first reheated to 800° to 900° C and are rolled without any further reheating to approximately $\frac{3}{8}$ in. diameter, the size depending on the class of material to be made. Very high rolling speeds are used in the finishing passes in order to increase the output, and such mills probably represent the highest stage of rolling development in the non-ferrous industry. In the early stages, steel or white iron dies are used for drawing, but for the finer wires and finishing passes, diamond dies are almost universally employed.

Great advances have been made in the machinery used for wire drawing and multiple die machines are now in common practice. In order to minimize oxidation and scaling, special types of annealing furnaces are employed for annealing the coils between the drawing operations. The Bates-Peard furnace is a typical example of the type of plant used, and consists of a gas-fired furnace chamber, the ends of which pass beneath water seals. The coils of wire are fixed to a moving chain which passes through the water seal into the furnace chamber; the furnace is continuous in operation, the coils passing slowly from one end to the other on the moving chain, and passing out through the water seal at the opposite end where they are quenched. Annealing by this method preserves the bright surface on the wire, and avoids any loss due to oxidation and scale. A considerable quantity of copper wire is marketed in the form of bare coils in the half-hard condition, but there is also a considerable tonnage which is subsequently covered with paper, cotton, silk, rubber or other insulating material for use in the form of covered conductors. Much of the wire is also supplied stranded, and all these operations are carried out on special machines which are largely automatic in operation. The machines consist essentially of a number of drums on which the wire or covering material is wound, and these drums are arranged so that they can be rotated on an axis through the central core as this passes through the machine. As the coils rotate round the core, the strands of wire or the covering material are automatically fed out under tension, and wind themselves round the core or central wire.

The cables have now, in many cases, to undergo a special process to render them as impervious as possible to moisture and at a later stage they may receive an outer protective covering, lead being the final protection in many instances. Lead covering is extruded on to the outside of the cable by means of a special pressure extruding plant. For immersion under water an additional protection has sometimes to be given in the form of hemp or metal armouring. Various designs of multiple cored and other special types of cable are manufactured and supplied for various purposes. The electrical industries also consume large quantities of bare copper strip for incorporation in electrical machinery. In the narrow widths and thicker gauges this form of the metal is produced mainly from wire bars which are rolled in a similar type of mill to that used for the production of wire. In addition, copper strip of greater width and much thinner gauge is produced in long lengths, and is usually supplied in the form of coils.

The term copper "strip" as distinct from copper "sheet" is usually assumed to apply to material less than 24 in. wide which is supplied in the form of long lengths. The majority of the strip used is under 12 in. wide and is manufactured by a process which has not yet found application in the rolling of material over 3 ft. in width. In the preliminary stages, the copper castings are rolled hot but in the later stages of manufacture, all the rolling is carried out cold, the material being coiled on coiling drums on each side of the rolling mills. Material produced by this method is of very even gauge and possesses an exceptionally good surface finish. The coils can be easily handled and are in general use for the manufacture of stampings, both in the electrical and other industries. Copper strip is supplied in various degrees of hardness according to the rolling it has received subsequent to the last annealing. The usual grades of hardness or temper are termed soft, quarter-hard, half-hard, three-quarters-hard and hard. These various tempers are selected according to the amount of subsequent mechanical deformation to which they will be subjected. Copper sheets are produced by somewhat similar methods of manufacture, and in America especially, the majority of copper sheets are made from electrolytic copper, but in Europe fire-refined arsenical copper is used very largely in the manufacture of sheets and plates. American and English practice is to use relatively small castings from 1 cwt. to 4 cwt. in weight, which are rolled out and cut to size. Both hot rolling and cold rolling is practised, depending on the surface of the sheet required, but American practice is tending more and more to use cold rolling for the final stages in sheet production, irrespective of the surface finish required. In Europe several finishes are marketed; the hot rolled and descaled sheet is known as ordinary quality and has a distinct red colour which is greatly valued in certain parts of the world. The red coloration is due to a thin film of cuprous oxide, which is easily removed by immersion in dilute acid, and sheets cleaned in this way, known as acid cleaned or dipped sheets, are gaining favour for many purposes, especially when they have to be tinned or soldered. The so-called "ash" copper is a special finish obtained by annealing the sheets in air-tight packs, sheets annealed in this manner having an exceptionally adherent coating of cuprous oxide, which gives them a distinctive red colour.

Cold Rolling.—Cold rolling is an operation carried out subsequent to hot rolling, and gives a sheet with an exceptionally smooth, bright finish, suitable for working up into highly polished articles. Cold-rolled sheets are manufactured in a variety of tempers similar to those already quoted for strip copper. In Europe methods have been developed to allow the use of large castings up to several tons in weight for sheet manufacture, and progress is also being made in the manufacture by strip rolling methods of much greater widths than have previously been attempted. In this method of manufacture the greater part of the rolling is a modified form of cold rolling, and the resultant sheets show a surface finish which is smoother than that obtained by the ordinary methods of hot rolling. In the thicker gauges, copper sheets find application in many industries, and are manufactured into pans and vessels of all kinds. The high heat conductivity of copper is of great value for such purposes, in addition to which the malleable nature of the metal allows it to be worked into very intricate shapes. Where the metal is subjected to furnace gases and relatively high temperatures, it is generally considered that pure copper is not as satisfactory as arsenical copper containing approximately .5% arsenic. This applies also to the use of copper in locomotive fireboxes. The Engineering Standards specifications and the British railway specifications require the metal to contain .3% to .5% arsenic. Copper is used almost exclusively for British locomotives' fireboxes, and also by many foreign railways. The plates used in their construction vary in thickness from ½ in. to 1 in., and undergo a very rigid testing before acceptance. Where alkaline waters are used, copper-nickel alloys are coming into favour, as it has been found that they withstand these conditions better and have a longer life than the ordinary arsenical copper fireboxes.

The use of copper for ordinary cooking utensils has declined owing to the competition of other metals, but its use still remains an important factor in the consumption of the metal in the eastern market owing to religious rites which necessitate food being cooked in metallic vessels. A large tonnage of copper is exported annually from Europe in the form of circles and square sheets for consumption in India and the eastern market, and owing to the severe hand working to which this material is subjected it requires to be of high quality. As one of the most malleable of common metals, copper is of great utility for working up by hand or by mechanical means into various shapes, and its increased use is mainly prevented by its cost as compared with other competitive metals. In general, however, the main qualities on which its use depends are its malleability, high heat conductivity and relative resistance to corrosion.

Alloys of Copper.—These are the most generally used of all nonferrous alloys and comprise mixtures of copper with zinc, tin, nickel, aluminium, lead, iron, manganese and phosphorus. In many instances they consist simply of binary alloys formed by the addition of one other metal to copper, but in other cases two or more metals may be added in order to impart certain special properties. The principal series of alloys in which copper forms the chief constituent are brass (copper-zinc), bronze (copper-tin) and German or nickel silver (copper-zinc-nickel) (*qq.v.*). In addition to these better known alloys, there are many others which are finding increasing application in industry as their properties become more widely recognized. Those of copper and nickel afford a typical example of this kind, and their manufacture has greatly increased during the 20th century. Owing to the fact that copper and nickel are completely miscible in the solid state, forming a complete series of solid solutions, the useful range of alloys is not confined within any definite limits of composition, although certain compositions have come into general use. Additions of 2–15% nickel to copper provide a series of alloys which are considerably stronger and more resistant to oxidation at high temperatures than copper. These alloys possess the additional quality of greater resistance to corrosion in alkaline water than arsenical copper, and have been adopted for locomotive firebox manufacture where these conditions are encountered. The alloy formed of 20% nickel with the remainder copper is one of the most ductile of commercial alloys, and may be subjected to the most severe cold working without the need of any intermediate annealing. It is also readily forged and rolled at a temperature above 800° C. These properties make it a very suitable alloy for drop forgings and cold stamping and pressing, and it has a variety of uses in automobile construction for exposed fittings as it takes a high polish and is resistant to atmospheric tarnishing. Other uses include bullet sheathing, for which purpose it is used by many nations including Great Britain and France. In the form of tubes its use is being rapidly extended for steam condensers, although the alloys containing 25% nickel and 30% nickel are stated by some authorities to give better results as condenser tubing than the softer and less resistant alloys of lower nickel content. The chief use of the 25% nickel alloy has been for coinage, and several of the British colonies employ it largely because of its resistance to corrosion. The alloy containing 40% nickel has become very widely known under the name "Constantan." It has a high electrical resistance which remains practically constant over an appreciable range of temperature. This property renders it of value to the electrical industry, in addition to which its resistance to corrosion by organic acids and its silvery white colour when polished are causing it to be employed in increasing quantities for tableware that has not to be silver-plated. Monel metal (*q.v.*) is a so-called natural alloy prepared by the reduction of a copper-nickel ore and containing 60%–70% nickel. In addition to copper and nickel it contains iron and manganese in small amounts, together with other impurities which influence its properties to some extent. It has been widely used in America for various engineering and culinary purposes, and possesses exceptional high strength at both normal and elevated temperatures. Alloys of similar nickel content are also being manufactured from the pure metals.

Copper also forms an important series of alloys with aluminium which are classed under the general term "aluminium bronzes" (*q.v.*). The properties of these alloys have been the subject of numerous scientific investigations which have shown that the useful alloys rich in copper contain up to 11% aluminium. They may be classified into two main groups: those containing up to 7.5% aluminium are extremely ductile, while those containing 8%–11% aluminium possess high tensile strength in the cast state. The ductile series containing less than 7.5% aluminium are especially useful for deep stamping, spinning and severe cold working of all kinds, and are finding application as a substitute for brass, compared with which they possess greater strength and resistance to atmospheric corrosion. The new bronze coinage introduced in France contains 8.25% aluminium together with a little manganese, and this mixture approaches very nearly the upper limit for satisfactory cold working. The alloys with 8%–11% aluminium usually contain in addition 1%–3% of iron and are in very general use for die castings, for which their high tensile strength and clean casting properties are a great advantage. They are resistant to corrosion by mineral acids and also resist oxidation at relatively high temperatures.

In addition to the alloys mentioned, copper is the standard alloying material used for gold and silver although the new British silver coinage also contains nickel. Manganese copper containing 3%–5% manganese is used in the form of rod by many continental railways for the manufacture of locomotive stay bolts as it is relatively resistant to oxidation and retains its strength at moderate temperatures. Manganin contains 17% manganese, 1%–2% nickel and the remainder copper, and has been extensively used for electrical resistances. It possesses the property of having a practically negligible temperature coefficient of electrical resistance at normal temperatures. There are also numerous more complex alloys containing three or more metals, such as the propeller bronzes, manganese bronzes, phosphor-bronzes, lead bronzes, etc., the properties of which render them particularly suitable for the purpose for which they are designed. Such alloys do not represent any important tonnage but their development indicates the progress of metallurgical science in providing materials to meet modern requirements.

(*See* Brass; Alloys; Zinc; Nickel; Aluminium, etc.)

(C. A. E.)

COPPERAS (Fr. *couperose;* Lat. *cupri rosa,* the flower of copper), a term formerly synonymous with vitriol and applied to the sulphates of copper, iron (ferrous) and zinc as blue, green and white copperas respectively. It is now applied exclusively to ferrous sulphate, $FeSO_4.7H_2O$, a light green solid which has an astringent, inky and somewhat sweetish taste and which is used in medicine, in dyeing and tanning, and in the manufacture of ink. (*See* Iron.) (J. B. Ps.)

COPPERHEAD (*Agkistrodon mokasen*), a North American snake allied to the moccasin (*q.v.*); one of the best known species of pit vipers.

COPPERHEADS, an American political epithet, applied by Union men during the Civil War to those men in the north who, deeming it impossible to conquer the Confederacy, were earnestly in favour of peace and, therefore, opposed to the war policy of the president and of congress. The term originated in the autumn of 1862, and its use quickly spread throughout the north. In the western States early in 1863 the terms "Copperhead" and "Democrat" had become practically synonymous. The name was adopted because of the fancied resemblance of the peace party to the venomous copperhead snake which strikes without warning. Though applied as a term of opprobrium, it was willingly assumed by those upon whom it was bestowed, and some advocates of the peace policy, to emphasize it, wore badges of heads cut from copper one-cent pieces.

COPPERMINE, a river of Mackenzie district, Canada, about 475m. long, rising in a small lake in approximately 110° 20′ W. and 65° 50′ N., and flowing south to Lake Gras and then northwestward to Coronation gulf in the Arctic ocean.

COPPERSMITH, in zoology, a bird (*Xantholaema haematocephala*) belonging to the barbet family (*Capitonidae*) and deriving its name from its metallic note. About the size of a sparrow, the coppersmith, which inhabits India, has green plumage with a red and yellow head. The allied Tinker (*Barbutula pusilla*), inhabits South Africa. It is black, yellow and white with a red cap.

COPPICE or **COPSE.** A small plantation of trees which are cut periodically for use or sale, before the trees grow into large timber. The produce is employed for hurdle, crate and basket-making, hop poles and many other purposes. Whether naturally or artificially grown the produce is looked on by the English law as *fructus industrialis.* The tenant for life or years may appropriate this produce. The word is derived from O. Fr. *copeis* or *coupeis,* from Late Lat. *colpare,* to cut with a blow.

COPRA, the dried, broken kernel of the coco-nut, from which coco-nut oil is extracted by boiling and pressing. Copra is the form in which the product of the coco-nut is exported for commercial purposes. It is dried in the sun or in kilns to prevent putrefaction. The oil is used largely in the soap, margarine and candle trades. The total annual production, mostly in the oriental tropics, is estimated at about 4,500,000,000 lb., with a plantation value of about £45,000,000. The Philippine Islands are among the foremost producers, the total production in 1926 exceeding 800,000,000 pounds. The imports of copra into Great Britain amounted in 1926 to 74,372 tons valued at £2,127,210; for the same year the imports into the United States were 204,312 tons valued at £4,838,065. The word copra is a Spanish-Portuguese adaptation of the Malay word *Kopperah* (Hindustani *Khopra*), the coco-nut. (*See* COCO-NUT OIL AND CAKE; OILS, FATS AND WAXES.)

COPROLITES. The name was originally given by Dr. William Buckland to certain bodies in the Lias of Gloucestershire which formerly had been considered fossil fir cones. He showed that they possessed characters which could be best explained on the supposition that they were the fossilized excreta of reptiles (from Gr. *κόπρος,* dung and *λίθος,* stone). Chemical analysis showed that they were very rich in phosphatic minerals.

Since Buckland's time the term has been extended to include practically all phosphatic nodules found in sedimentary rocks. The nodules, such as those of the Cambridge greensand, are largely lumps of phosphatized mud and frequently have been formed around some fossil which was derived from older beds or formed in and around shells of that period. Their formation appears to take place in a sea rich in phosphatic matter and where there are strong currents. Coprolites in the wide sense have been extensively dug in the past for artificial manure, since they yield from 50 to 55% $Ca_3P_2O_8$, but the industry is now almost extinct. (*See* also PHOSPHATES.) (W. B. R. K.)

COPTIC LANGUAGE. Amongst the Egyptian natives, Coptic, the descendant of the ancient Egyptian language (*q.v.*), survived the formidable inroads of Greek both in its pagan and Christian forms, and only succumbed at length to the overwhelming influence of Arabic, dying out finally in the 16th century. Early in the 2nd century A.D., pagan Egyptians, or perhaps foreigners settled in Egypt, essayed to write the native language for magical purposes in Greek letters with some necessary supplements borrowed from demotic. This "Old Coptic," as it is termed, was still almost entirely free from Greek loan-words, and its strong archaisms are doubtless accounted for by the fact that the literary language, even in its most "vulgar" forms, moved more slowly than the speech of the people. Christian literary Coptic, though at first contemporary with some of the documents of Old Coptic, is very different. The unknown evangelizers who must have perfected the adaptation of the alphabet to the various dialects of Egypt and translated the Scriptures out of Greek, flung away all pagan traditions, adopting, however, eight letters from demotic writing. The basis which they chose for the new literature was doubtless the simple language of their intercourse with Christians and others among the peasants. They found this already charged with expressions from Greek, and the Greek element was reinforced by words borrowed from the books which they were translating, until written Coptic became full of Greek words, including even particles of the most varied kinds; some of these were very useful additions to the language, while others were really superfluous. Written Coptic, once established, did not greatly change with time, although after the Muslim conquest it began to borrow scantily from Arabic and eventually took on the character of a dead language.

Four leading dialects of Christian Coptic are recognized: Sahidic (formerly called Theban) spoken in the Upper Thebais; Akhmīmic, in the neighbourhood of Akhmīm; Fayumic, with which are associated the dialects of Middle Egypt as far as Memphis—Fayumic was wrongly identified as "Bashmūric" by early scholars; Bohairic, the dialect of the "coast district" (formerly named "Memphite") spoken in the north-western Delta. The last, in accordance with its geographical position, shows wide differences from all the others. Native writers record also a special dialect among the rude inhabitants of the marshes in the province of Bashmūr in the north-east of the Delta, but no remnant has come down to us. The fragments of Old pagan Coptic show an Akhmīmic colouring, and in Akhmīmic and "sub-Akhmīmic" there are some very old translations from the Old and New Testaments and various Apocrypha. But the immense literary and other influence of the "archimandrite Shenūte" and his monastery near Akhmīm was exerted to spread its rival Sahidic ("Upper Egyptian") as the sole literary dialect throughout the south, and Akhmīmic disappeared in the 5th or 6th century even as far as the Fourth Cataract. The survivor actually penetrated far into Nubia, Nubian tomb-stones down to the 11th century being usually inscribed in Sahidic, even as far south as the Fourth Cataract. Middle Egyptian continued to be used longer than Akhmīmic at least for business purposes. Nothing is known of the early history of Bohairic which survives only in literary texts, beginning with an ms. of the end of the 9th century, and others somewhat later from the monastery of St. Macarius in the Nitrian desert. But Bohairic (with Arabic interpretations) has been the language of the sacred books of Christianity throughout the country since the 14th century. When Coptic ceased to be spoken or understood, Bohairic assumed this position owing to the hierarchical importance of Alexandria and the influence of the ancient monasteries established in the north-western desert.

Literature.—Coptic literature (apart from mere business documents and letters in Sahidic and Fayumic expressed in monkish language) is almost entirely religious and consists mainly of translations from Greek. Such was the enthusiasm for Christianity amongst the lower classes in Egypt that versions from the Old and New Testaments were made into Sahidic, Akhmīmic and Fayumic before the Council of Chalcedon (451); they probably date back at least as early as the middle of the 4th century, and are therefore of considerable textual importance. For dwellers in and about the Delta the Greek version was probably sufficient, until the break with the Greek (Melkite) Church in the 5th century induced them to make a separate Bohairic translation. The Gnostic heresy, otherwise known only through the works of its opponents, is illustrated in some Coptic mss. of the 4th century, the so-called *Pistis Sophia,* and the Bruce Codex, respectively in the British Museum and Bodleian libraries. According to Schmidt and Harnack they are translations dating from the 3rd century and belong to an ascetic or encratitic sect of the Gnostics which rose in Egypt itself. There is abundance of apocryphal works, of apocalypses, of patristic writings from Athanasius to the Council of Chalcedon, homilies, lives of saints and anecdotes of holy men, acts of martyrs extending from the persecution of Diocletian to that of the Persians in the 7th century, and lives of later ascetics and martyrs reaching down to the 14th century. Unless some of the Egyptian *acta sanctorum et martyrum* should prove to have been originally written in Coptic, almost the only original works in that language of any importance are the numerous sermons and letters of Shenūte, the long-lived and now celebrated monk of Atrēpe near Akhmīm, written in the Sahidic dialect in the 4th and 5th centuries. After the Arab conquest, as a defence to the threatened Church language and nationality, versifications of the Proverbs, of Solomon's Song and of various legends were composed, with other religious songs. They are mostly antiphonal, the numbers of stresses in a line marking the rhythm. There is no musical notation in the mss., but traditional church tunes are generally referred to or prescribed for the songs. Of secular literature strangely little existed or at least has survived; only a few magical texts and fragments of a medical treatise, of the story of Alexander, and of a story of the conquest of Egypt by Cambyses are known. According to all the evidence available, the Coptic portion of the great library in the monastery of St. Macarius, made after its restoration in the 9th century, was bare of everything but religious books.

Coptic was occasionally employed for literary purposes as late as the 14th century, but from the 10th century onwards the Copts wrote mostly in Arabic. Severus of Eshmunain (*c.* 950) who wrote a history of the patriarchs of Alexandria, was one of the first to employ Arabic; Cyril ibn Laklak and others in the 13th and 14th centuries translated much of the older literature from Coptic into Arabic and Ethiopic for the use of the Egyptian and Abyssinian churches. From this period also date the Arabic grammars of Coptic and vocabularies of Sahidic and Bohairic by Ibn ʻAssal and others. (*See* Copts.)

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COPTOS, the modern Kuft (a village near the east bank of the Nile about 25m. N.E. of Thebes), an ancient city, capital of the fifth nome of Upper Egypt, and the starting-point of several roads to the Red sea, particularly the route to Berenice (*q.v.*). The trade with Arabia and India raised Coptos to great commercial prosperity; but in A.D. 292 its share in the rebellion against Diocletian led to an almost total devastation. It again appears, however, as a place of importance and as the seat of a considerable Christian community, though the stream of traffic turned aside to the neighbouring Kūs. During part of the 7th century it was called Justinianopolis in honour of the emperor Justinian.

The local god of Coptos, as of Chemmis (Akhmīm, *q.v.*), was the ithyphallic Min; but in late times Isis was of equal importance in the city. Min was especially the god of the desert routes. Petrie's excavations on the site of the temple brought to light three very primitive limestone statues of the god with figures of an elephant, swords of sword-fish, sea-shells, etc., engraved upon them: there were also found some very peculiar terra-cottas of the Old Kingdom, and the decree of an Antef belonging to the latter part of the Middle Kingdom, deposing the nomarch for siding with the king's enemy.

COPTS, the early native Christians of Egypt and their successors of the Monophysite sect, now racially the purest representatives of the ancient Egyptians. The name is a Europeanized form, dating perhaps from the 14th century, of the Arabic Kibt (or Kubt), which, in turn, is derived from the Greek Αἰγύπτιοι "Egyptians" (the Copts in the Coptic language likewise style themselves "people of Egypt," "Egyptians"). (*See* Egypt: *History, Religion;* Egyptian Language.)

The beginnings of Christianity in Egypt are obscure; its existence among the natives (as opposed to the mixed "Greek" population of Egypt and Alexandria which produced so many leading figures and originated leading doctrines in the early church) can be traced back as far as the Decian persecution (249–251) in the purely Egyptian names of several martyrs. St. Anthony (*c.* 270) was a Copt; so also was Pachomius, the founder of Egyptian monasticism at the beginning of the 4th century. The Scriptures were translated into Coptic not later than the 4th century. A religion founded on morality and with a clear doctrine of life after death was specially congenial to the Egyptians; thus the lower orders in the country embraced Christianity fervently, while the Alexandrian pagans were lost in philosophical speculation and Neoplatonism was spread amongst the rich "Greek" landowners; these last, partly out of religious enthusiasm, partly from greed, annoyed and oppressed their Christian peasantry. Egypt was then terribly impoverished; the upper country was constantly overrun by raiders from Nubia and the desert; and the authority of the imperial government was too weak to interfere actively on behalf of the Christians. The monasteries, however, were refuges that could bid defiance to the most powerful of the pagan aristocracy as well as to barbarian hordes, and became centres of united action that, at the summons of Shenoute, the organizer of the national church, swept away the idols of the oppressors in riot and bloodshed. In the course of the 5th century the Christians reached a position in which they were able to treat the pagans mercifully as a feeble remnant.

The Copts had little interest in theology; they were content to take their doctrine as prepared for them by the subtler minds of their Greek leaders at Alexandria, choosing the simplest form when disputes arose. In 325 their elected patriarch, Athanasius, and his following of Greeks and Copts, triumphed at the council of Nicaea against Arius; but in 451 the banishment of Dioscorus, patriarch of Alexandria, by the council of Chalcedon created a great schism, the Egyptian church holding to his Monophysite tenets (see *Coptic Church,* below), while the Catholic and imperial party at Constantinople, called "Melkites," ever sought to further the orthodox theology of Chalcedon at the expense of the native church. Thenceforward there were generally two patriarchs, belonging to the rival communities, and the Copts were oppressed by the Melkites; Heraclius, in 638 after the repulse of the Persians, endeavoured to unite the churches, but, failing in that, he persecuted the Monophysites more severely than ever, until ʻAmr brought Egypt under the Moslem rule of ʻOmar during the period 627–641. Under the persecution many Copts had gone over to the Melkites, but now it was the turn of the Melkites, as supporters of the emperor of Constantinople to suffer, and they almost entirely disappeared from Egypt, though a remnant headed by a patriarch of Alexandria of the Orthodox Christians has survived to this day.

After a few years of the mild rule of ʻAmr the Egyptians began to suffer for the benefit of the Muslim exchequer and for their religion. Many of the more thoughtful Christians had already embraced the simple and congenial doctrines of Islam; others went over for the sake of material gain. Conflicts took place between the Mohammedan minority and the Christians. The Copts were excellent scribes and accountants and were continued in their posts under the Arab rule. The pride of the Copts was a serious danger, perhaps even a chief source of their troubles, in earlier days; devout Moslems on more than one occasion stirred the mob to fury when they saw Christians lording it over "true believers." The lower orders of the Copts were continually oppressed. Thus there was every inducement amongst the Christians to turn Mohammedan. Arab tribes, too, were encouraged to settle in Egypt until the Mohammedans exceeded the Copts in numbers.

The history of the Copts consists on the one hand of the record of religious strife, of simony and other scandals in the church, and attempted reforms; and on the other hand of persecutions at the hands of the Muslims. In the 8th century, the monks were not only compelled to pay a capitation tax, but were branded with name and number, civilians were oppressed with heavy taxation, churches demolished, pictures and crosses destroyed (722–723). Degrading dresses were imposed upon the Christians (849–850); later, under Hakim (997), they were compelled to wear heavy crosses and black turbans as an ignominious distinction. Saladin in 1171 re-enforced these statutes and defiled the churches. In 1301, the blue turban was introduced, but many Copts preferred a change of religion to its adoption. In 1348 a religious war raged at Cairo between the Copts and Mohammedans, and large numbers of Copts embraced Islam.

There have been very few cases of conversion from Mohammedanism to Coptic Christianity; and, as intermarriage of Christians with Mohammedans implied conversion to Islam, the Copts have undoubtedly preserved the race of the Egyptians as it existed at the time of the Arab conquest in remarkable purity. The Coptic fellahīn of Upper Egypt and elsewhere are not markedly different from the Mohammedan fellahīn, who, of course, are of the same stock, but mixed with Arab blood.

In trades and professions, so long as the Copts had no foreign competition, they held their own. But, with the extension of railways and agricultural roads and the increased facilities of communication and prosperity, there has been a great influx of Italian, Greek, Armenian and other Levantine workmen, who, with their better tools, are undoubtedly superior to the Copts, and have proved formidable rivals. Furthermore, the importation of cheap European wares of every description is slowly killing all native industry. Lastly, when the British, as the dominant race filled most posts of responsibility in the government, the Muslims, in general, were obliged to content themselves with the subordinate posts which in the past they left to the Copts. Some Copts have attained high office, and in 1908 a Copt became prime minister. Moreover, the Copts have to a certain extent made up for the ground they lose elsewhere by engaging in agriculture and banking, and there are now to be found many rich Coptic landowners and farmers, especially in Upper Egypt.

Language.—The language spoken by the Copts was of various dialects, named Sahidic, Akhmimic, Fayumic, etc., descended from the ancient Egyptian with more or less admixture of Greek (for the Coptic dialects *see* EGYPTIAN LANGUAGE). Coptic, however, has been entirely extinct as a spoken language for over 200 years, having been supplanted by Arabic; in the 13th century it was already so much decayed that Arabic translations of the liturgies were necessary. The literature is almost entirely religious, and consists mainly of translations from the Greek. Such was the enthusiasm for Christianity among the lower classes in Egypt that translations of the Bible were made into three of the dialects of Coptic before the council of Chalcedon; they probably date back at least as early as the middle of the 4th century. Coptic was occasionally employed for literary purposes as late as the 14th century, but from the 10th century onward the Copts wrote mostly in Arabic.

The Coptic Church.—Up to the 5th century the church of Alexandria played a part in the Christian world scarcely second to that of Rome; the names of Origen, Athanasius and Cyril bear witness to her greatness. But in the time of the patriarch Dioscorus the church, always fond of speculation, was rent asunder by the controversy resulting from the doctrine of Nestorius (*q.v.*) that the divine and human natures of Christ were "conjoined" by a moral not a metaphysical union, and the contrary doctrine of Eutyches that the divine and the human in Christ constituted a nature absolutely one. The Eutychian doctrine was condemned by the council of Chalcedon in 451. But to this decision, though given by 636 bishops, the Copts refused assent—a refusal which profoundly affected both the religious and the political history of their country. From that moment they were treated as heretics. The emperor appointed a new bishop of Alexandria, whose adherents the Copts styled Melkites or Imperialists, while the Copts are distinguished as Monophysites and Jacobites. The opposition was national as well as theological; it was in part an opposition of the native party and the Byzantine or court party.

The distinctive Monophysite doctrine of the Copts is not easy to state intelligibly, and yet they clung to it with something of the tenacity which marked their whole history. It is set forth in the Liturgy and recited at every Coptic mass in the following words:—"I believe that this is the life-giving flesh which thine only Son took from the . . . Holy Mary. He united it with His Divinity without mingling and without confusion and without alteration. . . . I believe that His Divinity was not separated from His Manhood for one moment or for the twinkling of an eye." On all other points of dogma the Copts agree with the Greek Orthodox Church.

The Hierarchy.—"The most holy pope and patriarch of the great city of Alexandria and of all the land of Egypt, of Jerusalem the holy city, of Nubia, Abyssinia and Pentapolis, and all the preaching of St. Mark," as he is still called, had originally jurisdiction over all the places named; but of places outside Egypt only jurisdiction over Abyssinia remains. The ancient rule is that no bishop is eligible for the patriarchate. The requirement of a period of desert life has so far prevailed that no one but a monk from one of the desert monasteries is now qualified. This rule, harmless perhaps when the monasteries were the great schools of learning and devotion, now puts a premium on ignorance, and is disastrous to the church; more particularly as even bishops must be chosen from the monks. The patriarch is elected by an assembly of bishops and elders. The patriarch's seat was transferred some time after the Arab conquest from Alexandria to the fortress town of Babylon (Old Cairo), and in modern times it was shifted to Cairo proper. The other orders and offices in the church are metropolitan, bishop, chief priest, priest, archdeacon, deacon, reader and monk.

Churches.—The numerous remaining churches in Egypt but faintly represent the vast number standing in ancient times. Rufinus says that he found 10,000 monks in the one region of Arsinoe. Later, in 616, the Persians are described as destroying 600 monasteries near Alexandria. Abū Sālih (12th century) gives a list of churches surviving in his day, and their number is astonishing. The earliest were cut out of rocks and caverns. In the days of Constantine and Justinian basilicas of great splendour were built, such as the church of St. Mark at Alexandria and the Red Monastery in Upper Egypt. This type of architecture permanently influenced Coptic builders, but there prevailed also a type, probably native in origin, though possessing Byzantine features, such as the domed roofing. There is no church now standing which bears any trace of the fine glass mosaics which once adorned the basilicas, nor is there any example of a well-defined cruciform ground-plan. But the use of the dome by Coptic architects is almost universal, and nearly every church has at least three domes overshadowing the three altars. The domes are sometimes lighted by small windows; but the walls are windowless, and the churches consequently gloomy.

Every church has three altars at the eastern end in three contiguous chapels. The central division, the *haikal* or sanctuary, is always divided from the choir by a fixed partition or screen with small arched doorway closed by double doors. This resembles the Greek iconostasis, the screen on which the sacred pictures are placed. Haikal screen and choir screen are often sumptuously carved and inlaid. A marble basin for the mandatum in the nave, and an epiphany tank at the west are common features. The altar is usually built of brick or stone, hollow within, and having an opening to the interior. A wooden altar-slab covered with crosses, etc., lies in a rectangular depression on the surface, and is used in case of need as a portable altar. Chalice and paten, ewer and basin, crewet and chrismatory, are found as in the Western churches. The aster consists of two crossed half-hoops of silver and is placed over the wafer. The flabellum is used, though now rarely made of precious metal. Some examples of silver-cased textus now remaining are very fine. Every church possesses thuribles—the use of incense being universal and frequent—and diadems for the marriage service. Church bells are forbidden by the Muslims, except in the desert, and church music consists merely of cymbals and triangles which accompany the chanting.

Ritual.—The Coptic ritual deserves much fuller study than it has received. Since the 7th century the church has been so isolated as to be little influenced by changes affecting other communions. Consequently it remains in many respects the most ancient monument of primitive rites and ceremonies in Christendom. But centuries of continuous subjection to Muslim rule have very greatly weakened it.

The Modern Copts.—The British occupation of Egypt profoundly modified Coptic religious life. Before it the Copts lived in their own semi-fortified quarters in Cairo or Old Cairo or in country or desert Dairs (Ders). Walls and gates were now thrown down or disused: the Copts began to mix and live freely among the Muslims, their children to frequent the same schools, and the people to abandon their distinctively Christian dress, names, customs and even religion. Freedom and prosperity threatened to injure the Church more than persecution; confession and fasts fell into neglect and the number of communicants diminished; while the facility of divorce granted by Islam occasioned many perversions from among the Copts to Mohammedanism. On the other hand the necessity of resistance to these tendencies and of reform from within was strongly realized.

See A. J. Butler, *Ancient Coptic Churches of Egypt* (1884) and *The Arab Conquest of Egypt* (1902); Crum, art. "Koptische Kirche" in Herzog-Hauck, *Realencyclopädie,* also the same writer's *Catalogue of Coptic MSS. in the British Museum* and his annual *reviews* in the *Archaeological Report* of the Egypt Exploration Fund; R. V. Scott-Moncrieff, art. "Coptic Church" in Hastings' *Encyclopaedia of Religion and Ethics;* Evetts and Butler, *Churches and Monasteries of Egypt,* by Abû Sâlih (Oxford, 1895).

COPYHOLD, in English law, an ancient form of land tenure, legally defined as a "holding at the will of the lord according to the custom of the manor." Its origin is to be found in the occupation by villani, or non-freemen, of portions of land belonging to the manor of a feudal lord. In the time of the Domesday survey the manor was in part granted to free tenants, in part reserved by the lord himself for his own uses. The estate of the free tenants is the freehold estate of English law; as tenants of the same manor they assembled together in manorial court or court baron, of which they were the judges. The portion of the manor reserved for the lord (the *demesne,* or domain) was cultivated by labourers who were bound to the land (*adscripti glebae*). They could not leave the manor, and their service was obligatory. These villani, however, were allowed by the lord to cultivate portions of land for their own use. It was a mere occupation at the pleasure of the lord, but in course of time it grew into an occupation by right, recognized first of all by custom and afterwards by law. This kind of tenure is called by the lawyers *villenagium,* and it probably marks a great advance in the general recognition of the right when the name is applied to lands held on the same conditions not by villeins but by free men. The tenants in villenage were not, like the freeholders, members of the court baron, but they appear to have attended in a humbler capacity, and to have solicited the succession to the land occupied by a deceased father, or the admission of a new tenant who had purchased the goodwill, as it might be called, of the holding, paying for such favours certain customary fines or dues. In relation to the tenants in villenage, the court baron was called the customary court. The records of the court constituted the title of the villein tenant, held by copy of the court roll (whence the term "copyhold"); and the customs of the manor therein recorded formed the real property law applicable to his case.

Copyhold had long been established in practice before it was formally recognized by the law. At first it was in fact, as it is now in the fictitious theory of the law, a tenancy at will, for which none of the legal remedies of a freeholder were available. In the reign of Edward IV., however, it was held that a tenant in villenage had an action of trespass against the lord. In this way a species of tenant-right, depending on and strongly supported by popular opinion, was changed into a legal right. But it retained many incidents characteristic of its historical origin. The life of copyhold assurance, it is said, is custom. Copyhold was necessarily parcel of a manor, and the freehold was said to be in the lord of the manor. The court roll of the manor is the evidence of title and the record of the special laws as to fines, quit rents, heriots, etc., prevailing in the manor. The lord, as legal owner of the fee-simple of the lands, had a right to all the mines and minerals and to all the growing timber, although the tenant may have planted it himself. A species of tenure resembling copyhold was what is known as *customary freehold.*

The feudal obligations attaching to copyhold tenure were found to cause much inconvenience to the tenants, while being of no great value to the lord. One of the most vexatious of these was the *heriot,* under which name the lord was entitled to seize the tenant's best beast or other chattel in the event of the tenant's death. The inconvenience caused by these feudal incidents of the tenure led to a series of statutes, having for their object the conversion of copyhold into freehold. By the Copyhold Act 1894, which thereafter governed statutory enfranchisement, the former Copyhold Acts 1841–87, were repealed, and the law was consolidated and improved. By Part V. of the Law of Property Act 1922, all copyhold land was enfranchised on the terms therein set forth and becoming effective on Jan. 1, 1925.

See C. Watkins, *On Copyholds* (1825); A. Brown, *Copyhold Enfranchisement Acts* (1895); *Scriven on Copyholds,* ed. A. Brown (1896); C. I. Elton, *Law of Copyholds* (1898).

COPYING MACHINES: *see* OFFICE APPLIANCES.

COPYRIGHT, the right now secured by the law of every civilized country to authors of literary, musical and artistic works, to prevent any reproduction of their works without their consent. The growth of the law of copyright protection has closely followed the development of mechanical means of reproduction. Literary copyright was protected only after the invention of printing; artistic copyright was only established with the expansion in the use of engravings and lithographs. It was only on July 1, 1912, that the law of copyright in England was given a general form by the statute which, passed in 1911 as a result of two years' investigation by the international copyright committee, came into force on that date.

The history of the law of copyright in England is one of a number of statutes passed from time to time to deal with abuses as they arose. It is still necessary in the case of works created before 1912 to ascertain whether they were protected under the pre-existing law, because by s. 24 of the act of 1911 copyright protection is given to persons enjoying copyright before its commencement. Some account of these statutes will therefore be useful.

Literary copyright was protected by the Literary Copyright Act 1842, which provided that the copyright in every book published in the life of the author should endure for the life of the author and for seven years after his death or for 42 years, if longer, and should be the property of the author and his assignees, and that the copyright in works published after the death of the author should endure for 42 years from publication and should be the property of the proprietor of the author's manuscript and his assigns. Provision was made for registration at Stationers' Hall and no action for infringement could be brought without prior registration. By s. 18 it was provided that the proprietor of every encyclopaedia, review, magazine, periodical or work published in a series of books or parts, who should have employed any person to compose any part thereof on the terms that the copyright should belong to the proprietor, should enjoy the copyright therein. "Book" was defined as including volume, part or division of a volume, pamphlet, sheet of letter press, sheet of music, map, chart or plan separately published. Engravings were protected by three acts, the Engraving Copyright Acts of 1734 and 1736 and the Prints Copyright Act 1777, and were entitled to copyright for 28 years from publication. Registration was not required but the name of the proprietor and the date of first publication had to be engraved on the plate and printed on each print. Copyright was given to sculptors by an act of 1814, provided that the name of the author and date of issue to the public appeared on each work. The period of copyright under this act was 14 years with a renewed period of 14 years if the author was alive at the end of the first period. The last class to be protected were artists and photographers whose protection was first secured by the Fine Arts Copyright Act 1862. This act gave protection for the life of the author and seven years after his death but such protection was lost if the author in selling the original failed to obtain a written reservation of copyright from the purchaser, and registration was required before any action could be brought. The sole right to perform dramatic pieces was secured by the Dramatic Copyright Act of 1833 and to play musical works by the act of 1842, but the making of gramophone records of musical works was held, in *Boosey* v. *Whight,* 1900, 1 Ch. 122, not to infringe the copyright therein on the ground that these were not "books" within the meaning of the act of 1842. Unpublished works had no statutory protection but a common law copyright in them was recognized.

The Copyright Act of 1911 repealed the whole of the earlier copyright statutes, except one section of the Fine Arts Copyright Act 1862 which penalized fraudulent alterations of artists' works and two short penal acts dealing with the sale of pirated copies of musical works. It provided that no person should be entitled to copyright otherwise than under and in accordance with its provisions, so that the common law copyright previously recognized in unpublished works is no longer in force. Copyright in published and unpublished works is in fact assimilated except in the case of the provisions limiting the area of protection and in respect of the term of protection. It is also important to observe that registration at Stationers' Hall is no longer necessary, so that copyright is now secured to the author by the act of creation and no formality of any kind is required.

The Subject Matter of Copyright.—Copyright, as is provided by s. 1 of the act of 1911, subsists in every original literary, dramatic, musical and artistic work, and these expressions are extended by the definition section of the act. "Literary work" includes maps, charts, plans, tables and compilations. It has been decided that the word "literary" does not connote style or literary finish but is used merely to indicate written or printed matter. Thus there may be copyright in a dictionary or in a mere list of meaningless words forming a telegraphic code or in a railway time-table. The only limit would appear to be that the work in which copyright is claimed must be sufficiently extensive to have demanded some skill in composition. Copyright protection is given not to ideas but to literary forms, and information will not be protected unless it is expressed in an original form. A list of horses published by a racing tipster failed to obtain copyright protection for this reason and the same difficulty arises in the case of a chemical formula. In such cases the real objection is not so much that there is no literary form but that the literary form, as distinct from the idea which it represents, is not original. The same difficulty arises in the case of compilations such as directories, dictionaries and selections of poems. The matter contained in such works is largely unoriginal but that which is protected is the compiler's arrangement. In a recent case it was held that the list of broadcast programmes published by the British Broadcasting company was the subject matter of copyright although in effect they consisted only of a list of titles and names not separately the subject of copyright. So long as the work as a whole represents original effort it will be protected although the component parts are taken from a non-copyright source. On the other hand, mere hack work such as the cutting down of a standard work into a form suitable for schools has failed to receive protection. But though originality is required for all protected works, in the case of artistic works a further difficulty arises. Artistic works are defined as including works of painting, drawing, sculpture and artistic craftsmanship and architectural works of art and engravings and photographs. But an engraving or photograph may be made of a picture and it has been decided that such a work is original though depicting the same object or scene. The protection of architectural works of art in the 1911 act is new and it means that not only can the copying of architectural plans be restrained but that it is an infringement to reproduce a building without the consent of the designer. The definition of dramatic work includes any piece for recitation or choreographic work or entertainment in dumb show, the scenic arrangement or acting form of which is fixed in writing or otherwise. This definition excludes mere "gag" which has no fixed form but it would include, for example, the movements of a musical comedy chorus which are often represented for the producer by a rough sketch or by symbols. The wide definition of artistic works in the act included of necessity designs, which were already protected by the Patents and Designs Act 1907 but for a shorter period and subject to registration. It was therefore provided by s. 22 of the Copyright Act that designs falling within the Designs Act and intended to be reproduced in large numbers by mechanical means should not receive copyright protection. This provision has given rise to a great deal of difficulty because, although the intention obviously was to exclude only purely utilitarian devices, the definition in the Designs Act is wide enough to include purely artistic works such as sculptures or paintings. If reproductions of these are intended to be sold in any quantity, therefore, and this intention is to be ascertained at the time of making the original, such works would appear only to enjoy the lesser protection given by the Designs Act and to require registration.

The cinematograph was for the first time recognized by the act of 1911. In the first place there is included in the means by which the copyright in literary, dramatic or musical works may be infringed "the making of any cinematograph films" thereof. In the second place it is made an infringement of copyright to produce "any visual representation of any dramatic action in a work by means of any mechanical instrument." In the third place copyright is defined as subsisting in "any cinematographic production where the arrangement or acting form, or the combination of incidents represented give the work an original character." In addition a cinematograph film is of course a series of photographs each of which is protected as an artistic work.

The making of any contrivance by means of which a literary, dramatic or musical work may be mechanically performed is an infringement of the copyright therein. The contrivances when made are also protected. Complicated provisions are, however made for the compulsory licensing of the making of gramophone records of musical works. Once the owner of copyright has allowed anyone to make records of a particular work he must permit any other person to make such records in return for a statutory royalty. The procedure for the collection of these royalties is that the person intending to make records gives to the owner notice of his intention to make records and particulars of the price at which he proposes to sell these. The owner then has to supply the manufacturer with adhesive stamps of the required value. If the owner of the copyright fails to send the stamps or cannot be found, the records may be sold unstamped and the royalty becomes a debt due to the owner, but in any other case the sale of such records unstamped is an infringement of copyright. The rate of the royalty prescribed by the act of 1911 is $2\frac{1}{2}\%$ of the retail selling price of each contrivance in case of works published before the commencement of the act and 5% thereof in the case of other works, and it is also provided that a minimum of one halfpenny shall be payable in respect of each separate musical work on every contrivance. The act provides for alteration of these rates by the Board of Trade; an enquiry was held in April 1928 with a view to the increase of these rates, and the tribunal recommended an increase of the 5% rate to $6\frac{1}{4}\%$ and of the minimum royalty from one halfpenny to three farthings.

Rights Under the Act.—The basic right of the owner of copyright is that he has "the sole right to produce or reproduce his work or any substantial part thereof in any material form whatsoever." He is also, however, given by the act of 1911 certain other important rights of which the most important is the sole right to perform his work in public. The question of what amounts to publicity for the purposes of this act has been recently discussed by the court of appeal in the case of *Harms (Incorporated)* v. *Martans Club Ltd.,* 1927, 1 Ch. 526, in which it was held that a performance at a private dance club in the presence of some 200 members and guests was an infringement of copyright. While declining to lay down any definition, the court indicated that matters which had to be considered were the profit made by the performer and the probable injury to the owner of the right and, if there were no charge for entry, whether the class of public admitted were such as would pay at a theatre to hear the same performance. It is also an infringement of copyright for a person for his private profit to permit a theatre or other place of entertainment to be used for the performance in public of a work without the consent of the owner of the copyright. It was for some time uncertain whether "broadcasting" was an infringement of copyright, since it was difficult to bring the operation within the definition in the act of "an acoustic representation of a work in public by means of a mechanical instrument." Liability on this point was, however, admitted by the British Broadcasting company in a recent case.

Other rights given to the owner of copyright are the sole right of translating his work, and the sole right of converting novels into dramas and dramas into novels. Section 2 (2) of the act provides for the liability of persons dealing with articles which they know to infringe copyright by selling such works or by distributing or exhibiting them by way of trade. It is also an infringement of copyright to import for sale into the country any work which to the importer's knowledge would infringe copyright if made there. For example a copy of an English novel may have been printed in France under a licence from the owner confined to France. The making of this copy, by the person who made it, in England would have been unlawful and if the importer knows of this he infringes the owner's copyright by importing it. It is obvious, however, that proof of such knowledge is a matter of difficulty. An additional protection to copyright owners is the provision in s. 7 that any copy of a work made or imported in infringement of the owner's copyright is the property of the owner. The owner can therefore bring an action for detinue or conversion against anyone in possession of such copies irrespective of his knowledge of the original unlawfulness of the manufacture, though in the case of an imported work, as has already been pointed out, the importing itself is not an infringement of the owner's copyright unless the importer knew that the work would have infringed it if made here, so that in the case of such works the owner has to establish in any event the guilty knowledge of the importer.

The Owner of the Right.—Section 5 (1) of the act of 1911 provides that subject to the provisions of the act the author of a work shall be the first owner of the copyright therein. "Author" is nowhere defined. It is clear however that, where the idea of a work is suggested by one person and the work is executed by another, the latter is the author for purposes of copyright. Thus a person who suggests the plot of a play (*Tate* v. *Thomas,* 1921, 1 Ch. 503), the inventor of a design for voting cards (*Kenrick* v. *Lawrence,* 1890, 25 Q.B.D. 99) and, under the old law, the poser of a photograph (*Nottage* v. *Jackson,* 1883, 11 Q.B.D. 627) have been held not to be authors. Section 21 of the 1911 act provides that the owner of the negative of a photograph at the time when such negative was made shall be deemed to be the author of the work. In two cases, however, the author of a work is not the first owner. In the case of an engraving, photograph or portrait, where the original has been ordered by some person and made for valuable consideration in pursuance of the order, then, in the absence of agreement to the contrary, the person ordering is the first owner. The agreement to the contrary may apparently be oral or implied from the conduct of the parties, so that in the vaguely defined relations which usually exist between canvassing photographers and their sitters it is extremely difficult to determine to whom the copyright belongs. The other provision is that a person employing the author of a work under a contract of service or apprenticeship shall, in the absence of agreement to the contrary, be the first owner of the copyright therein. The employment must be under a "contract of service" which implies a relationship of master and servant and does not include the case of isolated contributions for payment such as were included in s. 18 of the Literary Copyright Act 1842 referred to above. The first owner however can assign his right or may grant interests therein by way of licence provided that he does so in writing signed by himself or his authorized agent. He may assign any separate part of the rights given him by the act and he may assign his rights for a limited area or for a limited period of time and the assignee is in the position of an owner in respect of the right assigned. If however the assignment is made before the work is created, any action must be brought in the name of the assignor. The position of a licensee is more doubtful. If the licence is in writing and is expressed as a grant of an interest by way of licence there is some authority for the view that the licensee can in his own name bring actions against infringers of the right licence. On the other hand the owner of copyright may by words or conduct be held to have consented to reproductions of his work and if value be given for such consent it has been held to amount to an irrevocable license which, though it does not enable the licensee to sue infringers, affords him a good defence against the owner. There are certain provisions for compulsory licences. At the expiration of 25 years from the death of the author of a published work or from the publication of a work unpublished at the author's death copies may be reproduced and sold upon payment of a compulsory 10% royalty collected by stamps in a manner similar to that already explained in the case of gramophone records. The judicial committee of the privy council may also at any time after the author's death order the owner of the copyright of a literary, dramatic or musical work which has already been published or performed in public to grant licences for the reproduction in or performance of the work in such terms as they think fit.

Apart from the provisions already discussed there are two sets of special provisions as to the ownership of copyright. By s. 18 the copyright in any work prepared or published under the direction or control of the sovereign or any Government department is vested in the sovereign and is to endure for a period of 50 years from publication. The Government however does not insist on its right in the case of acts of parliament and parliamentary reports. Section 33 preserves the old perpetual copyright by an act of 1775 to books bequeathed in trust for the Universities of Oxford and Cambridge, the four universities of Scotland or the colleges of Eton, Westminster or Winchester and there printed for their sole benefit. The university libraries also enjoy the right under s. 15 of demanding a copy of every book published and a copy of every book must be sent without demand to the British Museum. It should be observed however that non-compliance with these provisions does not affect the copyright in the book but renders the publisher liable to a fine of £5 and the value of the book.

Duration of Copyright Protection.—As has been shown already, prior to the commencement of the Copyright Act of 1911, the period during which an author enjoyed copyright varied for different classes of work. Under the act of 1911 however, with certain limited exceptions, the copyright in all works endures for the life of the author and 50 years after his death. In the case of works of joint authorship, which are defined as works produced by the collaboration of two or more authors in which the contribution of one author is not distinct from the contribution of the other author, copyright subsists during the life of the author who dies first and 50 years after his death, or during the life of the author who dies last, whichever period is the longer. Works unpublished at an author's death enjoy copyright until publication and for 50 years thereafter, and publication means the issue of copies of the work to the public but does not include performance or exhibition in public. The chief exceptions to the general rules above stated are in regard to mechanical instruments, photographs and Government publications. By s. 19 (1) of the act copyright in gramophone records and similar contrivances subsists for 50 years from the making of the original plate. By s. 21 the term of copyright in photographs is to be 50 years from the making of the original negative. In the case of Government publications the term of copyright, as has been stated above, is 50 years from publication.

Infringement of Copyright.—Infringement of copyright is defined in the act of 1911 as the doing of anything the sole right to do which is conferred by the act on the owner of copyright. It is rather surprising that the act does not directly state the proposition which has always been put forward as the proper ground for distinguishing copyright from a monopoly, namely that it is no infringement of copyright to reproduce the same result provided that resort is not had to the author's original. The point is of considerable importance in the case of compilations, of commercial designs and of photographs since it is quite possible for works of this class to be practically identical although the author of neither work has seen the other. It has however always been assumed that the real basis of an action for infringement of copyright is culpable wrong-doing on the part of the defendant—literary theft—and there is no doubt that now, as under the old law, it is essential for the owner of copyright to prove that a defendant has either copied his work or copied something which was itself a copy. The inventor of a particular form of words or the artist who composes a picture of a particular scene or arrangement of figures has no monopoly of his inventions, and if, by chance, another author or artist hits upon the same words or the same scene he has committed no wrong either in fact or in law. Resemblance, therefore, though it may often lead to the inevitable conclusion that the defendant has in fact seen the plaintiff's work and so be excellent evidence that copying has occurred, is not in itself sufficient to substantiate a claim for infringement. Resemblance again may not amount to infringement of copyright because the resemblance, though due to the second author having seen the original, is so remote as not to injure the first author. The act of 1911 is not clear in regard to this matter either. In the early days of copyright protection, when this was extended only to "books" as such, attempts were made to evade the law by expressing the contents of books in other words. It was soon established that any "colourable imitation" of a book could be proceeded against and the doctrine was in due course extended to infringement of other copyright works. The act of 1911 however does not state this in any definite form. The expression "colourable imitation" is only employed in the definition of "infringing copies" and this phrase is not used in that part of the act which defines infringement. In fact however one of the most difficult questions which the courts have to determine is whether a defendant has so far copied the plaintiff's work that he can be said to have created a colourable imitation of it, or whether he has taken the idea only and clothed it in a new literary or artistic form. This problem arises forcibly in the case of plays which are alleged to infringe the copyright in a novel and in the case of cinematograph films. In such cases the form of artistic expression being different it is unlikely that much literal copying will be discoverable. The result of decisions on the subject appears to be that while the mere taking of a plot is not sufficient in itself to constitute an infringement, yet this, coupled with a close resemblance of situations and incidents, even without the taking of actual words or phrases, will be enough to give rise to a cause of action. In dealing with the question of colourable imitations in relation to artistic works the test has been suggested:—"A copy is that which comes so near the original as to suggest that original to the mind of every person seeing it." Similar principles have to be considered when dealing with burlesques which may constitute infringements if they are really representations of the original work in an altered form.

Another matter which has to be considered in relation to infringements is whether enough of the first work has been taken to create a wrong. Of course in dealing with composite works such as catalogues or magazines or cinematograph films of several reels it may be possible to split up the offending work into infringing and innocent matter and limit the injunction accordingly. On the other hand a work which it is not practicable to split up may contain a small amount of admittedly copyright matter but so small a quantity that it would be a hardship upon the defendant to restrain the circulation of the work. Certain specific cases where it is permissible to use copyright matter are dealt with below but besides this the act provides that it is only an infringement to take "a substantial part" of the original work. Cases dealing with the earlier acts which, though they did not use this exact phrase, were held to have implied it, have decided that "substantial" does not refer to quantity alone but also to the importance of the part taken in relation to the whole; a few bars out of a long piece of music may contain the essential melody or a few lines may hold the real beauty of a poem and the taking of these bars or lines would certainly be prohibited.

A matter of difficulty always is to decide how far copyright can be infringed by reproductions in a different form of art. The infringement of literary and dramatic works by their respective reproduction as plays or novels has already been mentioned as has also the question of mechanical reproductions. It had been considered before the act of 1911 that a statue would not infringe the copyright in a picture. The "Living Picture" cases had decided that *tableaux vivants* did not infringe the copyright in the picture which they purported to represent and it was thought that this doctrine would apply also in the case of sculptures. Under the act of 1911 however Coleridge J. in *Bradbury Agnew* v. *Day* 32 T.L.R. 349 indicated that the law as to *tableaux vivants* is now changed and it would seem that under the wide words of the act sculptures and pictures may be infringements of one another respectively.

A further right given to the author by s. 1 (2) is that of "authorizing" any of the acts in respect of which he is given the sole right by the act. For some time it was thought that this provision added nothing. No doubt it made the authorizing of a reproduction of a work without the author's consent an infringement of copyright, but apart from express provision the master whose servant commits a tort is liable and it has been indicated in the case of the *Performing Right Society* v. *Ciryl Syndicate,* 1924, 1 K.B. 1 that there was nothing in this provision to make a man liable for the infringements of copyright by persons employed as independent contractors. The court of appeal has however recently held in *Falcon* v. *Famous Players' Film Co.,* 1926, 2 K.B. 474 that the phrase "to authorize" does add something to the ordinary law of responsibility for servants and that anyone who "sanctions, approves or countenances" an infringement is liable for it.

Permitted Reproductions.—Section 2 (1) of the Copyright Act expressly provides that certain acts shall not constitute an infringement of copyright. There is in the first place a general provision that any fair dealing with a work for the purposes of private study, research, criticism, review or newspaper summary shall be allowed. Obviously "fair dealing" is difficult to define but it would seem that the question of whether the two works compete is of importance in judging of the fairness of the reproduction. Liberties of a similar nature are:—the publication of short passages from published literary works in collections for the use of schools; the publication in a newspaper of a report of a lecture, unless such report is prohibited by a conspicuous notice maintained during the lecture near the entrance of the building where the lecture is given; and the publication of reports of political speeches in a newspaper. Authors of artistic works in respect of which they do not own the copyright are entitled to use again sketches and moulds prepared by them in connection with the work, provided that they do not thereby repeat the main design of the work. Drawings and photographs of works of sculpture permanently situate in public buildings may be made and sold, and also, provided that they are not architectural plans, such reproductions of any architectural work. The reading or recitation in public of reasonable extracts of published works is also permitted. There is in s. 8 of the act a further provision which was also intended to protect the innocent since it provides that if a defendant proves that at the date of the infringement he was not aware of and had no reasonable ground for suspecting that copyright subsisted in the work the plaintiff shall not be entitled to damages. It was held however in *Byrne* v. *Statist,* 1914, 1 K.B. 622 that this provision did not assist defendant who thought he had a licence to copy but was innocently mistaken. Since any work may be the subject matter of copyright it is very difficult for any defendant to prove that he had no ground for suspecting that any particular work is the subject matter of copyright, so that the section does not in practice afford much protection. No action for infringement of copyright may be brought after the expiration of three years from the infringement.

Primarily the remedy for infringement of copyright is by action for an injunction and damages, but s. 11 of the act of 1911 provides certain summary remedies whereby the making, sale, distribution or importation of infringing copies is punishable by fine or imprisonment. The Musical (Summary Proceeding) Acts of 1902 and 1906 are also still in force, by which pirated copies of musical works may be seized by a constable without a warrant. There is also under the section of the Fine Arts Copyright Act 1862 still unrepealed a penalty upon persons fraudulently signing their name to paintings or photographs or selling or uttering such works so signed. The owner of copyright has a further remedy in the case of large importations of infringing copies in that he can apply to the commissioners of customs and excise for an order that all such copies shall be detained by the customs authorities under the provisions of s. 14 of the act.

Limits of Copyright Protection.—Copyright protection is limited to the safeguarding of the literary or artistic form of a work. What is known in Continental countries as the "droit moral"—the right of an author in the reputation of his work—is not directly recognized in English law. There are, however, certain forms of action available to authors from this point of view. There is the "passing off" action. An author has the right to restrain the passing off to the public of another's work as his. This form of action has been used to preserve an author's *nom-de-plume* and is available in the case of similar titles. In the latter case, however, it has to be shown that the public really so associated the title with the author plaintiff that they believed that the other work was also his. The converse case, however, is more difficult. The assignee of copyright has the right, as far as copyright goes, to make any use he pleases of the work assigned though such a use may be displeasing or even injurious to the author. Of course if alterations are made which suggest, for example, that the author writes illegal or immoral works the ordinary law of libel is available, but short of this the only form of action open to the author is one in the nature of slander of goods. As success in this action requires proof of real malice on the part of the defendant and actual damage to the plaintiff, it is not one which is often available. The literary reputation of authors is therefore not fully protected in English law as it exists at present. There is, however, in the case of artistic works the section of the Fine Arts Copyright Act 1862 already mentioned. The fourth clause of this section provides that it is an offence to sell, publish, or offer for sale any artistic work which to the knowledge of the vendor or publisher has been altered or added to without the consent of the artist. The sale must, however, be made under circumstances which amount to a representation that the original artist is the author of the work as altered (*Preston* v. *Raphael Tuck,* 1926, 1 Ch. 667).

Colonial Copyright.—The scheme of the Copyright Act of 1911 was that it should extend throughout the British dominions as one comprehensive code. The act throughout in speaking of the area covered by it uses the phrase "the parts of His Majesty's dominions to which this act extends," and it may be said at the present time that the act extends to the whole of His Majesty's dominions. Colonial copyright is dealt with in ss. 25–28 of the act. The act initially applied to British possessions but not to the self-governing dominions. It was provided that either the act might be declared to be in force in such a dominion by its own legislature or that, if a self-governing dominion enacted a similar act, the secretary of State for the colonies might by certificate cause the imperial act to apply to the colony, or, if the dominion legislature did not go so far in following the imperial act, but gave adequate protection to British subjects residing elsewhere, an Order in Council could give protection in Britain to the subjects of this dominion. The dominions took different courses. Newfoundland adopted the imperial act without qualification. The Commonwealth of Australia and the Union of South Africa have also adopted the act but with certain modifications. The Australian act of 1912 provides for registration though this is not compulsory except for the purpose of enjoying certain summary remedies. The South African act of 1916 has similar provisions for registration. New Zealand and Canada have their own Copyright Acts, but in the case of both dominions the certificates of the secretary of State for the colonies already mentioned have been given. The New Zealand act of 1913 contains sections identical with those of the imperial act arranged in a different order. It also provides for voluntary registration and there is a section enabling the governor in council to exclude published works from protection whose authors are subjects of a foreign country not giving reciprocal protection to New Zealand subjects. The original Canadian Copyright Act of 1921 contained certain provisions enabling compulsory licences to be obtained for the publication of books and serials. Such provisions were repugnant to the Berne Convention and by an amending act of 1923 it is provided that these provisions shall not apply to works whose authors are British subjects other than Canadian citizens or subjects or citizens of a country which has adhered to the Convention. The act, however, still contains provisions requiring the compulsory registration of assignments of copyright which appear to be difficult for foreigners to comply with. Apart from this the act contains sections similar to those in the imperial act. The colonies are therefore now all subject to the same code and by Orders in Council made from time to time under the provisions of s. 28 of the act of 1911 that act has been extended to the following protectorates:—Cyprus, Bechuanaland, East Africa, Gambia, Gilbert and Ellice islands, Northern Nigeria, Northern Gold Coast, Nyasaland, Northern Rhodesia, Southern Rhodesia, Sierra Leone, Somaliland, Southern Nigeria, Solomon islands, Swazieland, Uganda, Weiheiwei and Palestine. British India came under the act of 1911 initially but in 1914 passed an act introducing local modifications and in particular limiting the term of copyright of works first published in India to ten years. The Irish Free State was at first subject to the provisions of the act of 1911 by the effect of the Irish Free State Constitution Act 1922. The local legislature in 1927 repealed the 1911 act within the limits of the State and enacted a new Copyright Act which follows closely the old act but has certain additional provisions.

International Copyright.—International copyright has two aspects: the right extended to foreigners by Great Britain, and the right extended to British subjects by foreign countries. The act of 1911 in the first place by S. 1 extends, in the case of published works, to such works as are published in His Majesty's dominions before or within 14 days after publication elsewhere, and in the case of unpublished works to works whose authors were at the date of the making of the work British subjects or resident within His Majesty's dominions. But by S. 29 the act may by Order in Council be made to extend to works first published in a foreign country or to the unpublished works of authors who are foreigners or were resident in a foreign country at the date of the making of the work, provided that before the making of such an order in respect of any country, the foreign country must have undertaken to make similar provision for works of British subjects or first published in Britain. Such orders have been made in respect of all the foreign countries mentioned below as being members of the Berne Convention and the provisions of the act of 1911 consequently apply to works first published in these countries and to the unpublished works of their citizens and residents.

The orders however contain some limitations of which the most important is that the term of copyright is not to exceed that prescribed by the country to which the order relates. Besides these orders an order has been made extending the act to the unpublished works of citizens of the United States of America or of persons resident there at the date of the making of their works; there is however no copyright in works first published in the United States since that country does not extend reciprocal rights to British works. These orders do not apply to the self-governing dominions to which it is open to make their own arrangements with foreign countries, but in fact all the dominions are now members of the Berne Convention and afford reciprocal rights to other members.

The rights of British subjects abroad chiefly arise by reason of the provisions of the Berne Convention. This Convention consists of a series of treaties known as The Berne Convention of 1886, the Additional Act of Paris of 1896, The Revised Convention of 1908 and the Additional Protocol of 1914. The scheme of the Convention is that each of the contracting countries shall provide for works first published in other countries of the Union and for unpublished works whose authors are citizens of or resident in such countries a certain minimum copyright protection. The greater part of the countries of the Union have now acceded to the 1908 Revised Convention and so it will be sufficient to refer here to the provisions of this Convention.

The operative provision of the Convention is contained in art. 4 which provides that authors who are subjects or citizens of any of the countries of the Union shall enjoy in countries other than the country of origin of the work, for their works, whether unpublished or first published in a country of the Union, the rights which the respective laws do now or may hereafter grant to natives as well as the rights specially granted by the present Convention. The article proceeds to provide that no formality shall be required for the enjoyment of such rights. In other respects the extent of protection and the means of redress are to be governed exclusively by the laws of the country where protection is claimed. By art. 6 the same rights are extended to authors who are not subjects of a country of the Union who first publish their works in one of those countries. By art. 7 it is provided that the term of protection is to be regulated by the law of the country where protection is claimed but is not to exceed the term fixed by the country of origin. The provisions with regard to the publication of articles in newspapers are of importance. These are contained in art. 9. News items have no protection at all. Newspaper articles other than serials or tales may be copied unless the reproduction is expressly forbidden but the source from which they are copied must be indicated in relation to any reproduction. Stories, tales and other works may not be reproduced at all. It is not necessary to set out here the articles in the Convention defining the subject matter of copyright and the methods in which copyright may be infringed because the British act of 1911 was in fact based on the Convention and drawn up so as to put the provisions of the Convention into force in Britain, and consequently follows closely and works out in detail these provisions. By art. 13 authors of musical works are to have the exclusive right of authorizing the adaption of their works to instruments which can produce them mechanically and of authorizing the public performance of the said works by means of these instruments, but reservations and conditions as to the application of this article may be determined by the domestic legislation of each country. The provisions in Britain as to compulsory recording licences which have already been discussed are in pursuance of this proviso. The Convention established an international office under the authority of the Government of the Swiss Confederation to examine copyright questions and to publish a periodical report of the current changes in the law of copyright. The expense of the office is shared proportionately by the different countries. Provision is made for the revision of the Convention and discussions with regard to such revisions were held at Rome in May 1928. Non-member States may accede to the Union by giving notice of their accession in writing to the Swiss Government. The present members of the Copyright Union are:—Austria, Belgium, Brazil, Bulgaria, Czecho-Slovakia, Danzig, Denmark, Esthonia, France (including Algeria and other colonies and Syria and Lebanon), Germany, Great Britain (including her colonies and possessions, the self-governing dominions being individual members), Greece, Haiti, Hungary, Irish Free State, Italy, Japan, Siberia, Luxemburg, Morocco (excluding the Spanish zone), Monaco, the Netherlands and Dutch colonies, Norway, Poland, Portugal, Rumania, Spain, Sweden, Switzerland and Tunis.

See T. E. Scrutton, *Law of Copyright* (4th ed., 1903); E. J. MacGillavray, *The Copyright Act 1911* (1912); G. S. Robertson, *Law of Copyright* (1912), *Supplement* (1915); S. C. Isaacs, *The Law of Theatres, Music Halls and Cinemas* (1927); W. A. Copinger, *The Law of Copyright*, 6th ed. by F. E. Skone James (1927). (F. E. S. J.)

UNITED STATES

The protection of copyright by statute in the United States began with the enactment by the State of Connecticut in Jan. 1783, and by the State of Massachusetts in March of the same year, of acts which gave copyright for a term of 14 years, with the right of a 14-year renewal if the authors were living at the expiration of the first term. This action was the result of a vigorous crusade by Noah Webster. Before May 1786 ten more States had passed copyright acts for varying terms. These acts followed in principle, and substantially in form, the English statute of 1710 known as the Act of Queen Anne. Prior to the organization of the States in 1783, what protection had been enjoyed in America by authors had to be secured in the colonies, as in Great Britain, under the principles of common law.

In 1790, the U.S. Congress, influenced in large part by the arguments of Noah Webster and other literary workers, enacted the first national statute. This act gave to authors who were citizens or residents, and to their heirs and assigns, copyright protection for books, maps and charts for a term of 14 years, with the right to renewal for 14 years more at the expiration of that time. The statute provided for the deposit, before publication, of a printed title page in the clerk's office of the local U.S. district court. It provided further for the advertising of the book, with specification of the copyright entry, four times within the first two months after publication. Requirement was made for the deposit, within six months of publication, of a copy of the book with the U.S. secretary of State. The penalties imposed upon a printer of an unauthorized impression of the book so copyrighted included the forfeiture of his piratical copies and a fine of 50 cents for each sheet that was found. Half of this fine went to the owner of the copyright and half to the United States. The statute also made provision, in confirmation of rights existing under common law, against the unauthorized publication of manuscripts. This original act was followed by the act of 1802 which required the record of copyright to be printed on or following the title page. The same requirement was made for designs, engravings and etchings entered for copyright. The statute of 1819 gave to the U.S. circuit courts original jurisdiction in cases of copyright. The act of 1831 which was, in substance, a consolidation of the previous acts, included a provision for the protection of musical compositions. The term was extended to 28 years, with renewal for 14 years to the author, his widow or his children. The requirement of newspaper notice, except in the case of renewals, was cancelled. This statute confirmed the requirement for the deposit of a copy with the U.S. district clerk, this copy to be transmitted to the secretary of State within three months after publication. The act of 1834 required that record in the court of original entry should be made of any assignment of the copyright.

In 1846, the Smithsonian Institution was established by act of Congress, this act making provision for the delivery of one copy of a book securing copyright to the library of this institution. The same act provided for the delivery of one copy of the copyrighted book to the library of Congress. This was important because depositing and cataloguing these books in the library of Congress—a requirement confirmed in all subsequent acts—made it practicable, after 1846, to secure prompt and trustworthy information from the library and in later years from the bureau of copyright connected with this library, as to the status of the copyright of any literary work. The applicant desiring to ascertain whether or not a book is in the public domain, or who is the recorded owner of the copyright, made application, under the act of 1846, to the librarian of Congress, and since the establishment of the bureau of copyright, makes application to the register of the bureau, and secures for a fee of $1 the information required. This opportunity of ascertaining the precise status of literary productions which have been entered for copyright is of assured convenience and importance to the publishers and to the book-buying public.

The U.S. act of 1856 secured to dramatists the protection for the right of performance. The act of 1859 made the Interior Department, instead of the State Department, the custodian of copyright. The act of 1861 provided for an appeal to the Supreme Court in all copyright cases, irrespective of the estimated value of the property in question. For other than copyright appeals it is required that the property in question shall have value of not less than $5,000. The act of 1865 again placed under the control of the library of Congress the copies of books deposited in connection with the entry of copyright. This deposit had to be made within one month from publication. The provision covers not only books, but works of art, photographs and negatives. An amendment in 1867 provided for a penalty of $25 in the case of failure to deposit within the month specified. Twelve acts having to do with copyright had become law prior to 1870. That year brought a general act which provided protection not only for works of literature, but for paintings, drawings, statues, chromos, models or designs, and superseded previous statutes. This act cancelled the control by the local district courts of the system of registry, and made the librarian of Congress the copyright officer. It was required that the printed title of the book be filed in his office before publication, and two copies deposited within ten days after publication.

The application of copyright law, unlike that regarding patents, is solely a question for the courts. The librarian of Congress is simply an officer of record and makes no decisions. In 1874 an amendatory act made legal a short form of record—"Copyright, 18—, by A.B."—and the protection of label designs was transferred to the patent office. In 1879 the appropriation bill of the U.S. post office contained a provision prohibiting the transmission of any publication that violated copyright. In 1891, after a campaign extending over many years, a copyright measure providing international copyright became law. The first attempt to bring about international copyright had been made by a committee instituted in 1837 by George P. Putnam, who all his life worked actively for the establishment of copyright relations between the United States and the other literature producing nations of the world.

International Copyright.—In 1885 a copyright committee of authors and publishers was organized for the purpose of securing international copyright relations under United States statute. It became evident, during the succeeding years in which the committee was endeavouring to secure the enactment of an international copyright bill, that the United States could not secure membership in the Convention of Berne, under whose regulations copyright protection was secured for all countries accepting membership in the convention, the Governments of which were prepared to extend such protection to works originating in the other member States. The United States book-manufacturing interests took the ground that works securing the protection of copyright under United States statute must be entirely manufactured within the territory of the United States. This restriction was subsequently modified so that in the act of 1909 permission is accorded to include in a work securing American copyright and manufactured in the United States illustrations that have been produced outside of the United States, provided that "the article in the design did not exist within the territory of the United States."

This statute, which was enacted in March 1909, and which came into effect on the first of July, 1909, provided that the term of copyright should be twenty-eight years from the date of first publication, with a right of renewal for a further term of twenty-eight years, when application for such renewal and extension shall have been made within one year prior to the expiration of the original term of copyright. The right to secure such renewal is vested in the author, the members of the author's family, or his executors. In 1891, after six years of persistent effort, the committee representing the authors and the publishers secured the enactment of a measure which conceded copyright protection in the United States to countries, the copyright statutes of which granted similar protection to the works of American authors. This statute provided, as above specified, for the manufacture in the United States of all works securing American copyright. In 1919, the copyright bureau of the American Publishers' Copyright League secured the enactment of a statute which gave protection to the transatlantic works that during the years of the World War had failed to meet the requirements of the American copyright law, with the exception of books which had been reprinted in the United States during the war period. The reprinters were left at liberty to continue publishing books which at the time of their reprint had fallen into public domain. An Order in Council, issued through the efforts of Lord Askwith, secured for Great Britain similar copyright protection for works by American authors which during the war years had failed to meet the requirements of the English statute. Both in the American act and in the English Order in Council provision was made for the fulfilment at the time of the application for copyright of the original requirements.

Since 1891, repeated efforts have been made to bring about the enactment of a measure which should enable the United States to accept membership in the Convention of Berne, and in April 1928 a measure with this purpose was on the calendar of the House and of the Senate. This bill waives the requirement for American manufacture, but provides that the exclusive control of the work securing American copyright shall rest with the owner of the copyright, the author, or with his assign, the publisher. Under the statute existing in 1928, libraries and individuals have permission to import "for use and not for sale" copies of the transatlantic editions of books, the copyright of which is the property of the assign (the American publisher) of the trans-Atlantic author. In the absence of membership in the Convention of Berne, the United States has, since 1891, come into copyright relations with Great Britain and most of the States of Europe, and also with Japan, under special agreements. The act of 1891 went into force on July 1, and the list of countries with which from that date the United States was in copyright relations included Great Britain, France, Italy, Belgium, Switzerland, Spain and the Scandinavian States. The following year a copyright relation was established by treaty with Germany and some years later Japan, which had accepted membership in the Convention of Berne, brought into force a copyright treaty with the United States. It is the hope of authors, publishers and others who are interested in literary property, and who want to bring about the largest possible distribution of literary productions throughout the civilized world, that in the near future all barriers and restrictions interfering with the recognition of the property rights of the producer and his assign may be removed. The publishers have in mind, particularly, the extension of the publication of what have been called international series, such as the *Science Series*, the *Heroes of the Nations*, the *Story of the Nations*, etc. In such international series, the authors secure remuneration based upon the number of markets in which editions of the books can be placed. The cost of the authorship is divided between the editions issued in those markets. In like manner, the cost of the illustrations can be divided. As a result, the author secures from the increased circle of readers a larger remuneration than would ever come to him from the production of an edition for his home market alone, while the reader has placed in his hands, at a lower cost than would otherwise be practicable, a work which may have been written by the world's highest authority on the subject. Such an extension of publishing methods, for the benefit not only of authors and publishers but of the book-buying public, can be possible, however, only under world-wide international copyright, with a system in which the author is left at liberty to sell each market separately and to give to his assign, the publisher, an exclusive control of the market thus sold. (G. H. Pu.)

COQUELIN, BENOÎT CONSTANT (1841–1909), French actor, known as Coquelin *aîné*, was born at Boulogne on Jan. 23, 1841. He was originally intended to follow his father's trade of baker (he was once called *un boulanger manqué* by a hostile critic), but he entered Regnier's class at the Conservatoire in 1859. He won the first prize for comedy within a year, and made his début on Dec. 7, 1860, at the Comédie Française as the comic valet, Gros-René, in Molière's *Dépit amoureux*, but his first great success was as Figaro, in the following year. He was made *sociétaire* in 1864, and during the next 22 years he created at the Français the leading parts in 44 new plays, including Théodore de Banville's *Gringoire* (1867), Paul Ferrier's *Tabarin* (1871), Émile Augier's *Paul Forestier* (1871), *L'Étrangère* (1876) by the younger Dumas, Charles Lomon's *Jean Dacier* (1877), Edward Pailleron's *Le Monde où l'on s'ennuie* (1881), Erckmann and Chatrian's *Les Rantzau* (1884). In consequence of a dispute with the authorities over the question of his right to make provincial tours in France he resigned in 1886. Three years later, however, the breach was healed; and after touring in Europe and the United States he rejoined the Comédie Française as *pensionnaire* in 1890. In 1892 he broke definitely with the Comédie Française, and toured for some time through the capitals of Europe with a company of his own. In 1895 he joined the Renaissance theatre in Paris, and played there until he became director of the Porte Saint Martin in 1897. Here he won successes in Edmond Rostand's *Cyrano de Bergerac* (1897), Émile Bergerat's *Plus que reine* (1899), Catulle Mendès' *Scarron* (1905), and Alfred Capus and Lucien Descaves' *L'Attentat*

(1906). In 1900 he toured in America with Sarah Bernhardt, and on their return continued with his old colleague to appear in *L'Aiglon,* at the Théâtre Sarah Bernhardt. He was rehearsing for the creation of the leading part in Rostand's *Chantecler,* which he was to produce, when he died suddenly in Paris, on Jan. 27, 1909. Coquelin was an Officer de l'Instruction Publique and of the Legion of Honour. He published *L'Art et le comédien* (1880), *Molière et le misanthrope* (1881), essays on *Eugène Manuel* (1881) and *Sully-Prudhomme* (1882), *L'Arnolphe de Molière* (1882), *Les Comédiens* (1882), *L'Art de dire le monologue* (with his brother, 1884), *Tartuffe* (1884), *L'Art du comédien* (1894). *See* Schoen, *V. Sardou et Constant Coquelin* (1910).

His brother, ALEXANDRE COQUELIN (1848–1909), called Coquelin *cadet,* was born May 16, 1848, at Boulogne and entered the Conservatoire in 1864. He graduated with the first prize in comedy and made his début in 1867 at the Odeon. The next year he appeared with his brother at the Théâtre Français, and became a *sociétaire* in 1879. He played a great many parts, in both classic and the modern répertoire, and also had much success in reciting monologues of his own composition. He wrote *Le Livre des convalescents* (1880), *Le Monologue moderne* (1881), *Fairiboles* (1882), *Le Rire* (1887), *Pirouettes* (1888). He died on Feb. 8, 1909.

COQUEREL, ATHANASE JOSUE (1820–1875), French Protestant divine, son of A. L. C. Coquerel (*q.v.*), was born at Amsterdam on June 16, 1820. He studied theology at Geneva and Strasbourg, and at an early age succeeded his uncle, C. A. Coquerel, as editor of *Le Lien,* a post which he held until 1870. In 1852 he took part in establishing the *Nouvelle Revue de théologie,* the first periodical of scientific theology published in France, and in the same year helped to found the "Historical Society of French Protestantism." He had gained a high reputation as a preacher and an advocate of religious freedom; but his teaching offended the orthodox party, and on the appearance (1864) of his article on Renan's *Vie de Jésus* in the *Nouvelle Revue de théologie* he was forbidden by the Paris consistory to continue his ministerial functions. The *Union Protestante Liberale* provided him with the means to continue his preaching. He received the cross of the Legion of Honour in 1862. He died at Fismes (Marne), on July 24, 1875. His chief works are *Jean Calas et sa famille* (1858); *Des Beaux-Arts en Italie* (Eng. trs. 1859); *La Saint Barthélemy* (1860); *Précis de l'église reformée* (1862); *Le Catholicisme et le protestantisme considerés dans leur origine et leur développement* (1864); *Libres études,* and *La Conscience et la foi* (1867).

COQUEREL, ATHANASE LAURENT CHARLES (1795–1868), French Protestant divine, was born in Paris on Aug. 17, 1795. He received his early education from his aunt, Helen Maria Williams, an Englishwoman, author of the *Letters from France.* He studied at the Protestant seminary of Montauban. Coquerel became pastor of the Reformed Church in Paris, where he displayed liberal views on religion and education which caused some criticism. His defence of the University of Paris brought him membership of the consistory of the Legion of Honour. In 1841 appeared his *Réponse* to the *Leben Jesu* of Strauss. He sat as a moderate republican in the National Assembly of 1848, subsequently becoming a member of the Legislative Assembly. He supported the first ministry of Louis Napoleon, but after the *coup d' état* of Dec. 2, 1851, he confined himself to the duties of his pastorate. He died in Paris on Jan. 10, 1868. A large collection of his sermons was published in 8 vols. between 1819 and 1852. Other works were *Biographie sacrée* (1825–26); *Histoire sainte et analyse de la Bible* (1839); *Orthodoxie moderne* (1842); *Christologie* (1858), etc.

COQUES or **COCX, GONZALEZ** (1614–1684), Flemish portrait painter, son of Pieter Willemsen Cocx, was born at Antwerp on Dec. 8, 1614. At the age of 12 he entered the house of Pieter, the son of "Hell" Breughel, an obscure portrait painter, and later became a journeyman in the workshop of David Ryckaert the second. At 26 he matriculated in the gild of St. Luke; he then married Ryckaert's daughter, and in 1653 joined the literary and dramatic club known as the "Retorijkerkamer." He became president of his gild in 1665, and in 1671 painter in ordinary to Count Monterey, governor-general of the Low Countries. He married again in 1674, and died full of honours in his native place on April 18, 1684. Partnership in painting was common amongst the small masters of the Antwerp school; and it has been truly said of Coques that he employed Jacob von Arthois for landscapes, Ghering and van Ehrenberg for architectural backgrounds, Steenwijck the younger for rooms, and Pieter Gysels for still life and flowers; but the model upon which Coques formed himself was Van Dyck, whose sparkling touch and refined manner he imitated with great success.

COQUET (pronounced Cócket), a river of Northumberland, draining a beautiful valley about 40m. in length. Rising in the Cheviot hills, it follows a course generally easterly, past Rothbury, Brinkburn priory (with its fine transitional Norman church) and Warkworth. A short distance below this the Coquet has its mouth in Alnwick bay (North sea), with the small port of Amble on the south bank, and Coquet island a mile out to sea. The river is frequented by sportsmen for salmon and trout fishing.

COQUET, to simulate the arts of love-making, from motives of vanity, to flirt; figuratively, to trifle with anything (from Fr. *coqueter,* to strut like a cock). The French substantive, *coquet,* in the sense of "beau" was once common in English, but only the feminine form, *coquette,* has survived, in the sense of a woman who gratifies her vanity by using her powers of attraction frivolously. Hence "to coquet" is now more often written "to coquette." "Coquet" is still occasionally used as an adjective, but the usual form is coquettish. The crested humming-birds of the genus *Lophornis* are known as coquettes.

COQUIMBO, city and port of the province of Coquimbo and department of La Serena, Chile. Pop. (1940) 18,863. The extension northward of Chile's railway system has brought Coquimbo into direct communication with Santiago. The city has a good well-sheltered harbour, reputed the best in northern Chile, and is the port of La Serena, the provincial capital, 9 mi. distant, with which it is connected by rail. There are copper-smelting establishments in the city, which exports copper, gold and silver, and cattle and hay to the more northern provinces.

The province of Coquimbo, which lies between those of Aconcagua and Atacama and extends from the Pacific inland to the Argentine frontier, has an area of 15,401 sq.mi., a small part of which was annexed from Aconcagua in 1928. Pop. (1940) 245,-609. It is less arid than the province of Atacama, the surface near the coast being broken by well-watered river valleys, which produce alfalfa, and pasture cattle for export. Near the mountains grapes are grown, from which wine of a good quality is made. The mineral resources include extensive deposits of copper, iron and some less important mines of gold and silver. At El Tofo, about 40 mi. north of La Serena, rich deposits of iron are being exploited, and a railway, 15 mi. long has been built to Cruz Grande on the coast for the shipment of ore. The climate is dry and healthful, and there are occasional rains. Several rivers, the largest of which is the Río de Elquí with a length of 125 mi., cross the province from the mountains. The capital is La Serena, population (1940) 21,383. The principal cities are Coquimbo, Ovalle, population (1940) 15,033 and Illapel, population (1940) 6,048.

CORABECAN, a small group of tribes of South American Indians, regarded on very meagre evidence, as constituting an independent linguistic stock. The Corabecas and other tribes of the group lived in eastern Bolivia on the border of the Chaco, between the Lago de la Concepcion in 18° S. lat. eastward toward the Paraguay river. They were an intractable, nomadic hunting folk, who early broke away from the mission of San Rafael and withdrew into the forested country where possibly some remnants may yet survive. Apart from brief references in the mission chronicles, nothing is known in regard to them.

See A. D'Orbigny, *L'Homme Americain* (Paris, 1839).

CORACIIDAE: *see* ROLLER.

CORACIIFORMES, an order of birds comprising 14 families of doubtful mutual affinities, and including the oilbird, frogmouths, kingfishers, rollers, motmot, hoopoes, hornbills, nightjars, swifts and hummingbirds (*qq.v.*) and bee-eaters. In the most recent classifications, the oilbird, frogmouths and nightjars are separated as the order *Caprimulgiformes* and the swifts and hummingbirds as the order *Micropodiformes*. (*See* ORNITHOLOGY.)

CORACLE, a leather-covered wicker boat used in Wales.

CORAËS, ADAMANTIOS (in French, Diamant Coray) (1748–1833), Greek scholar and patriot, was born at Smyrna, the son of a merchant. His name is also spelt Koraïs. As a schoolboy he distinguished himself in the study of ancient Greek, but from 1772 to 1779 he managed his father's business affairs in Amsterdam. In 1782, on the collapse of his father's business, he went to Montpellier, where for six years he studied medicine. He then settled in Paris, where he lived until his death on April 10, 1833. He devoted himself to the cause of Greek independence, endeavouring to rouse the enthusiasm of the Greeks for the idea that they were the true descendants of the ancient Hellenes by teaching them to regard as their own inheritance the great works of antiquity. He sought to purify the ordinary written language by eliminating the more obvious barbarisms, and by enriching it with classical words (*see* further GREEK LANGUAGE: *Modern*). Under his influence, though the common patois was practically untouched, the language of literature and intellectual intercourse was made to approximate to the pure Attic of the 5th and 4th centuries B.C. His chief works are his editions of Greek authors contained in his Ἑλληνικὴ Βιβλιοθήκη and his Πάρεργα; his editions of the *Characters* of Theophrastus, of the *De aere, aquis, et locis* of Hippocrates, and of the *Aethiopica* of Heliodorus, elaborately annotated.

BIBLIOGRAPHY.—His literary remains have been edited by Mamoukas and Damalas (1881–1887); collections of letters written from Paris at the time of the French Revolution have been published (in English, by P. Ralli, 1898; in French, by the Marquis de Queux de Saint-Hilaire, 1880). His autobiography appeared at Paris (1829; Athens, 1891), and his life has been written by D. Thereianos (1889–1890); *see* also A. R. Rhangabé, *Histoire littéraire de la Grèce moderne* (1877).

CORAL. The hard skeletons of various marine organisms. It is chiefly carbonate of lime, and is secreted from sea-water and deposited in the tissues of Anthozoan polyps, the principal source of the coral-reefs of the world (*see* ANTHOZOA), of Hydroids (*see* HYDROZOA), much less important in modern reef-building, but extremely abundant in Palaeozoic times, and of certain Algae. The skeletons of many other organisms, such as Polyzoa and Mollusca, contribute to coral masses but cannot be included in the term "coral." The structure of coral animals (sometimes erroneously termed "coral insects") is dealt with in the articles cited above; for the distribution and formation of reefs *see* CORAL REEFS.

Beyond their general utility and value as sources of lime, few of the corals present any special feature of industrial importance, excepting the red or precious coral (*Corallium rubrum*) of the Mediterranean Sea. It, however, is and has been from remote times very highly prized for jewellery, personal ornamentation and decorative purposes generally. About the beginning of the Christian era a great trade was carried on in coral between the Mediterranean and India, where it was highly esteemed as a substance endowed with mysterious sacred properties. It is remarked by Pliny that, previous to the existence of the Indian demand, the Gauls were in the habit of using it for the ornamentation of their weapons of war and helmets; but in his day, so great was the Eastern demand, that it was very rarely seen even in the regions which produced it. Among the Romans branches of coral were hung around children's necks to preserve them from danger, and the substance had many medicinal virtues attributed to it. A belief in its potency as a charm continued to be entertained throughout mediaeval times; and even to the present day in Italy it is worn as a preservative from the evil eye, and by females as a cure for sterility.

The precious coral is found widespread on the borders and around the islands of the Mediterranean Sea. It ranges in depth from shallow water (25 to 50ft.) to water over 1,000ft., but the most abundant beds are in the shallower areas. The most important fisheries extend along the coasts of Tunisia, Algeria and Morocco; but red coral is also obtained in the vicinity of Naples, near Leghorn and Genoa, and on the coasts of Sardinia, Corsica, Catalonia and Provence. It occurs also in the Atlantic off the north-west of Africa, and recently it has been dredged in deep water off the west of Ireland. Allied species of small commercial value have been obtained off Mauritius and near Japan. The black coral (*Antipathes abies*), formerly abundant in the Persian Gulf, and for which India is the chief market, has a wide distribution and grows to a considerable height and thickness in the tropical waters of the Great Barrier Reef of Australia.

Coral Fisheries. From the middle ages downwards the securing of the right to the coral fisheries on the African coasts was an object of considerable rivalry among the Mediterranean communities of Europe. Previous to the 16th century they were controlled by the Italian republics. For a short period the Tunisian fisheries were secured by Charles V. to Spain; but the monopoly soon fell into the hands of the French, who held the right till the Revolutionary Government in 1793 threw the trade open. For a short period (about 1806) the British Government controlled the fisheries, and now they are again in the hands of the French authorities. Previous to the French Revolution much of the coral trade centred in Marseilles; but since that period, both the procuring of the raw material and the working of it up into the various forms in which it is used have become peculiarly Italian industries, centring largely in Naples, Rome and Genoa. On the Algerian coast, however, boats not flying the French flag have to pay heavy dues for the right to fish, and in the early years of the 20th century the once flourishing fisheries at La Calle were almost entirely neglected. Two classes of boats engage in the pursuit—a large size of from 12 to 14 tons, manned by ten or twelve hands, and a small size of three or four tons, with a crew of five or six. The large boats, dredging from March to October, collect from 650 to 850 lb. of coral, and the small, working throughout the year, collect from 390 to 500 lb. The Algerian reefs are divided into ten portions, of which only one is fished annually—ten years being considered sufficient for the proper growth of the coral.

The range of value of the various qualities of coral, according to colour and size, is exceedingly wide, and notwithstanding the steady Oriental demand its price is considerably affected by the fluctuations of fashion. In China large spheres of good coloured coral command high prices, being in great requisition for the button of office worn by the mandarins. It also finds a ready market throughout India and in Central Asia; and with the negroes of Central Africa and of America it is a favourite ornamental substance.

CORAL GABLES, a residential city on the east coast of Florida, U.S.A., adjoining Miami (*q.v.*) which is served by the Florida East Coast and Seaboard Air Line railways. It has a land area of 14 sq.mi., laid out on a comprehensive plan and developed in Spanish and Moorish architecture, with 6 mi. of Venetian waterways. The city was created in a few years by immense investment of capital and modern engineering. In 1925 the population (state census) was 901; in 1940 it was 8,294 by the federal census. Assessed valuation of property in 1941 was $25,-052,331. It has a commission-manager form of government.

CORAL REEFS are formed of the whitish calcareous framework of various marine organisms, of which corals (*q.v.*) and nullipores are the two most important. These reef-builders flourish only at moderate depths—the nullipores usually not below 50 fathoms and the corals not below 25—in the warmer oceans. The minute larval forms of corals and the still more minute spores of nullipores given off in myriads by the adult forms float passively in the ocean waters; if they happen to drift with currents of fitting temperature to a shore of firm rock or to a shallow bank where pebbles or shells lie undisturbed by surface waves, they may attach themselves there and in time form a new reef.

Coral reefs are of three kinds: fringing reefs, barrier reefs and atolls. Fringing reefs are sea-level flats, up to a quarter or half mile in width built out upon salient parts of continental or insular shores, with fronts that fall off seaward to moderate depths. They are composed largely of dead reef rock, and are occupied by living reef-builders chiefly on their outer edge and slope. Reefs of this kind are common in the East Indies. Barrier reefs have, like fringes, a narrow or broad sea-level flat and an outer growing face; but they are separated from the coast which they front by a salt-water lagoon, from half a mile to a score of miles or more in width and from 20 to 40 or more fathoms in depth. The lagoon floor is usually rather smoothly strewn over with fine calcareous detritus. The inner shore is commonly occupied by a fringing reef, the growth of which is less vigorous than that of non-enclosed fringes. The outer or growing face of a barrier is continued in a gentle slope to 40 or 50 fathoms, followed by a steep pitch to great depths. Barrier reefs are frequently interrupted by passages or "passes," through which ocean-going vessels may enter the protected lagoon. When barriers encircle islands, the leeward arc of their circuit is, as a rule, interrupted by wide breaches, largely because of the leeward drift of lagoon sediments. The Great Barrier Reef of north-eastern Australia, 900 nautical miles in length, is the largest of its kind; the lagoon is from 20 to 70m. in width. Many small and large islands rise from the lagoon within this great natural breakwater, and they as well as the embayed mainland coast are little cliffed or not at all, indicating long-continued protection from ocean waves by the reef; but the cooler and reefless coast farther south, also embayed, is island-free and strongly cliffed, indicating its long exposure to ocean waves while an inorganic continental shelf was accumulating off-shore.

Atolls resemble barrier reefs, except that no island rises from their lagoon. The largest atolls are about 40m. in diameter; the smallest, less than a mile with no lagoon. They are rarely circular, usually irregular in pattern. The reef flats of barriers and atolls are often heaped with low islands of reef sand, which come to be covered with vegetation. The reef-islands of atolls are frequently inhabited, although exposed to the occasional danger of being overwhelmed by earthquake waves. The origin and history of barrier reefs may be inferred less from the facts observed in the reefs than from those seen in the coasts that they adjoin or front; and in the absence of neighbouring lands, sea-level atolls are inscrutable structures. The three classes of reefs grade into each other. A fringe separated from its coast by a shallow water belt resembles a close-set barrier; the central islands of certain barriers are so small that the reefs may be called almost atolls. All classes of reefs are found either elevated above or depressed below sea-level. Vatu Vará is a small atoll in central Fiji, 1,030ft. in altitude. The large island of Timor in the East Indies has many elevated reefs at various altitudes on its slopes, the loftiest being almost atolls or atolls on the island crest, about 4,000ft. above sea-level. Chagos atoll, from 65 to 95m. in diameter, in the Indian ocean, is slightly submerged nearly all around its circuit. Reef-building corals have been dredged in the Ceram sea, Dutch East Indies, from a depth of over 700 fathoms, 30m. distant from the nearest shore.

Three contrasted theories of coral reefs are as follows: Darwin (1838–42) explained barrier reefs as the upgrowth of fringing reefs on slowly subsiding coasts or islands, and atolls in the main as the continued upgrowth of barrier reefs until the central island sinks below sea-level. Murray (1880) rejected subsidence and explained barrier reefs by the outgrowth of fringing reefs from stationary coasts on their own talus. He believed the lagoon was excavated by solution of the dead reef rock behind the growing reef front, thus repeating an idea of Semper's (1863–81). He suggested also that atolls might be developed from barrier reefs by the gradual degradation of the central island, but his preferred view was that they are coral crowns on banks that were organically built up over still-standing foundations, usually volcanic cones, of whatever depth, thus repeating an idea of Rein's (1870). Guppy (1887) thought that coral reefs were formed on rising foundations; atolls would thus crown shoaling but not emerging banks; barrier and fringing reefs would lie on emerged coastal slopes. He explained the lagoons of barrier reefs as covering platforms of abrasion cut in coastal slopes during a pause in their emergence, thus repeating in essence an idea of Tyerman and Bennet's (1832).

The inventors of these theories adopted them without making a sufficiently thorough deduction of their consequences. Thus Guppy overlooked three significant points: (1) If fringing reefs are formed on rising coasts, they should lie on non-eroded slopes; but most fringes lie on eroded slopes, showing that subsidence had preceded reef growth, even if in some cases the subsidence were followed by upheaval. (2) If barrier reefs rise from abraded platforms on rising coasts, the shore back of them should be cliffed and not embayed, but such shores are in nearly all cases embayed and not cliffed. (3) If atolls are based on non-emerged shoals, their limestones should lie on the non-eroded surface of the shoals, but several elevated atolls are known to rest unconformably on subaerially eroded foundations. which must therefore have sunk before the atolls were built upon them.

Murray overlooked five significant points: (1) Narrow fringing reefs would ordinarily be smothered by detritus outwashed from valleys in a stationary coast before they could grow out as barriers. (2) If a fringe on a stationary coast succeeded in growing out as a barrier, the shore behind it would not be embayed, but such shores are always embayed. (3) If lagoons are excavated by solution their floors should be covered by insoluble residue, instead of by accumulating calcareous detritus, as is usually the case. (4) If barrier reefs are transformed into atolls by the degradation of their stationary central island, then the islets of almost atolls should be low and flat; but almost atoll islets are of steep-sloping, mountain-top form. (5) If most atolls are crowns on organically aggraded banks, then elevated atolls should show pelagic deposits between a non-eroded volcanic base and the coral crown; but only two elevated atolls—Roti in the East Indies and Barbadoes in the Lesser Antilles—are known to be underlaid by pelagic deposits, and in both cases these deposits rest unconformably on a subaerially eroded, non-volcanic rock, thus showing that island subsidence, at a rate too rapid to be compensated by reef upgrowth, had preceded a later and slower upheaval, with reef growth and emergence.

Darwin failed to recognize three significant consequences of his theory: (1) Subsidence provides by far the best means of disposing of the great volume of detritus that has been eroded from the coasts fronted by barrier reefs. (2) If barrier reefs have grown up from slowly subsiding foundations, the coasts from which they are offset should be embayed by the partial submergence of the coastal valleys. (3) If the formation of barrier reefs and atolls is associated with the subsidence of their foundations, their lagoon limestones—but not necessarily their external talus—should lie unconformably on the eroded surface of the foundation rocks. But while the unnoticed consequences of Murray's, Guppy's and certain other theories are contradicted by the facts of observation, thus invalidating those theories, all the unnoticed consequences of Darwin's theory are confirmed by the facts. (1) The volume of detritus that has been eroded from reef-fronted coasts would in nearly all cases have filled—often much more than filled—the lagoons and overwhelmed the reefs if the coasts had remained stationary. (2) The central islands of barrier reefs are embayed, as Darwin knew, but it was Dana who first showed (1849) that the embayments result from the entrance of arms of the sea into the valleys of subsiding coasts. (3) In the elevated atoll of Tuvutha in eastern Fiji, Foye has reported (1918) an unconformable contact of the atoll limestones on a subaerially eroded volcanic foundation, and the same observer found in the neighbouring Exploring isles a similar relation between the limestones of several elevated reefs and their volcanic bases. The elevated barrier reef of Mangaia in the Cook group has recently been shown by Marshall (1927) to rest unconformably upon the slopes of a well-dissected volcanic island. In all these cases the association of subsidence with reef growth seems unquestionable, and the same association is therefore probable in the case of sea-level barriers and atolls; for it is not to be believed that deep-seated telluric forces selected reefs of exceptional origin to be elevated. Hence, inasmuch as the consequences of Darwin's theory, though they were not perceived by its inventor, have now been confirmed by previously unknown facts, the theory is strongly supported.

The novel glacial-control theory, recently put forth by Daly (1910–15), is based upon the similar depth of many reef-enclosed lagoons, which he believes cannot be explained by Darwin's subsidence theory. He assumes that, as a rule, reef foundations have long been stationary; that many of the older volcanic islands of the Pacific had been degraded in pre-glacial times to low relief with deep-weathered soils: that with the coming of the Glacial period the ocean was lowered some 30 or 40 fathoms by withdrawal of water to form continental glaciers and ice sheets; that even in the torrid zone the chill of the lowered ocean killed the reef-builders, the ocean waves abrading the reefs and worn-down islands to low-level platforms; and that as the ocean rose and warmed in post-glacial time, barrier and atoll reefs grew up with it on the platform margins. But this theory is largely invalidated by the evidence given above of island instability, also by the prevailing absence of cliffed shores within close-set barrier reefs in the coral seas; yet as a good number of plunging-cliff islands surmounting imperfectly reefed banks occur in the marginal belts of the Pacific and Atlantic coral seas, it seems probable that Daly's factor of low-level abrasion—but not his postulate of insular stability—has there had application. In this and a few other respects Darwin's theory may be subordinately modified to advantage, as follows:—

Young volcanic islands are as a rule unfavourable sites for fringing reefs because of the abundance of down-washed detritus which soon forms a reef-smothering beach around the shore; such islands are therefore attacked by the waves and cut back in cliffs; witness Réunion in the Indian ocean. Not until the subsidence of such an island has disposed of a great volume of detritus eroded from it—the isostatic subsidence of the island being likely because of its imense weight, as Molengraaff has suggested (1916)—will the eventual submergence of its rising, cliff-base beach permit reef growth to begin, either on the faces of the plunging cliffs or somewhat off-shore. The Marquesas islands, strongly cliffed and well embayed, seem to offer examples of incipient cliff-face reefs so conditioned. Thus subsidence favours the initiation of fringing reefs as well as their further development and transformation into barriers. But not unless subsidence continues slowly and maintains embayments in the coastal valley mouths, where down-washed detritus will be deposited in bay-head deltas, are up-growing reefs likely to persist. Even then they may be drowned by rapid subsidence, as seems to have happened with a young barrier now submerged around Tutuila, Samoa. But if subsidence continues slowly an on-shore or a near-shore reef may grow up as an off-shore barrier before the cliffs previously cut are wholly submerged; this appears to be the case at Tahiti, in the Society group, where the island spurs are cut off in cliffs that seem to plunge below sea-level. Yet here an extended pause has permitted the filling of the drowned valley embayments with deltas which have now advanced into the lagoon, smothering many cliff-face fringes, and even the off-shore barrier appears to be endangered by out-flowing floods of muddy fresh water. A renewal of subsidence would widen the narrowed lagoon and re-embay the valleys, and the barrier reef would then be rescued from the danger of muddy floods. Thus in time the early-cut cliffs would disappear and the inter-bay spurs of the diminishing island would slope gradually into the widening lagoon. This stage appears to have been reached in the other barrier-reef members of the Society group, for as one proceeds north-westward, the islands are found to be more and more dissected and degraded, and of smaller and smaller size as if increasingly submerged. Borabora, Darwin's type barrier-reef island, is the next to the last of the series. Several atolls follow, the volcanic foundations of which have entirely disappeared. It would be difficult to imagine a better confirmation of Darwin's theory than these islands and their reefs provide. In Fiji the distribution of various kinds of reefs, both at sea-level and elevated above it, especially in the eastern part of the group, at first appears so confused that Darwin's theory has been held to be inapplicable there; but a closer examination shows that this old theory is really the only one which can reasonably account for the Fiji reefs. In the East Indies movements of elevation and subsidence have been so active that typical sea-level barrier and atoll reefs are not often found there, but sea-level fringes and elevated reefs of various kinds abound.

The several groups of atolls in the central Pacific can be to-day explained only by analogy with elevated reefs elsewhere, as above intimated, except that on the atoll of Funafuti in the Ellice group a boring in the reef, made under the direction of the Royal Society of London, 1,184ft. deep—a small measure compared to the presumable reef thickness—has shown that shallow-water organisms prevail to that depth in the reef rock, while deep-water organisms are found at similar depths on the exterior slope of the reef. This supports Darwin's theory. A number of reefs in Florida have been shown by Vaughan to have been formed at times of subsidence, but they are of small thickness. In view of what is at present known concerning the coral reef problem, it may be concluded that although Darwin's theory was abandoned by many students of the subject during the past 50 years, it may—slightly modified as above—regain in the next 50 years the general acceptance that it enjoyed through the middle of the last century.

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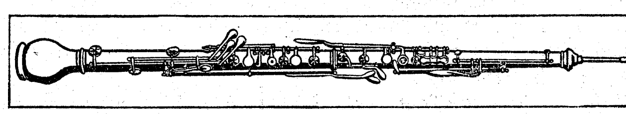
CORAM, THOMAS (1668–1751), English philanthropist, was born at Lyme Regis, Dorset. He began life as a seaman and rose to the position of merchant captain. He settled at Taunton (Mass.) for several years, engaging there in farming and boat-building, and in 1703 returned to England. After 17 years of unwearied exertion, he obtained in 1739 a royal charter authorizing the establishment of his hospital for foundling infants (*see* FOUNDLING HOSPITALS). His later years were spent watching over the interests of the hospital; he was also one of the promoters of the settlement of Georgia and Nova Scotia; and his name is honourably connected with various other charities. In carrying out his philanthropic schemes he spent nearly all his private means; and an annuity of £170 was raised for him by public subscription.

COR ANGLAIS, or ENGLISH HORN, a wood-wind double-reed instrument of the oboe family, of which it is the tenor. It is not a horn, but bears the same relation to the oboe as the basset horn does to the clarinet. The cor anglais differs slightly in construction from the oboe; the conical bore of the wooden tube is wider and slightly longer, and there is a large globular bell and a curved metal crook to which the double reed mouthpiece is attached. The fingering and method of producing the sound are, however, so similar in both instruments that the player of the one can, in a short time, master the other. The quality of the



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THE COR ANGLAIS, OR ENGLISH HORN

cor anglais is penetrating like that of the oboe, but mellower and more melancholy. The cor anglais is the alto Pommer (*q.v.*) or *haute-contre de hautbois* (*see* OBOE), gradually developed, improved, and provided with key-work.

The origin of the name of the instrument is a matter of conjecture. Two theories exist—one that cor anglais is a corruption of *cor anglé,* a name given on account of the angular bend of the early specimens. The other is that when the instrument was given a bend in order to facilitate its handling, the name was adopted to mark its resemblance to a kind of hunting-horn said to be in use in England at the time. But this suggestion does not seem to be a happy one in default of record of any kind of horn of the sort implied.

CORAOPOLIS, a borough of Allegheny county, Pennsylvania, U.S.A., 10m. N.W. of Pittsburgh, on the west bank of the

Ohio river, and served by the Pittsburgh and Lake Erie railroad. The population in 1940 was 11,086. It is in an oil and gas field, and has steel and iron foundries, glass works and factories making springs, nuts and bolts. The borough was incorporated in 1886.

CORATO, a city of Apulia, Italy, in the province of Bari, 26 mi. W. of Bari by steam tramway. Pop. (1936), town 43,907; commune 44,561. It is in the centre of an agricultural district.

CORBAN (קָרְבָּן), an Aramaic word meaning "a consecrated gift." Josephus uses the word of Nazirites and of the temple treasure of Jerusalem. Such a votive offering lay under a curse if it were diverted to ordinary purposes, like the spoil of Jericho which Achan appropriated (Josh. vii.), or the temple treasure of Delphi which was seized by the Phocians, 356 B.C. The word is found in Mark vii. 11, the usual interpretation of which is that Jesus refers to an abuse—a man might declare that any part of his property which came into his parents' hands was *corban,* consecrated, *i.e.,* that he might evade the fifth commandment by pleading a vow. But this interpretation is impossible. In fact, Jesus and the Rabbis agree on this point. The rule which Jesus attributes to tradition is in flat contradiction to the Mishnah and universal Jewish practice. Further, the assertion that the Pharisees violated the Law of God in order to maintain their own rules is not proved by this instance. A totally different explanation of the passage is put forward by J. H. A. Hart in *The Jewish Quarterly Review* for July 1907, the gist of which is that Jesus commends the Pharisees for insisting that when a man has vowed a vow to God he should pay it even though his parents should suffer.

See pp. 148 foll. of vol. i. of sec. ed. of C. G. Montefiore's *Synoptic Gospels* (1927); J. V. Bartlet in *Century Bible* (Mark *in loc.*) (Edinburgh, 1922): p. 711 of vol. i. of H. L. Strack and P. Billerbeck, *Komm. z. Neuen Test.* (Munich, 1922).

CORBEIL, WILLIAM OF (d. 1136), archbishop of Canterbury, was born probably at Corbeil on the Seine, and educated at Laon. He was soon in the service of Ranulf Flambard, bishop of Durham; then, having entered the order of St. Augustine, he became prior of the Augustinian foundation at St. Osyth in Essex. In 1123 he was chosen archbishop of Canterbury, and as he refused to admit that Thurstan, archbishop of York, was independent of the see of Canterbury, this prelate refused to consecrate him, and the ceremony was performed by his own suffragans. Proceeding to Rome the new archbishop found that Thurstan had anticipated his arrival and had prejudiced Pope Calixtus II.; however, the exertions of the English king Henry I. and of the emperor Henry V. prevailed, and the pope gave William the pallium. The archbishop's next dispute was with the autocratic papal legate, Cardinal John of Crema, which ended in William himself being appointed papal legate (*legatus natus*) in England and Scotland, an important precedent in the history of the English Church. The archbishop had sworn to Henry I. to support the claim of his daughter Matilda to the English crown, but nevertheless he crowned Stephen in Dec. 1135. He died at Canterbury on Nov. 21, 1136. William built the keep of Rochester Castle, and finished the cathedral at Canterbury, which he dedicated with great pomp in May 1130.

See the article by F. Tout in the *Dict. of Nat. Biog.*, where earlier work on the subject is summed up.

CORBEIL, a town of northern France, capital of an arrondissement in the department of Seine-et-Oise, at the confluence of the Essonne with the Seine, 21 m. S. by E. of Paris. Pop. (1936) 11,180. From the 10th to the 12th century Corbeil was the chief town of a powerful countship, but it was united to the crown by Louis VI.; it continued for a long time to be an important military post. In 1258 St. Louis concluded a treaty here with James I. of Aragon. It was besieged by the Huguenots in 1562, and by Alexander Farnese, prince of Parma, in 1590. A bridge across the Seine unites the main part of the town on the left bank with a suburb; handsome boulevards lead to the town of Essonnes (pop. 10,397), about 1 mi. S.W. St. Spire, the only survivor of the formerly numerous churches of Corbeil, dates from the 12th to the 15th centuries. Behind the church there is a Gothic gateway. Corbeil is the seat of a sub-prefect, and has tribunals of first instance and commerce and a chamber of commerce. It has flour-mills, tallow-works, printing-works and paper-works and manufactures plaster.

CORBEL, in architecture, a means of supporting a projecting weight; a bracket or weight-carrying member, built deeply into the wall so that the pressure on its embedded portion counteracts any tendency to overturn or fall outwards. Corbels may be either individual pieces of stone, separated from each other like brackets, as in the case of many mediaeval cornices, or continuous courses of masonry, *e.g.,* the corbels under projecting oriel windows (*see* BAY). A "corbel table" is a projected band or string course carried on corbels. Corbels are favourite places for decoration. Mediaeval cornices frequently have corbels ornamented with leaves, animals or human heads; and the corbels common in English Gothic, to support vaulting shafts, are rich with leafage. The sides and faces of Renaissance corbels are carved with scrolls and acanthus leaves. In many cases corbels are moulded, without other carving, especially those carrying mediaeval battlements. Corbels decorated with an S-scroll are known as consoles. (*See* CONSOLE.)

CORBET, RICHARD (1582–1635), English bishop and poet, was born in 1582 at Ewell, Surrey, and died at Norwich on July 28 1635. At Oxford, to which he proceeded from Westminster school in 1597, he was noted as a wit. In 1628 he was made bishop of Oxford, and in 1632 was translated to the see of Norwich. Corbet's verses were first collected and published in 1647. He was a boon companion in his early days of Ben Jonson, who always remained his close friend.

CORBETT, GAIL SHERMAN, American sculptor, wife of Harvey Wiley Corbett, born in 1873 in Syracuse, N.Y. She was educated in public and private schools, at the Art Students League in New York and at the École des Beaux Arts in Paris. Later she was a pupil of Augustus Saint Gaudens. Her best-known works are the Hamilton S. White memorial and the Kirkpatrick fountain in Syracuse, the bronze entrance doors of the municipal group at Springfield, Mass., and the medallion head of Washington in the pediment of the George Washington National Masonic memorial at Alexandria, Va.

CORBETT, HARVEY WILEY (1873–), American architect, born in San Francisco, Jan. 8, 1873. He graduated from the University of California in 1895 and from the École des Beaux Arts, Paris, in 1900. He is a member of the firm of Corbett and MacMurray, New York city. Among the buildings his firm has designed are the Bush Terminal office building, New York city, Bush house, London; and Kings county hospital, Holy Innocents church and St. Francis Xavier's school in Brooklyn, New York. Corbett is a member of the Societé Beaux Arts Architectes, the Societé des Architectes Diplômés par le Gouvernement Français, the Architectural League, New York, and the National Sculpture Society. He is also a fellow of the Society of Architects of London and of the Royal Institute of British Architects and was architectural chairman of Chicago's Century of Progress in 1933.

CORBRIDGE, a town of Northumberland, England; 3½ mi. E. of Hexham, on the north bank of the river Tyne, which is here crossed by a fine seven-arched bridge dating from 1674. Pop. (1931) 2,050. Its name is derived from the small river Cor, a tributary of the Tyne. The Roman station of *Corstopitum* (also called Corchester) lay half a mile west of Corbridge at the junction of the Cor with the Tyne. Excavations have shown the site to have had at first a military importance, but it was later occupied by a civilian population. Corstopitum ceased to exist early in the 5th century, and the site was never again occupied.

About 760 Corbridge became the capital of Northumbria. In 1138 David of Scotland made it a centre of military operations, and it was ravaged by Wallace in 1296, by Bruce in 1312, and by David II. in 1346. It has a square peel-tower and a cruciform church (St. Andrew), partly of pre-Conquest date, but mainly Early English.

CORBULO, GNAEUS DOMITIUS (1st century A.D.), Roman general. In the reign of Tiberius, he was praetor, and was appointed to the charge of the roads and bridges. Under Claudius he was governor of lower Germany (A.D. 47). He punished the Frisii who refused to pay the tribute, and was about to advance against the Chauci when he was ordered by the emperor to withdraw behind the Rhine. Corbulo cut a canal from the Mosa (Meuse) to the northern branch of the Rhine, which still forms one of the chief drains between Leyden and Sluys.

Soon after the accession of Nero, Vologaeses (Vologasus), king of Parthia, overran Armenia, drove out the Roman nominee, and set his own brother Tiridates on the throne. Corbulo was thereupon sent out to the East with full military powers. Two years were spent in reorganizing the demoralized Syrian legions; in 58 Corbulo took the offensive, and in the brilliant campaign of 59 he captured Artaxata and Tigranocerta. In 60 a Romanized prince, Tigranes, was set up as king of Armenia; but in 61 he provoked the Parthians by invading their territory, and was driven from Armenia. Corbulo concluded an armistice for the winter (61–62) by which both sides were to evacuate Armenia, and the matter was to be referred to Nero. Nero decided to annex Armenia, and Paetus was sent out to attack from Cappadocia while Corbula held Syria, but his incompetence led to his total defeat at Rhandeia (62). Corbulo was now given supreme command, and in 63 crossed the Euphrates with a strong army; the enemy submitted, and Tiridates laid down his diadem at the foot of the emperor's statue at Rhandeia, promising not to resume it until he received it from the hand of Nero in Rome. In 67 disturbances broke out in Judaea, but Nero gave the command to Vespasian and summoned Corbulo to Greece. On his arrival at Cenchreae he received the order to commit suicide. Without hesitation he obeyed, exclaiming, "I have deserved it" ("Ἄξιος"). Whether he was really guilty of conspiracy is unknown, but so great was his popularity that he could easily have seized the throne. Corbulo wrote an account of his Asiatic experiences, which is lost.

See Tacitus, *Annals,* xii.–xv.; Dio Cassius, lix. 15, lx. 30, lxii. 19–23, lxiii. 6, 17, lxvi. 3; H. Schiller, *Geschichte des römischen Kaiserreichs unter der Regierung des Nero* (1872); E. Egli, "Feldzüge in Armenien von 41–63," in M. Büdinger's *Untersuchungen zur römischen Kaisergeschichte,* i. (1868); Mommsen, *Hist. of the Roman Provinces,* ii. (1886); for the Armenian campaigns *see* B. W. Henderson in *Classical Review* (April, May, June, 1901) and W. Schur, "Untersuchungen zur Geschichte der Orient feldzüge Corbulos" (*Klio* xix.) and *Die Orientpolitik des Kaisers Nero* (Leipzig, 1923); in general D. T. Schoonover, *A Study of Gn. Domitius Corbulo* (Chicago, 1909).

CORD, a length of twisted or woven strand (Lat. *chorda,* the string of a musical instrument). From the use of such a cord for measuring, the word is applied to a quantity of cut wood. For "vocal cords" *see* PHONETICS; VOICE; SINGING. For "umbilical cord" *see* INFANCY; PLACENTA.

CORDAY D'ARMONT, MARIE ANNE CHARLOTTE (1768–1793), the murderess of Marat, born at St. Saturnin des Lignerets, near Séez in Normandy, was descended from a noble but poor family, and numbered among her ancestors the dramatist Corneille. Charlotte Corday was educated in the convent of the Holy Trinity at Caen, and then sent to live with an aunt. Here she saw hardly any one but her relative, and passed her lonely hours in reading the works of the *philosophes,* especially Voltaire and the Abbé Raynal. Another of her favourite authors was Plutarch. On the downfall of the Girondins on June 2, 1793, many of the leaders took refuge in Normandy. Charlotte attended their meetings, and heard them speak; but there is no reason to believe that she saw any of them privately till the day when she went to ask for introductions to friends of theirs in Paris. She saw that their efforts to rouse Normandy in their favour were doomed to fail. She had heard of Marat as a tyrant and the chief agent in their overthrow, and conceived the idea of going alone to Paris and assassinating him. In Paris she wrote to Marat: "Citizen, I have just arrived from Caen. Your love for your native place doubtless makes you desirous of learning the events which have occurred in that part of the republic. I shall call at your residence in about an hour; have the goodness to receive me and give me a brief interview. I will put you in a condition to render great service to France." She was twice refused admittance at Marat's door, but on her third visit (July 13) Marat, hearing her voice in the antechamber, consented to see her. She spoke to Marat of what was passing at Caen, and his only comment (as she alleged) was that all the men she had mentioned should be guillotined in a few days. As he spoke she drew from her bosom a dinner-knife (which she had bought the day before for two francs) and plunged it into his left side. It pierced the lung and the aorta. When she was brought before the Revolutionary Tribunal her advocate, C. F. C. Lagarde, put forward the plea of insanity. She was sentenced to death, and was guillotined on July 17, 1793, meeting her fate with complete calmness. Lamartine called her *l'ange de l'assassinat,* and Vergniaud said, *"Elle nous perd, mais elle nous apprend à mourir."*

See *Oeuvres politiques de Charlotte Corday* (Caen, 1863; some letters and an *Adresse aux Français amis des lois et de la paix*), with a supplement printed in the same year; C. Vatel, *Dossiers du procès criminel de Charlotte de Corday . . . extraits des archives impériales* (1861), and *Dossier historique de Charlotte Corday* (1872); Austin Dobson, *Four Frenchwomen* (1890); Dr. Cabanes "La vraie Charlotte Corday," in *Le Cabinet secret de l'histoire* (1897–1900); E. Defrance, *Charlotte Corday et la mort de Marat* (1909). Her tragic history was the subject of two anonymous tragedies, *Charlotte Corday* (1795), said to be by the Conventional F. J. Gamon, and *Charlotte Corday* (Caen, 1797), neither of which has any merit.

CORDELE, a city of Georgia, U.S.A., 140 mi. S.E. of Atlanta; county seat of Crisp county. It is on federal highways 41 and 280, and is served by the Atlanta, Birmingham and Coast, the Georgia South-western and Gulf, the Seaboard Air Line and the Southern railways. The pop. in 1920 was 6,538, of whom 3,254 were Negroes, and was 7,929 by the federal census in 1940. It ships great quantities of peanuts, and manufactures peanut confections, cotton oil and fertilizer. Cordele was for a time the home of Joseph E. Brown, the Civil War governor of Georgia, and was a temporary capital of the state. It was incorporated as a city in 1888, and in 1923 adopted a commission-manager form of government.

CORDELIERS, CLUB OF THE, or SOCIETY OF THE FRIENDS OF THE RIGHTS OF MAN AND OF THE CITIZEN, a popular society of the French Revolution. It was formed by the members of the district of the Cordeliers, when the Constituent Assembly suppressed the 60 districts of Paris to replace them with 48 sections (May 21, 1790). It held its meetings at first in the suppressed monastery of the Cordeliers,—the name given in France to the Franciscan Observantists. From 1791, however, it met in a hall in the rue Dauphine. Its principal function, according to its charter, was "to denounce to the tribunal of public opinion the abuse of the various powers and all infractions of the Rights of Man." Its badge was an open eye—symbol of suspicious watchfulness. Though its leaders were men of middle class, it identified itself with the interests of the masses, its power being based on its association with the popular fraternal societies and its influence in the revolutionary sections. It raised and organized the popular battalions and inspired and directed the great demonstrations and risings (*e.g.,* those of June 20 and Aug. 10, 1792). After the withdrawal of the more moderate elements, it was dominated by the *enragés,* by Marat, and, after his death, by Hébert and his associates. After the execution of the Hébertists, March 24, 1794, the club ceased to exist.

The papers emanating from the Cordeliers are enumerated in M. Tourneux, *Bibliographie de l'histoire de Paris pendant la Révolution* (1894), i. (on the trial of the Hébertists) Nos. 4204–4210, ii. Nos. 9795–9834 and II, 813. *See* also A. Bougeart, *Les Cordeliers, documents pour servir à l'histoire de la Révolution* (Caen, 1891); G. Lenotre, *Paris révolutionnaire* (1895) and Albert Mathiez, *Le Club des Cordeliers* (1910).

CORDES, a town of southern France, in the department of Tarn, 15 mi. N.W. of Albi. Pop. (1936), 912. It was a bastide founded by Raymond VII, count of Toulouse, in 1222, and was named *Cordua* after the Spanish city Cordova. A large number of houses of the 13th and 14th centuries, with decorated fronts, form its chief attraction. A church of the same periods and remains of the original ramparts are also to be seen.

CORDIERITE, a silicate of magnesia, alumina and ferrous oxide ($2\,[Mg,FeO]\cdot 2Al_2O_3\cdot 5SiO_2$) occasionally cut as a gem stone, and named in 1813 by Haüy in honour of P. L. Cordier, who discovered its remarkable pleochroism, or exhibition of varying colours viewed from different directions. The natural mineral commonly contains 0·5%–3% of water, and is sometimes referred to as iolite (ἴον, violet; λιθος, stone) in allusion to the violet colour of many specimens, or dichroite in allusion to its dichroism (pleochroism).

Cordierite crystallizes in the orthorhombic system, well developed crystals being usually short prisms with large basal planes. In rocks cyclic twins are common, giving crystals a pseudo-hexagonal habit. The pleochroism of the mineral is often strongly marked, the colours being dark blue or violet, pale blue and yellowish. These colours can be frequently seen without the dichroscope. In refraction, density and hardness, it much resembles quartz, but in thin sections it is distinguished by its biaxial character and common alteration. The pure magnesian cordierite has been prepared artificially. Through formation of solid solution with silica the artificial cordierite shows a range of composition from $2MgO \cdot 2Al_2O_3 \cdot 5SiO_2$ to $2MgO \cdot 2Al_2O_3 6SiO_2$. It melts incongruently with formation of mullite ($3Al_2O_3 \cdot SiO_2$) and glass. By crystallization of glasses of the composition of cordierite at 900° C, an unstable modification (U. cordierite) has been obtained. This passes at 925°–1,150° into the normal α cordierite, but the reverse change has not been effected.

Cordierite occurs in igneous rocks only as a result of contamination of the magma by aluminous sediment. As such it is known in granites, norites, rhyolites, andesites and lamprophyres. The true home of cordierite is in the thermally altered argillaceous sediments surrounding igneous intrusions and in the paragneisses and schists. In the former it is the commonest constituent of the spots of spotted slates (spilosites, desmosites). In the hornfelses it is frequently associated with andalusite, sillimanite, spinel and corundum. The common alteration product of cordierite—often developed as pseudomorphs—is known as pinite, a variable mixture of chlorite and sericite. Fine, well-developed crystals of cordierite are rare. (C. E. T.)

CORDILLERA, a Spanish term for a range or chain of mountains, derived from the Old Spanish *cordilla,* the diminutive of *cuerda,* a cord or rope. The name first given to certain mountain-ranges of South America, *Las Cordilleras de los Andes,* was applied to the extension of the system into Mexico. In North America the Rocky Mountains, the Sierra Nevada and the mountains between them are collectively known as the "Cordilleras," and the entire area has been termed the "Cordilleran region." The name is now not restricted to America but is often used as a generic term for any long parallel ranges of mountains.

CORDITE, a propellant employed in various military services, so called because of its usual cord-like form. It is also made up into other shapes such as flakes, ribbons or tubes with one or more perforations. Cordite is essentially a thoroughly blended mixture of nitro-glycerine and gun-cotton gelatinized effectively by acetone. Soft paraffin or vaseline, obtained during the distillation of petroleum, is added as a stabilizing agent. The original cordite (Cordite, Mark 1), as manufactured at the Royal gunpowder factory, Waltham Abbey, England, in 1890, was composed of 37 parts of gun-cotton, 57·5 parts of nitro-glycerine and 5 parts of mineral jelly together with 0·5% of acetone. Owing to its large content of nitro-glycerine this cordite had a high temperature of explosion and produced considerable erosion of big guns. A modified composition—Cordite M.D.—which was introduced in 1901, contains 64 parts of gun-cotton, 30·2 parts of nitro-glycerine and 5 parts of vaseline with about 0·8% of acetone. Both varieties are in use and other modifications have been adopted. Soluble nitro-cellulose has been used instead of gun-cotton with a higher proportion of nitro-glycerine in order to give a similar ballistic effect to that produced by Cordite M.D. (*See* EXPLOSIVES.)

CÓRDOBA, GONZALO FERNÁNDEZ DE (1453–1515), Spanish general and statesman, was the son of the count of Aguilar. He was born near Cordova on March 16, 1453. He was first attached to the household of Don Alphonso, the king's brother, and upon his death devoted himself to Isabella, afterwards queen. During the civil war, and the conflict with Portugal which disturbed the first years of her reign, he fought under the grand master of Santiago, Alonso de Cardenas. The ability he displayed during the ten years' war for the conquest of Granada led the queen to choose him as commander of the Spanish expedition sent to support the Aragonese house of Naples against Charles VIII. of France. In Italy, where he won the title of the Great Captain, he twice held the command. In 1495 he was sent with about 5,000 men to aid Ferdinand of Naples to recover his kingdom, and he returned home after achieving success in 1498. His mountain warfare in Calabria against the French forces, consisting largely of Swiss pikemen and of their own men-at-arms, led him to see the inadequacy of foot soldiers armed with sword and buckler, or arquebuses and crossbows, and light cavalry, and to introduce the pike as a weapon, insisting at the same time on a much closer infantry formation.

After a brief interval of service in Spain against the Moors, Gonzalo returned to Italy in 1501, and was first employed in driving the Turks from Cephalonia. In the subsequent campaign against the French, Gonzalo stood at bay in the entrenched camp at Barletta, on the shores of the Adriatic, awaiting reinforcements and harassing the French communications. Then in the early part of 1503 he pounced on the enemy's depot of provisions at Cerignola, took a strong position, threw up hasty field works, and strengthened them with a species of wire entanglements. The French made a headlong front attack, were repulsed, assailed in flank, and routed. The later operations on the Garigliano were very similar, and led to the total expulsion of the French from Naples. Gonzalo remained as governor of Naples till 1507. The death of the queen in 1504 had deprived him of a friend, and King Ferdinand, after loading him with titles and fine words, recalled him and left him unemployed till his death on Dec. 2, 1515.

The Great Captain is sometimes spoken of as the first of modern generals. There is much in his methods which bears a likeness to those of the duke of Wellington; Barletta, for instance, has a distinct resemblance to the Torres Vedras campaign, and the battle on the Garigliano to Assaye. As an organizer he founded the Spanish infantry of the 16th and 17th centuries, and he gave the best proof of his influence by forming a school of officers.

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CÓRDOBA, a large central province of Argentina; pop. (1914 census) 735,476, (1943 est.) 1,358,523; area, 65,195 sq.mi. The western sixth of the province is traversed from north to south by the famous Sierras de Córdoba, comprised of three parallel chains separated by beautiful valleys. Of the numerous rivers that originate on the eastern slopes of the Cadena Oriental (Sierra Chica), only the Tercero has sufficient volume and force to cross the plains to the Paraná; the others are lost in swamps or the saline waters of Mar Chiquita and other large, shallow lakes. The climate is characterized by wet summers and rather marked seasonal contrasts in temperature. Except for the scattered woodlands and cultivated areas, the eastern plains are covered with natural grasses; forests extend up the slopes of the Sierras to an altitude of about 5,000 ft., above which lie the pasturelands of the *pampa serrana.*

The climate and scenic attractions of the province make it a favorite vacation and touring centre for tens of thousands of Argentines annually. The tourist trade and a well developed agricultural and industrial economy make Córdoba one of the most prosperous states in the republic. The Central Argentino, Pacífico, Central Norte Argentino, Central Córdoba and Santa Fé railways, with a combined total of more than 3,000 mi. of track, provide the province with excellent transportation facilities. More than 3,000 mi. of national and provincial highways, many of them paved, complement the railroads, and the province is served by both national and international air lines. Among the varied sources of wealth in the province, agriculture occupies first place. The total area cultivated during the agricultural year 1940–41 approached 17,000,000 ac., nearly one-fourth of which was planted in wheat. Other cereals grown extensively include corn, flax (linseed), rye, oats, barley and birdseed. Compared with other provinces and territories in Argentina, Córdoba ranks second in the production of wheat and birdseed, third in corn, rye and barley and fourth in flax and oats. Commensurate with the importance of livestock in the economy more than 3,500,000 ac. are planted in alfalfa. In 1936 there were more than 3,500,000 cattle, 1,500,000 each of horses and sheep and about 800,000 hogs in Córdoba. The majority of the 4,192 industrial establishments of the province (1939) are engaged in the processing of foods.

(R. W. Rd.)

CÓRDOBA, a city in the central part of the Argentine Republic, capital of the above province, on the Río Primero, 432 mi. by rail northwest of Buenos Aires by way of Rosario, 246 mi. from the latter. Pop. (1914) 134,935—the suburbs having some 20,000 more; 1943 estimate 287,598. The city is connected by railway with Buenos Aires and Rosario, and with the capitals of all the surrounding provinces. Córdoba stands on a high eastward-sloping plain called the "Altos," 1,440 ft. above sea-level, and is built in a broad river bottom washed out by periodical inundations and the action of the rains on the alluvial banks. The inundations have been brought under control by the construction of barriers and dams, but the banks are constantly broken down. The city is regularly laid out and contains many fine edifices and dwellings. Several suburban settlements surround the city, the more important of which are served by the urban tramway lines. The noteworthy public buildings include the cathedral, a handsome edifice curiously oriental in appearance, a massive old Jesuit church with a ceiling of richly carved and gilded cedar, the old university, founded in 1613, which still occupies the halls built by the Jesuits around a large quadrangle, the fine old *cabildo,* or Government house, of Moorish appearance, and the national observatory on the *barranca* overlooking the city. There are also two national colleges (*Colegio Nacional de Monserrat* and *Colegio Nacional y Liceo de Señoritas*), four libraries, a provincial museum, zoological gardens and a meteorological station. The water supply of Córdoba is derived from the Río Primero, 12 mi. above the city, where an immense dam (Dique San Roque), one of the largest of its kind in South America, has been built across the river valley. This dam also serves to irrigate the valley below and to furnish power for the electric plant which provides Córdoba with light and electric power. In and about the city there are several industrial establishments which have sprung into existence since the opening of the first railway in 1870. The surrounding country is well cultivated, and produces an abundance of fruit and vegetables.

The city was founded in 1573 by Jerónimo Luis de Cabrera and was for a long time distinguished for its learning and piety. It was the headquarters of the Jesuits in this part of South America for two centuries, and for a time the capital of the Spanish *intendencia* of Tucumán.

CÓRDOBA, a town of the state of Veracruz, Mexico, 55 mi. W.S.W. of the port of Veracruz, in a highly fertile valley, near the volcano of Orizaba, and 2,880 ft. above sea level. Pop. (1940) 17,865. The surrounding district produces sugar, tobacco and coffee, Córdoba being one of the principal coffee-producing centres of Mexico. It also manufactures cotton and woollen fabrics. Córdoba was a town of considerable importance in colonial times, but fell into decay after the revolution. The railway from Veracruz to Mexico City, which passes through it, and the development of coffee production helped the city to recover a part of its lost trade.

CORDON, a word used in many applications of its meaning of "line" or "cord," and particularly of a cord of gold or silver lace worn in military and other uniforms. The word is especially used of the sash or ribbon worn by members of an order of knighthood, crossing from one shoulder to the opposite hip. The *cordon bleu,* the sky-blue ribbon of the knight's grand cross of the order of the Holy Spirit, the highest order of the Bourbon kings of France, was, like the "blue ribbon" of the English Garter, taken as a type of the highest reward or prize to which anyone can attain (*see* also Cookery). In heraldry, "cordons" are the ornamental cords which, with the hats to which they are attached, ensign the shields of arms of certain ecclesiastical dignitaries; they are interlaced to form a mesh or network and terminate in rows of tassels. A cardinal's cordon is red with five rows of 15 tassels, an archbishop's green with four rows of ten, and a bishop's also green with three rows of six. In architecture a "cordon" is a projecting band of stone along the outside of a building, a string-course. The word is frequently used in a transferred sense of a line of posts or stations to guard an enclosed area from unauthorized passage, *e.g.,* a military or police cordon, and especially a sanitary cordon, a line of posts to prevent communication from or with an area infected with disease.

CORDONNIER, VICTOR LOUIS ÉMILIEN (1858–1936), French general, was born at Surgy (Nièvre) on March 23, 1858. After passing through the military college of St. Cyr he entered the infantry as sub-lieutenant in 1879. In 1887 he graduated from the École de Guerre, and staff and regimental service (including duty in the Alps and in Algeria) alternated until in 1905 he became instructor at the École de Guerre. From this time until 1910 his work was wholly instructional. In this period he wrote *Les Japonais en Mandchourie* (1911, Eng. trs. Part I 1912, Part II, 1914). In 1913 he was promoted general of brigade and appointed to command the new 87th Brigade, forming part of the reinforced *couverture* created by the Three Years' Service Act. In command of this brigade, Cordonnier distinguished himself at Mangiennes on Aug. 10, 1914, and in the heavy fighting of the IV. Army in the Ardennes. He was advanced to the command of the 3rd Division, which he led in the battle of the Marne, and in the advance to Ste. Menehould and the Argonne which followed. On Sept. 15 he was severely wounded, and though he resumed his command in October, he had again to be invalided. In December, having become general of division and an officer of the Legion of Honour, he commanded his division in the bitter trench-warfare fighting in the Argonne, and in Jan. 1915 commanded the VIII. Corps in the St. Mihiel sector. In July 1916, after receiving the grade of commander in the Legion of Honour, he was appointed to command the French contingent of the Salonika armies grouped under Sarrail, which became the "Armée francaise d'Orient."

In general charge of the Allied left wing in Sarrail's autumn offensive he fought the actions of Ostrovo, Florina, Armenohor and Kenali, but owing to acute differences with Sarrail, he returned to France just before the battle at Monastir which his movements and combats had prepared. He was already gravely ill, and was unable to hold any further command. He then devoted himself to historical and critical work on the war. In 1921 he published an account of the operations of the 87th Brigade under the title *Une Brigade au feu, Potins de Guerre.*

CÓRDOVA, a province of southern Spain, bounded N.E. by Ciudad Real, E. by Jaén, S.E. by Granada, south by Málaga, southwest and west by Seville, and northwest by Badajoz. Pop. (1940) 761,150; area, 5,300 sq.mi. The river Guadalquivir, flowing through the province from east-northeast to west-southwest, divides it into two very dissimilar portions. North of the river lies the mountain belt of the Sierra de Morena, south of it the more fertile and populated great plains (*La Campiña*), rising in the southeast through undulating country to the borders of the Sierra de Nevada. The Cuzna, Guadiato and Bembezar tributaries join the Guadalquivir on its right bank and the Guadajoz and Genil on its left. Small tributaries of the Guadiana drain the northern districts (*Los Pedroches*). The climate exhibits great contrasts. Snow may lie for months on the mountain peaks while temperatures are mild in the plains, except in the few torrid summer months, when rain seldom falls. The chief wealth of the province lies in the agricultural products of its plains and the mineral deposits of its mountains, though, owing to the conservatism and backward education of the people, neither are fully developed. The fertile Campiña produces much wine and oil of high quality, cereals, fruits and vegetables and a famous breed of horses. In the Sierra de Morena sheep are reared on the pastures and pigs in the oak forests, but far more important are coal, including anthracite from the Belmez district, silver-lead and zinc, and small quantities of copper, iron and bismuth obtained from various localities. South of the river salt is mined at Rute There are no large manufacturing towns but there is a marked contrast between the ancient market centres of the south and the more modern mining towns of the Sierra A fairly complete road and railway system exists, especially in the mining districts. The main Madrid-Linâres-Seville line follows the Guadalquivir valley. At Córdova it meets the north-south line from Almorchón to Málaga which has four important branches—Bélmez-Fuente del Arco, Bélmez-Conquista, Córdova-Utrera and Puente Genil-Jaén. The principal towns (pop. 1940) are Córdova (*q.v.*), Lucena (22,659), Priego de Córdoba (12,134), Puente Genil (22,309), Baena (19,787), Montilla (18,224), Fuenteovejuna (5,688), Cabra (15,172), Pozoblanco (13,466), Montoro (9,541) and Aguilar (15,144). These are described in separate articles. Others of less importance are the mining centres, Hinojosa del Duque (13,393), Bélmez (8,088), and Villanueva de Córdoba (15,903), Penarroya-Pueblonuevo (19,105), and the market towns Castro del Rio (15,916), Rute (13,155) and Bujalance (14,392). (*See* also ANDALUSIA.)

CÓRDOVA, capital of the Spanish province described above; on the southern slopes of the Sierra de Córdova, and the right bank of the river Guadalquivir; on the junction of the main Madrid-Seville railway with branch lines to Almorchón, Utrera and Málaga. Pop. (1940) 116,046 (mun., 143,296). Córdova is an episcopal see. It is typically Moorish, with narrow, winding streets, especially in the older quarter of the centre and west. Beyond several ruined towers and gates, few fragments remain of the ancient walls which once surrounded it, except in the southwest where they show traces of Roman foundations, and in the northeast. The hills behind the city are planted with olive and orange groves and there are gardens beyond the walls on the west. A Moorish bridge with 16 arches on Roman bases connects Córdova with its suburb across the river. At the south end of the bridge stands the tower of La Calahorra; at the north a ruined gateway and near by an elevated statue of the city's patron saint, St. Raphael. West of the bridge, near the river, lies the Alcázar or palace quarter, probably the original nucleus of the town. Here stood the Roman civil and military buildings which the Arab caliphs converted into a royal residence. The site of the Old Alcázar, where the royal guards were quartered, has been gradually built over by workmen's houses. The New Alcázar, which was the palace itself and was later the residence of the Holy Inquisition, is now mainly in ruins, except one wing, which is used as a prison. Gardens overlooking the river, the bishop's palace and an ecclesiastical seminary also occupy part of the site. Other important public buildings are the old monastic establishments, the churches, the city hall, the hospitals and the schools and colleges, including the academy for girls, founded in 1590 by Bishop Pacheco of Córdova, which is empowered to grant degrees.

But the glory of Córdova, surpassing all its other Moorish or Christian buildings, is the *mezquita,* or mosque, now a cathedral, but originally founded on the site of a Roman temple and a Visigothic church by Abd-ar-Rahman I (756–788), who wished to confirm the power of his caliphate by making its capital a great religious centre, rivalling those of the East. The growing population of the city soon rendered a larger mosque necessary and, by orders of Abd-ar-Rahman II (822–852) and Al-Hakim II (961–976), the original size was doubled. After various minor additions, Al-Mansur, the vizier of the caliph Hisham II (976–1009), again enlarged the *Zeca,* or House of Purification, as the mosque was named, to twice its former size, rendering it the largest sacred building of Islam, after the Kaaba at Mecca. The ground plan of the completed mosque forms a rectangle, measuring 590 ft. by 425 ft., or little less than St. Peter's in Rome. About one-third of this area is occupied by the famous Court of the Oranges and the cloisters which surround it on the north, west and east. Passing through the courtyard, the visitor enters on the south a labyrinth of pillars in which porphyry, jasper and many-coloured marbles are boldly combined. Part came from the spoils of Nîmes or Narbonne, part from Seville or Tarragona, some from the older ruins of Carthage, and others as a present to Abd-ar-Rahman I from the East Roman emperor Leo IV, who sent also from Constantinople his own skilled workmen, with 16 tons of tesserae for the mosaics. Originally of different heights, the pillars have been adjusted to their present standard of 13 ft. either by being sunk into the soil or by the addition of Corinthian capitals. The present 850 pillars divide the building into 19 north to south and 29 east to west aisles, each row supporting a tier of open Moorish arches of the same height (12 ft.), with a third and similar tier superimposed upon the second. The Moorish character of the building was unfortunately impaired in the 16th century by the erection in the interior of a *crucero,* or high altar and large cruciform choir, by the formation of numerous chapels along the sides of the vast quadrangle, and by the addition of a belfry 300 ft. high in place of the old minaret. Modern vaulting is now being removed to reveal a wooden Moorish ceiling carved and painted and still practically intact. The most exquisite work in the whole mosque is found in the third *Mihrab,* or prayer niche, a small octagonal recess roofed with a single block of white marble, carved in the form of a shell and with its walls inlaid with Byzantine mosaics. Córdova was celebrated in the time of the Moors for its silversmiths, its silk embroideries and for a peculiar kind of leather which took its name from the city, whence is derived the word *cordwainer.* Fine gold and silver filigree ornaments are still produced but the leather industry has degenerated into an imitation of Moorish work. The chief modern industries of Córdova are brewing and distilling and the manufacture of textiles. The exports, besides some copper from neighbouring mines, are filigree work and oil and rough clothing for sale in the Andalusian fairs.

Córduba, probably of Carthaginian origin, was occupied by the Romans under Marcus Marcellus in 152 B.C., and shortly afterward became the first Roman *colonia* in Spain, later with the title of *Patricia.* After the battle of Munda in 45 B.C. the city was severely punished by Caesar and 20,000 of its inhabitants massacred for having supported the sons of Pompey. Under Augustus, if not before, it became a municipality, and capital of the province of Baetica. Strabo (*c.* 63 B.C.–A.D. 21) testifies to its importance at this period. Its prosperity was due partly to its position on the Baetis, then navigable up to the city, and on the Via Augusta, the great commercial road from northern Spain built by Augustus, and partly to its proximity to mines and rich grazing and grain-producing districts. Under the rule of the Visigoths from the 6th century to the beginning of the 8th its importance declined but, captured and largely destroyed by the Moors in 711, it entered 50 years later on its period of greatest prosperity. In 756 'Abd-ar-Rahman I (*q.v.*) made it the capital of Moorish Spain, and the centre of an independent caliphate. Under the Omayyad dynasty the city was reconstructed and filled with palaces and mosques and the walls extended so that the enclosed area was doubled. It reached the summit of its splendour in the middle of the 10th century, under Abd-ar-Rahman III. A period of decadence began during the year of 1010 owing to rivalry for the caliphate and in 1236 Córdova was easily captured by Ferdinand III of Castile. The substitution of Spanish for Moorish supremacy rather accelerated than arrested the decline of art, industry and population; and in the 19th century Córdova never completely recovered from the disaster of 1808, when it was stormed and sacked by the French. It was captured by Franco's nationalist troops early in the civil war of 1936–39. Tourist traffic ordinarily forms an important source of wealth to its inhabitants. Córdova also was the birthplace of the rhetorician Marcus Annaeus Seneca, and his more famous son Lucius (*c.* 3 B.C.–A.D. 65); of the poet Lucan (A.D. 39–65); of the philosophers Averroes (1126–98) and Maimonides (1135–1204); of the Spanish men of letters, Juan de Mena (*c.* 1411–56), Lorenzo de Sepúlveda (d. 1574) and Luis de Gongora y Argote (1561–1627); and the painters Pablo de Céspedes (1538–1608) and Juan de Valdés Leal (1630–91). The celebrated captain Gonzalo Fernández de Córdoba (*q.v.*), the conqueror of Naples (1495–98), was born in the nearby town of Montilla.

See *Estudio descriptivo de los monumentos árabes de Granada y Córdoba,* by R. Contreras (Madrid, 1885); *Córdoba,* a large illustrated volume of the series "España," by P. de Madrazo (Barcelona, 1884); *Inscripciones árabes de Córdoba,* by R. Amador de los Ríos y Villalta (Madrid, 1886).

CORDOVA, a town of southwestern Alaska within the embayment known as Prince William's sound; situated in lat. 60° 31′ N., long. 145° 45′ W., about 1,500 mi. N.W. of Seattle. Pop. (1940) 938.

Cordova is an old town in name and place and an old fishing centre. Its importance once lay in the fact that it was the ocean terminus of the Copper river and North-western railway. This road, 196 mi. in length, was constructed (1907–11) for the sole purpose of bringing to the coast the copper ores from the Kennicott mines. These famous mines, four in number, reached a depth of some 2,500 ft., with more than 40 mi. of underground workings, and in the thirty years of their operation produced $200,000,000 worth of copper. What was probably the richest copper deposit known was exhausted in 1938 and the railroad and mine were shut down.

Cordova is now dependent on its fisheries, salmon, crab and clam canneries. (W. P. R.; X.)

CORDUROY, a cotton cloth of the fustian kind, made like a ribbed velvet. It is generally a coarse heavy material and is used largely for workmen's clothes, but some finer kinds are used for ladies' dresses, upholstery, etc. According to the *New English Dictionary* the word is understood to be of English invention, "either originally intended, or soon after assumed, to represent a supposed French *corde du roi.*" It is said that a coarse woollen fabric called *duroy,* made in Somerset during the 18th century, has no apparent connection with it. From the ribbed appearance of the cloth the name *corduroy* is applied, particularly in America, to a rough road of logs laid transversely side by side, usually across swampy ground. (*See* FUSTIAN.)

CORDUS, AULUS CREMUTIUS, Roman historian of the later Augustan age. He was the author of a history of the civil wars and the reign of Augustus, from at least 43–18 B.C. In A.D. 25 he was brought to trial for having praised Brutus and Cassius. His real offence was a jibe against Sejanus, who put up two of his creatures to accuse him in the senate. Cordus starved himself to death. The senate ordered his works to be confiscated and burned by the aediles, but his daughter saved some copies of the eulogy, and after the death of Tiberius the work was published at the wish of Caligula. It is impossible to form an opinion of it from the scanty fragments (H. Peter, *Historicorum Romanorum Fragmenta,* 1883). According to ancient authorities, the writer was very outspoken (Quintilian, *Instit.* x. 1, 104). Two passages in Pliny (*Nat. Hist.* x. 74 [37], xvi. 108 [45]) seem to refer to a different work—perhaps a treatise on *Admiranda* or remarkable things.

See Tacitus, *Annals,* iv. 34, 35; Suetonius, *Tiberius,* 61, *Caligula,* 16; Seneca, *Suasoriae,* vii., esp. the *Consolatio* to Cordus's daughter Marcia; Dio Cassius lvii. 24. There are monographs by J. Held (1841) and C. Rathlef (1860). Also H. Peter, *Die geschichtliche Literatur über die römische Kaiserzeit* (1897); Teuffel-Schwabe, *Hist. of Roman Lit.,* Eng. trans., 277, 1.

CORELLI, ARCANGELO (1653–1713), Italian violin-player and composer, holds an honoured place in musical history in both capacities. Of his life little is known except that he travelled widely about Europe and was everywhere held in the highest esteem. The style of execution introduced by Corelli and preserved by his pupils, such as Geminiani, Locatelli, and many others, has been of vital importance for the development of violin-playing, even though he employed only a limited portion of the instrument's compass, as may be seen by his writings, wherein the parts for the violin never proceed above D on the first string, the highest note in the third position. It is even said that he refused to play, as impossible, a passage which extended to A in altissimo in the overture to Handel's *Trionfo del Tempo,* and took serious offence when the composer played the note in evidence of its practicability. His compositions for the instrument mark an epoch in the history of chamber music. Nor was his influence confined to his own country; even Sebastian Bach was not insensible to it. Corelli's numerous compositions are distinguished by a beautiful flow of melody and by a masterly treatment of the accompanying parts, which he is justly said to have liberated from the strict rules of counterpoint.

CORELLI, MARIE (1855–1924), English novelist, was the daughter of Dr. Charles Mackay (*q.v.*) the song-writer and journalist, and his second wife, formerly Mary Elizabeth Mills. She was sent to be educated in a French convent with the object of training her for the musical profession. She became suddenly famous in 1886 with the publication of her brilliant and fantastic *Romance of Two Worlds.* She then wrote in succession a series of melodramatic romantic novels which had an enormous vogue; these were *Vendetta* (1886), *Thelma* (1887), *Ardath* (1889), *The Soul of Lilith* (1892), *Barabbas* (1893), *The Sorrows of Satan* (1895), *The Mighty Atom* (1896), and others, down to *The Master Christian* (1900), and *Temporal Power* (1902). Her later books were less successful. Marie Corelli wrote quite sincerely and with conviction, if in bad style. Her later years were spent at Stratford-on-Avon, where she died on April 24, 1924.

CORENZIO, BELISARIO (1558 or 1560–1643), Italian painter, a Greek by birth, studied at Venice under Tintoretto, and then settled at Naples. Though careless in composition and a mannerist in style, he possessed an acknowledged fertility of invention and readiness of hand. When Guido Reni came, in 1621, to Naples to paint in the chapel of St. Januarius, Corenzio suborned an assassin to take his life. The hired bravo killed Guido's assistant and effectually frightened Reni, who prudently withdrew to Rome. Corenzio later supplanted Ribera in the good graces of Don Pedro di Toledo, viceroy of Naples, who made him his court painter. His best works were frescoes, one of the principal examples at Naples being the "Miracle of the Loaves and Fishes" for the refectory of San Severino. Corenzio died, it is said, at the age of 85 by a fall from a scaffolding.

CO-RESPONDENT: *see* DIVORCE.

CORFE CASTLE, a small town of Dorsetshire, England, in the district called the Isle of Purbeck, 129½ mi. S.W. by W. from London by the Southern railway. Pop. (1931) 1,409. The castle guarded a gap in the line of hills which rise in the centre of Purbeck. It is strongly placed and its ruins are extensive, dating from the Norman period to the reign of Edward I., with traces of an earlier settlement (Saxon).

According to William of Malmesbury the church was founded by St. Aldhelm in the seventh century. In 1086 the abbey of Shaftesbury held the manor, which afterwards passed to the Norman kings. The castle was held for Maud against Stephen in 1139, was frequently the residence of John, and was a stronghold of the barons against Henry III. The town dependent on it seems to have grown up during the 13th century, being first mentioned in 1290. Elizabeth in 1577 gave exclusive admiralty jurisdiction within the island of Purbeck to Sir Christopher Hatton. The castle withstood a protracted siege by the Parliamentarians in 1643, and fell to them by treachery in 1646, after which it was dismantled and wrecked. Elizabeth incorporated Corfe Castle in 1576 and Charles II in 1663, but the corporation was abolished following the Corporations Act of 1883. It first returned two representatives to parliament in 1572, but was disfranchised in 1832. As early as the 14th century the quarrying and export of marble gave employment to the men of Corfe, and during the 18th century the knitting of stockings was a flourishing industry.

CORFINIUM, in ancient Italy, the chief city of the Paeligni, 7m. N. of Sulmona in the valley of the Aternus, near the modern village of Pentima. It does not appear in Roman history before the Social War (90 B.C.), in which it was adopted by the allies as the capital and seat of government of their newly founded state under the name Italia. The Via Valeria (according to Strabo) had reached Corfinium before the time of Claudius: he extended it to the Adriatic, and at the same time constructed the *Via Claudia Nova* (*q.v.*). Another road ran south-south-east past Sulmo to Aesernia. It was thus an important road centre, and in the imperial period, a town of some size. The origin of the imposing church of S. Pelino may be traced to the end of the 5th century when it was the cathedral of the see of Valva, the immediate successor of Corfinium. *See* R. Gardner in *Papers of the British School at Rome* ix. 89.

CORFU (anc. and mod. Gr. *Κέρκυρα* or *Κόρκυρα,* Lat. *Corcyra*), an island of Greece, in the Ionian Sea, separated from the coast of Epirus by a strait from 2 to 15 m. broad. The name Corfu is an Italian corruption of the Greek *κορυφαί* (crests, Byz. *κορυφώ*). Its length is about 40 m.; greatest breadth about 20. The island consists of three districts, of which the northern is mountainous, the central undulating and the southern low-lying: all are of limestone formation and picturesque scenery. Two principal ranges are San Salvador (3,300 ft.) (ancient Istone) lying east and west from Cape St. Angelo to Cape St. Stefano. The second culminates in Santa Decca (Greek οἱ Ἅγιοι Δέκα, "The Ten Saints"). Pop. (1938) 106,253.

Corfu is well-watered, widely fertile, and the most beautiful of the Greek isles, but the prevalent olives give monotony to its colouring. Undisturbed by cultivation, myrtle, arbutus, bay and ilex form thick brushwood. Once planted all the fruit trees known in southern Europe thrive, with the Japanese medlar. Olive oil is a principal crop; the wine is for local consumption.

The common form of land tenure is the *colonia perpetua,* by which the landlord grants a lease to the tenant and his heirs for ever, in return for a rent, payable in kind, and fixed at a certain proportion of the produce. Such a tenant could not be expelled except for non-payment, bad culture or the transfer of his lease without the landlord's consent. Attempts have been made to prohibit so embarrassing a system; but, as it is preferred by the agriculturists, the existing laws permit it. The large old fiefs (*baronie*) in Corfu, as in the other islands, have left traces in quit-rents generally equal to one-tenth of the produce. But they have been much subdivided, and the vassals may by law redeem them. None of the Corfu wines is much exported. The capital is the only city in the island; but there are numerous villages. Near Gasturi stands the Achilleion palace, built for the Empress Elizabeth of Austria, and later owned by William II. of Germany. The town of Corfu stands on the broad part of a peninsula within the central bay of the east coast. The steep twin-peaked citadel has the sea on two sides, and is cut off from the town by a natural gully, with an artificial salt-water ditch at the bottom. The old fortifications were in great part thrown down by the English, and defences were limited to the island of Vido and the old capital; even these are now dismantled. Having grown up within fortifications, the town is a labyrinth of narrow, tortuous, up-and-down streets. But there is a wide esplanade between town, citadel and palace, and a promenade by the seashore towards the suburb Castrades. The palace, built by Sir Thomas Maitland (?1759–1824; lord high commissioner of the Ionian Islands, 1815), is of white Maltese stone. A few houses survive from Venetian times with traces of past splendour, but the modern buildings are in French or Italian style. There are thirty-seven Greek churches. The cathedral is dedicated to Our Lady of the Cave (ἡ Παναγία Σπηλιώτισσα); St. Spiridion's has the tomb of the patron saint of the island; and the suburban church of St. Jason and St. Sosipater is reputed the oldest. The city has a Greek and a Roman Catholic archbishop; a gymnasium, a theatre, and a library and museum preserved in the buildings of the former university, founded by Frederick North, 5th earl of Guilford in 1823, but disestablished when the English protectorate ceased.

The site of the ancient city is about 1½ mi. to the south-east of Corfu, between the lagoon of Calichiopulo and the bay of Castrades, in each of which it had a port. The circular tomb of Menecrates, and the remains of a very simple Doric temple are noteworthy. Of ancient Cassiope the name is preserved by the village of Cassopo; but the temple of Zeus Cassius has disappeared. There are numerous monasteries and Venetian buildings. Many of Corfu's buildings were destroyed during World War II.

History.—In local tradition Corcyra was the Homeric island of Scheria, the home of Phaeacians. In early Greek times it was colonized from Corinth, but seems to have had earlier settlers from Eretria. The position of Corcyra on the highway between Greece and the West favoured rapid growth, and freedom of action; and its people, contrary to the practice of Corinthian colonies, maintained an independent and even hostile attitude towards the mother city. In the early part of the 7th century, their fleets fought the first naval battle recorded in Greek history (about 664 B.C.). The Corinthian tyrant Periander (*c.* 600), governed Corcyra by deputy, and induced it to join in the colonization of Apollonia and Anactorium. But the island regained its independence and devoted itself to purely mercantile policy. During the Persian invasion of 480 it manned 60 ships, but took no active part. In 435 in a quarrel with Corinth it sought assistance from Athens. This was one of the chief immediate causes of the Peloponnesian War (*q.v.*), in which Corcyra was of considerable use to the Athenians as a naval station and base for supplies though it was twice nearly lost to Athens by internal feuds; on each occasion, 427 and 425, the popular party ultimately won; after a third abortive rising in 410 it passed out of the war. In 375 a fresh Athenian alliance resulted in hostilities with Sparta. In the Hellenistic period Corcyra was besieged by Cassander, and occupied in turn by Agathocles Pyrrhus and Illyrian corsairs. From these last, in 229, it was delivered by the Romans, who retained it as a naval station and made it a "free state." In 31 B.C. Octavian used it as a base against Antony, but his victory-foundation, Nicopolis, soon out-rivalled it and Corcyra for long passed out of notice.

With the rise of the Norman kingdom in Sicily and the Italian naval powers, Corcyra again became a frequent object of attack. In 1081–1085 it was held by Robert Guiscard, in 1147–1154 by Roger II. of Sicily, in 1197–1207 by Genoese privateers who were expelled by the Venetians. In 1214–1259 it passed to the Greek Despots of Epirus, and in 1267 to the Neapolitan house of Anjou. Under this weak rule the island suffered from various adventurers; in 1386 it placed itself under the protection of Venice, and in 1401 under its formal sovereignty. Corcyra remained in Venetian hands till 1797, though several times attacked by the Turks with notable sieges in 1536 and 1716–1718. Under Venetian feudalism the island took the new name of Corfu. The Corfiotes were encouraged to cultivate the olive, but were debarred from commercial competition with Venice. The island served as a refuge for Greek scholars from Turkish conquests and in 1732 became the home of the first academy of modern Greece, but no serious impulse to Greek thought came from this quarter.

By the treaty of Campo Formio, Corfu was ceded to the French, who occupied it for two years, until they were expelled by a Russo-Turkish armament (1799). For a short time it became the capital of the self-governing federation of the Hephtanesos ("Seven Islands"); in 1807 its faction-ridden government was again replaced by a French administration, and in 1809 it was attacked by a British fleet. By the treaty of Paris of November 5th, 1815, the Ionian Islands were placed under the protectorate of Great Britain and Corfu became the seat of the British high commissioner. Though the native senate and assembly were retained, British administration improved conditions, but its strictness displeased the natives, and in 1864 Corfu was ceded with the other Ionian Islands to the kingdom of Greece, in accordance with the wishes of the inhabitants. (J. L. My.)

Although the neutralization of Corfu was maintained after the Balkan wars, its military importance grew so greatly during World War I, after the Serbian retreat across Albania, that the French, ignoring a Greek protest, landed there on Jan. 11, 1916. They were followed by the first detachment of retreating Serbs four days later, and by Feb. 10 some 75,000 Serbian troops, as well as Montenegrin soldiers, had been landed in the island, whither on the previous day the Serbian Government had transported its seat and where, on Sept. 10, the Serbian Parliament met in the theatre. In July 1917 the "Pact of Corfu" was signed, which proclaimed the union of the Yugoslavs.

On Aug. 27, 1923, the Italian delegate for the delimitation of the Albanian frontier, Gen. Tellini, was assassinated at Kakavia. There was no proof that the assassins were Greeks; but Signor Mussolini held the Hellenic Government responsible and sent an Italian fleet to Corfu, which bombarded the town and killed several Greek and Armenian refugees. After exacting from Greece 50,000,000 lire as an indemnity, the Italians evacuated Corfu. In World War II, the island was bombed heavily by the Italians. It fell to the Germans during the Balkan campaign of April 1941.

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CORI (anc. *Cora*), a town and episcopal see of the province of Littoria, Italy, 36 mi. S.E. by rail from the town of Rome, on the lower slopes of the Volscian mountains, 1,300 ft. above sea-level. Pop. (1936) 7,191 (town), 9,289 (commune). It occupies the site of the ancient Volscian town of Cora. It was devastated by the partisans of Marius during the struggle between him and Sulla. It lay just above the older road from Velitrae to Terracina, which followed the foot of the Volscian hills, but was 6m. from the Via Appia. Three different *enceintes,* one within the other, enclose the upper and lower town and the acropolis. They are built in "Cyclopean" work, and different parts vary considerably in the roughness or fineness of the jointing and hewing of the blocks; but explorations at Norba have clearly proved that this has nothing to do with their relative antiquity. There is a fine single-arched bridge, now called the Ponte della Catena, just outside the town on the way to Norba. At the summit of the town is a Doric tetrastyle temple, belonging probably to the 1st century B.C., built of limestone. Lower down are two columns of a Corinthian temple dedicated to Castor and Pollux. The church of Santa Oliva stands upon the site of another temple. The cloister, constructed in 1466–80, is in two stories. There are remains of a series of large cisterns probably belonging to the imperial Roman period. The chapel of Annunziata outside the town has frescoes of the Roman school of the 15th century.

CORIANDER, the fruit, improperly called seed, of an umbelliferous plant (*Coriandrum sativum*), a native of the south of Europe and Asia Minor, but cultivated in the south of England and on the continent, where it is also found as an escape from cultivation. The plant produces a slender, erect, hollow stem rising 1 to 2 ft. in height, with bipinnate leaves and small flowers in pink or whitish umbels. The fruit is globular and externally smooth, having five indistinct ridges, and the mericarps, or half-fruits, do not readily separate from each other. It is one of the few umbelliferous plants producing seeds with concave face. It is used in medicine as an aromatic and carminative. The active principle of its volatile oil (*Coriandrol*) consists mainly of linalool (2:6 dimethyl$-\triangle^{2:7}$ (or $\triangle^{1:7}$)$-$octadien$-6-$ol). It is a favourite ingredient in hot curries and sauces. The fruit is also used in confectionery, and as a flavouring ingredient in liqueurs. As a medicine, it possesses carminative properties. The young leaves and shoots are used in soups and salads.

CORINGA, a seaport of British India, in the district of Godavari and the presidency of Madras, on a canal from the Godavari to the sea. The Dutch were the first to establish themselves at Coringa. In 1759 the English took possession of the town and erected a factory 5 m. to the south of it. The harbour is protected by the projection of Point Godavari, and affords shelter to vessels during the south-west monsoon; but though formerly the most important on this coast it has been silted up and lost its trade. The repairing and building of small coasting ships is an industry at Tallarevu in the vicinity.

CORINNA, surnamed "the Fly," a Greek poetess, born at Tanagra in Boeotia, flourished about 500 B.C. She was the instructress of Pindar, whom she defeated in five poetical contests. According to Pausanias (ix. 22. 3), her success was chiefly due to her beauty, and her use of the local Boeotian dialect. The extant fragments of her poems, dealing chiefly with mythological subjects, such as the expedition of the Seven against Thebes, will be found in Bergk's *Poëtae Lyrici Graeci.*

Some considerable remains of two poems on a 2nd-century papyrus (*Berliner Klassikertexte,* v., 1907) have also been attributed to Corinna (W. H. D. Rouse's *Year's Work in Classical Studies,* 1907; J. M. Edmonds, *New Frags. of . . . and Corinna,* 1910; E. Diehl, *Supplementum Lyricum,* 1910).

CORINTH, LOVIS (1858–1925), German painter, was born at Tapiau, East Prussia, on July 21, 1858, the son of a tanner. With Walter Leistikow and Max Liebermann he became one of the main supporters of the Berlin Secessionists. The last years of his life he spent, for the greater part, in his cottage on the Walchensee in Bavaria, where some of his most beautiful pictures of still life and landscape were painted. Corinth died July 18, 1925 at Zandvoort, Holland.

Among his most famous pictures are his portraits of Graf E. Keyserling (1896), Pfarrer Moser (1899), Max Liebermann (1899), Peter Hille (1902), Konrad Ansorge (1904), Rudolf Rittner as Florian Seyer (1907), and of himself (1918). Corinth wrote: *Das Erlernen der Malerei* (1909); *Legenden aus dem Künstlerleben* (1909); *Das Leben Walter Leistikows* (1910). *See* Alfred Kuhn, *Lovis Corinth* (1925).

CORINTH, a city of Greece, situated 1½ m. south of the isthmus (*see* CORINTH, ISTHMUS OF) which connects Peloponnesus and central Greece, and separates the Saronic and the Corinthian gulfs. The citadel, or Acro-Corinthus, rises precipitously on the south to a height of 1,886 ft. and commands all routes into Peloponnese. The territory of Corinth was small and unfertile; but its position made it a commercial centre, and ships were hauled across the isthmus. With its western port of Lechaeum it was connected by two continuous walls, with Cenchreae and Schoenus on the east by forts.

Modern Town.—The modern town of New Corinth, the head of a district in the province of Corinth, is situated on the western side of the Isthmus, 3½ m. north-east from the ancient city. It was founded in 1858, when Old Corinth was destroyed by earthquake, and was almost wholly destroyed by earthquake in 1928. It is connected by railway with Athens (57 m.), with Patras (80 m.) and with Nauplia (40 m.), the capital of Argolis. Communication by sea with Athens, Patras, the Ionian Islands and the Ambracian Gulf is frequent since the opening of the ship canal, in 1893. But it has few local resources. Its chief exports are currants (which have their name from the town), olive-oil, silk and cereals from north-east Peloponnese. Old Corinth, being a considerable town, after the War of Liberation was suggested as the capital of the new kingdom. Since the earthquake of 1858, it is a poor village, mostly Albanian, with a pop. of 6,141.

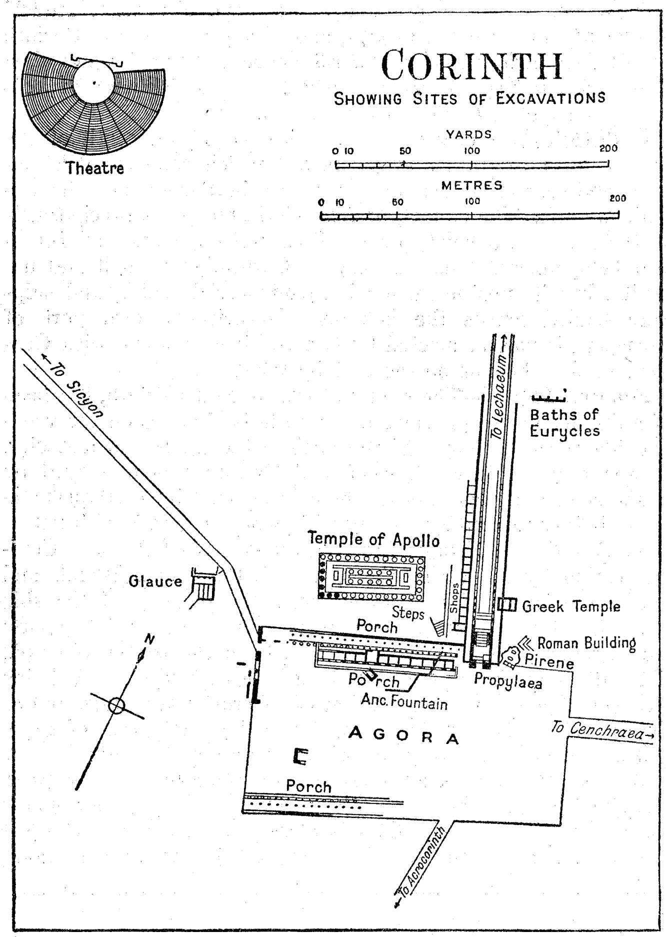
Archaeology.—The ancient city spreads out over two terraces, one about 100 ft. above the other; both are ancient shore-lines: the present coast of the Gulf is about 1½ m. distant. Here at the nearest point to the city was laid its western harbour,

BY COURTESY OF THE AMERICAN WOMEN'S HOSPITAL
RUINS ON THE SITE OF ANCIENT CORINTH

Lechaeum, excavated far into the shore and joined with the city by long walls. The heart of the ancient city was in an indentation about the middle of the upper terrace. At its lower end is the modern public square, shaded by a gigantic plane tree. On the terrace to the west is a venerable temple ruin, and, directly up the hollow, Acro-Corinthus rises over 1,500 ft. above the village. Even from the village, the view over the gulf includes Parnassus on the north, Cyllene on the west, and Geraneia on the north-east. From Acro-Corinthus the view is still finer.

Excavations begun in 1896 by the American School of Classical

Studies at Athens, and still in progress, have brought to light important monuments of the ancient city, both Greek and Roman. Principal discoveries are the ancient market-place (*agora*), on the terrace south of the ancient temple, surrounded with colonnades and monuments; the harbour road which enters the *agora* up the hollow east of the temple, through a stately gateway; the famous fountain of Pirene, east of this gateway; large public baths a short distance along the harbour road, and the theatre some way below and to the west. Other roads towards Sicyon, Cenchreae and Acro-Corinth leave the *agora* on its other three sides. Many bases of statues have been found, but little sculpture of outstanding merit, even of periods subsequent to the spoliation of 146 B.C. Pottery of all periods from the earliest bronze age enable the main phases of early settlement to be reconstructed; but for prehistoric archaeology the stratified village-site at Korakon close to Lechaeum is of greater significance.



At Korakon settlement begins early in the bronze age, and passes through periods of Cycladic, Minyan and Mycenaean influence, declining in importance during the domination of Mycenae (1600–1200 B.C.), but disappearing with its collapse, and the establishment of the Dorian city at Corinth itself. *See* reports of excavations annually in *American Journal of Archaeology* from 1896; C. W. Blegen, *Korakon,* Boston, 1921.

History.—In mythology, Corinth, the home of Medea, Sisyphus and Bellerophon, had over-sea commercial activity. The presence of Phoenician traders was attested by Sidonian cults (*Aphrodite Ourania,* Melikertes; *i.e.,* Melkarth, etc.). In the Homeric poems Corinth is a dependency of Mycenae. Conquered by the Dorians, it retained much of its "Ionian" population whose god Poseidon was worshipped at the Isthmian games. The maritime expansion of Corinth in the 8th and 7th centuries B.C. is proved by the foundation of colonies at Syracuse and Corcyra and the equipment of a fleet of triremes to quell a revolt of the latter city.

Corinth's real prosperity dates from the time of the tyranny (657–581 B.C.), established by Cypselus (q.v.) and continued under his son Periander (q.v.). Under these remarkable men the city rapidly developed. She extended her sphere of influence throughout the coast-lands of the western gulf; she controlled the Italian and Adriatic trade-routes and secured a large share of the commerce with the western Greeks. Connexions grew up with Miletus, Lydia, Phrygia, Cyprus, and Egypt. As an industrial centre, Corinth achieved pre-eminence in pottery, metal-work, and decorative handicraft; her bronze and her pottery were widely exported over the Mediterranean.

The tyranny was succeeded by an oligarchy which pursued a commercial policy to the neglect of military efficiency. Late in the 6th century, Corinth joined the Peloponnesian league under Sparta, in which her financial resources and strategic position secured her an unusual degree of independence. The city befriended the Athenians against Cleomenes I. (q.v.) and supported them against Aegina, their common commercial rival. In the great Persian war of 480 B.C., Corinth served as the Greek headquarters; her army took part at Thermopylae and Plataea (q.v.) and her navy at Salamis and Mycale. Later the development of Athenian trade and naval power became a serious menace. In 459 B.C. the Corinthians, with the Aeginetans, made war upon Athens, but lost both by sea and land. The Athenians extended their rivalry even into the Corinthian gulf. Syracuse remained friendly, but the disaffection of Corcyra hampered the Italian trade. The alliance of Corcyra with Athens led the Corinthians to incite Sparta to war with Athens in 432 B.C. In the war Corinth displayed great activity, and gave valuable support to Syracuse (*see* PELOPONNESIAN WAR).

In 395 B.C., the domineering attitude of Sparta impelled the Corinthians to conclude an alliance with Argos, Thebes and Athens. Later Corinth rejoined Sparta and after Leuctra (q.v.) opposed the Thebans. In 344 B.C. a political struggle ended in the tyranny of Timophanes, who was put to death by his brother Timoleon (q.v.).

After Chaeroneia (q.v.), Philip II. of Macedon summoned a Greek congress at Corinth and left a garrison on the citadel. This citadel, one of the "fetters of Greece," after Alexander's death fell to Antigonus Gonatas. In 243 B.C. Corinth was freed by Aratus and incorporated into the Achaean league (q.v.), but was again surrendered to Macedonia. T. Quintius Flamininus, after proclaiming the liberty of Greece at the Isthmus, restored Corinth to the league (196 B.C.). With the revival of its political and commercial importance the city became the centre of resistance against Rome. After the war of 146 B.C. the Romans despoiled Corinth of its art treasures and destroyed the entire settlement.

In 46 B.C. Julius Caesar repeopled Corinth with Italian freedmen and dispossessed Greeks; it rapidly recovered its commercial prosperity. Augustus made it the capital of Achaea; Hadrian enriched it with public works. Its prosperity is attested by the New Testament, by Strabo, and by Pausanias.

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CORINTH, a city of northeastern Mississippi, U.S.A., on federal highways 45 and 72, 90 mi. E. by S. of Memphis; the seat of Alcorn county. It is served by the Illinois Central, the Gulf, Mobile and Ohio and the Southern Railway systems. Population was 7,818 in 1940 by federal census. Corinth has two machine shops, a hosiery mill, a pants factory, an automobile trailer factory, a brick plant and other manufacturing plants. It was an important objective in the western campaigns of the American Civil War. The national cemetery there has 5,754 graves. Corinth was fortified early in 1862 by Gen. P. G. T. Beauregard. The battle of Shiloh, April 6–7, 1862, fought 20 mi. N.E., in Tennessee, and the battle of Corinth, Oct. 3–4, 1862, were decisive victories for the Union forces, under Gen. Grant and Gen. Rosecrans respectively.

The Shiloh battlefield is a national military park.

CORINTH, ISTHMUS OF, in Greece, dividing the Gulf of Corinth from the Saronic Gulf. Ships were dragged across it in ancient times. Nero, in A.D. 67, began a canal through it. A ship canal begun in 1881 was opened in 1893 with its western entrance about $1\frac{1}{4}$ m. N.E. of New Corinth. It is about 4 m. long, 70 ft. broad, and 26 ft. deep. It shortens the journey from the Adriatic to the Peiraeus by 202 m., for such vessels as can navigate it. Traces of an ancient wall may still be seen parallel to the canal. Just to the south of it lies the fortified sanctuary of Poseidon, where the Isthmian games were celebrated.

CORINTHIAN ORDER, the third of the Greek and the fourth of the Roman orders of architecture, characterized by an elaborate capital decorated with acanthus leaves and scrolls (*see* ORDER).

CORINTHIANS, EPISTLES TO THE, two books of the New Testament. The founding of the Church in Corinth is told in Acts xviii. 1–18. St. Paul's success was prompt and large, and in the year and six months of his stay a vigorous Church was gathered, including Aquila and Priscilla, as well as Crispus, the "ruler of the synagogue" (*cf.* 1 Cor. i. 14); whether Sosthenes, who seems to have succeeded Crispus in his office (Acts xviii. 17), was afterwards converted and became the Christian brother mentioned in 1 Cor. i. 1 cannot be known. The Church evidently consisted mainly of Gentile converts (1 Cor. x. 14; xii. 2), but may have included some Jews (vii. 18). The latter must have been such as were willing to live under the conditions imposed by full fellowship with Gentile Christians.

The apostle's next long stay was at Ephesus, whither he seems to have gone in the course of the same year in which he left Corinth, and where he stayed three years. Before he arrived at Ephesus, Aquila and Priscilla, who had settled there, had made the acquaintance of Apollos (*q.v.*), a well-educated Jew from Alexandria, who with imperfect Christian knowledge was zealously preaching the gospel of Jesus in the synagogue. He presently went to Corinth (Acts xviii. 24–28). "I planted," says Paul (1 Cor. iii. 6), "Apollos watered." From this point on, our information comes from the two epistles, of which the first was written from Ephesus before Pentecost, probably in the year in which Paul left that city, A.D. 54–58 (1 Cor. xvi. 8). It appears that the Church grew in numbers, for Paul refers in 2 Cor. i. 1, to "the saints who are in all Achaea." Its membership was mostly of humble people (1 Cor. i. 26–29), but Crispus, Stephanas (who with his household was able to render services that may well have been costly, 1 Cor. xvi. 15), Gaius and Erastus (Rom. xvi. 23) would appear to have been persons of some substance. It included tradesmen prosperous enough to enter into law-suits; its earning-capacity was sufficient to make gifts to the Jerusalem Christians possible; and the letters imply some degree of education in the readers.

The first need of the Church for help from Paul seems to have grown out of the dangers from surrounding heathenism. In 1 Cor. v. 9 we read of a letter in which Paul had directed the Christians "not to have company with fornicators." Some hold that this letter is partly preserved in 2 Cor. vi. 14–vii. 1, but the evidence that those verses do not belong in their present position is insufficient. While at Ephesus, where communication with Corinth was easy and frequent, Paul was visited by persons of the household of Chloe (1 Cor. i. 11), and by Stephanas with Fortunatus and Achaicus (perhaps his slaves, xvi. 17). From them and from a letter (vii. 1), perhaps brought by Stephanas, he was able to gain the intimate knowledge which the epistles everywhere reveal. The letter from Corinth must have contained enquiries as to practical conduct with regard to marriage (vii. 1), meat offered to idols (viii. 1), and the spiritual gifts (xii. 1), and may well have related to other matters, such as the collection of money for Jerusalem (xvi. 1), the visit of Apollos (xvi. 12), the position of women (xi. 2). Paul's reply includes many other topics. At the time of sending it, his trusted helper Timothy had also started on his way (probably through Macedonia) to Corinth, to contribute there to the edification of the Christians (iv. 17, xvi. 10). The letter itself was doubtless sent by the hand of Corinthians returning home by sea, possibly by the unnamed brethren referred to in xvi. 11, and was expected to arrive before Timothy.

FIRST EPISTLE TO THE CORINTHIANS

The first epistle is a pastoral letter, dealing both with positive evils that need correction and with difficult questions of practice and thought. Through it all runs a genial undercurrent of confidence in the loyalty of the Corinthian Church to Paul as its spiritual father. After the opening paragraphs (i. 1–9) in which the usual sequence of Paul's epistles, as of many simple Greek letters, is followed, the first large section (i. 10–iv. 21) introduces us to conditions at Corinth. First Corinthians shows us the earlier stage of a quarrel, which later, flaring into passion, caused Paul the greatest anxiety, and of which the dying embers still contained fire when Second Corinthians was written. The sensitiveness of the situation can be recognized from the guarded way in which Paul approaches it by reproving a tendency to divide into parties (i. 10–17; iii. 4–9; iv. 6)—of Paul, of Apollos, of Cephas, and perhaps (although his meaning is here disputed) of Christ. This factiousness would, indeed, have been an evil, but the actual topic of the section is in the main a different issue. The vagueness of Paul's allusions is studied, and avoids direct references, but his language shows that he had chiefly in mind certain persons who prided themselves on their eminent possession of the Spirit and vaunted the superiority of their divinely bestowed "wisdom" as well as their excellency of speech, and who set themselves up in outspoken and arrogant personal hostility to Paul. It is against such as these that Paul directs his actual attack, not against the mere division into a Cephas-party of Judaizers like those in Galatia, an Apollos-party of admirers of learning and rhetoric, a Paul-party of personal adherents, and a Christ-party of (for us) undiscoverable aim and character. Sharing, we may suppose, Paul's great principle that believers in the risen Christ have received the Holy Spirit, are a "new creation," and by being withdrawn from the domain of the flesh into that of the Spirit, have become free from obligation to the Law, these persons would appear to have drawn the logical, but impossible, conclusion that moral discipline pertains only to those who walk in the flesh, not to the "spiritual," and that they themselves constituted a body of superior Christians, indeed the only "perfect" Christians. Against such elements, perhaps intruders in Corinth, Paul here extends to the Church, as to beloved children, his warning, in language sharp, ironical, sarcastic. He avoids direct mention of the dangerous would-be leaders, but makes the pregnant observation (iv. 6); "And these things, brethren, I have in a figure transferred to myself and to Apollos." From such an understanding of this section, as furnishing a curiously veiled indication of the ultimate ground of Paul's concern, most of the particular situations outlined in the rest of the epistle become comprehensible. It is only fair to state that most scholars take the division into parties (i. 10–17) more seriously, as a direct reference to a grave evil, and emphasize the conjectured characteristics of the several parties. But under this view it is admitted that these parties cannot be brought into any significant relation to the problems treated later in the First Epistle, while in the Second Epistle the factions are nowhere mentioned—unless it be the Christ-party, the existence of which is highly problematical even for the First Epistle.

From First Corinthians we gain a vivid picture of the experience of a Christian Church in a centre of Greek life. A member of the Church has married his widowed stepmother, an offence detestable even by heathen standards; he must be cut off (v. 1–13). The previous letter from Paul referred to above has been misunderstood (or misrepresented); its real purpose is now clearly explained (v. 9–13). Law-suits between Christians before heathen judges call forth indignant protest (vi. 1–11). Sexual incontinence occurs, and appears to have been excused (as to-day) by various sophistries (vi. 12–20). Marriage presented its problems, some of which the Corinthians had raised in their letter and Paul gives a wide range of advice (vii. 1–40). A great section (viii. 1–xi. 1) is devoted to the question of participation in feasts at heathen temples and in social meals where the guests were offered meat that had been, or might have been, previously employed in heathen sacrifices. Was it a denial of the faith to eat such food or not? The scrupulous, or "weak," made it a religious principle to abstain; the "strong" denied that such food differed from other food. Paul sides with neither and gives well-balanced counsel.

A certain degree of emancipation of women under the principle of Christian equality raised problems (xi. 2–16, xiv. 34–36); the observance of the Lord's Supper in connection with a meal in the proper sense had been the occasion of indecorous practices degrading the sacramental solemnity (xi. 17–34). The "gifts of the Spirit," that is, unusual powers and capacities possessed by Christians, are treated at length (xii.–xiv.), because it was claimed that the "gift of tongues" (a semi-ecstatic unintelligible speech manifesting itself in praise and prayer at Christian meetings) entitles its possessors to a consciousness of God's special favour. (*See* TONGUES, GIFT OF.) The answer is that the "gifts" are valuable in proportion to their usefulness to others, and that love, from which graces of character proceed, is superior to any of them (xiii.). The only theological topic treated with any fullness comprises questions about the resurrection (xv.), evidently raised by Gentiles for whom Jewish conceptions made difficulty. The last chapter of the epistle (xvi.) is occupied with personal matters, including the collection of money for the Jerusalem brethren and Paul's plans for a visit at Corinth.

SECOND EPISTLE TO THE CORINTHIANS

After the despatch of First Corinthians Paul left Ephesus and went to Macedonia (Acts xx. 1; 2 Cor. ii. 13), and there wrote Second Corinthians, probably nearly a year after the earlier epistle. In the meantime exciting events had taken place which (though we can trace them but imperfectly) explain the great difference in tone between the second epistle and the first. While still at Ephesus Paul was led, evidently by the growing insubordination of the Corinthians, to go to Corinth (*cf.* 2 Cor. ii. 1; xii. 14; xii. 21; xiii. 2). On this occasion some insult was offered to the apostle (*cf.* 2 Cor. ii. 5–11; the offender cannot safely be identified with the gross sinner of 1 Cor. v. 1–8), and his adversaries seem to have triumphed for the moment. This visit seems to have been followed by a severe letter (2 Cor. ii. 3, 4, 9; vii. 8, 12), perhaps sent by Titus, whom Paul commissioned to go to Corinth and try to mend matters. In Macedonia, while Paul was in extreme anxiety about the situation (2 Cor. ii. 12, 13), Titus rejoined him with good news of the penitence of the Corinthian Church. The way was now open, and Titus, equipped with Second Corinthians, was sent back to finish his good work and prepare for Paul's own coming (viii. 6, 16–24) by effecting the completion of the collection of money for Jerusalem.

The greater part of the epistle (i.–vii.) consists of an outpouring of Paul's gratitude to God and affectionate feelings for the Corinthians, with defence of his sincerity, explanations of his personal conduct, justification of his procedure and assumption of dignity as an apostle and a minister of the New Covenant, and interpretation of his many sufferings as incurred in God's service. Incidentally he takes occasion to enlarge on various topics, and the whole epistle, though intensely personal and intimate, is full of striking sentences of much significance for Paul's deeper religious thought. After an extended appeal (viii.–ix.) for generosity in their gifts to the collection, which evidently played a large (though to us obscure) part in the whole series of events, the epistle returns to Paul's personal relations. The background of all the earlier chapters (*cf.* iii. 1; ii. 17; v. 12, 13, etc.) is the activity in Corinth of bitter opponents of Paul, and in all probability many of Paul's vehement protestations of probity and affection were called out by their calumnies. They had, indeed, been disavowed by the Corinthian Church, which as a whole he addresses, but nevertheless, in a final appeal for the strengthening of the Corinthians' loyalty (x. 1–xii. 10), he not unnaturally proceeds to meet some of the abusive flings of his enemies, to point out his superiority at the very points which they have chosen for their condescending comparison, and with an emphasis enhanced by his repeated affirmations of reluctance, to reaffirm his dignity as an apostle and unselfish devotion as a minister of Christ. In it all he seems to count on the reader's substantial agreement with his fiery utterances.

These paragraphs of invective leave the motives and principles of the disturbing intruders uncertain. They were Jews (xi. 22), but nothing suggests an effort like that in Galatia, probably much earlier, to induce these Gentile Christians to subject themselves to circumcision and the Jewish law. This would have been so vital an issue that somewhere in this long epistle Paul would surely have made unmistakable reference to it. To call the opponents "Judaizers" is not justified. The intolerable arrogance of these "very chiefest apostles" with their "letters of commendation" (doubtless from some other Church) is their clearest trait. They seem to have charged Paul with walking "according to the flesh" (x. 2), not "according to the spirit," and they perhaps prided themselves on their superior "knowledge" (xi. 6). In the earlier part of the epistle Paul repels with an almost angry rejoinder the accusation of "hiding his gospel" (iv. 2–4) and of having "known Christ after the flesh" (v. 16), and the most reasonable theory of the matter is that the opponents were persons who believed themselves completely transformed by the Spirit, a "new creation," possessing divine gifts of knowledge, and who regarded Paul's attitude of conservative good sense and practical insistence on moral discipline as the half-way hesitancy of a teacher recreant to his announced principles. Although of Jewish origin they were in thought and piety much further removed from Judaism than was Paul. On this theory their character clearly coincides with that of the persons against whom 1 Corinthians i. 18–iv. 13 is really levelled, and from this point of view Second Corinthians throws a good deal of light on First Corinthians. The concluding paragraphs of Second Corinthians (xii. 11–xiii. 13) explain why Paul has written as he has—partly to demonstrate the inferiority in every way of these "apostles," partly to ensure that his approaching visit shall find the Corinthians under no mistake either as to his power to be severe or as to his affectionate desire to render them helpful service. Paul's success is attested by the calm tone of the Epistle to the Romans, written at Corinth in the following spring, and by the reverence felt for Paul at Corinth some 35 years later (Clement of Rome, *c.* A.D. 95).

CRITICAL QUESTIONS

The use of first Corinthians by early writers, from Clement of Rome on, is abundant; that of Second Corinthians is sufficient; and the external and internal evidence together leave no doubt as to the genuineness of both epistles. In Second Corinthians the right of vi. 14–vii. 1 to its present position has been challenged, but the arguments to show that the passage is drawn from some other lost epistle of Paul are not convincing. The view that 2 Cor. x.–xiii. is drawn from a different letter, possibly the intermediate letter preceding Second Corinthians, has found favour (more in England and America than in Germany), and is supported by the obvious increase of tensity of feeling in these chapters and by a supposed difference of implied situation, together with other more special arguments; but to other scholars the chapters seem not inappropriate as the conclusion of this epistle. Full discussion of these questions will be found in the works named below.

BIBLIOGRAPHY.—Besides Lives of Paul and works on New Testament Intro. (esp. J. Moffatt's *Introduction*) and on the Apostolic Age, *see* W. Lütgert, *Freiheitspredigt und Schwärmgeister in Corinth* (1908); Kirsopp Lake, *The Earlier Epistles of St. Paul* (1911); E. von Dobschütz, *Christian Life in the Primitive Church* (1902; Eng. trans. 1904); F. W. Robertson, *Sermons on St. Paul's Epistles to the Corinthians* (1859). Commentaries. In English: H. A. W. Meyer (5th ed. 1870; Eng. trans. 1887); A. Robertson and A. Plummer (Internat. Crit. Comm., 1911, 1915). In German, J. Weiss (1 Cor.; Meyer's Kommentar, 9th ed. 1910; a notable contribution); H. Windisch (2 Cor.; Meyer's Kommentar, 9th ed. 1924); H. Lietzmann (Handbuch zum N. T., 2nd ed. 1923). (J. H. Rs.)

CORINTO, chief seaport of Nicaragua, Central America, terminus of the Pacific Ry., which serves the capital and the principal towns of western Nicaragua between Puerto Morazán on the Gulf of Fonseca and Granada on Lake Nicaragua. Pop. of *municipio* (1940) 4,876. It is built on a small, sandy island of the same name at the entrance of Realejo bay. The island, 87 mi. from Managua, is connected to the mainland by a bridge. About

75% of the foreign commerce of Nicaragua passes through Corinto, which is normally a port for lines running from the west coast of North America to Panamá, South America, and the east coast of North America.

The city lies on the shore side of the island, furnishing practically the only sheltered port on the Pacific coast of Central America, with the exception of La Unión, Salvador, and Amapala, Honduras, both on the Gulf of Fonseca. A semicircular pier, with rail and warehouse facilities, extends out into deep water. The principal exports are coffee, sugar, hides, cattle, woods and gold.

CORIOLANUS, GAIUS or **GNAEUS, MARCIUS,** early Roman hero of patrician descent. According to tradition, his surname was due to his bravery at the siege of Corioli (493 B.C.) in the war against the Volscians (but *see* below). In 492, when there was a famine in Rome, he advised that the people should not share the corn obtained from Sicily unless they would consent to the abolition of their tribunes. For this he was accused by the tribunes, and, being condemned to exile, took refuge with the king of the Volscians and led the Volscian army against Rome. In vain the Romans prayed for moderate terms. He would agree to nothing less than the restoration to the Volscians of all their land and their admission among the Roman citizens. A mission of the chief priests also failed. At last, persuaded by his mother and his wife, he led back the Volscian army and restored the conquered towns. He died at an advanced age in exile amongst the Volscians; according to others, he was put to death by them as a traitor; a third tradition (mentioned, but ridiculed, by Cicero) represents him as having taken his own life.

The legend is open to serious criticism. At the traditional date (493 B.C.) Corioli was not a Volscian possession, but a Latin city in alliance with Rome; further, Livy himself states that the chroniclers knew nothing of a campaign against the Volscians in which Coriolanus is said to have served. The conquest of Corioli by Coriolanus seems to have been invented to explain the surname. The details of the famine are borrowed from those of later years, especially 433 and 411, while the flight of Coriolanus to the Volscian king bears a suspicious likeness to the story of Themistocles. It is suggested that the historical nucleus of the tradition is an attack on Rome by Herdonius *c.* 443, when the city was in distress, perhaps as a result of pestilence.

See Plutarch's *Life;* Livy ii. 34–40; Dion. Halic. vi. 92–4, vii. 21–7, 41–7, viii. 1–60; Cicero, *Brutus,* x. 42. The story is the subject of Shakespeare's *Coriolanus.* For a critical examination of the story *see* Schwegler, *Römische Geschichte,* bk. xxiv.; Sir G. Cornewall Lewis, *Credibility of Early Roman History,* ch. xii. 19–23; W. Ihne, *History of Rome,* i.; T. Mommsen, "Die Erzählung von Cn. Marcius Coriolanus," in *Hermes,* iv. (1869); E. Pais, *Storia di Roma,* i. ch. 4 (1898).

CORIOLI, an ancient Volscian city in *Latium adiectum,* taken, according to the Roman annals in 493 B.C., with Longula and Pollusca, and retaken for the Volsci by Gaius Marcius Coriolanus, its original conqueror, who, in disgust at his treatment by his countrymen, had deserted to the enemy. After this it does not appear in history, and we hear soon afterwards (443 B.C.) of a dispute between Ardea and Aricia about some land which had been part of the territory of Corioli, but had at an unknown date passed to Rome with Corioli. The site cannot be accurately fixed and even in the time of Pliny it ranked among the lost cities of Latium. *See* CORIOLANUS.

CORIPPUS, FLAVIUS CRESCONIUS, Roman epic poet of the 6th century A.D. He was a native of Africa, but is not to be identified with the 7th century bishop of the same name. He is known only from his own poems. He appears to have held the office of tribune or notary (*scriniarius*) under Anastasius, imperial treasurer and chamberlain of Justinian, at the end of whose reign he left Africa for Constantinople, having lost his property during the Moorish and Vandal wars. He was the author of two poems, one of which was not discovered till the beginning of the 19th century. This poem, which comes first in point of time, is called *Iohannis* or *De bellis Libycis,* and relates the overthrow of the Moors by a certain Johannes, *magister militum* in 546; it is in eight books (the last is unfinished) and contains about 5,000 hexameters. The other poem (*In laudem Iustini minoris*), in four books, contains the death of Justinian, the coronation of his successor, Justin II. (Nov. 14 565), and the early events of his reign. It is preceded by a preface, and a panegyric on Anastasius. The *Laus* was published at Antwerp in 1581 from a 9th or 10th century ms. The preface contains a reference to a previous work by the author on the wars in Africa; it was not till 1814 that this was discovered at Milan by Cardinal Mazzucchelli, librarian of the Ambrosian library, from the codex Trivultianus (in the library of the marquis Trivulzi), the only ms. of the *Iohannis* still extant.

The *Iohannis* is of great value, as giving a description of the land and people of Africa; a number of its statements as to manners and customs are confirmed by independent ancient authorities and by our knowledge of the modern Berbers. The *Laus* throws much light upon Byzantine court ceremony, as in the account of the accession of Justin and the reception of the embassy of the Avars. The language and metre of Corippus are remarkably pure.

The editions of the *Iohannis* by P. Mazzucchelli (1820) and of the *Laus* by P. F. Foggini (1777) are still valuable for their commentaries. They are both included in the 28th vol. of the Bonn *Corpus scriptorum historiae Byzantinae.* The best modern editions are by J. Partsch (in *Monumenta Germaniae historica,* 1879), with very valuable prolegomena, and M. Petschenig (*Berliner Studien für klassische Philologie,* iv., 1886); *see* also Gibbon, *Decline and Fall,* ch. xlv.

CORISCO, the name of a bay and an island on the Guinea coast, West Africa. The bay is bounded north by Cape San Juan (1° 10′ N.) and south by Cape Esterias (0° 36′ N.), and is about 31m. across, while it extends inland some 15 miles. The bay is much encumbered with sandbanks, and the southern entrance to it is obstructed by the Bana bank, which extends for 9 miles. The bay encloses many small islands and islets, some submerged at high water, giving rise to a native saying that "half the islands live under water." The principal islands are Corisco, and Great and Little Elobey; they were annexed to Spain in 1846.

Corisco island is the largest of the group, with an area of approx. 5½ sq.mi. Maximum elevation above the sea is less than 100 ft. There is great variation in conditions on the island, ranging from swampland to forest or grassland. Forest products are ebony and logwood, with construction of boats or canoes a local industry. The natives gain their livelihood through both fishing and agriculture. Pop. *c.* 650; it is steadily declining. The natives are a Bantu-Negro tribe called Benga. Corisco has a Catholic mission house classed as one of the most pretentious in the area. Little Elobey (area: 35 ac.), with a climate better than that of neighbouring islands, is devoted to coco-nut culture. Pop. (also declining) 10 Europeans and 130 natives. Great Elobey (area *c.* .6 sq.mi.; pop. 120) is similar to Corisco in general conditions. The islands are in the Kogo governmental district.

See E. L. Perea, "Guinea española: La isla de Corisco," in *Revista de geog. colon. y mercantil* (Madrid, 1906); *Anuario-guia Oficial de Marruecos* (Madrid, 1928); *Spanish Guinea* (Brit. For. Off. 1920).

CORK, RICHARD BOYLE, 1ST EARL OF (1566–1643), Irish statesman, was born at Canterbury on Oct. 3, 1566, and educated at King's school and Bennet (Corpus Christi) college, Cambridge. He afterwards studied law at the Middle Temple, and, settling in Dublin, became escheator to John Crofton, the escheator-general. On losing his rapidly acquired fortune during the rebellion in Munster, in Oct. 1598, Boyle returned to England, was taken into the service of Essex, and after successfully repudiating before the Star Chamber various accusations, won the graces of Elizabeth, who made him clerk of the council of Munster.

In 1602 Boyle bought for £1,000 the whole of Sir Walter Raleigh's lands in Cork, Waterford and Tipperary. On these 12,000 acres he established manufactures and the mechanical arts, opened mines, built bridges and roads, settled towns, and generally resuscitated a war-devastated country. In 1603 he married his second wife, Catherine Fenton, daughter of the secretary of State, and was knighted. In 1606 he became a privy councillor for Munster, and in 1613 for Ireland. Three years later he became Lord Boyle, baron of Youghal, and in 1620 was created earl of Cork and Viscount Dungarvan. He was appointed a lord justice in 1629 and lord high treasurer in 1631. The appointment of Wentworth (Lord Strafford), however, as lord deputy in 1633 ended the power of Cork in Ireland. Wentworth forced him to remove his wife's tomb from the choir in St. Patrick's, Dublin, and arbitrarily deprived him of much of the revenue from Youghal, a part of the Raleigh estates. In Wentworth's fall, Cork played no retaliatory part. His last service to the State was his repression of the Munster rebellion. Cork died on Sept. 15, 1643.

Four of his seven sons received independent peerages—Richard (d. 1698) created Baron Clifford and earl of Burlington (he inherited his father's title and from 1680–95 was lord treasurer of Ireland); Lewis, Viscount Kinalmeaky, killed at the battle of Liscarrol (1642); Roger, baron of Broghill and earl of Orrery; and Francis, Viscount Shannon. Another son was Robert Boyle (*q.v.*), the famous natural philosopher and chemist.

In 1753 the earldom of Cork fell to the younger branch of the family, in the person of John, 5th earl of Orrery, he and later earls being "of Cork and Orrery." John, who was born on Jan. 2, 1707, and died on Nov. 16, 1762, translated the *Letters of Pliny the Younger,* and published *Remarks on the Life and Writings of Jonathan Swift* and *Memoirs of Robt. Carey, earl of Monmouth.* The earldom is now held by the 10th earl (b. 1861). The wife of the 7th earl (*see* CORK AND ORRERY, MARY, COUNTESS OF) was famous in early 19th century society.

BIBLIOGRAPHY.—*True Remembrances,* written by the 1st earl and published in Birch's ed. of the works of Robert Boyle; *Lismore Papers,* ed. A. B. Grosart (10 vols. 1886–87), the first series containing the diary and autobiographical notes and the second the correspondence; D. Townshend, *Life of Lord Cork* (1904); Strafford's *Letters; Calendars of State Papers, Domestic and Irish,* and *Carew Papers;* E. Budgell, *Memoirs of the Boyles* (1737) and E. Edwards, *Life of Raleigh* (1868).

CORK, a county of Eire, in the province of Munster, bounded south by the Atlantic ocean, east by the counties Waterford and Tipperary, north by Limerick, and west by Kerry. It is the largest county in Eire, having an area of 2,880 sq.mi. Pop. (1936), 355,957.

The physical structure is closely related to the "Hercynian" folds. In the north the Old Red sandstone may be seen in the Bally Loura hills, and in the western spur of the Knockmealdown mountains. To the south of this line occur carboniferous limestone, millstone grit and coal-measures, now forming the valley of the Blackwater. Between this river and the Lee the Old Red sandstone reappears, the chief heights being the Boggeragh mountains (Musheramore, 2,118 feet). In the lower Lee valley, and extending to the east beyond Midleton, are carboniferous limestone and limestone shales. Some of the limestone here has become crystalline, veined and brecciated, while a fine red staining, especially at Little Island, adds to its value as a marble. After another anticlinal of the Old Red sandstone, the Carboniferous slate occupies most of the country southward, with occasional appearances of the basal Coomhola grits and of the underlying Old Red sandstone along anticlinals. The rivers, especially the Blackwater, provide excellent examples of river capture.

There are several Ogham stones scattered throughout the county and also two round towers, one opposite Cloyne cathedral, the other at Kinneigh. The remains of the old ecclesiastical buildings, of which the chief are Kilcrea, Timoleague church and Buttevant abbey, are, on the whole, in a very ruinous condition. Many of the vantage points have castles in varying degrees of preservation. At Kilcolman castle, near Doneraile, the "Faerie Queene" was written by Spenser.

Cork is one of the counties which is generally considered to have been instituted by King John. Its existing boundaries include part of the ancient territory of Desmond (*q.v.*), which, in the latter half of the 16th century, ranked as a separate county. In 1598, however, there were two sheriffs in the county Cork, one especially for Desmond, which was then included in Cork, but was afterwards amalgamated with the county Kerry. In the same period lands in the county were given to settlers under the Crown, and among these were Sir Walter Raleigh and Edmund Spenser the poet. Richard Boyle, 1st earl of Cork, had large areas colonized with English settlers; and by founding or rebuilding the towns of Bandon, Clonakilty, Baltimore, Youghal, and afterwards those of Midleton, Castlemartyr, Charleville and Doneraile, which were incorporated and made parliamentary boroughs, the family of Boyle became possessed of nearly the entire political power of the county.

The soils vary from sandy loams, usually on the higher ground, to stiff clays along the limestone hollows. Agriculture is important in the river valleys and on the coastal plains; oats, potatoes and turnips being the principal crops.

The county has been famous for its copper-mines, notably at Allihies in the extreme west. The region south-west of Bantry has been mined in several places. Both gold and silver have been found in the copper-ores of this latter area. Barytes has been mined near Bantry, Schull and Clonakilty, and manganese-ore at Glandore. Anthracite has been raised from time to time in the band of coal measures south-west of Kanturk. The marble of Little Island near Cork is quarried under the name of "Cork Red," and the veined pink and grey marble of Midleton is also much esteemed.

Dairies are numerous, and Cork butter and farmyard produce are noted for their quality. Youghal, Kinsale, Queenstown, Castletown and Bearhaven are the deep-sea and coast fishing district centres of the county; while the salmon fishing is distributed among the districts of Cork, Bandon, Skibbereen and Bantry. The mackerel fishery is especially productive from mid-March to mid-June. The Blackwater, Lee and Bandon, apart from the netting industry, afford good rod-fishing for salmon and trout.

Blackrock, Passage, Monkstown, Queenstown, and other waterside villages in the vicinity of Cork, together with Bantry, Baltimore, Kinsale, Glengarriff and Youghal are much frequented during the summer months.

The county is served by lines of the Great Southern railway radiating from Cork. A gap to the north of that city has facilitated communications with central Ireland, whilst the valleys of the Bride, a tributary of the Lee and the Bandon have been utilized for western routes. To the east the coastal plain is followed by the line to Midleton and Youghal. Branch lines serve the towns of the south coast.

There are three electoral areas—North Cork, West Cork and South-East Cork. The first-named returns four members, the second five and the last three members to Dáil Eireann.

CORK, county borough and seaport of Co. Cork, Eire, at the head of the inlet of Cork Harbour, on the river Lee, 165½ m. S.W. of Dublin by the Great Southern Railway. Pop. (1936) 80,765. Until the middle of the 19th century it ranked second only to Dublin, but is now surpassed by Belfast in commercial importance. It is an important centre of the Great Southern Railway system. There are regular steamer routes to British ports.

The nucleus of the city occupies an island formed by the North and South Channels, two arms of the river Lee, and in former times no doubt merited its name, which signifies a swamp.

The original site of Cork seems to have been in the vicinity of the Protestant cathedral; St. Finbar's ecclesiastical foundation attracting many students and votaries. In the 9th century the town was frequently pillaged by the Northmen. According to the *Annals of the Four Masters* a fleet burned Cork in 821; in 846 the Danes appear to have been in possession of the town, for a force was collected to demolish their fortress; and in 1012 Cork again fell in flames. The Danes then appear to have founded a trading centre on the banks of the Lee. It was anciently surrounded with a wall, an order for the reparation of which is found as late as 1748 in the city council books (which date from 1610). The town submitted to Henry II. in 1172, and was subsequently held by the English for a long period. Cork showed favour to Perkin Warbeck in 1492. In 1649 it surrendered to Cromwell and in 1689 to the earl of Marlborough. It was a borough by prescription, and successive charters were granted to it from the reign of Henry II. onward. By a charter of Edward IV. the lord mayor of Cork was created admiral of the port. The island still includes many of the principal thoroughfares.

Bridges across the North and South Channels connect it with later extensions of the city. Public grounds are few, but on the outskirts are a park and race-course. The Mardyke walk, on the west of the island, was the site of the international exhibition held in 1902. Both branches of the Lee are lined with quays.

The Protestant cathedral, founded in 1865, is built in the Early French (pointed) style, with an eastern apse and a striking west front. Dedicated to St. Fin Barre or Finbar, who founded the original cathedral in the 7th century, it is situated in the southwest part of the city, and replaces a structure erected in 1735 on the site of the ancient cathedral, which suffered during the siege of Cork in Sept. 1689. The Roman Catholic cathedral, also dedicated to St. Finbar, is conspicuous on the north side of the city; it dates from 1808, but has been since restored. The court house in Great George's street has a Corinthian portico. The custom-house commands the river at the lower junction of the branches. The commercial and public buildings are mainly on the island. The most notable educational establishment is the University college. Founded as Queen's college under an Act of 1845, it became a constituent college of the National University of Ireland in 1908. Built in Tudor style, it stands near the river in the west of the city, where Gill abbey, of the 7th century, formerly stood. The Cork library (founded 1790) contains a valuable collection of books. The Royal Cork Institution (1807), in addition to a library and a rare collection of oriental mss., possesses a valuable collection of minerals, and collections of casts from the antique.

The harbour, sheltered by many islands, is considered one of the finest natural harbours in the kingdom. Military depots occupy several of the smaller islets, and batteries guard the entry. This is about 1 mi. wide, but within the width increases to 3 mi. while the length is about 10 mi. The Atlantic port of Queenstown (*see* Cobh) is on Great Island at the head of the outer harbour. Tivoli (the residence of Sir Walter Raleigh), Fort William, Lota Park and Blackrock castle are notable features on the shore; and Passage, Blackrock, Glenbrook and Monkstown are waterside resorts. Trade is mainly with Bristol and the ports of south Wales. The imports include wheat and maize, while the exports are chiefly of cattle, provisions, butter and fish. The Cork Butter exchange was important in the early part of the 17th century, and the present market was founded in 1769. There are distilleries, breweries, tanneries and iron foundries, and manufactures of woollen and leather goods, tweeds, friezes, gloves and chemical manure. Cork's industrialization advanced as a result of de Valera's self-sufficiency policy. There are large tractor works in the city. Nearly six-sevenths of the population are Roman Catholics. During the troubles of 1919–20 there were riots in and near the city, and the city hall and Carnegie library were burned during reprisals. The government of Cork is by a manager and an elected council. The county borough of Cork returns four members to Dáil Eireann.

CORK, the outer layer of bark of an evergreen oak (*Quercus suber* and a subspecies, *Quercus suber occidentalis*). The adult tree averages 30 to 40 ft. in height and grows in the south of Europe and on the North African coasts. Annual production varies from 275,500 to 330,500 short tons, of which more than 90% comes from Portugal, Spain, Algeria, Morocco and Tunisia. The outer layer of bark of the cork oak by annual additions from within gradually becomes a thick soft homogeneous mass, possessing those compressible and elastic properties upon which the economic value of the material chiefly depends. The bark of most trees contains cork cells but only in the cork oak are these cells in layers of sufficient thickness to be of commercial importance. In some cases, as on young shoots of the cork elm, the development is irregular and winglike outgrowths of cork are formed. In northern U.S.S.R. a method similar to that used for obtaining cork from the cork oak is employed with the birch. In Brazil, several native trees, of which the Pao Santo is the most common, produce a bark which can be used for the manufacture of cork-like products. The bark of the Japanese Abemaki is an inferior cork substitute. Considerable experimenting has been done in the United States with the bark of the Douglas fir, which contains corky flakes.

The first stripping of the cork oak occurs when the trees are from 15 to 20 yr. of age. The yield, which is rough and somewhat woody in texture, is called virgin cork and is used principally for the manufacture of cork insulation and isolation products. Subsequently the bark is removed every 8 or 10 yr., the quality of the cork (known as reproduction cork) improving with each successive stripping through the 5th or 6th, whereupon quality remains fairly stable. The trees continue to live and thrive under the operation for 150 yr. more or less. Much of the 2nd and subsequent strippings or barkings is of a low grade known as refugo, which, like virgin, is ground up for the manufacture of insulation and composition cork products.

The operation of stripping the trees takes place during June through August. Two cuts are made round the stem—one a little above the ground, and the other immediately under the spring of the main branches. Between these cuts three or four longitudinal incisions are then made, the utmost care being taken not to injure the inner bark. The cork is thereafter removed in the sections into which it has been cut, by inserting under it the wedge-shaped handle of the stripping axe used in making the incisions. The lower limbs of the larger and older trees are also stripped, especially in years of high cork prices. The structural part of the cork oak which is hard and dense has a very limited use as lumber because of its tendency to check and crack. The wood of old and fallen trees makes excellent charcoal, and charred or calcined cork ground into a very fine dead black powder is the pigment known as Spanish black.

Cork possesses a combination of properties which peculiarly fits it for many and diverse uses, for some of which it alone is found applicable. Most of its distinctive properties result from the fact that it is completely cellular in structure. A one-inch cube of natural cork contains approximately 200,000,000 tiny air-filled cells, so that slightly more than 50% of the volume of a piece of cork is accounted for by the captive air within the cells. This cellular structure results in cork having a specific gravity of only .25 and accounts for its buoyancy, compressibility, elasticity and relatively high degree of imperviousness to both air and water penetration as well as for a high coefficient of friction and a low thermal conductivity value.

Like most products of nature, cork in its natural state has very few uses, and these are relatively unimportant as witness the use of virgin cork by florists for decoration and rustic work. It is as the raw material for an industry that the bark of the cork oak assumes importance and economic significance. Until about the end of the 19th century, cork was used almost entirely for the manufacture of bottle stoppers and bungs and a variety of natural cork articles including life preservers, floats and buoys, hat linings and shoe soles, the latter use dating back to ancient Rome. The manufacture of all these products continues, but during the decade 1900–10, the character of the cork industry was completely changed from that of a relatively simple cork-cutting trade to that of a much more complex industry, the principal products of which result from grinding up and then combining under heat and pressure the lower qualities of cork such as the virgin and refugo referred to above and the by-product scrap from the natural cork product manufacture. This transformation of the cork industry was partly the cause and partly the effect of a number of economic changes which revolutionized the technique in whole industries. For example, the invention and manufacture of insulation corkboard completely altered cold-storage construction and usage by providing an efficient insulating material to take the place of such makeshift materials as sawdust, shavings, hay, cinders and charcoal. Again, the composition cork gasket helped make possible the mass production technique of the automobile industry which required the substitution of parts stamped out of sheet steel for heavy, expensive castings with machined faces. In similar fashion, the transformation of the cork industry was both a cause and effect factor in the development of the beverage and food packing industries, so that in order of economic importance, the industry's leading products became:

Insulation Corkboard, pipe covering and ground cork and isolation corkboard are used extensively as low-temperature insulation in cold storages, photographic material and gasoline and synthetic rubber plants, air-conditioning installations, in ship and submarine construction and for deadening or dampening vibrations and sound. Insulation corkboard is one of the most efficient forms of low-temperature insulation and has a thermal conductivity coefficient (k) of only $0.275\pm$ under the usual operating conditions.

Composition Cork Products.—Made of finely ground cork with a binder, these products include automotive engine and equipment gaskets, beverage and food cap liners, shoe fillers and inner soles, polishing wheels, road joint material, textile spinning cots, cigarette tips and numerous other specialty products.

Cork Stoppers.—The well-known closures used on bottles, jars, jugs, casks and kegs, commonly called "corks," were a development, apparently, of the 15th century. The stopper division of the cork industry also makes a wide variety of natural-cork specialty products including clutch corks, carburetor and tank floats, handle grips and badminton "birds."

Cork Marine Products.—These include life preservers, ring and mooring buoys, floats and fenders. The use of cork as a buoyant material was so common among the ancient Romans that the Latin phrase *nare sine cortice* meaning literally "to swim without (the use of) cork" came to mean idiomatically "to need no (more) assistance."

Floor and Wall Covering Material and Miscellaneous.—Ground cork in the form of linoleum, cork tile, cork carpet and cork brick is one of the most widely used materials for floor and wall covering. Among a number of miscellaneous cork products are cork insulating brick, steel ingot insulation (to reduce the wasteful cavity which forms in cooling) and synthetic rubber and plastic products containing cork. Before World War II, the U.S.S.R. imported French cork oak acorns for experimental planting in the Caucasus, and the possibility during 1941–43 that the United States might be completely cut off from its Mediterranean cork sources resulted in a large expansion in a cork planting project in California and several other southwestern states sponsored by one of the large American cork companies with state and federal government co-operation.

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(A. L. F.)

CORK AND ORRERY, MARY, COUNTESS OF (Mary Monckton) (1746–1840), was born on May 21, 1746, the daughter of the first Viscount Galway. Through her influence her mother's house in London became a favourite meeting-place of literary celebrities. Dr. Johnson was a frequent guest. Sheridan, Reynolds, Burke and Horace Walpole were among her constant visitors, and Mrs. Siddons was her closest friend. In 1786 she married the 7th earl of Cork and Orrery, who died in 1798. As Lady Cork she was an even more famous hostess. Among her regular guests were Canning and Castlereagh, Byron, Sir Walter Scott, Lord John Russell, Sir Robert Peel, Theodore Hook and Sydney Smith. She is supposed to have been the original of Lady Bellair in Disraeli's *Henrietta Temple,* and Dickens is believed to have drawn on her for some of the peculiarities of Mrs. Leo Hunter in *Pickwick.* She died in London on May 30, 1840.

CORKWOOD, the name given to several tropical American trees and shrubs with light porous wood, especially to the alligator-apple or pond-apple (*Annona glabra*), found in the Everglades of Florida and widely in the tropics; the magaguabush (*Hibiscus tiliaceus*) of the Florida Keys, the West Indies and other warm regions; and the balsa (*Ochroma Lagopus*), widespread in tropical America. The North American corkwood (*Leitneria floridana*), a small tree with pale yellow wood, is confined to semi-tropical swamps in Florida and Texas and to muddy sloughs in southeastern Missouri. In New South Wales, a tree, *Duboisia myoporoides,* of the nightshade family (Solanaceae), is called corkwood. The buoyant wood of these trees is utilized for floats and numerous other purposes, especially that of the balsa (*q.v.*).

CORLEONE, a town of Sicily, province of Palermo, 42m. S. of Palermo by rail and 21m. direct, 1,949ft. above sea-level. Pop. (1936) 14,197 (town); 14,725 (commune). The town was a Saracen settlement, but a Lombard colony was introduced by Frederick II. Two mediaeval castles and some churches are of interest.

CORLEY MOUNTAIN HIGHWAY, a thoroughfare that begins at Colorado Springs and ends at Cripple Creek, Colo., covers 45m. of unusual mountain scenery. It was built along the railroad bed of the old Cripple Creek Short Line, now abandoned, and leads to what formerly were the greatest gold-mining camps of the world.

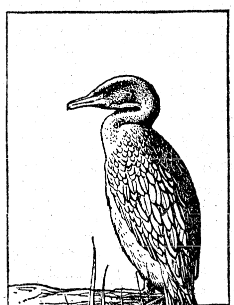
CORMENIN, LOUIS MARIE DE LA HAYE, VICOMTE DE (1788–1868), French jurist and political pamphleteer, was born in Paris on Jan. 6, 1788, and died there on May 6, 1868. The son of a State official, he became auditor of the council of State (1810) under Napoleon I., and after the Bourbon restoration master of requests. To this period of his life belongs his most important work as a jurist, his *Questions de droit administratif* (1822; 5th rev. ed., 1840), in which he gave scientific shape to the scattered elements of administrative law. In 1828 he entered politics, and became a most effective political pamphleteer on behalf of civil liberty, universal suffrage and other causes. His pamphlets were at first issued under the pseudonym of "Timon," and had an enormous circulation. Cormenin sat in the chamber of deputies from 1828 to 1846, when he lost his seat by his tracts on behalf of religious liberty—*Oui et non* (1845) and *Feu! Feu!* (1846). After the Revolution of 1848 he was one of the vice-presidents of the constituent assembly, and for some time president of the constitutional commission for drafting the republican constitution. Nevertheless he accepted office under the Empire. Among Cormenin's best works are *Livre des orateurs* (1838; 18th ed., 1860), containing studies of the great orators of the restoration and the reign of Louis Philippe, and the *Entretiens du village* (1846).

CORMON, FERNAND (1845–1924), French historical and portrait painter, was born in Paris in 1845 and died there in 1924. He became a pupil of Cabanel, Fromentin and Portaels, and at an early age attracted attention by the better class of sensationalism in his art, as in the "Murder in the Seraglio" (1868) and the "Death of Ravara, Queen of Lanka," at the Toulouse Museum. The Luxembourg has his "Cain flying before Jehovah's Curse"; and for the Mairie of the fourth arrondissement of Paris he executed in grisaille a series of Panels: "Birth," "Death," "Marriage," "War," etc.

CORMONTAIGNE, LOUIS DE (*c.* 1697–1752), French military engineer, was born at Strasbourg. He was present as a volunteer at the sieges of Freiburg and Landau in the later years of the War of the Spanish Succession, and in 1715 he entered the engineers. After being stationed for some years at Strasbourg he became captain, and was put in charge (at first in a subordinate capacity, and subsequently as chief engineer) of the new works, Forts Moselle and Bellecroix, at Metz, which he built according to his own system of fortification. He was present at the siege of Philipsburg in 1733, and took part in most of the sieges in the Low Countries during the War of the Austrian Succession. His *Architecture militaire,* written in 1714, was long kept secret by order of the authorities, but, an unauthorized edition having appeared at The Hague in 1741, he himself prepared another version called *Premier mémoire sur la fortification,* which from 1741 onwards was followed by others. His ideas are closely modelled on those of Vauban (*q.v.*). It was not until 20 years after his death that his system became widely known. Fourcroy de Rainecourt, then chief of engineers, searching the archives for valuable matter, chose the numerous memoirs of Cormontaigne for publication amongst engineer officers in 1776. The *Oeuvres posthumes de Cormontaigne* (1806–09) were edited by Fourcroy and La Fitte de Clavé.

See Von Brese-Winiari, *Über Entstehen . . . der neueren Befestigungsmethode* (1844); Prévost du Vernois, *De la fortification depuis Vauban* (1861); Cosseron de Villenoisy, *Essai historique sur la fortification* (1869).

CORMORANT, a sea-bird of the genus *Phalacrocorax* and the family *Phalacrocoracidae.* The cormorant (*P. carbo*) is distributed throughout the world. It frequents the sea-coast of Europe, and breeds in societies at various stations, generally on steep cliffs. The nest consists of a large mass of sea-weed. The eggs, from four to six in number, are small, and have a thick, soft, calcareous shell, bluish-white when first laid, but soon becoming discoloured. The young are hatched blind, and covered with an inky-black skin. As squabs they are highly esteemed for food by the northern islanders. Their first plumage is of a sombre brownish-black above, and more or less white beneath They take two or three years to assume the fully adult dress, which is deep black, glossed above with bronze, and varied in the breeding season with white on the cheeks and flanks, besides being adorned by filamentary feathers on the head, and a bright yellow gape. The brilliant gape is displayed in courtship. The flesh of the adult is uneatable.



BY COURTESY OF THE LONDON ZOOLOGICAL SOCIETY

THE CORMORANT, A SEA BIRD TRAINED BY THE CHINESE TO CATCH FISH IN SHALLOW RIVERS

Taken from the nest, this bird is easily tamed and can be trained to fish for its keeper, as was of old time commonly done in England, where the master of the cormorants was one of the officers of the royal household. The practice is nearly obsolete in Europe, though still common in China. A strap is fastened round the bird's neck so as, without impeding its breath, to hinder it from swallowing its captures. The activity the bird displays under water is almost incredible. *See* Salvin and Freeman, *Falconry* (1859).

Nearly allied to the cormorant, and having much the same habits, is the shag, or green cormorant (*P. graculus*). The shag is about one-fourth smaller, is much more glossy in plumage, and its nuptial embellishment is a nodding plume. Its tail feathers number 12 instead of 14.

In the south of Europe a much smaller species (*P. pygmaeus*) is found. This is a fresh-water bird. Further species, to the number of more than 30, have been discriminated from other parts of the world, but all have a great similarity; New Zealand and the west coast of northern America are particularly rich, and the species found there are the most beautifully decorated of any. All are remarkable for their curiously formed feet with all four toes connected by a web, for their long, stiff tails, and for the absence, in the adult, of any exterior nostrils. When gorged they are fond of sitting on an elevated perch, with extended wings, and in this attitude they will remain motionless for a considerable time. Their voracity is proverbial.

Besides the common cormorant, the crested cormorant (*P. auritus*) is found in the eastern United States, with a more southerly distribution.

CORN, originally meaning a small hard particle or grain, as of sand, salt, gunpowder, etc. It thus came to be applied to the small hard seed of a plant, as still used in the words barleycorn and peppercorn. In agriculture it is generally applied to the seed of the cereal plants. It is often locally understood to mean that kind of cereal which is the leading crop of the district; thus in England it refers to wheat, in Scotland and Ireland to oats, and in the United States to maize (Indian corn). (*See* GRAIN PRODUCTION AND TRADE; CORN LAWS; AGRICULTURE; WHEAT; MAIZE; etc.). The term "corned" is given to a preparation of meat (especially beef) on account of the original manner of preserving it by the use of salt in grains or "corns."

The differences in the application of the word corn in various countries and districts have sprung from the nature of the favourite grain-crop in the locality. "Corn in Egypt" is a world-wide expression for plenty. When first used, it probably meant wheat, but may have meant barley as well, the only two cereals in cultivation in contemporary civilizations. In Britain, where the only cereals widely grown are wheat, barley and oats, "corn" has come to mean two things. It is either a generic term for these three cereals, though it would also cover maize and rye, or it is a synonym for wheat alone; and wheat has generally been regarded in Britain, as in many other countries, as the essential grain of arable farming. In Scotland, on the other hand, corn commonly (though by no means invariably) means oats, for the reason that oats are the chief cereal of the country and so the index of plenty.

The strictest use of the word is found in America. Throughout the United States and in South America wherever English is used, corn means specifically maize, often called in Britain Indian corn. Maize has doubtless acquired the name because the crop is of more importance than all the other grains in these countries; but this American use of the word has spread to Canada and is gaining ground elsewhere. Where maize is used as a cooked vegetable, as even in Britain, it is frequently eaten from the cob and is then known as corn-on-the-cob. So corn may be said to carry three meanings in Britain; and the result has been to confuse many minds. Indeed a large proportion of the vast urban populations has no clear idea of the meaning of the word. But the generic use is the commonest. A corn-field means a field given up to grain; and a cornflower and a corncockle describe flowers whose habitat is in the arable field where any sort of grain is sown.

Nor do these interpretations exhaust the meaning of the word. As its derivation and verbal connection with "grain" and "kernel" indicate, corn may mean a single grain of any of the cereals. In this regard local use varies a great deal. In the chief corn-growing counties of England, farmers chiefly use the scientifically incorrect word "berry" for the single grain of an ear.

See MAIZE.

CORN, in pathology, a small local outgrowth of the outer skin (epidermis) with great enlargement of the horny layers (callosity). Most of the underlying nerve-bulbs waste away, but, if only one or two remain, pressure on the enlarged part causes acute pain. The condition results from intermittent pressure, particularly that of ill-fitting boots. If the horny layers are sheltered from evaporation, *e.g.,* between the toes, the corn is soft. Infection may occur leading to suppuration. The only certain treatment is removal of the cause, but in otherwise healthy subjects much may be done by hot water bathing, paring with a sharp knife or painting with a solution of salicylic acid in collodion.

CORNARO, CATERINA (1454–1510), queen of Cyprus, was the daughter of Marco Cornaro, a Venetian noble, whose brother Andrea was an intimate friend of James de Lusignan, natural son of King John II. of Cyprus. On the king's death in 1458 the succession was disputed, and James, with the help of the sultan of Egypt, seized the island. It was important that he should make a marriage such as would secure him powerful support. Andrea Cornaro suggested his niece Caterina, famed for her beauty, as that union would bring him Venetian help. The contract was signed in 1468. Caterina was solemnly adopted by the doge as a "daughter of the Republic" and sailed for Cyprus in 1472 with the title of queen of Cyprus, Jerusalem and Armenia. In 1473 her husband died of fever, leaving his kingdom to his queen and their child as yet unborn. In August the child James III. was born, but as soon as the Venetian fleet sailed away a plot to depose him in favour of Zarla, James's illegitimate daughter, broke out, and Caterina was kept a prisoner. The Venetians returned, and order was soon restored, but the republic was meditating the seizure of Cyprus, although it had no valid title whatever, and after the death of Caterina's child in 1474 Venice really governed the island. In 1488 the republic, fearing that Sultan Bayezid II. intended to attack Cyprus, and having also discovered a plot to marry Caterina to King Alphonso II. of Naples, decided to recall the queen to Venice and formally annex the island. Caterina at first refused, for she clung to her royalty, but Venice would not be gainsaid; she was forced to abdicate in favour of the republic, and returned to Venice in 1489. The Government conferred on her the castle and town of Asolo for life, and there in the midst of a learned and brilliant little court, of which Cardinal Bembo was a shining light, she spent the rest of her days in idyllic peace. She died in July 1510. Titian's famous portrait of her is in the Uffizi gallery in Florence.

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CORNARO, LUIGI (1467–1566), a Venetian nobleman, who, after a severe illness at the age of 40, became an apostle of abstinence. In later life he found one egg a day sufficient solid food. His *Discorsi sulla vita sobria* (1558) was translated into many languages and has often been reprinted. He died at Padua at the age of 98 on May 8, 1566.

CORN BELT, a name applied to that region of the United States where Indian corn is the chief crop. The belt, which extends westward from central Ohio, includes, besides the western portion of that State, Indiana, Illinois, Iowa, the southern third of Minnesota, eastern Nebraska, the south-eastern corner of South Dakota, the northern three-fourths of Missouri and the north-eastern end of Kansas. A deep soil, an abundant rainfall and hot summer nights make this region peculiarly adapted to the culture of Indian corn. The nine States above named produce annually about 65% of the total corn crop of the United States; in 1925 it was 70% and in 1926, 62%. While every State in the Union produces some corn, it is from this area that most of the commercial crop is shipped.

CORNCRAKE: *see* RAIL.

CORN-CRUSHER: *see* PROCESSING MACHINERY.

CORNEILLE, PIERRE (1606–1684), French dramatist and poet, was born at Rouen, in the rue de la Pie, on June 6, 1606. His father, Pierre Corneille, a magistrate of Rouen, was ennobled in 1637, and the honour was renewed in favour of his sons Pierre and Thomas in 1669, though the poet himself did not assume the "de" of nobility. His mother's name was Marthe le Pesant.

Corneille was educated by the Jesuits at Rouen, was entered as *avocat,* and in 1624 took the oaths. He was afterwards appointed advocate to the admiralty, and to the "waters and forests," posts which he disposed of in 1650 for the insignificant sum of 6,000 livres. In that year and the next he was *procureur-syndic des Etats de Normandie.* His first play, *Mélite,* was acted in 1629. In 1632 *Clitandre,* a tragedy, was printed (it may have been acted in 1631); in 1633 *La Veuve* and the *Galerie du palais,* in 1634 *La Suivante* and *La Place Royale,* all the last-named plays being comedies, saw the stage. Having composed a Latin elegy to Richelieu on the occasion of the cardinal's visit to Rouen (1634), he was enrolled among the "five poets." These officers (the others being G. Colletet, Boisrobert, C. de l'Etoile and J. de Rotrou), had the task of working up Richelieu's ideas into dramatic form. No one could be less suited for such work than Corneille, and he soon (it is said) incurred his employer's displeasure by altering the plan of a play which had been entrusted to him.

Meanwhile the year 1635 saw the production of *Médée,* a grand but unequal tragedy. In the next year the singular extravaganza entitled *L'Illusion comique* followed, and was succeeded about the end of November by the *Cid,* based on the *Mocedades del Cid* of Guillen de Castro. The triumphant success of this, perhaps the most "epoch-making" play in all literature, the jealousy of Richelieu and the Academy, the open attacks of Georges de Scudéry and J. de Mairet and others, and the pamphlet-war which followed, are among the best-known incidents in the history of letters. The trimming verdict of the Academy, which we have in J. Chapelain's *Sentiments de l'Académie française sur la tragi-comédie du Cid* (1638), when its arbitration was demanded by Richelieu, and not openly repudiated by Corneille, was virtually unimportant; but it is worth remembering that no less a writer than Georges de Scudéry, in his *Observations sur le Cid* (1637), gravely and apparently sincerely asserted and maintained of this great play that the subject was utterly bad, that all the rules of dramatic composition were violated, that the action was badly conducted, the versification constantly faulty, and the beauties as a rule stolen! Corneille himself was awkwardly situated in this dispute. The *esprit bourru* by which he was at all times distinguished, and which he now displayed in his rather arrogant *Excuse à Ariste,* unfitted him for controversy, and it was of vital importance to him that he should not lose the outward marks of favour which Richelieu continued to show him. Perhaps the pleasantest feature in the whole matter is the unshaken and generous admiration with which Rotrou, the only contemporary whose genius entitled him to criticise Corneille, continued to regard his friend, rival, and in some sense (though Rotrou was the younger of the two) pupil. Finding it impossible to make himself fairly heard in the matter, Corneille (who had retired from his position among the "five poets") withdrew to Rouen and passed nearly three years in quiet there, perhaps revolving the opinions afterwards expressed in his three *Discours* and in the *Examens* of his plays, where he bows, somewhat as in the house of Rimmon, to "the rules." In 1639, or at the beginning of 1640, appeared *Horace* with a dedication to Richelieu. The good offices of Madame de Combalet, to whom the *Cid* had been dedicated, and perhaps the satisfaction of the cardinal's literary jealousy, had healed what breach there may have been, and indeed the poet was in no position to quarrel with his patron. Richelieu not only allowed him 500 crowns a year, but soon afterwards, it is said, though on no certain authority, employed his omnipotence in reconciling the father of the poet's mistress, Marie de Lampérière, to the marriage of the lovers (1640). In this year also *Cinna* appeared. A brief but very serious illness attacked him, and the death of his father the year before had increased his family responsibilities.

In 1643 appeared *Polyeucte,* the memorable comedy of *Le Menteur,* which though adapted from the Spanish stood in relation to French comedy very much as *Le Cid,* which owed less to Spain, stood to French tragedy; its less popular and far less good *Suite,*—and perhaps *La Mort de Pompée. Rodogune* (1644) was a brilliant success; *Théodore* (1645), a tragedy on a somewhat perilous subject, was the first of Corneille's plays which was definitely damned. On Jan. 22, 1647 the Academy at last (it had twice rejected him on frivolous pleas) admitted the greatest of living French writers. *Héraclius* (1646), *Andromède* (1650), a spectacle-opera rather than a play, *Don Sanche d'Aragon* (1650) and *Nicomède* (1651) were the products of the next few years' work; but in 1652 *Pertharite* was received with decided disfavour, and the poet in disgust resolved, like Ben Jonson, to quit the loathed stage. In this resolution he persevered for six years, during which he worked at a verse translation of the *Imitation of Christ* (finished in 1656), at his three *Discourses on Dramatic Poetry,* and at the *Examens* which are usually printed at the end of his plays. In 1659 Fouquet, the Maecenas of the time, persuaded him to alter his resolve, and *Oedipe,* a play which became a great favourite with Louis XIV., was the result. It was followed by *La Toison d'or* (1660), *Sertorius* (1662) and *Sophonisbe* (1663). In this latter year Corneille (who had at last removed his residence from Rouen to Paris in 1662) was included among the list of men of letters pensioned at the proposal of Colbert. He received 2,000 livres. *Othon* (1664), *Agésilas* (1666), *Attila* (1667), and *Tite et Bérénice* (1670), were generally considered as proofs of failing powers,—the cruel quatrain of Boileau—

> Après l'*Agésilas*
> Hélas!
> Mais après l'*Attila*
> Holà!

in the case of these two plays, and the unlucky comparison with Racine in the *Bérénice,* telling heavily against them. In 1665 and 1670 some versifications of devotional words addressed to the Virgin had appeared. The part which Corneille took in *Psyché* (1671), Molière and P. Quinault being his coadjutors, showed signs of renewed vigour; but *Pulchérie* (1672) and *Suréna* (1674) were allowed even by his faithful followers to be failures. He lived for ten years after the appearance of *Suréna,* but was almost silent save for the publication, in 1676, of some beautiful verses thanking Louis XIV. for ordering the revival of his plays. He died at his house in the rue d'Argenteuil on Sept. 30, 1684.

Corneille was buried in the church of St. Roch, where no monument marked his grave until 1821. He had six children, of whom four survived him. Pierre, the eldest son, a cavalry officer who died before his father, left posterity in whom the name has continued; Marie, the eldest daughter, was twice married, and by her second husband, M. de Farcy, became the ancestress of Charlotte Corday.

The portraits of Corneille (the best and most trustworthy of which is from the burin of M. Lasne, an engraver of Caen), represent him as a man of serious, almost of stern countenance, and this agrees well enough with such descriptions as we have of his appearance, and with the idea of him which we should form from his writings and conduct. His nephew Fontenelle admits that his general address and manner were by no means prepossessing. Others use stronger language, and it seems to be confessed that either from shyness, from pride, or from physical defects of utterance, probably from all three combined, he did not attract strangers. Racine is said to have assured his son that Corneille made verses "cent fois plus beaux" than his own, but that his own greater popularity was owing to the fact that he took some trouble to make himself personally agreeable. Almost all the anecdotes which have been recorded concerning him testify to a rugged and somewhat unamiable self-contentment. "Je n'ai pas le mérite de ce pays-ci," he said of the court. "Je n'en suis pas moins Pierre Corneille," he is said to have replied to his friends as often as they dared to suggest certain shortcomings in his behaviour, manner or speech. "Je suis saoul de gloire et affamé d'argent" was his reply to the compliments of Boileau. Yet tradition is unanimous as to his affection for his family; and as to the harmony in which he lived with his brother Thomas who had married Marguerite de Lampérière, younger sister of Marie, and whose household both at Rouen and at Paris was practically one with that of his brother. No story about Corneille is better known than that which tells of the trap between the two houses, and how Pierre, whose facility of versification was much inferior to his brother's, would lift it when hard bestead, and call out "Sans-souci, une rime!" Notwithstanding this domestic felicity, an impression is left on the reader of Corneille's biographies of a certain natural melancholy of temperament.

Although his actual poverty has been denied, he cannot have been affluent. His pensions covered but a small part of his long life and were most irregularly paid. Thomas Corneille himself, who to his undoubted talents united wonderful facility, untiring industry, and (gift valuable above all others to the playwright) an extraordinary knack of hitting the public fancy, died, notwithstanding his simple tastes, "as poor as Job." We know that Pierre received for two of his later pieces 2,000 livres each, and we do not know that he ever received more.

But his reward in fame was not stinted. Corneille, unlike many of the great writers of the world, was not driven to wait for "the next age" to do him justice. The cabal or clique which attacked the *Cid* had no effect whatever on the judgment of the public. All his subsequent masterpieces were received with the same ungrudging applause, and the rising star of Racine, even in conjunction with the manifest inferiority of Corneille's last five or six plays, with difficulty prevailed against the older poet's towering reputation. The great men of his time—Condé, Turenne, the maréchal de Grammont, the knight-errant duc de Guise—were his fervent admirers. Balzac did him justice; Rotrou, as we have seen, never failed in generous appreciation; Molière in conversation and in print recognized him as his own master and the foremost of dramatists. Racine, in discharge of his duty as respondent at the Academical reception of Thomas Corneille, pronounced upon the memory of Pierre perhaps the noblest and most just tribute of eulogy that ever issued from the lips of a rival.

His Plays.—Producing, as he certainly has produced, work which classes him with the greatest names in literature, Corneille also signed an extraordinary quantity of verse which has not merely the defects of genius, irregularity, extravagance, *bizarreté,* but the faults which we are apt to regard as exclusively belonging to those who lack genius, to wit, the dulness and tediousness of mediocrity. Molière's manner of accounting for this is famous in literary history or legend. "My friend Corneille," he said, "has a familiar who inspires him with the finest verses in the world. But sometimes the familiar leaves him to shift for himself, and then he fares very badly." That Corneille was by no means destitute of the critical faculty his *Discourses* and the *Examens* of his plays (often admirably acute, and, with Dryden's subsequent prefaces, the originals to a great extent of specially modern criticism) show well enough. But an enemy might certainly contend that a poet's critical faculty should be of the Promethean, not the Epimethean order. The fact seems to be that the form in which Corneille's work was cast, and which by an odd irony of fate he did so much to originate and make popular, was very partially suited to his talents. He could imagine admirable situations, and he could write verses of incomparable grandeur—verses that reverberate again and again in the memory, but he could not, with the patient docility of Racine, labour at proportioning the action of a tragedy strictly, at maintaining a uniform rate of interest in the course of the plot and of excellence in the fashion of the verse. On the English stage the liberty of unrestricted incident and complicated action, the power of multiplying characters and introducing prose scenes, would have exactly suited his somewhat intermittent genius, both by covering defects and by giving greater scope for the exhibition of power.

How great that power is can escape no one. The splendid soliloquies of Medea which, as Voltaire happily says, "annoncent Corneille," the entire parts of Rodogune and Chimène, the final speech of Camille in *Horace,* the discovery scene of *Cinna,* the dialogues of Pauline and Sévère in *Polyeucte,* the magnificently-contrasted conception and exhibition of the best and worst forms of feminine dignity in the Cornélie of *Pompée* and the Cléopâtre of *Rodogune,* the singularly fine contrast in *Don Sanche d'Aragon,* between the haughtiness of the Spanish nobles and the unshaken dignity of the supposed adventurer Carlos, and the characters of Aristie, Viriate and Sertorius himself, in the play named after the latter, are not to be surpassed in grandeur of thought, felicity of design or appropriateness of language. Therefore his rank among the greatest of dramatic poets is not a matter of question. For a poet is to be judged by his best things, and the best things of Corneille are second to none.

We have seen it said of the *Cid* that it is difficult to understand the enthusiasm it excited. But the difficulty can only exist for persons who are insensible to dramatic excellence, or who so strongly object to the forms of the French drama that they cannot relish anything so presented. Rodrigue, Chimène, Don Diègue are not of any age, but of all time. The conflicting passions of love, honour, duty, are here represented as they never had been on a French stage, and in the "strong style" which was Corneille's own. Of the many objections urged against the play, perhaps the weightiest is that which condemns the frigid and superfluous part of the Infanta. *Horace,* though more skilfully constructed, is perhaps less satisfactory. There is a hardness about the younger Horace which might have been, but is not made, imposing, and Sabine's effect on the action is quite out of proportion to the space she occupies. The splendid declamation of Camille, and the excellent part of the elder Horace, do not altogether atone for these defects. *Cinna* is perhaps generally considered the poet's masterpiece, and it undoubtedly contains one of the finest scenes in all French tragedy. The blot on it is certainly the character of Emilie, who is spiteful and thankless, not heroic. *Polyeucte* has sometimes been elevated to the same position. There is, however, a certain coolness about the hero's affection for his wife which somewhat detracts from the merit of his sacrifice; while the Christian part of the matter is scarcely so well treated as in the *Saint Genest* of Rotrou or the *Virgin Martyr* of Massinger. On the other hand, the entire parts of Pauline and Sévère are beyond praise, and the manner in which the former reconciles her duty as a wife with her affection for her lover is an astonishing success. In *Pompée* (for *La Mort de Pompée,* though the more appropriate, was not the original title) the splendid declamation of Cornélie is the chief thing to be remarked. *Le Menteur* fully deserves the honour which Molière paid to it. In *Sertorius* we have one of Corneille's finest plays.

Bibliography.—The subject of the bibliography of Corneille was treated in the most exhaustive manner by M. E. Picot in his *Bibliographie Cornélienne* (1875–76). Less elaborate, but still ample information may be found in J. A. Taschereau's *Vie* and in M. Marty-Laveaux's edition of the *Works.* The individual plays were usually printed a year or two after their first appearance; but these dates have been subjected to confusion and to controversy. The chief collected editions in the poet's lifetime were those of 1644, 1648, 1652, 1660 (with important corrections), 1664 and 1682, which gives the definitive text. In 1692 T. Corneille published a complete *Théâtre* in 5 vols. Numerous editions appeared in the early part of the 18th century, that of 1740 (6 vols., Amsterdam) containing the *Oeuvres diverses* as well as the plays. Several editions are recorded between this and that of Voltaire (12 vols., Geneva, 1764; 8 vols., 1776), whose *Commentaires* have often been reprinted separately. In the year IX. (1801) appeared an edition of the *Works* with Voltaire's commentary and criticisms thereon by Palissot (12 vols.). Of the numerous editions published since that date that of Ch. Marty-Laveaux in Regnier's *Grands Ecrivains de la France* (12 vols., 1862–68) is still the standard. It contains the entire works, a lexicon, full bibliographical information, and an album of illustrations of the poet's places of residence, his arms, some title-pages of his plays, facsimiles of his writings, etc. Nothing is wanting but variorum comments, which Lefèvre's edition supplies. Fontenelle's life of his uncle is the chief original authority on that subject, but Taschereau's *Histoire de la vie et des ouvrages de P. Corneille* (1st ed. 1829, 2nd in the *Bibl. elzévirienne,* 1855) is the standard work. Of the exceedingly numerous writings relative to Corneille we may mention the *Recueil de dissertations sur plusieurs tragédies de Corneille et de Racine* of the abbé Granet (1740), the criticisms already alluded to of Voltaire, La Harpe and Palissot, the well-known work of Guizot, first published as *Vie de Corneille* in 1813 and revised as *Corneille et son temps* in 1852, and the essays, repeated in his *Portraits littéraires,* in *Port-Royal,* and in the *Nouveaux Lundis* of Sainte-Beuve. More recent, besides essays by MM. Brunetière, Faguet and Lemaître and the pertinent part of M. E. Rigal's work on 16th century drama in France, *see* Gustave Lanson, *Corneille* in the *Grands Ecrivains français* (1898); F. Bouquet, *Points obscurs et nouveaux de la vie de Pierre Corneille* (1888); J. Levallois, *Corneille inconnu* (1876); J. Lemaître, *Corneille et la poétique d'Aristote* (1888); J. B. Segall, *Corneille and the Spanish Drama* (1902); and the recently discovered and printed *Fragments sur Pierre et Thomas Corneille* of Alfred de Vigny (1905). On the *Cid* quarrel E. H. Chardon's *Vie de Rotrou* (1884) bears mainly on a whole series of documents which appeared at Rouen in the proceedings of the *Société des bibliophiles normands*

during the years 1891–94. *See* also Benedetto Croce, *Scritti di storia letteraria* (*XIV. Ariosto, Shakespeare e Corneille* 1911; Eng. trans., 1921); Abbé Renault, *Une fille inconnue de Pierre Corneille* (1922); E. de Saint-Auban, *Maître Pierre Corneille, avocat* etc. (1923); L. M. Riddle, *The Genesis and Sources of Pierre Corneille's Tragedies from Medée to Partherite* (1926, Johns Hopkins Studies in Romance Literatures and Languages, vol. 3); R. Bray, *La Tragédie Cornelienne devant la critique classique, d'après la querelle de Sophonisbe, 1663* (1927).

CORNEILLE, THOMAS (1625–1709), French dramatist, was born at Rouen on Aug. 20, 1625, being nearly 20 years younger than his brother, the great Corneille. At the age of 15 he composed a play in Latin which was represented by his fellow-pupils at the Jesuits' college at Rouen. His first French play, *Les Engagements du hasard,* was acted in 1647. *Le Feint Astrologue,* imitated from the Spanish, and imitated by Dryden, came next year. At his brother's death he succeeded to his vacant chair in the Academy. A complete translation of Ovid's *Metamorphoses* (he had published six books with the *Heroic Epistles* some years previously) appeared in 1697. In 1704 he lost his sight and was constituted a "veteran," a dignity which preserved to him the privileges, while it exempted him from the duties, of an academician. Nevertheless in 1708 he produced a large *Dictionnaire universel géographique et historique* in three volumes folio. This was his last labour. He died at Les Andelys on Dec. 8, 1709, aged 84. The two Corneilles were strongly attached to one another, and practically lived in common. Of 42 plays by Thomas (this is the utmost number assigned to him) the last edition of his complete works contains only 32, but he wrote several in conjunction with other authors. Two are usually reprinted as his masterpieces at the end of his brother's selected works. These are *Ariane* (1672) and the *Comte d'Essex.*

See G. Reynier, *Thomas Corneille, sa vie, ses ouvrages* (1892), and Alfred de Vigny, *Fragments inédits de critique sur Pierre et Thomas Corneille* (1905).

CORNELIA (2nd cent. B.C.), daughter of Scipio Africanus the elder, mother of the Gracchi and of Sempronia, the wife of Scipio Africanus the younger. She was so devoted to her sons Tiberius and Gaius that it was even asserted that she was concerned in the death of her son-in-law Scipio, who by his achievements had eclipsed the fame of the Gracchi, and was said to have approved of the murder of Tiberius. When asked to show her jewels she presented her sons, and on her death a statue was erected to her memory inscribed, "Cornelia, the mother of the Gracchi." After the murder of her second son Gaius she retired to Misenum, where she devoted herself to Greek and Latin literature and to the society of men of letters. She was a highly educated woman, and her letters were celebrated for their beauty of style.

CORNELIUS, pope, was elected in 251 during the lull in the persecution by the emperor Decius. In 253, under the emperor Gallus, he was exiled to Centumcella (Civita Vecchia), where he died in the same year. He is commemorated with his friend, St. Cyprian, on Sept. 16.

CORNELIUS, CARL AUGUST PETER (1824–1874), German musician and poet, born at Mainz, son of an actor at Wiesbaden, grandson of the engraver Ignaz Cornelius, and nephew of Cornelius the painter, was himself intended to be an actor, but turned his attention to music. In 1852 he came in touch with Liszt, and at Weimar he heard Berlioz' delightful *Benvenuto Cellini,* a work which ultimately exercised great influence over him. For the time, however, he devoted himself, on Liszt's advice, to Church compositions, the influence of the Church on him at that time being so great that he applied, but vainly, for a place in a Jesuit college. At the same time his mind was bent on the production of a long contemplated comic opera, but the composition of this was delayed by the work of translating the prefaces to Liszt's symphonic poems and the texts of works by Berlioz and Rubinstein. Eventually, however, he wrote the *Barbier von Bagdad,* supplying the "book" as well as the music himself, and on Dec. 15, 1858, the opera was produced at Weimar under Liszt. It was however completely misunderstood by the public of that day, and hissed off the stage, whereupon Liszt indignantly resigned his post. Shortly afterwards Cornelius went to Vienna and Munich, and still later came very much under Wagner's influence. Subsequently his opera *Le Cid* was completed and produced at Weimar. For the last nine years of his life (1865–74) Cornelius was occupied with his opera *Gunlöd* and other compositions, besides writing ably and abundantly on Wagner's music-dramas. In 1867 he became teacher of rhetoric and harmony at the Musikschule, Munich, and married Berthe Jung. He died on the 26th of October, 1874. Not the least of Cornelius's many claims to fame was his remarkable versatility. Many of his original poems, as well as his translations from the French, rank high. Among his songs, special mention may be made of the lovely "Weihnachtslieder," and of the "Vätergruft," an unaccompanied vocal work for baritone solo and choir.

CORNELIUS, PETER VON (1783–1867), German painter, was born in Düsseldorf on Sept. 27, 1783. His earliest work of importance was the decoration of the choir of the church of St. Quirinus at Neuss. At the age of 26 he produced his designs from *Faust.* On Oct. 14, 1811, he arrived in Rome, where he soon became one of the most promising of that brotherhood of young German painters which included Overbeck, Schadow, Veit, Schnorr and Ludwig Vogel (1788–1879)—a fraternity (some of whom selected a ruinous convent for their home) who were banded together for resolute study and mutual criticism. Out of this association came the men who, though they were ridiculed at the time, were destined to found a new German school of art.

At Rome Cornelius participated, with other members of the fraternity, in the decoration of the Casa Bartoldi and the villa Massimi. From Rome he was called to Düsseldorf to remodel the academy, and to Munich by the then crown-prince of Bavaria, afterwards Louis I., to direct the decorations for the Glyptothek. On the death of Director Langer (1825), he became director of the Munich academy.

The fresco decorations of the Ludwigskirche, which were for the most part designed and executed by Cornelius, are perhaps the most important mural works of the 19th century. Amongst his other great works in Munich may be included his decorations in the Pinakothek and in the Glyptothek. About the year 1839–40 he left Munich for Berlin to proceed with that series of cartoons, from the Apocalypse, for the frescoes for which he had been commissioned by Frederick William IV., and which were intended to decorate the Campo Santo or royal mausoleum. Cornelius and his associates endeavoured to follow in their works the spirit of the Italian painters. But the Italian strain is to a considerable extent modified by the Dürer heritage. This Dürer influence is manifest in a tendency to overcrowding in composition, in a degree of attenuation in the proportions of, and a poverty of contour in the nude figure, and also in a leaning to the selection of Gothic forms for draperies. These peculiarities are even noticeable in Cornelius's principal work of the "Last Judgment" in the Ludwigskirche in Munich. Karl Hermann was one of Cornelius's earlier and most esteemed scholars, a man of simple and fervent nature, painstaking to the utmost, a very type of the finest German student nature; Kaulbach and Adam Eberle were also amongst his scholars.

To comprehend and appreciate thoroughly the magnitude of the work which Cornelius accomplished for Germany, it must be remembered that at the beginning of the 19th century Germany had no national school of art and was in painting and sculpture behind all the rest of Europe. Yet in less than half a century Cornelius founded a great school, revived mural painting, and turned the gaze of the art world towards Munich. The German revival of mural painting had its effect upon England, as well as upon other European nations, and led to the famous cartoon competitions held in Westminster hall, and ultimately to the partial decoration of the Houses of Parliament. When the latter work was in contemplation, Cornelius, in response to invitations, visited England (Nov. 1841). He died on March 6, 1867.

See Förster, *Peter von Cornelius* (1874); A. Kuhn, *Peter Cornelius und die geistigen Strömungen Seiner Zeit* (1921).

CORNELL, EZRA (1807–1874), American capitalist and philanthropist, was born at Westchester Landing, N.Y., on Jan.

11, 1807, of Quaker parents. His early education was received in the common schools but throughout life he was an ardent student and became noted for his practical and scientific attainments. In 1828 he settled at Ithaca, N.Y., where he later served as manager of flour mills. In 1842 he became associated with S. F. B. Morse in the early development of the electric telegraph and superintended the construction of the first telegraph line in America, opened between Baltimore and Washington in 1844. He then became one of the most active pioneers in the establishment of telegraph lines throughout the country, in connection with which he accumulated a substantial fortune, being a founder and for some time the largest stock-holder in the Western Union Telegraph company, organized in 1855. Settling on a farm near Ithaca, he became especially interested in the development of agriculture. Following the passage in 1862 of the Morrill Act providing national support for agricultural colleges, he took steps which led to the founding at Ithaca of Cornell university, which was formally opened in 1868. His original endowment of $500,000, given in 1865, was increased by further personal contributions of about $400,000, and by more than $3,000,000 realized as profits from his operations in purchasing and allocating public lands for the benefit of the new institution, which has since risen to front rank among American universities. He also established the Cornell library at Ithaca and built railway lines facilitating access to the university town. He died in Ithaca on Dec. 9, 1874.

See Alonzo B. Cornell, *True and Firm: a Biography of Ezra Cornell* (1884).

CORNELL UNIVERSITY, an American institution of higher education, situated at Ithaca, New York. Its campus has a fine situation on a hill 800ft. above sea level and 400ft. above Cayuga lake, between deep gorges cut by two creeks, and commands a wide view of the lake and the town. The university was founded in 1865 and was named in honour of Ezra Cornell, its principal benefactor. It was organized by Andrew D. White, its first president, and was opened in 1868. It is co-educational (since 1872) and comprises the graduate school, with 630 students in 1927; the college of arts and sciences (1,898 students); the law school (175 students), established in 1887; the medical college (263 students), a graduate college established in 1898 by the gift of Oliver Hazard Payne, situated in New York city but maintaining a division in Ithaca; the New York State veterinary college (107 students), established by the State legislature in 1894; the New York State college of agriculture (664 students), maintained by the State since 1904 and closely related to two experiment stations, the one at Ithaca supported by the Federal Government and the other at Geneva, 40m. away, maintained by the State Government; the State college of home economics (451 students), established by the State legislature in 1925; the college of architecture (182 students); and the college of engineering, comprising three schools: civil engineering (328 students), mechanical engineering (431 students) and electrical engineering (309 students). The total enrolment was 5,438 students, including 1,271 women. In addition, 2,053 students were enrolled in the 1927 summer session and 79 in the short winter courses in agriculture. Nearly all the States and territories of the United States and 35 foreign countries were represented.

The government is vested in a board of trustees consisting of 15 persons co-opted, ten elected by the graduates and five appointed by the governor of New York, these 30 persons for terms of five years; the president of the university, the governor and lieutenant governor of New York, the speaker of the assembly, the State commissioners of education and agriculture, the president of the State agricultural society and the librarian of the Cornell library in the town of Ithaca, each of these eight persons *ex officio;* the eldest male descendant of Ezra Cornell for the term of his natural life, and a representative of the State Grange elected annually. The university faculty elects three delegates who sit with the board and have the usual powers of trustees except the right to vote. The group of State colleges, the graduate school and the medical college are each governed by the board through a council composed of trustees and members of the faculty. The presidents have been Andrew Dickson White, 1866–85; Charles Kendall Adams, 1885–92; Jacob Gould Schurman, 1892–1920; Livingston Farrand, 1921–37, and Edmund Ezra Day, 1937– .

The university libraries contain about 750,000 vols., most of them in the general library building, which, with an endowment (1891) of $300,000 for the purchase of books and periodicals, was the gift of Henry Williams Sage (1814–97), who had succeeded Ezra Cornell as chairman of the board of trustees; in

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BUILDINGS OF CORNELL UNIVERSITY

1906 the general library received an additional endowment fund of about $500,000 by the bequest of Willard Fiske, who gave it also four rich collections; viz., the Dante (8,000 vols.), Petrarch (4,000 vols.), Rhaeto-Romanic (1,300 vols.) and Icelandic (15,000 vols.). It includes the President White historical library, 23,000 vols. and pamphlets, given by President White, especially rich in the primary sources of history and containing useful collections on the period of the Reformation, on the English and French revolutions, on the American Civil War and on the history of superstition. Other special collections are the classical library of Charles Anthon, the philological library of Franz Bopp, the Goldwin Smith library (1869), the White architectural library, the Spinoza collection presented by President White (1894), the library of Jared Sparks, the Samuel J. May collection of works on the history of slavery, the Zarncke library of Germanic philology and literature, the Eugene Schuyler collection of Slavic folk-lore, literature and history, the Wordsworth collection made by Mrs. Cynthia Morgan St. John, the Charles W. Wason collection of works relating to China and the Chinese, the James Verner Scaife collection of books relating to the American Civil War and the Emil Kuichling library of hydraulic and sanitary engineering. The law library (60,000 vols.) includes complete collections of the reports of the Federal courts and the several American State jurisdictions and of the English, Scotch, Irish and English colonial reports. The Flower veterinary library has 6,000 vols. and an endowment of $10,000. The general library has published catalogues of the Dante, Petrarch and Icelandic collections given by Willard Fiske; it issues *Islandica,* an annual relating to Iceland and to the Icelandic collection.

In common with many of the State universities, Cornell university was founded on the Morrill Act of 1862, by which the Federal Government apportioned to the several States 9,500,000ac. of the public lands, from the proceeds of the sale of which each State was to endow at least one college "where the leading object shall be . . . to teach such branches of learning as are related to agriculture and the mechanic arts." But it was Ezra Cornell (*q.v.*) who established the foundations, and Andrew D. White who determined the form of the new university. They were members of the New York legislature that in 1863–65 considered what disposition should be made of this State's share of the Federal grant. In 1864 Cornell, at White's suggestion, determined to found a university of a new type, "an institution"—as he expressed his own ideal—"where any person can find instruction in any study." He offered to give it $500,000 and 200ac. of land if the State would agree to endow it with all the proceeds of New York's portion of the Federal grant. The proposed charter provided that, besides those branches of learning which the Morrill Act had specified, "such other branches of science and knowledge may be embraced in the plan of instruction and investigation pertaining to the university as the trustees may deem useful and proper"; the university was to be made non-sectarian by a provision that a majority of the board of trustees should never be of one religious sect or of no religious sect and that persons of every religious denomination or of no religious denomination should be equally eligible to all offices and appointments. Despite bitter opposition, especially on the part of the denominational schools and press, a charter was granted April 27, 1865.

The trustees committed to Mr. White the task of preparing a scheme for the university's internal organization, and in 1866 they accepted his report and elected him president. (For his own account of his labours in organizing the university consult the *Autobiography of Andrew D. White,* vol. i. [1905].)

In the early years there were three or four general courses designed to afford the student some freedom in his choice of studies, ranging from a course in which the classics preponderated to one which was built around the modern sciences. At first all the work of each of these courses was prescribed, but after a few years the student was permitted to elect some or all of the subjects of his study in the latter years of the course; in 1896 the system of freely elective studies was adopted and the general courses were organized in a college of arts and sciences.

The college of agriculture, the veterinary college and the college of home economics, with the State agricultural experiment station, form a group unique in their organization, being maintained by the State but administered by the trustees as units of the university, a privately endowed institution. The college of agriculture, established on a foundation of courses given since 1868 and with a Federal experiment station founded in 1879, was organized in 1890 and made a State college in 1904 with Prof. L. H. Bailey (b. 1858) as director. The present director is Prof. A. R. Mann (b. 1880). The veterinary college was organized by Prof. James Law (1838–1921), F.R.C.V.S., and is now under the direction of Prof. V. A. Moore (b. 1859). This group of colleges has steadily enlarged its resources both for instruction and for scientific research; the State government has given it buildings and equipment costing more than $3,000,000; and through its experiment stations and departments of extension it renders constant service to agricultural enterprise and rural interests throughout the State.

The school of mechanical engineering owes its foundation to Hiram Sibley (1807–88), a banker of Rochester, N.Y., who gave $180,000 for its endowment and equipment and whose son Hiram W. Sibley has helped to maintain it; it was built up under Prof. R. H. Thurston (1839–1903), its director in 1885–1903; in 1921 it was combined with the college of civil engineering and the school of electrical engineering in a single college under the direction of Prof. D. S. Kimball (b. 1865). The college occupies the Sibley group of laboratories and shops, Lincoln, Franklin and Rand halls and the Fuertes observatory, and possesses a hydraulic laboratory built so as to use a 70ft. fall of water in the gorge of Fall Creek; it maintains various museums and laboratories of research and publishes a *Bulletin* of its engineering experiment station. The college of architecture gives courses leading to degrees in architecture, landscape architecture and fine arts. The law school became a graduate school in 1925; it publishes the *Cornell Law Quarterly,* established in 1915.

The medical college after its foundation in 1898 occupied a building extending from 27th to 28th street in First avenue opposite Bellevue hospital, in New York, and enjoyed relations with New York hospital and Bellevue hospital by which they admitted its students to their wards for instruction and research. In 1927 the university entered into an agreement with New York hospital by which that hospital and the college are permanently affiliated and are to occupy for their joint operation a new building to be erected at 68th street and Avenue A, near the Rockefeller Institute for Medical Research. To aid in carrying out this project the general education board appropriated $7,500,000; large legacies to both the hospital and the college were contained in the will of Payne Whitney, the vice president of the hospital, who had devoted himself for several years to the perfecting of the project. The college is affiliated with the Memorial hospital for the study and treatment of cancer and with the John E. Berwind maternity clinic; it operates a pay clinic whose attendance has averaged 335 patients daily.

A group of dormitories for men was begun in 1914. For undergraduate women, in addition to Sage college (1874) and Prudence Risley hall (1913), a group of new halls was provided for by a gift of $1,650,000 received in 1928. There were 64 fraternities, most of them chapters of national "Greek-letter" societies, in 1927, and 14 similar organizations of student women, housing and boarding their members.

The regular annual tuition fees in 1927 ranged from $500 in the medical college to $200 in the State colleges, which, however, receive residents of New York State free of tuition in their undergraduate courses.

For athletic recreation the trustees in 1902 appropriated to the students 55ac. of the campus, 35ac. of which are always open for games; the athletic association uses the remainder, having a football field, a baseball field, two quarter-mile cinder tracks and appropriate stands and buildings. The association owns and operates two boat-houses and their equipment of racing boats and motor launches on the main inlet of Cayuga lake, and, in the winter, provides conveniences for skaters on Beebe lake, above the dam of the hydraulic laboratory, where it conducts a clubhouse and restaurant. During their first two years all undergraduate students are required to receive physical training, which for the men takes the form of military training under officers detailed by the War department; the university's unit of the reserve officers' training corps of the army occupies the New York State drill hall (1913), the floor of which is 2ac. in area. A staff of medical advisers safeguards the students' health by means of periodical consultations or examinations; weekly lectures on hygiene and preventive medicine are prescribed for all first year undergraduate students.

In the years 1869–1927 the university conferred 29,532 degrees, including 3,375 advanced degrees. The graduates are organized in many local associations and clubs, and in the Cornell alumni corporation, which meets at Ithaca every June with the primary duty of canvassing the postal ballot for alumni members of the board of trustees. Through the Cornellian council, which they organized in 1908, former students have contributed more than $1,500,000 to the university; they publish the *Cornell Alumni News,* a 16-page weekly newspaper. An undergraduate board publishes the *Cornell Daily Sun,* founded in 1880, and undergraduate boards with faculty advisers publish the *Sibley Journal of Engineering,* the *Cornell Civil Engineer,* and (in the college of agriculture) the *Cornell Countryman.* (W. P.)

CORNER. In commerce, the manipulation of a market to secure the monopoly of the supply of a commodity, or such a degree of control of supply as will enable the speculator to raise prices. From time to time corners have been made in the shares of companies, in corn and in metals. It sometimes happens that when "bears" (*see* BEAR) sell heavily on the stock exchange the shares of a company which they do not possess, the shares are cornered against them so that they are eventually forced to pay an exorbitant price to buy back what they have sold. There have been large-scale instances of wheat cornering, but such examples are rare, for the risks involved are very great (*see* MONOPOLY).

CORNET, a word having two distinct significations and two etymological histories, both, however, ultimately referable to the same Latin origin:—

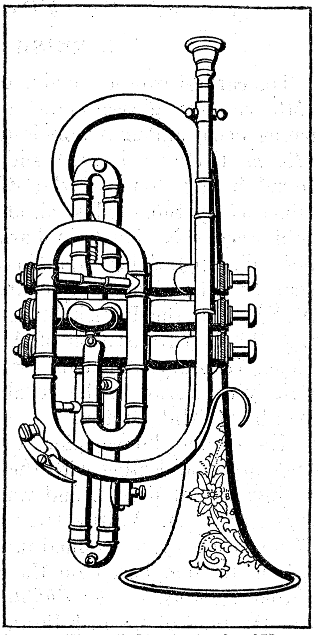
1. (Fr. *cornette,* dim. of *corne,* from Lat. *cornu,* a horn), a small standard, formerly carried by a troop of cavalry, and similar to the pennon in form, narrowing gradually to a point. The term was then applied to the body of cavalry which carried a cornet, and later to the junior officer who, like the "ensign" of foot, carried the colour.

2. (Fr. *cornet,* Ital. *cornetto,* Med. Lat. *cornetum,* a bugle, from Lat. *cornu,* a horn), in music, the name of two varieties of wind instruments (*see* below), and also of certain stops of the organ.

(*a*) CORNET or CORNETT is the name given to a family of not brass, but wood wind instruments, now obsolete, and differing entirely from the modern cornet à pistons. In Germany in the

17th and 18th centuries, they were used with trombones in the churches to accompany the chorales, and there are examples of this use of the instrument in the sacred cantatas of J. S. Bach. Gluck was the last composer of importance who scored for the cornet.

(*b*) Cornet à Pistons, Cornet and Cornopaean are the names of a modern brass wind instrument, a transformation of the old post-horn, of the same pitch as the trumpet. There are no fixed notes on the cornet, as in instruments with lateral holes, or with keys; the musical scale is obtained by means of the power the performer possesses of producing the notes of the harmonic series by over-blowing, *i.e.,* by varying the tension of the lips and the pressure of breath, the intermediate notes being obtained by means of three pistons. The *timbre* of the cornet lies somewhere between that of the horn and the trumpet, having the blaring, penetrating quality of the latter, without its brilliant, noble sonorousness.



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MODERN CORNET

CORNETO TARQUINIA: *see* Tarquinia.

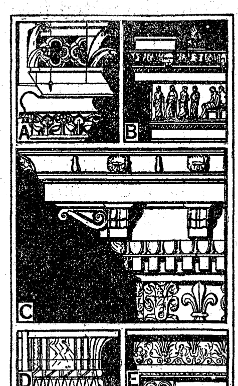
CORNFLOUR. The starch of maize (Indian corn) refined for use as a foodstuff. A grain of maize has a complicated structure, consisting mainly of an embryo plant and starchy food to sustain its early growth. The endosperm or store of food is a mass of minute granules of starch, corn gluten and protein. Each granule is a unit of definite shape and size, and the cell in which it lies might be compared to the cells of a honeycomb, only infinitely smaller; this is the common characteristic of the grass family.

The main problems of the manufacture of cornflour are: (1) the separation of the starch granules from the germs, hull, and gluten; (2) the purifying of these granules; and (3) the selection of those granules which possess in the highest degree purity and strength, *i.e.,* the quality of forming a stiff paste when boiled with water or milk. To obtain the best result, the grain used must be carefully selected. Maize is now grown in many parts of the world. The chief exporting countries in the past have been the United States, the Danubian provinces, and Argentina. More recently maize has been shipped from South Africa and Rhodesia, West and East Africa, and to a lesser extent Rangoon, Egypt, and elsewhere.

The grain first undergoes dry cleaning, all dirt and dust being removed. It is then scoured in water to remove the last traces of foreign matter. The clean grain is carried by elevators and conveyors to steeping tuns. Steeping is done with a dilute solution of sulphuric dioxide gas. This prevents fermentation and helps to soften the kernels so that the germs are easily separated and the hull loosened. The steep water is evaporated and valuable solubles recovered. The time of steeping and the temperature are important factors. The grains, brought to the right degree of softness, are ground and split, to free the germ from the rest of the grain. The broken mass passes into a germ separator, where the germ, being lighter, is floated off. The germ, which contains about 40% of oil, is then dried and sent to the oil mill for the extraction of the oil. This oil, which in its crude state is not fit for human food, can by careful refining be made suitable for edible purposes, and is largely used for cooking, baking and as salad oil. After the extraction of the oil, the residue of the germ is made into a cake which is of special value for fattening cattle and sheep and is sold under the name "maize germ cake."

The germ eliminated, the corn is finely ground in a wet state, and the starch granules separated from the coarser constituents, which form a valuable cattle food. The milky starch thus obtained is further refined by passing over a long series of inclined "runs" or tables. The starch granules, being heavier than water, fall and settle on the smooth surface of the runs. There is, however, in the liquid, along with the comparatively pure starch granules, a certain quantity of yellow starch matter or corn gluten (with other impurities) which, being lighter than the starch, is kept in suspension, and eventually flows over the tail end of the runs and is collected to be mixed into cattle food. Thus a further separation has been effected, but the pure starch required for cornflour has not yet been obtained. Periodically the flow over the run is stopped, and the settled starch is cut out from the runs into vats, which have a central stirrer. When a sufficient quantity has been collected in a tun, clean fresh water is run in, along with caustic soda liquor, and the stirrer is set in motion, so that by degrees the starch is lifted into suspension. Certain of the nitrogenous elements of the grain, which are intimately mixed with the starch in its present state, are now dissolved away by the caustic liquor. After stirring, the starch is pumped to another tun in the washing house, where it is allowed to settle, the solid starch granules slowly falling to the bottom, and forming a hard compact mass, on the surface of which there settles out a small quantity of softer yellow matter (called "the tops"). This settling takes from two to four days. The "tops" are removed, and the fine residuum washed several times. Next comes drying, and when this is done, the flour is raked down into hoppers, from which it is drawn off into bags. This is now finished cornflour in the "crisp" state, and all that remains to be done is to pulverize it. This is done in a special mill, but even here care has to be taken to eliminate any foreign particles. A careful sieving therefore forms the actual final operation.

CORNFLOWER (*Centaurea Cyanus*), a well-known plant of the family Compositae, called also bluebottle and bachelor's button. It is a native of Europe, a familiar weed in Great Britain, and has become widely naturalized from cultivation in many parts of North America from Quebec to the Pacific coast, where in Washington and California it is a common wayside weed. It is a slender, branching annual, 1 ft. to 2 ft. high, with narrow, more or less toothed or divided leaves and brilliant usually blue flowers, in heads an inch or more across, borne on long leafless stalks. In the United States it is popular for garden planting, being one of the "old-fashioned flowers." It is the national flower of Germany. (*See* Centaurea.)



A. Notre Dame, Paris
B. Erechtheum, Athens
C. Farnese Palace
D. Temple, Edfu
E. Door of Erechtheum

CORNICE, in architecture, the decorated projection at the top of a wall provided to throw off rain from the wall face or to ornament and finish the eaves. The term is used as well for any projecting element which crowns an architectural feature. A cornice is also specifically the top member of the entablature of a classic order (*q.v.*); it is in this case divided into three parts, a bed mould, corona and cymatium.

CORNICHE, THE, the name of a carriage road built by Napoleon along the Mediterranean slopes of the Maritime Alps, between Nice and Genoa it is famous for its sea and alpine views. The name is applied to-day to the three roads known respectively as the Grand, the Middle and the Little Corniche (*Grande, Moyenne, et Petite Corniche*), of which the first, ascending directly from Nice, reaches within a few miles a height of over 1,700 ft., and passing via the Col d'Eze descends via La Turbie to Mentone, while the Little Corniche follows the coast route through Beaulieu, Monaco, Monte Carlo and Roquebrunne.

CORNIFICIUS, the author of a work on rhetorical figures, and perhaps of a general treatise (*ars,* τέχνη), on the art of rhetoric (Quintilian, *Instit.,* iii. 1. ix. 3.). He has been identified with the author of the four books of *Rhetorica* generally known as *Auctor ad Herennium*. The chief argument in favour of this identity is the fact that many passages quoted by Quintilian from Cornificius are reproduced in the *Rhetorica*. But it seems improbable that the question of authorship will ever be satisfactorily settled. Internal indications point to the date of composition as 86–82 B.C., the period of Marian domination in Rome. The unknown author, as may be inferred from the treatise itself, did not write to make money, but to oblige his relative and friend Herennius. He expresses his contempt for the ordinary school rhetorician. Finally, he admits that rhetoric is not the highest accomplishment, and that philosophy is more deserving of attention.

The first and second books of the *Rhetorica* treat of *inventio* and forensic rhetoric; the third, of *dispositio, pronuntiatio, memoria,* deliberative and demonstrative rhetoric; the fourth, of *elocutio*. The chief aims of the author are conciseness and clearness. The work as a whole is considered very valuable. The question of the relation of Cicero's *De inventione* to the *Rhetorica* is a matter of much dispute.

BIBLIOGRAPHY.—The best modern editions are by C. L. Kayser (1860), in the Tauchnitz, and W. Friedrich (1889) in the Teubner edition of Cicero's works, and separately by F. Marx (1894); *see* also M. Wisen, *De scholiis Rhetorices ad Herennium* (1905). Full references to authorities will be found in the articles by Brzoska in Pauly-Wissowa, *Realencyklopädie* (1901); M. Schanz, *Geschichte der römischen Litt.*, i. (2nd ed., pp. 387–394); and Teuffel-Schwabe, *Hist. of Roman Lit.* (Eng. trans., p. 162); *see* also Mommsen, *Hist. of Rome,* bk. iv. ch. 13.

CORNING is a city in Steuben county, New York, U.S.A., in the southern part of the state, on the Chemung river. It is served by the Erie, the Lackawanna and the New York Central railways. Pop. (1940 federal census) 16,212. Corning is the trading and shipping centre of a dairying and tobacco-growing region, and has important manufacturing industries, with an annual output valued at $12,000,000. The leading products are technical glass, cut and flint glass in many forms, furnaces, stoves and fibre boxes and cartons. There are also large foundries and railroad shops and car factories. There were settlers here as early as 1789. The village was incorporated in 1848 and named after Erastus Corning, the railway builder. It was chartered as a city in 1890.

CORNISH, a breed of poultry apparently developed in England about the middle of the 19th century and first imported into America in 1887. It gained considerable popularity partly because of its excellent fleshing properties and its yellow skin. It has close feathering and a compact, heavily-meated body, the breast being very deep and broad. The cornish lays a brown-shelled egg and is a broody fowl. It has a pea comb. In spite of its excellent fleshing properties, the cornish has never demonstrated that it is a very great layer. There are three varieties, the dark, the white, and the white-laced red, the latter being a novelty. The plumage of the dark cornish is largely lustrous greenish-black and dark red intermixed. The under-colour is dark slate, and the beak, shanks and toes, yellow. The plumage of the white cornish is pure white; the beak, shanks, and toes are yellow, which is also the colour of the skin. The white-laced red cornish has been developed in America quite recently. The plumage is, for the most part, red with a narrow lacing of white on each feather. In both sexes the neck feathers are rich red which, in the male, are laced with silvery white, and in the female, with white. The tail feathers in the male are white, and in the female they are red except that the end of each feather is laced with white. The under colour in both sexes is white, and the skin, beaks, shanks and toes are yellow. (*See* POULTRY AND POULTRY FARMING.)

CORNISH LANGUAGE. This extinct language belonged to the Brythonic group of the Celtic division of the Indo-European family of languages. It is, therefore, akin to Welsh and to Breton—indeed it is suggested that up to 1400–1600 a Cornishman could understand a Breton speaker. It is, however, a characteristic feature of Cornish, even in old forms, to change non-initial *t* and *d* into *s* or *z*. With the Reformation, it decayed as the Prayer Book and the Scriptures circulated in English—so that the people became bilingual, and then lost their original speech, though there is evidence that people who lived into the 19th century were able to converse in it. The modern speech of western Cornwall still contains Celtic words and "since by Pol, Tre and Pen, you may know the Cornish men," from Tamar to Land's End are found personal and place names of Celtic origin.

BIBLIOGRAPHY.—*See* H. Jenner, *Handbook of the Cornish Language* (1904); J. Loth, *Revue Celtique,* vols. xvii. to xxiv. and xxxii. to xxxvii.; F. W. P. Jago, *Ancient Language and Dialect of Cornwall* (1882); and *English Cornish Dictionary* (1887).

CORNISH LITERATURE

The earliest extant remains of Cornish consist of proper names, 10th century glosses and a 12th century vocabulary. The names occur among manumissions of serfs in the Bodmin Gospels (*Revue Celtique,* i. 232) and in Domesday Book. Glosses are found in a volume at the Bodleian and also in a treatise on Donatus by Smaragdus, abbot of Saint-Mihiel, which is at the Bibliothèque Nationale in Paris (*Archiv. für celtische Lexicographie,* iii. 249). These remains belong approximately to the 10th century. The vocabulary occurs in a 12th century ms. (Cott. Vesp. A. XIV.) at the British Museum. Prof. Max Förster has shown that this is a translation of Abbot Aelfric's famous Latin-Anglo-Saxon Glossary. Though the language is termed Old Cornish, strictly the forms in the vocabulary correspond to those of Mid. Welsh and Mid. Breton.

The earliest known piece of connected Cornish consists of 41 lines of verse dealing with the subject of marriage. This may be a fragment of drama, and was written about 1400 (*Revue Celtique,* iv. 258). A little later comes the *Passion of Our Lord* or *Mount Calvary,* a versified narrative (259 stanzas) of the events of the Passion based on the Gospel and apocryphal narratives (Stokes, *Trans. of the Philological Society,* 1860–61, appendix). But the bulk of Cornish literature is made up of plays, of which the earliest form a trilogy named *Ordinalia,* the oldest copy of which is a 15th century Oxford manuscript. They were published by Edwin Norris in two volumes under the title of *The Ancient Cornish Drama* (1859). The first play, *Origo Mundi,* begins with the creation and ends with the building of Solomon's temple. The second, *Passio Domini,* gives the history of Christ from the temptation to the crucifixion. The third, *Resurrectio Domini,* continues the second without interruption, and ends with the resurrection and the ascension. It embraces the harrowing of hell, the legend of St. Veronica and Tiberius, and the death of Pilate. In addition to the biblical narrative, apocryphal sources have been extensively drawn upon in the work, as in the *Passion of Our Lord.* The Gospel of Nicodemus is very much in evidence throughout. The plays are of learned origin and are imitations, if not adaptations from English (and possibly French) sources. Practically no originality is displayed (though many of the events are represented as having taken place in well-known Cornish localities), except in the comic or sarcastic parts. There are many signs of linguistic impurity in these plays, and one is fully prepared for the debasement which increasingly occurs in the later works.

The next play to notice is *Ordinale de Vita Sancti Mereadoci, Episcopi et Confessoris,* the ms. of which was written in 1504 and is now Peniarth ms. 105 at the National Library of Wales. It was published under the titles *Beunans Meriasek, The Life of St. Meriasek,* by Stokes in 1872. The play deals with the life and death of Meriasek (in Welsh *Meiriadog,* in Breton *Meriadek*), son of a duke of Brittany, and the legend of St. Silvester and the emperor Constantine, though Meriasek belongs to the 7th century and St. Silvester to the 4th. The construction of the play is unskilful, and, as le Braz has shown, the author drew his materials from Latin and English sources. Something truly Cornish might have been expected in a play based upon an early patron saint of Camborne, but no immediate Cornish traditions appear, the story of Meriasek having been taken from a Breton source. At the end of each of the two parts of the play the minstrels are bidden to pipe and the spectators to dance and carouse. The usual comic element is supplied by Constantine's quack doctor, by torturers, outlaws and crucifiers. The language is more recent than in the dramas published by Norris, and English words are on the increase. The last play is that published by Stokes in 1864 under the titles *Gwreans an Bys, The Creation of the World,* from the oldest ms., which is at the Bodleian and dated 1611. This copy was written by William Jordan of Helston. The play greatly resembles the *Origo Mundi* of Norris's edition, of which whole passages have been borrowed. The language shows considerable signs of decay, English words occur in plenty, and Lucifer and his angels are often made to speak English.

Later original compositions in Cornish are *Nebbaz Gerriau dro tho Carnoack* ("A few words about Cornish") by John Boson (*Journ. of the R. Inst. of Cornwall,* 1879) and *Dzhûan Tshei an hor* ("John of Ram's house"), a folk-tale printed with a Welsh version by Lhuyd in his *Archaeologia Britannica* (1707) and with an English version in Pryce's *Archaeologia Cornu-Britannica* (1790). Andrew Borde's *Booke of the Introduction of Knowledge* (1542) contains some Cornish conversations (ed. by Stokes, *Rev. Celtique,* iv. 262, and Loth, *Arch. fuer Celt. Lex,* i. 224). A number of words and phrases occur in Carew's *Survey of Cornwall.* Lhuyd's preface to his Cornish grammar is written in Cornish, and he also wrote an elegy in Cornish on William of Orange. In addition there are fragments of Cornish consisting of songs, verses, proverbs, epigrams, epitaphs, maxims, letters, conversations, mottoes and translations of passages of Scripture, the Creed, etc. They are enumerated, classified and described by Jenner in his *Handbook.* In recent years there appear signs of a reviving interest being taken by Cornishmen in Cornish as a living language. A few poems and short stories (including translations) have been published. But the general barrenness of Cornish literature is to be regretted all the more when one thinks that it is to the land where Cornish was once spoken that the world probably owes the *Matter of Britain.* (*See* Loth, *Rev. Celtique,* xxxiii. 258–310.)

Bibliography.—E. Norris, *The Ancient Cornish Drama* (2 vols. 1859); H. Jenner, *Handbook of the Cornish Language* (1904); A. le Braz, *Le Théâtre celtique* (1905); L. C. Stern, *Die Kultur d. Gegenwart,* i. xi. i., pp. 131–132. (H. Le.)

CORN LAWS. From the very earliest times, States which have attained to any degree of civilization have found it necessary to take measures to ensure a sufficient supply of cereals for the population. In communities which were wholly or mainly agricultural, such measures were only of a temporary nature, resorted to in times of failure of crops or of war. Thus in early Egypt (*c.* 2000 B.C.) steps were taken to store grain in years of plenty, against the prospect of lean years to come (Genesis xxi. 46–57). Similar measures were taken in China at an equally early date. When, however, populations became divided into agricultural and non-agricultural, by the institution of, *e.g.,* sacerdotal or military castes, it became necessary to make permanent provision for the feeding of this non-agricultural element. Thus in imperial Rome, the tribute payable by conquered races frequently took the form of grain to ensure supplies for Rome itself and for the army. The system of tithes similarly arose from the need for supplying the clergy from the produce of the land cultivated by those to whom they ministered.

Up to the 14th century the question was mainly one of providing for those members of a self-supporting community, who, for any reason, were not themselves in a position to produce their own sustenance. With however the rise of industrial and commercial classes, the production of the agricultural section was not sufficient to supply the needs of all, at any rate in years when the yield was in any way below normal, and supplies had to be sought elsewhere. From this arose the need for state intervention in the import and export of corn. At this period communications were in a very primitive stage of development, and intercourse was only possible between comparatively neighbouring communities or states. Thus it frequently happened that years of bad crops were more or less general over the area in which trade normally took place, and the high prices that could be obtained led to corn being sent to accessible parts of a foreign country rather than to less accessible parts of the producing country. This caused steps to be taken to maintain home supplies, by the regulation of imports and exports. These regulations usually took the form of prohibiting export, or only permitting it when prices were sufficiently low to indicate sufficiency, if not satiation, on the home market, and by only allowing imports when the home price reached a high level, thus operating against what is now termed "dumping," and ensuring a fair return to home producers, while in times of shortage, the specified price would be reached, and imports were authorized to alleviate risk of famine.

In modern times, instead of actual prohibition of import or export, it became the practice to impose high, and therefore effectively prohibitive duties, sometimes in conjunction with specified price limits or with a sliding scale dependent on prices in the home market. With the rise of intensive cereal culture in America, Canada, Rumania and elsewhere, protective import duties have been levied in certain countries to prevent the flooding of the home market with cheap grain to the detriment of the domestic producer.

ENGLAND

During four centuries after the Conquest the corn law of England simply was that export of corn was prohibited, save in years of extreme plenty under forms of state licence, and that producers carried their surplus grain into the nearest market town, and sold it there for what it would bring amongst those who wanted it to consume; and the same rule prevailed in the principal countries of the continent of Europe. The prohibition of export discouraged agricultural improvement, and in so much diminished the security and liberality even of domestic supply; while the intolerance of any home dealing or merchandise in corn prevented the growth of a commercial and financial interest strong enough to improve the means of transport by which the plenty of one part of the same country could have come to the aid of the scarcity in another.

English Corn Laws, 1436–1603.—Apart from this general feudal germ of legislation on corn, the history of the British corn laws may be said to have begun with the statute in the reign of Henry VI. (1436), by which exportation was permitted without state licence, when the price of wheat or other corn fell below certain prices. The reason given in the preamble of the statute was that the previous state of the law had compelled farmers to sell their corn at low prices, which was no doubt true, but which also showed the important turn of the tide that had set in. One may readily perceive that the cultivators of the wheat lands in the south-eastern counties of England, for example, who could frequently have sold their produce in that age to Dutch merchants to better advantage than in their own market town, or even in London, but were prohibited to export abroad, and yet had no means of distributing their supplies at home so as to realize the highest medium price in England, must have felt aggrieved, and that their barons and knights of the shire would have a common interest in making a strong effort to rectify the injustice in parliament. This object appears to have been in some measure accomplished by this statute, and 27 years afterwards (1463) a decided step was taken towards securing to agriculturists a monopoly of the home market by a statute prohibitory of importation from abroad. Foreign import was to be permitted only at and above the point of prices where the export of domestic produce was prohibited. The landed interest had now adopted the idea of sustaining and equalizing the value of corn, and promoting their own industry and gains, which for four centuries, under various modifications of plan, and great changes of social and political condition, were to maintain a firm place in the legislation and policy of England. But there were many reasons why this idea when carried into practice should not have the results anticipated from it.

The import of grain from abroad, even in times of dearth and high prices at home, could not be considerable as long as the policy of neighbouring countries was to prohibit export; nor could the export of native corn, even with the Dutch and other European ports open to such supplies, be effective save in limited maritime districts, as long as the internal corn trade was suppressed, not only by want of roads, but by legal interdict. The regulation of liberty of export and import by rates of price, moreover, had the same practical objection as the various sliding scales, bounties, and other legislative expedients down to 1846, viz. that they failed, probably more in that age than in later times, to create a permanent market, and aimed only at a casual trade. When foreign supplies were needed, they were often not to be found, and when there was an excess of corn in the country a profitable outlet was both difficult and uncertain. It would appear, indeed, that during the Wars of the Roses the statutes of Henry VI. and Edward IV. had become obsolete; for a law regulating export prices in identical terms of the law of 1436 was re-enacted in the reign of Mary I. (1554).

In the preceding reign of Edward VI., as well as in the succeeding long reign of Elizabeth, there were unceasing complaints of the decay of tillage, the dearth of corn, and the privations of the labouring classes; and these complaints were met by the same kind of measures—by statutes encouraging tillage, forbidding the enlargement of farms, imposing severer restrictions on storing and buying and selling of grain, and by renewed attempts to regulate export and import according to prices. In 1562 the price at which export might take place was raised to 10*s.* per quarter for wheat, and 6*s.* 8*d.* for barley and malt. This only lasted a few years, and in 1570 the export of wheat and barley was permitted from particular districts on payment of a duty of 1*s.* 8*d.* per quarter, although still liable to prohibition by the Government or local authority, while it was entirely prohibited under the old regulations from other districts. Only at the close of Elizabeth's reign (1603) did a spark of new light appear in a further statute, which removed the futile provisions in favour of tillage and against enlargement of pastoral farms, and rested the whole policy for promoting an equable supply of corn, while encouraging agriculture, on an allowed export of wheat and other grain at a duty of 2*s.* and 1*s.* 4*d.* when the price of wheat was not more than 20*s.*, and of barley and malt 12*s.* per quarter. The import of corn appears to have been much lost sight of from the period of the statute of 1463. The internal state of England, as well as the policy of other countries of Europe, was unfavourable to any regular import of grain, though many parts of the kingdom were often suffering from dearth of corn. It is obvious that this legislation, carried over more than a century and a half, failed of its purpose, and that it neither promoted agriculture nor increased the supply of bread. So great a variance and conflict between the intention of statutes and the actual course of affairs might be deemed inexplicable, but for an explanation which a close economic study of the circumstances of the times affords.

Besides the general reasons of the failure already indicated, there were three special causes in active operation, which, though not seen at the period, have become distinct enough since. (1) A comparatively free export of wool had been permitted in England from time immemorial. It was subject neither to conditions of price nor to duties in the times under consideration, was easier of transport and less liable to damage; while corn, a prime rural product, was subject, as an article of merchandise, to every difficulty, internally and externally, which meddling legislation and popular prejudice could impose. The numerous statutes enjoining tillage and discouraging pastoral farms—or in other words requiring that agriculturists should turn from what was profitable to what was unprofitable—had consequently no substantial effect, save in the many individual instances in which the effect may have been injurious. (2) The value of the standard money of the kingdom had been undergoing great depreciation from two opposite quarters at once. The pound sterling of England was reduced in the weight of pure metal; while, at the same time, the greater abundance of silver, which now began to be experienced in Europe from the discovery of the South American mines, was steadily reducing the intrinsic value of the metal. Hence a general rise of prices remarked by Hume and other historians; and hence also it followed that a price of corn fixed for export or import at one period became always at another period more or less restrictive of export than had been designed. (3) The wages of labour would have followed the advance in the prices of commodities had wages been left free, but they were kept down by statute to the three or four pence per day at which they stood when the pound sterling contained one-fourth more silver and silver itself was much more valuable.

M'Culloch found from a comparison of prices of corn and wages of labour in the reign of Henry VII. and the latter part of the reign of Elizabeth, that in the former period a labourer could earn a quarter of wheat in 20, a quarter of rye in 12, and a quarter of barley in 9 days; whereas, in the latter period, to earn a quarter of wheat required 48, a quarter of rye 32, and a quarter of barley 29 days' labour.

The result was chronic privation and discontent among the common people, by which all the conditions of agriculture and trade in corn were further straitened and barbarized; and the age was marked by an enormous increase of pauperism, and by the introduction of the merciful but wasteful remedy of the Poor Laws.

English Corn Laws 1660–1773.—The corn legislation of Elizabeth remained without change during the reign of James, the civil wars and the Commonwealth. But on the restoration of Charles II. in 1660, the question was resumed, and an act was passed of a more prohibitory character. Export and import of corn, while nominally permitted, were alike subjected to heavy duties—the need of the exchequer being the paramount consideration, while the agriculturists were no doubt pleased with the complete command secured to them in the home market. This act was followed by such high prices of corn, and so little advantage to the revenue, that parliament in 1663 reduced the duties on import to 9% *ad valorem*, while at the same time raising the price at which export ceased to 48*s.*, and reducing the duty on export from 20*s.* to 5*s.* 4*d.* per quarter. In a few years this was found to be too much free-trade for the agricultural liking, and in 1670 prohibitory duties were re-imposed on import when the home price was under 53*s.* 4*d.*, and a duty of 8*s.* between that price and 80*s.*, with the usual make-weight in favour of home supply, that export should be prohibited when the price was 53*s.* 4*d.* and upwards. But complaints of the decline of agriculture continued to be as rife under this act as under the others, till on the accession of William and Mary, the landed interest, taking advantage of the Revolution, as they had taken advantage of the Restoration, to promote their own interests, took the new and surprising step of enacting a bounty on the export of grain. This evil continued to affect the corn laws of the kingdom, varied, on one occasion at least, with the further complication of bounties on import, until the 19th century. The duties on export being abolished, while the heavy duties on import were maintained, this is probably the most one-sided form which the British corn laws ever assumed, but it was attended with none of the advantages expected. The prices of corn fell, instead of rising. There had occurred at that period of the Revolution a depreciation of the money of the realm, analogous in one respect to that which marked the first era of the corn statutes (1436–1551) and forming one of the greatest difficulties which the Government of William had to encounter. The coin of the realm was greatly debased, and as rapidly as the mint sent out money of standard weight and purity, it was melted down and disappeared from the circulation. The influx of silver from South America to Europe had spent its action on prices before the middle of the century; the precious metals had again hardened in value; and for 40 years before the Revolution the price of corn had been steadily falling in money price. The liberty of exporting wool had also now been cut down before the English manufacturers were able to take up the home supply, and agriculturists were consequently forced to extend their tillage. When the current coin of the kingdom became wholly debased by clipping and other knaveries there ensued both irregularity and inflation of nominal prices, and producers and consumers of corn found themselves equally ill at ease. The farmers complained that the home market for their produce was unremunerative and unsatisfactory; the masses of the people complained that their money wages could not purchase the necessaries of life. The state of agriculture could not be prosperous under these conditions. But when the Government of William surmounted this difficulty of the coinage, as they did surmount it, under the guidance of Sir Isaac Newton, with remarkable statesmanship, it necessarily followed that prices, so far from rising, declined, because, for one reason, they were now denominated in a solid metallic value. The rise of prices of corn attending the first years of the export bounty was consequently of very brief duration. The average price of wheat in the Winchester market, which in the ten years 1690–99 was £2 10*s*., fell in the ten years 1716–25 to £1 5*s*. 4*d*. and in the ten years 1746–55 to £1 1*s*. 2¾*d*.

The system of corn law established in the reign of William and Mary was probably the most perfect to be conceived for advancing the agricultural interest in any country. Every stroke of the legislature seemed complete to this end. Yet it wholly failed of its purpose. The price of wheat again rose in 1750–60 and 1760–70 to £1 19*s*. 3¼*d*. and £2 11*s*. 3¾*d*., but many causes had meanwhile been at work. Between the reign of William and Mary and that of George III. the question of bounty on export of grain, had, in the general progress of the country, fallen into the background, while that of the heavy embargoes on import had come to the front. Therefore it is that Burke's Act of 1773, as a deliberate attempt to bring the corn laws into some degree of reason and order, is worthy of special mention. This statute permitted the import of foreign wheat at a nominal duty of 6*d*. when the home price was 48*s*. per quarter, and it stopped both the liberty to export and the bounty on export together when the home price was 44*s*. per quarter. The one blemish of this statute was the stopping export and cutting off bounty on export at the same point of price.

Few questions have been more discussed or more differently interpreted than the elaborate system of corn laws dating from the reign of William and Mary. So careful an observer as Malthus was of opinion that the bounty on export had enlarged the area of subsistence. That it had large operation is sufficiently attested by the fact that, in the years from 1740 to 1751, bounties were paid out of the exchequer to the amount of £1,515,000, and in 1749 alone they amounted to £324,000. But the trade thus forced was of no permanence, and the British exports of corn, which reached a maximum of 1,667,778 quarters in 1749–50, had fallen to 600,000 quarters in 1760 and continued to decrease.

English Corn Laws, 1791–1846.—Burke's Act lasted long enough to introduce a regular import of foreign grain, varying with the abundance or scarcity of the home harvest, yet establishing in the end a systematic preponderance of imports over exports. The period, moreover, was marked by great agricultural improvements, by extensive reclamation of waste lands, and by an increased home produce of wheat, in the 20 years from 1773–93, of nearly 2,000,000 quarters. Nor had the course of prices been unsatisfactory. The average price of British wheat in the 20 years was £2 6*s*. 3*d*. and in only three years of the 20 was the price a fraction under £2. But the ideas in favour of greater freedom of trade were overwhelmed in the extraordinary excitement caused by the French Revolution, and all the old corn law policy was destined to have a sudden revival. The landowners and farmers complained that an import of foreign grain at a nominal duty of 6*d*., when the price of wheat was only 48*s*., deprived them of the ascending scale of prices when it seemed due; and on this instigation an act was passed in 1791, whereby the price at which importation could proceed at the nominal duty of 6*d*. was raised to 54*s*., with a duty of 2*s*. 6*d*. from 54*s*. to 50*s*., and at 50*s*. and under 50*s*. a prohibitory duty of 24*s*. 3*d*. The bounty on export was maintained by this act, but exportation was allowed without bounty till the price reached 46*s*., and the permission accorded by the statute of 1773 to import foreign corn at any price, to be re-exported duty free, was modified by a warehouse duty of 2*s*. 6*d*. in addition to the duties on import payable at the time of sale, when the corn, instead of being re-exported, happened to be sold for home consumption. The legislative vigilance in this statute to prevent foreign bread from reaching the home consumer is remarkable. There were deficient home harvests for some years after 1791, particularly in 1795 and 1797, and parliament was forced to the new expedient of granting high bounties on importation. At this period the country was involved in a great war; all the customary commercial relations were violently disturbed; freight, insurance and other charges on import and export were multiplied fivefold; heavier and heavier taxes were imposed; and the capital resources of the kingdom were poured with a prodigality without precedent into the war channels. The consequence was that the price of corn, as of all other commodities, rose greatly; and the Bank of England having stopped paying in specie in 1797, this raised nominal prices still more under the liberal use of bank paper in loans and discounts, and the difference that began to be established in the actual value of Bank of England notes and their legal par in bullion.

The average price of British wheat rose to £5 19*s*. 6*d*. in 1801. So unusual a value must have led to a large extension of the area under wheat, and to much corn-growing on land that after great outlay was ill prepared for it. In the following years there were agricultural complaints; and in 1804, though in 1803 the average price of wheat had been as high as £2 18*s*. 10*d*., an act was passed, so much more severe than any previous statute, that its object would appear to have been to keep the price of corn somewhere approaching the high range of 1801. A prohibitory duty of 24*s*. 3*d*. was imposed on the import of foreign wheat when the home price was 63*s*. or less; and the price at which the bounty was paid on export was lowered to 40*s*., while the price at which export might proceed without bounty was raised to 54*s*. Judging from the prices that ruled during the remaining period of the French wars, this statute would appear to have been effective for its end, though, under all the varied action of the times on a rise of prices, it would be difficult to assign its proper place in the general effect. The average price of wheat rose to £4 9*s*. 9*d*. in 1805, and the bank paper price in 1812 was as high even as £6 6*s*. 6*d*. The bullion prices from 1809–13 ranged from 86*s*. to 100*s*. 3*d*. But it was foreseen that when the wars ended a serious reaction would ensue, and that the rents of land, and the general condition of agriculture, under the warlike, protective and monetary stimulation they had received, would be imperilled. In the brief peace of 1814 the average bullion price of British wheat fell to 55*s*. 8*d*. All the means of select committees of inquiry on agricultural distress, and new modifications of the corn laws, were again brought into requisition. The first idea broached in parliament was to raise the duties on foreign imports, as well as the prices at which they were to be leviable, and to abolish the bounty on export, while permitting freedom of export whatever the home price might be. The latter part of the scheme was passed into law in the session of 1814; but the irritation of the manufacturing districts against the new scale of import duties was too great to be resisted. In the subsequent session an act was passed, after much opposition, fixing 80*s*. (14*s*. more than during the wars) as the price at which import of wheat was to become free of duty.

This act of 1815 was intended to keep the price of wheat in the British markets at 80*s*. per quarter; but the era of war and great expenditure of money raised by public loans had ended, the ports of the continent were again open to some measure of trade and to the equalizing effect of trade upon prices, the Bank of England and other banks of issue had to begin the uphill course of a resumption of specie payments, the nation had to begin to feel the whole naked weight of the war debt, and the idea of the protectors of a high price for corn was proved by the event to be an utter hallucination. The corn statutes of the next 20 years, though occupying an enormous amount of time and attention in the Houses of Parliament, may be briefly treated, for they are simply a record of the impotence of legislation to maintain the price of a commodity at a high point when all the natural economic causes in operation are opposed to it. In 1822 a statute was passed reducing the limit of prices at which importation could proceed to 70*s*. for wheat, 35*s*. for barley, 25*s*. for oats; but behind the apparent relaxation was a new scale of import duties, by which foreign grain was subjected to heavy three-month duties up to a price of 85*s*.—17*s*. when wheat was 70*s*., 12*s*. when between 70*s*. and 80*s*., and 10*s*. when 85*s*., showing the grasping spirit of the would-be monopolizers of the home supply of corn, and their reluctance to believe in a lower range of value for corn as for all other commodities. This act never operated, for the reason that, with the exception in some few instances of barley, prices never were so high as its projectors had contemplated. The corn trade had passed rapidly beyond reach of the statutes by which it was to be so painfully controlled; and as there were occasional seasons of scarcity, particularly in oats, the King in Council was authorized for several years to override the statutes, and do whatever the public interests might require.

In 1827 Canning introduced a new system of duties, under which there would have been a fixed duty of 1*s.* per quarter when the price of wheat was at or above 70*s.*, and an increased duty of 2*s.* for every shilling the price fell below 69*s.*, but though Canning's resolutions were adopted by a large majority in the House of Commons, his death and the consequent change of ministers involved the failure of his scheme of corn duties. In the following year Charles Grant introduced another scale of import duties on corn, by which the duty was to be 23*s.* when the price was 64*s.*, 16*s.* 8*d.* when the price was 69*s.*, and only 1*s.* when the price was 73*s.* or above 73*s.* per quarter; and this became law the same year. This sliding scale was more objectionable, as a basis of foreign corn trade, than that of Canning, though not following so closely shilling by shilling the variation of prices, because of the abrupt leaps it made in the amount of duties leviable. For example, a merchant who ordered a shipment of foreign wheat when the home price was 70*s.*, and rising to 73*s.*, instead of having a duty of 1*s.* to pay, should on a backward drop of the home price to 69*s.*, have 16*s.* 8*d.* of duty to pay. The result was to introduce wide and incalculable elements of speculation into all transactions in foreign corn. Prices during the greater part of this period were under the range at which import was practically prohibited. The average price of British wheat was 96*s.* 11*d.* in 1817, but from that point there was in succeeding years a rapid and progressive decline, varied only by the results of the domestic harvests, till in 1835 the average price of wheat was 39*s.* 4*d.*, of barley 29*s.* 11*d.* and oats 22*s.* The import of foreign grain in these years consisted principally of a speculative trade, under a privilege of warehousing accorded in the statute of 1773, and extended in subsequent acts, by which the grain might be sold for home consumption on payment of the duties, or re-exported free, as suited the interest of the holders.

The act of 1822 admitted corn of the British possessions in North America under a favoured scale of duties, and in 1825 a temporary act was passed, allowing the import of wheat from these provinces at a fixed duty of 5*s.* per quarter, irrespective of the home price, which, if maintained, would have given some stability to the trade with Canada. The idea of a fixed duty on all foreign grain, however, appears to have grown in favour from about this period. It was included in the programme of import duty reforms of the Whig Government in 1841, and fell with its propounders in the general election of that year. Sir Robert Peel, on succeeding to office, introduced and carried in 1842 a new sliding scale of duties somewhat better adjusted to the current values. But public opinion by this time was changing, and the prime minister, convinced, as he confessed, by the arguments of Cobden and the Anti-Corn-Law League, and stimulated into action by the failure of the potato crop in Ireland, put an effectual end to the history of the corn laws by the famous act of 1846. It was provided under this measure that the maximum duty on foreign wheat was to be immediately reduced to 10*s.* per quarter when the price was under 48*s.*, to 5*s.* on barley when the price was under 26*s.*, to 4*s.* on oats when the price was under 18*s.*, with lower duties as prices rose above these figures; but the conclusive part of the enactment was that in three years—on Feb. 1, 1849—these duties were to cease, and all foreign corn to be admitted at a duty of 1*s.* per quarter, and all foreign meal and flour at a duty of 4½*d.* per cwt.—the same nominal imposts which were conceded to grain and flour of British possessions abroad from the date of the act. In 1869 even these nominal duties were abolished by Robert Lowe in a Customs Duties Act. In 1902 a registration duty of 3*d.* per cwt. was imposed on imported corn, and 5*d.* per cwt. on imported flour, in the expectation that such a duty would broaden the basis of taxation. The duty was, however, repealed the following year. A low duty on imported foreign corn was made an essential part of the tariff reform scheme advocated by Mr. Joseph Chamberlain (*q.v.*) from 1903 onwards, but this scheme never became a practical proposition.

During the World War imports and exports were under strict Government control, and prices for the home market were fixed. In connection with any scheme of tariff reform which might be introduced at a later date by the Conservative Government, that took office in 1924 a pledge was given not to tax foodstuffs.

CORN LAWS IN OTHER COUNTRIES

In Europe generally, the import and export of corn was prohibited until the rise of industrialism in the beginning of the 19th century caused many countries to take steps to maintain their food supplies, either by permitting free import, and thus becoming dependent on imported cereals, or by protective tariffs or prohibition of exports, to encourage home supplies.

France.—Prior to the French Revolution, the movement of corn, even between the various provinces, was subject to restrictions, but in 1789, importation into all parts of France was permitted, free of duty. In 1814 it was proposed to prohibit exports, but owing to the decline in prices, export was permitted when prices fell to a certain low level, in order so far as possible to secure a fair return to the grower by not limiting his market artificially. In 1816, a small import duty was imposed for revenue purposes, but in 1819 a protective duty was levied, consisting of a fixed rate, together with a surtax varying with the prices in the home market; if the price reached a fixed minimum, imports were entirely prohibited. In 1821 the limits at which surtax became payable or prohibition enforced were raised. These conditions remained in force until 1860, although the sliding scale was suspended (1853–59) on account of the high prices reached on the home market. In 1861, the sliding scale was abolished and exports were freed from restriction, while a small duty was imposed on imports. The whole tariff was revised in 1881, while in 1885 duties were imposed on rye, barley and oats, which had been free since 1861, and the duty on wheat flour was increased to fivefold. In 1887 these rates were again increased. The effect of this increased protection was to maintain prices, which in England were falling rapidly, owing to the development of cereal culture in America and elsewhere. When the tariff was revised in 1892 grain duties were unaltered, but in 1894, the duties on wheat and flour were increased. In the 1910 tariff these were unchanged, but on the outbreak of war (1914), these duties were suspended and exports prohibited. The duties on wheat were however re-imposed after the 1915 harvest, and on oats, barley and maize in 1919.

After the war, co-efficients of increase were applied to the basic tariff rates to keep the duties in line with the values, as expressed in paper currency. In Sept. 1927 higher basic rates in currency were imposed, to be again increased in Nov. 1927.

Germany.—Modern German Customs practice may be dated from the formation of the Zollverein (Customs Union), between certain of the German states in 1834. It was not till 1879 however that, in response to the demand from agricultural interests, who were feeling the competition, in both home and foreign markets, of America, Russia, etc., import duties were imposed on corn. These duties were increased from time to time till 1888, while in 1892 a series of commercial treaties were negotiated, by which, in return for concessions on German manufactures, import duties on corn were reduced. The rates thus fixed were not to be altered, by the terms of the several treaties, until the end of 1903, and in that year a new tariff law was enacted. This provided a "general" tariff, applicable to all countries, but the Government was authorized to negotiate commercial treaties, and to make concessions on these "autonomous" rates, by fixing certain rates for specified commodities, imported from the other contracting power. While generally, the Government was left free to make whatever concessions were found necessary to obtain the desired reductions from the other party, the legislation authorizing the tariff laid down for certain cereals, definite limits below which concessions could not be made. The rates finally negotiated were, by the operation of the "most favoured nation" clause, applied to almost all the producing countries: the "general" tariff rates were about 50% higher. By the terms of the act, any excess (per head of population) in the receipts from these and certain other duties on foodstuffs, over the average yield during the period 1898–1903 was to be used for the establishment of widows' and orphans' funds. The negotiation of these treaties took some time, and the tariff did not come into force till March 1, 1906, and remained in force till the outbreak of war. Under this tariff, the exporters of milled cereals received certificates (Einfuhrscheine) permitting them to import, free of duty, grain corresponding to the amount of foreign grain contained in the exported products. During the war, these duties were suspended, but from Sept. 1, 1925, duties were again imposed and were increased from Aug. 1, 1926, but still below the level of the 1903 tariff, although the basic rates of that tariff are the standard, the present rates being temporary reductions. The export of grain was freed from control Oct. 1, 1925.

Denmark.—Exports of grain have been free of duty since 1820, and imports since 1848. This is one of the earliest examples of complete freedom of trade in cereals, and has not been followed by any general decline in home production, as has been claimed by the agricultural interests to be a result of unlimited competition of foreign grain.

Netherlands.—When the kingdom of Netherlands was set up in 1813, the French protectionist system was in vogue. In 1822 and 1825 the grain duties were increased. In 1835 a sliding scale was established, dependent on the price of grain in various home markets. This was repealed in 1847, and moderate import duties imposed. These duties were finally fixed in 1862, while from July 1, 1877, imports of grain have been entirely free of duty. Export duties were abolished in 1847.

Belgium.—The duties in force in the Netherlands were continued when the separation from that country occurred in 1830, and in 1835 a similar sliding scale of duties was imposed, together with a merely nominal export duty. The latter was removed in 1850, since when the export of grain has been free. The import duties were reduced to a nominal level at the same time, and were withdrawn in 1854; they were re-imposed in 1857, and finally withdrawn 1872. (A duty on imported oats was re-imposed in 1895 and is still in force.)

Spain.—Export duties were abandoned in 1820, but the import of cereals was prohibited till 1867, when on account of bad harvests, the ban was suspended. After the revolution of 1868, the prohibition was definitely withdrawn, but moderately high duties were imposed. These duties have varied from time to time; immediately before the war they stood at about the same level as in 1882. During the war import duties were suspended and exports were prohibited. The duties in the 1922 tariff are higher than those prevailing before the war, while different rates for the First and Second Tariffs (the former applicable to countries not having commercial treaties) are imposed, the former being three times the latter. In 1926 the prohibition of exports was raised, but control of imports was continued and imports subjected to sufficient duties to maintain home prices.

Norway.—From July 1, 1927, a state monopoly of grain and grain products has been established. The state buys up the Norwegian crop, and has the sole right to import grain, but licences are issued to persons who prove that they have purchased from the state a corresponding quantity of Norwegian grain. Import duties were modified at the same time.

Italy.—At the formation of the kingdom of Italy in 1861, free trade in cereals was permitted, but in 1866 both import and export duties were imposed; and the latter were abolished in 1867. The import duties were increased in 1887, again in 1888, and finally in 1895; the rates then fixed were unaltered till the outbreak of war (1914), when import duties were suspended and export prohibited. Import duties were re-imposed from Jan. 1, 1926, but export of wheat is still prohibited.

Austria-Hungary.—Export duties on cereals were abolished in 1852, and imports from the German Zollverein were admitted free of duty from 1853 onwards. These constituted the greater proportion of imports. At the end of 1866, cereals from the former Austrian Italy were admitted into Tirol free of duty, while in July 1876 Rumania was accorded the same exemption from duty as the Zollverein. In 1879 all import duties were removed, but in 1883 duties were re-imposed, although the bulk of the supplies came from Rumania and were admitted duty free. In July 1886 this preferential treatment was abrogated. Increased customs duties were imposed in 1892; and further increases were made in the 1906 tariff, even in the conventional rates agreed upon in the series of commercial treaties consequent upon the introduction of these revisions. These rates were adopted by the Succession States after the war, but their application was suspended for some time owing to shortage of foodstuffs.

In the case of *Austria,* duties were again levied from Jan. 1925, based on a sliding scale. New definite duties have been enacted, but had not been put into operation at the end of 1927. In *Hungary,* all restrictions on imports and exports were withdrawn from the beginning of 1925, and import duties were imposed shortly afterwards. In *Czechoslovakia,* cereals were admitted free of duty under the tariff of 1921. In 1925 the sliding scale principle was introduced, while a fixed scale of duties has been levied since July 1926; higher rates are charged on imports from countries which have no treaties with Czechoslovakia. This provision led to the commercial treaty with Hungary negotiated in 1927.

United States.—In view of the large exportable surplus of cereals produced in the United States, import duties are of little importance in price regulation, but are of considerable interest as matter of practical politics. The general tendency of American tariff legislation has been protective, and the agricultural interests have always obtained their share of the protective duties. It may be said that the only source of supply is Canada, and this fact has coloured all the tariff legislation relating to cereals. Under the earliest tariffs (1789 onwards) cereals were not enumerated separately and paid duty at *ad valorem* rates under "unenumerated articles." Specific duties were imposed in 1824, but *ad valorem* rates were again used from 1832 onwards until 1857. Under the reciprocity agreement (1854) imports from Canada were free of duty, but this was abrogated in 1866, and the normal tariff rates again became payable. Increased duties were imposed in 1894; temporary reductions were made in 1890; but in 1897 the 1890 rates were restored. In the 1913 tariff, wheat, maize, rye and flour were made free of duty, but a duty was imposed on Canadian cereals on the ground that Canada imposed a duty on American wheat. On the entry of America into the war in 1917 this was remitted and imports were free of duty until the coming into force of the 1921 emergency tariff which re-imposed duties. The Fordney-McCumber tariff continued these duties, which were at about the same level (specific rates) as in 1890. On the ground that the difference in cost of production in Canada was not equalized by this duty, the rates on wheat and wheat products were increased in March 1924.

British Countries Overseas.—Imports of grain into *Canada* from the United States were free of duty during the continuance of the Reciprocity Treaty of 1855–66, but duties have been payable since.

Import duties are also levied in *Australia* and *New Zealand,* but in the case of Australia, wheat is admitted free under the British Preferential Tariff. In *South Africa* a moderate import duty is levied, which is stated to have materially encouraged home production.

No duty is levied on imports into the Irish Free State, nor into British India. An export duty on rice is imposed by the last named, but none of the British Overseas Dominions imposes such duties.

Export Duties.—Some of the more important producing countries retained export duties on cereals until the war, *i.e.,* Rumania and Bulgaria, and these are still in force, while since 1918, Argentina has levied a variable duty dependent on the price. This was introduced as a temporary measure, but has not yet been withdrawn.

Information as to the actual rates in force in any particular country can be obtained from the Department of Overseas Trade, London, or from similar official trade development organizations in the principal countries, such as the Department of Commerce, Washington. (H. Cr.)

CORNPLANTER (1732–1836), an American Indian chief of the Seneca tribe, was born in Conewaugus, on the Genesee river, in New York, in 1732, the half-breed son of John O'Bail, an Indian trader. In alliance with the French against the English, Cornplanter became the leader of a war-party of the Senecas, and was present at Braddock's defeat near Ft. Duquesne in 1755. During the Revolutionary War he participated in the destruction of frontier settlements in New York and in the valley of Wyoming in Pennsylvania, but later displayed a genuine friendship for the white people. For many years Cornplanter and his able associate, Red Jacket (*q.v.*), were the most influential counsellors of their people. Cornplanter is said to have been one of the first temperance lecturers in America. He died on the Seneca reservation, on Feb. 13, 1836.

CORNPLANTER: *see* AGRICULTURAL MACHINERY AND IMPLEMENTS.

CORN-SALAD or **LAMB'S LETTUCE,** *Valerianella olitoria* (family Valerianaceae), a weedy annual, native of southern Europe, but naturalized in cornfields in central Europe and in various parts of the United States and Canada, and not infrequent in Britain. In France it is used in salads during winter and spring as a substitute for lettuce, but it is less esteemed in England. The sorts principally grown are the round-leaved and the Italian; the last is a distinct species, *V. eriocarpa.*

CORN SYRUP, a product of the partial hydrolysis of corn starch. It is a yellowish liquid which does not easily crystallize and so is valuable in the manufacture of jams, preserves and candy.

CORN TRADE: *see* GRAIN, PRODUCTION and TRADE.

CORNU, MARIE ALFRED (1841–1902), French physicist, was born at Orleans and was professor of experimental physics in the École Polytechnique, Paris, from 1867 until his death. Although he made various excursions into other branches of physical science, undertaking, for example, with J. B. A. Baille about 1870 a repetition of Cavendish's experiment for determining the mean density of the earth, his original work was mainly concerned with optics and spectroscopy. He carried out a classical redetermination of the velocity of light by A. H. L. Fizeau's method, introducing various improvements in the apparatus, which added greatly to the accuracy of the results.

BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

CORNU COPIAE, CARVED AND PAINTED, ON FRENCH WOODWORK OF THE XVIIITH CENTURY

CORNU COPIAE or **CORNUCOPIA** ("horn of plenty"), a horn, generally twisted, filled with fruit and flowers, or an ornament representing it. It was used as a symbol of prosperity and abundance, and hence in works of art it is placed in the hands of Plutus, Fortuna and similar divinities.

CORNUS, an ancient town of Sardinia, of Phoenician origin, on the west coast, 18m. from Tharros, and the same from Bosa. At the time of the second Punic War it is spoken of as the principal city of the district, and its capture by the Romans was the last act in the suppression of the rebellion of 215 B.C.; it had served as a place of refuge for fugitives after the defeat of the combined forces of rebels and Carthaginians. The site of the ancient acropolis, covered with debris, may still be made out. A necropolis of the Roman period and Phoenician rock-cut tombs may be seen.

CORNUTUS, LUCIUS ANNAEUS, Stoic philosopher, flourished in the reign of Nero. He was a native of Leptis in Libya, but resided for the most part in Rome. He is best known as the teacher and friend of Persius, whose satires he revised for publication after the poet's death, but handed them over to Caesius Bassus to edit, at the special request of the latter. He was banished by Nero (in 66 or 68) for having indirectly disparaged the emperor's projected history of the Romans in heroic verse (Dio Cassius, lxii. 29), and disappears from history. He was the author of various rhetorical works in both Greek and Latin (Ῥητορικαὶ τέχναι, *De figuris sententiarum*). Another rhetorician, also named Cornutus, who flourished A.D. 200–250 (or in the second half of the 2nd century) was the author of a treatise Τέχνη τοῦ πολιτικοῦ λόγου (ed. J. Graeven, 1890). A philosophical treatise, *Theologiae Graecae compendium,* is still extant. It is a manual of Stoic etymological interpretation of popular mythology (ed. C. Lang, 1881). Simplicius and Porphyry refer to his commentary on the *Categories* of Aristotle, whose philosophy he is said to have defended against an opponent Athenodorus in a treatise Ἀντιγραφὴ πρὸς Ἀθηνόδωρον. Excerpts from his treatise *De enuntiatione vel orthographia* are preserved in Cassiodorus. The so-called *Disticha Cornuti* (ed. Liebl, Straubing, 1888) belong to the late middle ages.

See G. Martini, *De L. Annaeo Cornuto* (1825); O. Jahn, *Prolegomena* to his edition of Persius; H. von Arnim in Pauly-Wissowa's *Real-encyclopädie,* i. pt. ii. (1894); W. Christ, *Geschichte der griechischen Litteratur* (1898), pp. 702, 755; M. Schanz, *Geschichte der römischen Litteratur,* i. 2 (1901), p. 285; Teuffel-Schwabe, *Hist. of Roman Literature* (Eng. trans.) § 299, 2; P. Schundt, *De Cornuti . . . Compendia* (Dissertationis plutologicae Halenses, vol. xxi.) (1912).

CORNWALL, the south-westernmost county of England, bounded north and north-west by the Atlantic ocean, east by Devonshire, and south and south-west by the English Channel. Area 1,356.5 sq.mi. The most southerly extension is Lizard Point, and the most westerly point of the mainland Land's End, but the county also includes the Scilly Isles (*q.v.*), lying 25 m. W. by S. of Land's End. The form is that of a peninsula 75 m. long and 45 m. broad across the base. It owes its main features to the folding movement of the Armorican system complicated by a series of granite intrusions. The latter form moorland bosses decreasing in height from east to west. Dartmoor in Devon is the largest and highest, Bodmin Moor reaches 1,375 ft. in Brown Willy, Hensbarrow Beacon is under 1,000 ft., Carn Menellis and the St. Just boss are lower; a further granite mass now largely submerged forms the Scilly Isles. The lower-lying regions are mainly of folded slaty rock of Devonian Age, striking largely east to west, with some limestone; in the extreme north-east there are Carboniferous grits and shales. From Tintagel Head northwards to Hartland Point in Devon the distorted strata form steep cliffs because of the rapid maritime erosion that goes on. The veins of ore are chiefly in the slaty rock near the granite masses which themselves give kaolin by decomposition of felspar. A Tertiary, supposedly Pliocene, uplift and tilt apparently gave especially the south flowing streams an additional impetus and led to the cutting of deep valleys in what the uplift had converted from a peneplane into a plateau or a succession of plateaus formed by an uplift with warping. Post-pleistocene sinking has given rise to the sunken estuaries of south Cornwall and the drainage lines are chiefly those between the granite bosses, the Tamar which forms most of the boundary between Devon and Cornwall draining between Dartmoor and Bodmin moor into its great southern estuary. The Camel drains northward to Padstow bay and the Fowey southward into a long estuary between Bodmin moor and Hensbarrow Beacon. The Fal estuary is placed between the Hensbarrow and the Carn Menellis bosses and there is a low line across from Mount's bay to St. Ives bay between Carn Menellis and the St. Just boss. The sinking movement, probably partly at least since the appearance of man in the west, is held to have given rise to many legends of west Britain.

The climate is soft but sunny, though sea-mists are common, especially in spring and autumn. The average temperature for January is 43° at Bude and 43·7° at Falmouth. The vegetation in shelter is correspondingly luxuriant and southern in type. Rainfall is heavy and, though only 32·8 inches per annum at Bude, it reaches 44·4 inches at Falmouth and 50·6 inches at Bodmin.

The wind-swept moorlands and cliffs gave opportunities for early settlement and when the use of metal was beginning to spread, or just prior to this, west Cornwall became important, as its wealth of megalithic monuments shows. They include dolmens such as those of Lanyon, Mulfra, Chûn and Zennor. Monoliths have a wider distribution, those in the parish of St. Buryan being well known. The principal stone circles are the Hurlers, near Liskeard; the Boskednan, Boscawen-ûn, and Tregeseal circles and that called Dawns-un at Boleigh. All these except the Hurlers are in the Land's End district. There are also alinements on the moors near Rough Tor and Brown Willy. It has been thought that this culture is part of an elaborate movement from the Mediterranean, which brought Cornwall and the southwest definitely into touch with Brittany, and this connection was perpetuated in different ways almost until modern times. A few Early Bronze implements have been found but the Beaker movement apparently did not reach Cornwall. The coastal promontories and river estuaries are protected by clusters of earthworks of presumed Iron Age date, but mining operations have destroyed so many that it is impossible to argue from their type and distribution. Roman occupation and Saxon colonization of the lands farther east caused westward pressure and it is to these influences that must be assigned the emigration of Brythonic speaking people into southwest England and from southwest England to Brittany. Remains of Celtic Christianity in Cornwall include crosses of various dates from the 6th century onward, inscribed sepulchral stones, generally of the 7th and 8th centuries, and oratories. These have their parallels in Ireland, as the prehistoric contacts with Ireland and Wales and Brittany were maintained in early Christian times. In all these regions dedications to local saints are a great feature. The oratory buildings are very small and rude, always placed near a spring. The best example is St. Piran's near Perranzabuloe, which long lay buried in sand dunes. St. Piran was a missionary sent from Ireland by St. Patrick in the 5th century, and became the patron saint of the tin-miners.

Cornwall was the last portion of British territory in the south to submit to the Saxon invader. In 815 Egbert directed his efforts towards the subjugation of the West-Welsh of Cornwall, and after eight years' fighting compelled the whole of Dyvnaint to acknowledge his supremacy. Assisted by the Danes the Cornish revolted but were again defeated, probably in 836, at the battle of Hengestesdun, Hingston Down in Stoke-Climsland. Ninety years later Aethelstan banished the West-Welsh from Exeter and made the Tamar the boundary of their territory. The thoroughness of the conquest is evident from the fact that in the days of the Confessor nearly the whole of the land in Cornwall was held by men bearing English names. As the result of the Norman conquest less than one-twelfth of the land (exclusive of that held by the church) remained in English hands. Six-sevenths of the manors were assigned to Robert of Mortain, and became the foundation of the earldom held by the eldest son or near relative of the king. In the 15th century Cornwall strongly supported the Lancastrian cause, and its remoteness from the capital made it a potential field for revolt. This is seen in the support given to the Thomas Flamank rebellion in 1497, to Perkin Warbeck in the same year, and to the Humphry Arundell rebellion, over the religious question, in 1549. During the civil wars Cornwall strongly resisted the new ideas of the English. The king's Cornish troops defeated General Ruthen on Bradoc Down, while General Chudleigh, another parliamentary general, was repulsed near Launceston, and the earl of Stamford at Stratton. The whole county was thereby secured to the king. The subsequent fighting tended in favour of the Royalists, but dissensions hastened their overthrow. The 18th century was remarkable for the fervour shown by Cornishmen in the Methodist movement.

The old Cornish language survives in a few words still in use in the fishing and mining communities, as well as in the names of persons and places, but the last persons who spoke it died towards the end of the 18th century. It belonged to the Cymric or Brythonic division of Celtic, in which Welsh and Breton are also included. Three miracle plays written in Cornish are important relics of the language.

Agriculture.—Oats and mixed corn form the main grain-crops, with acreages of 43,988 and 40,322 respectively in 1939. Cabbage for fodder at 8,039 ac., turnips and swedes at 5,567 ac., and potatoes and mangolds at about 4,500 ac. each, made up the bulk of the root crops. The number of cattle (chiefly of the Devonshire breed) is large, having been 240,301 in 1939, while in the same year 287,398 sheep were kept and 196,042 pigs. The total acreage in the county under crops and grass was 610,635 ac. in 1939. Market-gardening is largely carried on in the neighbourhood of Penzance, where the climate is specially suitable for the growth of early potatoes, broccoli and asparagus, early fruit and flowers for the markets of the great cities, the Scilly Isles sharing in the industry, especially as regards flowers. In the valleys the soil is frequently rich and deep; there are good arable and pasture farms, and the natural oak-wood has been preserved and increased by plantation. In 1941 the National Trust owned 1,425 acres.

Mining.—The wealth of Cornwall, however, lies not so much in the soil, as underground and in the surrounding seas. Hence the favourite Cornish toast, "fish, tin and copper." The tin of Cornwall has been known and worked from the Bronze Age. By ancient charters the "tinners" were exempt from all jurisdiction (save in cases affecting land, life and limb) other than that of the Stannary courts, and peculiar laws were enacted in the Stannary parliaments (*see* STANNARIES). A tax on the tin, after smelting, was paid to the earls and dukes of Cornwall. The smelted blocks had to be coined, that is, stamped with the duchy seal, before they could be sold. In 1838 the dues on coinage were abolished, and a compensation awarded to the duchy instead of them. Cornish miners often directed successful developments of mining in many parts of the world, and much emigration took place in the middle of the 19th century. The industry suffered from periods of depression, as before the accession of Queen Elizabeth, who introduced miners from Germany to resuscitate it; and in modern times the shallow workings, from which tin could be easily "streamed," became practically exhausted. The deeper workings are more costly and foreign competition is greater. There was a slight revival during World War I, but later mining greatly diminished. A rise in the price of tin 1926–28 caused renewed activity especially in the Redruth-Camborne district, but the amount of ore raised in 1937, 3,367 tons, was more than 1,000 tons less than in 1919. The more important mines are at Carn Brea, Illogan and near St. Just in the extreme west, with others near Callington in the southeast. The largest tin-mine is that of Dolcoath near Camborne. Copper is extracted at St. Just and at Carn Brea. No mine seems to have been worked exclusively for copper before 1770. In 1718 John Coster gave a great impulse by draining the deeper mines, and introduced an improved method of dressing ore. In 1851 the mines of Devon and Cornwall were estimated to furnish one-third of the copper raised in Europe. Iron (brown haematite) has been worked near Lostwithiel and elsewhere. The St. Austell district produces china clay and after its extended use for paper filling, and the textile trade, it became a very important commodity, Cornwall exporting 759,704 tons in 1937. Much is exported to the United States. Granite is largely quarried in various districts, as at Luxulian (between St. Austell and Lostwithiel), and in the neighbourhood of Penryn. Fine slate is quarried and largely exported, as from the Delabole quarries near Tintagel. These slates were in great repute in the 16th century and earlier. Serpentine is quarried in the Lizard district. Pitchblende also occurs, and is mined for the extraction of radium.

Fisheries.—The fisheries of Cornwall and Devon are the most important on the southwest coasts. The pilchard is in great measure confined to Cornwall and the neighbourhood of the Scilly Isles. In summer and autumn they are caught by drift nets, while later in the year they are taken off the northern coast by seine nets. The principal fishing stations are on Mount's bay and at St. Ives, but boats are employed all along the coast. The pilchards are cured and packed locally, an old standing export being to Naples and other Italian ports. But the rise in the Italian standard of living now reacts on the market. The chief catches are mackerel and herring, together with sole, plaice and whiting.

Population and Administration.—The area of the county is 1,356.5 sq.mi., including the 6 sq.mi. of the Scilly Isles. The population was estimated in 1938 at 309,900, excluding the islands. In 1861 the population was 369,390, and had shown an increase up to that census. The county was an ideal one as a reception area for evacuees in World War II; immigration caused an increase of 17% in the population between Sept. 1939 and Feb. 1941. Of the 12 municipal boroughs the chief are Bodmin, Falmouth, Penzance, St. Ives and the city of Truro. There are eight urban districts and ten rural districts. Cornwall is divided into 17 petty sessional divisions. The boroughs of Bodmin, Falmouth, Helston, Launceston, Liskeard, Penryn, Penzance, St. Ives and Truro have separate commissions of the peace and Penzance has a separate court of quarter sessions. The Scilly Isles are administered by a separate council and form one of the petty sessional divisions. The county boundary was doubtless roughly determined by Aethelstan's day. In 1386 disputes arose and a commission was appointed to determine the Cornish border between North Tamerton and Homacot. Traces of jurisdictional differentiation anterior to Domesday survive in the names of at least five of the hundreds. At the time of the *Inquisitio Geldi* they were as follows: Straton, Fawiton, Panton, Tibeste, Wineton, Conarditon and Rileston. The shire court was held at Launceston except from about 1260 to 1386, when it was held at Lostwithiel. In 1716 the summer assize was transferred to Bodmin. After 1836 both assizes were held at Bodmin. Cornwall had its own bishops from the middle of the 9th century until 1018. In 1049 the see of the united dioceses of Devon and Cornwall was fixed at Exeter. Cornwall was formed into an archdeaconry soon after, and, as such, continued until 1877, when it was reconstituted a diocese with its see at Truro. The parishes of St. Giles-in-the-Heath, North Petherwyn and Werrington, wholly in Devon, and Boyton, partly in Devon and partly in Cornwall, which were portions of the ancient archdeaconry, and also the parishes of Broadwood-Widger and Virginstow, both in Devon, which had been added to it in 1875, thus came to be included in the Truro diocese. Of these, Broadwood-Widger was transferred to Exeter and Virginstow became associated with St. Giles-in-the-Heath. The county has 240 civil parishes, of which 5 are in the Scilly Isles. Two members for the county were summoned by Edward I to the parliament of 1295, and two continued to be the number of county members until 1832. Six boroughs were granted the like privilege by the same sovereign. To strengthen and augment the power of the crown as against the commons, between 1547 and 1584, 15 additional towns and villages received the franchise, with the result that, between the latter date and 1821, Cornwall sent no less than 44 members to parliament, and became notorious for the number of its rotten boroughs. The allocation of members proportionately to the population continued irregular until 1885. The parliamentary divisions are five, Bodmin, Camborne, Northern, Penryn and Falmouth, and St. Ives. In 1937 the East Cornwall Joint Planning committee was formed to prepare a planning scheme for nearly all East Cornwall. The area covered was about 637 sq.mi.

Communications.—The principal ports are Falmouth and Penzance. The G.W.R. main line passes through the county and terminates at Penzance. Fowey, Penryn and Falmouth, and Helston on the south, Newquay and St. Ives in the north are served by branch lines. The northeastern parts of the county, Launceston, Bude, Bodmin, Wadebridge and Padstow are served by the S.R. Motorbus traffic has greatly improved communications in the rural areas. In 1943 there were 3,850 mi. of roads in the county. Many of the small seaside towns have become favourite holiday resorts, such as Bude, Newquay and St. Ives.

Bibliography.—*See* Richard Carew, *Survey of Cornwall* (1602); W. Borlase, *Antiquities of Cornwall* (1754 and 1769); D. Gilbert, *Parochial History of Cornwall* (1837–1838), incorporating collections of W. Hals and Tonkin; J. T. Blight, *Ancient Crosses in the East of Cornwall* (1858), and *Churches of West Cornwall* (1865); G. C. Boase and W. P. Courtney, *Bibliotheca Cornubiensis,* a catalogue of the writings, both ms. and printed, of Cornishmen, and of works relating to Cornwall (Truro and London, 1864–1881); R. Hunt, *Popular Romances and Drolls of the West of England* (1865); W. Bottrell, *Traditions and Hearthside Stories of West Cornwall* (Penzance, 1870–1873); J. H. Collins, *Handbook to the Mineralogy of Cornwall and Devon* (Truro, 1871); W. C. Borlase, *Naenia Cornubia* (1872); *Early Christianity in Cornwall* (1893); J. Bannister, *Glossary of Cornish Names* (1878); W. P. Courtney, *Parliamentary Representation of Cornwall to 1832* (1889); G. C. Boase, *Collectanea Cornubiensia* (Truro, 1890); J. R. Allen, *Old Cornish Crosses* (Truro, 1896); A. H. Norway, *Highways and Byways in Cornwall* (1904); Lewis Hind, *Days in Cornwall* (1907); *Victoria County History, Cornwall;* G. Barrow, "The High Level Platforms of Bodmin Moor." *Quart. Journ. Geol. Soc.* (London, 1908); H. Dewey, "River Gorges in Cornwall and Devon," *Quart. Journ. Geol. Soc.* (London, 1916); E. M. Hendriks, "The Physiography of Southwest Cornwall," *Geol. Mag.* (1923); J. H. Collins, *The West of England Mining Region* (Plymouth, 1907); W. S. Lewis, *The West of England Tin-mining* (Exeter, 1923); *The Land of Britain* (Land Utilization Survey of Britain) Part 91 (London, 1941).

CORNWALL, founded as New Johnstown by United Empire Loyalists in 1784, incorporated in 1834, and now the capital of the united counties of Stormont, Dundas and Glengarry, Ontario, Canada, 67 mi. southwest of Montreal, on the left bank of the St. Lawrence river. Pop. (1941) 14,117. It is an important station on the Canadian National, Canadian Pacific, and New York Central railways, is a port of call for all steamers between Montreal and Lake Ontario ports, and is connected by an inter-nation bridge with the United States.

The surplus from the Cornwall canal furnishes excellent water privileges for its factories, which include cotton and woollen mills and grist and saw mills.

CORNWALLIS, CHARLES CORNWALLIS, 1st Marquess (1738–1805), eldest son of Charles, 1st Earl Cornwallis (1700–62), was born on Dec. 31, 1738, and educated at Eton and Clare college, Cambridge. He entered the army, and served in Germany in 1761. Succeeding to the earldom in 1762, in 1765 he was made aide-de-camp to the king and gentleman of the bedchamber, and in 1770 was appointed governor of the Tower. He served as major-general in the American War of Independence, and in 1780 commanded the British forces in South Carolina; in 1781 he defeated Greene at Guildford Court House, and raided Virginia, but was besieged at Yorktown by the French and American armies, and was forced to capitulate on Oct. 19, 1781. With him fell the English cause in the United States. Appointed governor-general of India and commander-in-chief of Bengal in 1786, he was interrupted in his administrative reforms by the quarrel with Tippoo Sahib. After capturing Bangalore (1791) and laying siege to Seringapatam, he concluded a treaty which stripped Tippoo Sahib of half his realm. The settlement of the land revenue under his administration is frequently called the Cornwallis code. Cornwallis returned to England in 1793, received a marquessate, and was made master-general of the ordnance. As viceroy of Ireland (June, 1798–1801) he gained the goodwill of both Roman Catholics and Orangemen, and a few weeks after a general amnesty had been proclaimed (July 17, 1798) the French army under Humbert was forced to surrender. In 1802 Cornwallis was appointed plenipotentiary to negotiate the treaty of Amiens. In 1805 he was again sent to India as governor-general, to replace Lord Wellesley, whose policy was too advanced for the directors of the East India company, but he died on Oct. 5, 1805, on his way up country to assume command of the troops. He was succeeded as 2nd marquess by his only son, Charles (1774–1823). On his death the marquessate became extinct, but the title Earl Cornwallis passed to his uncle, James (1743–1824), bishop of Lichfield. In 1852, on the death of his son and successor, James, the 5th earl, the Cornwallis titles became extinct.

See W. S. Seton-Karr, *The Marquess Cornwallis,* "Rulers of India" series (1890).

CORNWALLIS, SIR WILLIAM (1744–1819), British admiral, was the brother of the 1st Marquess Cornwallis, governor-general of India. He was born on Feb. 20, 1744, entered the navy as a boy of 11, and had reached post-rank when he was 22. In 1779 he commanded the "Lion" in the fleet of Admiral Byron. The "Lion" was very roughly handled in the battle off Grenada on July 6, 1779, and had to make her way alone to Jamaica. In March 1780 he fought an action in company with two other vessels against a much superior French force off Monti Cristi, and had another encounter with them near Bermuda in June. The force he engaged was the fleet carrying the troops of Rochambeau to North America, and was too strong for his squadron of two small liners, two 50-gun ships and a frigate. After taking part in the second relief of Gibraltar, he returned to North America, and served with Hood in the actions at the Basse Terre of St. Kitts, and with Rodney in the battle of Dominica on April 12, 1782. Some very rough verses which he wrote on the action have been printed in Leyland's *Brest-Papers,* published for the Navy Record Society, and show that he thought very ill of Rodney's conduct of the battle. Cornwallis's papers on this and other actions are valuable in the history of the British navy. In 1788 he went to the East Indies as commodore, and had some share in the war with Tippoo Sahib, and helped to reduce Pondicherry. His promotion to rear-admiral dates from Feb. 1, 1793, and on July 4, 1794, he became vice-admiral.

In the Revolutionary War his services were in the Channel. The most signal of them was performed on June 16, 1795, when he carried out what was always spoken of with respect as "the retreat of Cornwallis." He was cruising near Brest with four sail of the line and two frigates, when he was sighted by a French fleet of 12 sail of the line, and many large frigates commanded by Villaret Joyeuse. The odds being very great he was compelled to make off. But two of his ships were heavy sailers and fell behind. He was consequently overtaken, and attacked on both sides. The rearmost ship, the "Mars" (74), suffered severely in her rigging and was in danger of being surrounded by the French. Cornwallis turned to support her, and the enemy, impressed by a conviction that he must be relying on help within easy reach, gave up the pursuit. In 1796 he incurred a court-martial, but was practically acquitted. The substance of the case was that he demurred on the ground of health at being called upon to go to the West Indies, in a small frigate, and without "comfort." He became full admiral in 1799, and held the Channel command for a short interval in 1801 and from 1803 to 1806, but saw no further service. He was made a G.C.B. in 1815, and died on July 5, 1819.

See G. Cornwallis-West, *The Life and Letters of Admiral Cornwallis* (1927).

CORO, a small city and the capital of the State of Falcón, Venezuela, 7m. W. of La Vela de Coro (its port on the Caribbean coast), with which it is connected by rail, and 199m. W.N.W. of Carácas. Pop. (1940) 18,962. Coro stands on a sandy plain between the Caribbean and the Gulf of Venezuela, and near the isthmus connecting the peninsula of Paraguaná with the mainland. Its elevation above sea-level is only 105ft., and its climate is hot but not unhealthy. It is the commercial centre for an extensive district on the east side of Lake Maracaibo and the Gulf of Venezuela, which exports large quantities of goat-skins, an excellent quality of tobacco, and some coffee, cacao, castor beans, timber and dye-woods. American and British oil companies have taken up oil-land concessions throughout this coastal region and are exploring for petroleum both west and east of Coro. There are salt deposits and coal mines worked by the government in the vicinity. It was founded in 1527 by Juan de Ampués, who gave to it the name of Santa Ana de Coriana (afterwards corrupted to Santa Ana de Coro) in honour of the day and of the tribe of Indians inhabiting this locality. It was also called Venezuela (little Venice) because of an Indian village on the gulf coast built on piles over the shallow water; this name was afterwards bestowed upon the province of which Coro was the capital. Coro was also made the chief factory of the Welsers, the German banking house to which Charles V. mortgaged this part of his colonial possessions, and it was the starting-point for many exploring and colonizing expeditions into the interior. It was made a bishopric in 1536, and for a time Coro was one of the three most important towns on the northern coast. The seat of government was removed to Caracas in 1578 and the bishopric five years later. Coro is celebrated in Venezuelan history as the scene of Miranda's first attempt to free his country from Spanish rule.

COROLLARY, a proposition, geometric or not, incidentally proved in the demonstration of another proposition, and therefore following from it without further proof. Hence the significance of the word, from late Latin *corollarium,* a gift, money paid for a *corolla,* a garland. Euclid gave no corollaries, the modern examples having been added by commentators on, or editors of, the *Elements.*

COROMANDEL COAST, a name formerly applied officially to the eastern seaboard of India approximately between Cape Calimere, in 10° 17′ N., 79° 56′ E., and the mouths of the Kistna river. The shore, which is low, is without a single good natural harbour, and is at all times beaten by a heavy sea. The north-east monsoon, which lasts from October till April, is violent for the first months. From April till October hot southerly winds blow by day; at night the heat is tempered by sea-breezes. The principal places frequented by shipping are Pulicat, Madras, Sadras, Pondicherry, Cuddalore, Tranquebar, Nagore and Negapatam. The name Coromandel is said to be derived from *Cholamandal,* the mandal or region of the ancient dynasty of the Chola.

CORONA, a city of Riverside county, California, U.S.A., 45m. E.S.E. of Los Angeles, on Temescal creek, and served by the Santa Fe Railway. The population was 8,764 in 1940. There are mineral springs and quarries (cement, lime, clay and porphyry) in the vicinity. Natural gas is used. The city ships oranges, lemons and other fruits, beets and alfalfa, and manufactures lemon products, boxes, sewer pipe, terra-cotta, pressed brick and chemicals.

CORONA. During the period of totality of an eclipse of the sun there is seen surrounding it a halo, pearly-white in colour, of irregular shape, but roughly circular in form, about twice the size of the sun, with faint streamers extending several diameters from the limb of the sun. This is termed the Solar Corona. It was long uncertain whether the corona belonged to the sun or to the moon, or if it arose in the earth's atmosphere. It cannot originate in the atmosphere since it presents the same appearance when seen from widely separated positions on the earth's surface, and photographs show that the dark moon moves across the background formed by the corona, so that it cannot belong to the moon. It will be obvious that many of the phenomena that will now be described are inconsistent with any but a solar origin.

Phenomena.—The plate gives a good idea of typical coronae. There is an approximately circular, and not very large, bright inner corona around which are more or less extensive streamers proceeding in a roughly radial direction mainly from the neighbourhood of the solar equator; and there are curved rays (the "polar brushes") proceeding from the north and south poles of the sun. The forms observed can be classified into two main types occurring alternately, at regular intervals, with intermediate forms between. At times of minimum sun-spot activity the polar brushes are short, and the equatorial streamers long; at times of maximum sun-spot activity the polar rays are longer, the equatorial streamers shorter and the corona is more circular in form. Near prominences the corona is brighter and shows an arched structure. It is uncertain how long the different forms endure, since observations are possible only during a total eclipse; thus there was a sun-spot maximum in Aug. 1917, but the corona of June 1918 was not a typical maximum type. In general after a maximum the streamers draw away from the poles and the longest rays are found in the sun-spot zones, making the corona rectangular in appearance. The extent of the corona varies greatly. Streamers have been followed out to the enormous distance of twelve solar diameters, *i.e.,* over 10,000,000m. from the surface of the sun, but commonly three or four diameters is its extent.

Coronae near sun-spot maximum are found to differ more than those occurring near a sun-spot minimum. It is definitely established that changes occur and that the broad features may be correlated with sun-spot activity. It remains at present undecided whether any changes occur during the short periods of time for which the corona can be observed at any one eclipse. Certainly no changes have been found during the time of totality at any one station, which is necessarily less than about seven and a half minutes. The interval of time between totality at different points of the earth's surface lying within the zone of totality may, however, be several hours, and it is of interest to compare observations of the corona made at widely separated stations. The evidence is on the whole in favour of changes taking place. In 1905 plates taken in Egypt and in Spain with an interval of 70min. showed no movement, but in 1918 stations 26min. apart showed changes in the coronal arches, indicating that they were receding from the sun with a velocity of about 16km. per sec., and Prof. Horn d'Arturo, comparing photographs of the corona of Jan. 14, 1926, taken in East Africa and in Sumatra, with an interval of 150min., finds considerable changes and velocities of recession of the coronal material of the order of 1km. per sec. Of course, rapid motions along the lines of the streamers might exist and escape detection.

The Radiation from the Corona.—The greater part of the light from the corona shows a continuous spectrum; a number of bright emission lines are present, and also the Fraunhofer spectrum (the ordinary solar spectrum). The spectrum of the inner corona (from 8 to 10min. of arc from the limb of the sun, the diameter of which is about 30min.) is mainly continuous and the bright lines are strongest here; farther out, in the middle and outer corona, the Fraunhofer lines are visible. It is important to know if, and how, the radiation from the corona is polarized. It is found that the bright-line spectrum is unpolarized, but the continuous radiation shows strong radial polarization. The polarization rises rather rapidly to a maximum of about 11% in the visible region of the spectrum, at 5 or 6min. from the limb, and thereafter decreases more slowly. Unfortunately little or nothing is known about the way in which the polarization varies over the spectrum. H. F. Newall found that there came from the veil of illuminated sky between the observer and the corona as much polarized light as from the corona itself at 3–4° from its centre.

The Distribution of Intensity. The older measurements are quite inconsistent. More recent measurements agree more or less with the law found by Bergstrand in 1914. He found that the intensities near the solar equator differ greatly from those near the poles at the same distance from the centre of the sun. The equatorial rays are three times as intense as the polar rays. He suggested that we regard the corona as the superposition of an interior corona existing only in the equatorial zone, and a general outer corona. In both the intensity decreases as the inverse square of the distance from the edge of the sun, but the intensity of the equatorial corona is double that of the outer corona. However, on account of the complex detailed structure of the corona, any attempt to derive a law of intensity distribution of the kind just examined, which ignores variation round the sun and treats the corona as if it were a disc whose brightness varies only along a radius, is foredoomed to failure if regarded as anything but a rough approximation.

The Total Radiation from the Corona. In view of the great uncertainty of the older measurements and the paucity of modern ones, caution must be used in giving any figures for the total radiation, but it seems fairly clear that the total energy radiated is from about a quarter to a half that received by us from the full moon, and that it is not constant but varies from one eclipse to another, the measures indicating, for example, that it was 40% greater in 1926 than in 1925.

The Continuous Spectrum of the Corona.—The eclipse of 1922 showed that the Fraunhofer spectrum of the corona does not come from terrestrial scattering of direct sunlight, since no trace of it was found beyond the limits of the coronal spectrum on the plates. It is found that the continuous spectrum and the Fraunhofer lines are strong, and the coronal green emission lines are weak, near a time of sun-spot minimum and this, on the whole, indicated that the coronal radiation is richer in red and infra-red rays than is direct sunlight, but the amount of the difference is small and uncertain. There seems to be no appreciable radiation from the corona in the infra-red region beyond about 55,000 A.U.

The Bright-line Spectrum of the Corona.—A number of bright lines are found in the spectrum of the corona, which are definitely not due to the higher regions of the chromosphere. None of them is very bright, and the older measures are very inaccurate. The table gives a summary of the most accurate measures available of lines definitely believed to belong to the corona. None of them is identified with any known line in the spectrum of an element observed in the laboratory, and when they were first discovered the name "Coronium" was proposed for the hypothetical element to which they were supposed to owe their origin. Their behaviour, however, seems hard to reconcile with the idea that they have a common origin. Thus the structure of the monochromatic images of the inner corona obtained by use of a prismatic camera, indicates that the lines can be grouped in pairs, such as 3454 and 3643 and 3601 and 4086.

The Bright Line Spectrum of the Corona

Wave-lengths in international Angstrom units	Intensities	Wave-lengths in international Angstrom units	Intensities
3387·96	20	4311	2
3454·13	5	4359	4
3600·97	9	4567	6
3642·87	3	4586	4
3800·77	4	5118	2
3986·88	10	5302·80	20
4086·0	8	5536	2
4231·4	10	6374·8	5

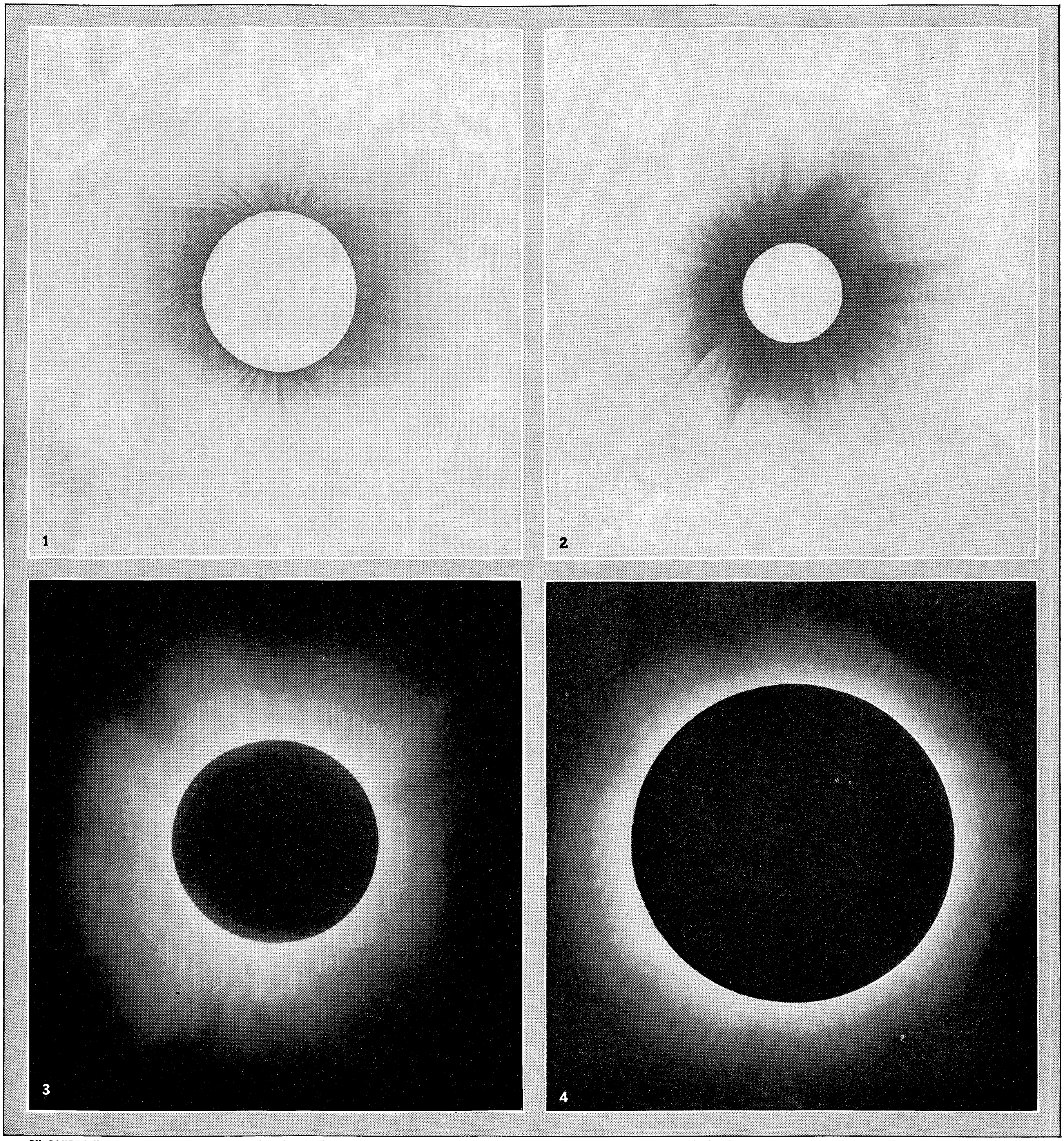
Of these lines 4231 and 4586 are near strong lines due to ionized iron, and 5536 is near a strong iron line and near a strong line due to ionized strontium. These lines are, however, possibly coronal in origin. Three lines in the far ultra-violet (3164, 3170 and 3237) have been observed by Deslandres once only, and are probably of chromospheric origin due to TiII. A few other very doubtful lines are 3461, 4241, 4245, 4398, 4533 and 4567. *See* C. R. Davidson and F. J. M. Stratton, *Mem. Roy. Ast. Soc.*, 64, 142 (1927).

The distribution of intensity of the lines across the corona groups these same pairs together, and also 3388 and 3987; the line 5303 appears to belong to the 3601 group and 6374 resembles 3388 and 3987 but not very closely.

A remarkable relation between the wave-lengths of certain coronal lines discovered in 1911 by J. W. Nicholson (resembling the relation between nebular lines also discovered by him), and accounted for in terms of a dynamical theory of a hypothetical atom, seems not to have stood the test of time. He found that most of the lines then classed as coronal lines could be fitted to a formula of the type $\lambda = a(n+\mu)^3$ where n is an integer. Increasing accuracy of measurement has not improved the fit of this formula, moreover some of the lines used by him are of very doubtful coronal origin or even existence, and some have been identified as chromospheric lines due to ionized iron or titanium.

Rotation of the Corona.—It is generally assumed that the corona close to the sun rotates with it, but there is no definite evidence of any motions in it that could be interpreted as rotational. We do not know independently the wave-lengths of any of the coronal lines, so we cannot say from the observed wave-lengths if there is any displacement that could be interpreted as due to motion toward or away from the observer in the line of sight. Attempts have been made to discover rotational effects by comparing the wave-lengths of a coronal line at two ends of a solar diameter. They have been unsuccessful on account of the great weakness of the lines at any appreciable distance from the sun's limb. It has been observed, though confirmation of this is desirable, that the Fraunhofer lines in the coronal spectrum are slightly displaced. This might indicate rotational movement but might, on the other hand, be due to the reflection of sunlight from particles moving radially from the surface of the sun, as suggested by H. N. Russell.

Theories of the Corona.—The presence of the Fraunhofer lines in the spectrum of the corona suggests strongly that there is an atmosphere of dust particles or a gaseous envelope scattering the solar radiation, as does also the polarization of the coronal light. The density of the coronal material must be very low since there is no appreciable refraction produced by it, nor do comets, which sometimes almost graze the solar surface, suffer any detectable perturbations in passing through the corona. One of the oldest theories of the corona is that it consists of a swarm of meteoric particles revolving round the sun. This theory has the disadvantage of explaining none of the observations, and was probably only put forward because this was the only known means, at the time, of maintaining any kind of atmosphere against the force of gravitation. Various so-called mechanical theories have been put forward from time to time, based on the original one of Schaeberle. According to these the corona is due to light emitted and reflected from streams of matter, which are ejected from the sun by forces acting along lines roughly normal to the solar surface and localized chiefly in sun-spot zones (to account for the correlation with sun-spot activity). The main difficulty in these theories has been that of providing a suitable expelling agency;



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CORONAE AT VARIOUS STAGES OF SUN-SPOT ACTIVITY

1. Corona, May 18, 1901, near time of minimum sun-spot activity. Characteristic sun-spot minimum with short polar brushes and long equatorial streamers

2. Corona, Aug. 30, 1905, near time of maximum sun-spot activity. The circular corona characteristic of a sun-spot-maximum period and the long equatorial streamers which give it its typical form are here visible

3. Corona during total eclipse of June 8, 1937, characteristic of maximum sun-spot activity. Photograph taken at Canton island

4. Solar corona, Alhambra, Spain, Aug. 31, 1905. Photograph taken with 40-ft. telescope; exposure time 25 seconds

NOTE: THE RANGE OF BRIGHTNESS IN THE CORONA IS SO GREAT THAT ANY ONE PHOTOGRAPH CAN SHOW DETAIL EITHER OF THE INNER OR OUTER CORONA ONLY. FIGS. 1 AND 2 ARE FROM COMPOSITE DRAWINGS MADE FROM ORIGINAL NEGATIVES, WITH CONTRAST REDUCED

moreover the explanation of the continuous spectrum is not thereby completed, and the problem of the bright line spectrum is left quite unsolved.

Probably the view to take at the present time is something like this. We have a satisfactory theory of the chromosphere, whereby it turns out to be a gaseous atmosphere consisting largely of electrons and ionized atoms supported by radiation pressure (the competent force lacking in older theories). At the top of the chromosphere the density is very low, pressure is of the order of 10–12 atmospheres, and since we can scarcely suppose the density to increase outwards from the sun, there is no difficulty in fitting on to it a tenuous coronal envelope. The mechanism of the radiation pressure supporting the atoms is that of line absorption, which is very different from that of pressure on small particles. In particular it is selective in its action. Only those atoms are capable of existing in such an atmosphere that are ionized to the appropriate degree under the existing conditions of temperature and pressure, so that they can absorb the requisite amount of radiation from the supply provided, which last is determined by the surface temperature of the sun. This is quite welcome, however, for since we have to account for the coronal lines we must suppose them due to some atoms, and since there are not many of them only a few atoms should be concerned in their production. The coronal region must consist of gases in a rather higher degree of ionization than in the chromosphere, since the pressure is so much lower, and though there may not be possible a static equilibrium for such an atmosphere, yet, owing to recombination of ions (allowing suitably powerful absorption to occur from time to time) there may be a dynamical equilibrium. We do not require to suppose the corona quiescent. If we regard coronal material as shot up from below, owing to excessive radiation pressure, we have a good reason for the observed connection between coronal arches and streamers and prominences, since, near prominences and sun-spots, locally superheated regions of the solar surface are found to occur; moreover the connection with sun-spot activity is no longer mysterious. There will be present a considerable proportion of free electrons; these can scatter light and, it turns out, would do so in the right kind of way, so far as observation is possible; and the scattering by atoms present is not inconsistent with observation.

Finally with regard to the origin of the coronal lines, it seems most likely that they are to be explained in the same way as the nebular lines, *i.e.*, as due to known atoms in circumstances which cannot so far be imitated in the laboratory; so that transitions can occur sufficiently often under the conditions of low density (*i.e.*, long undisturbed life of the individual atoms) and appropriate stimulation, so as to produce "forbidden" lines of appreciable intensity and to suppress the ordinary lines. The atoms involved would presumably be those capable of existing (possibly at a lower stage of ionization) in the high chromosphere, and indeed doubly ionized calcium has been suggested as the source of these lines, with some plausibility, but so far it is not more than a suggestion; ionized titanium seems also very likely to be involved.

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CORONA, in architecture the central division of a classic cornice, usually consisting of a projecting block, with its under side approximately flat, and its outer face vertical, and forming a simple, continuous band along the length of the cornice. (*See* ORDER.)

CORONACH, the lamentation or dirge for the dead which accompanied funerals in the Highlands of Scotland and in Ireland. (A Gaelic word, from *comh,* with, and *ranach,* wailing.) The more usual term in Ireland is "keen," "caoine" or "keening."

CORONADO, FRANCISCO VASQUEZ DE (*c.* 1500–1554), Spanish explorer of the American southwest, accompanied Antonio de Mendoza to New Spain in 1535, and became a leading grandee. In 1538 he was chosen a *regidor,* or member of the town council, of Mexico City, and in 1539 was appointed governor of the province of New Galicia. In the same year Melchior Díaz reaffirmed the fabulous report of Fray Marcos de Niza concerning the "seven cities of Cibola" (now identified almost certainly with the Zuñi pueblos of New Mexico), and in February of 1540 Coronado left Compostela, at the head of an expedition of 250 horsemen, 70 Spanish footmen, and several hundred friendly Indians with baggage animals and herds of cattle, for their exploration and conquest. Coronado with a part of his force captured the "seven cities" in July. The fabled wealth, however, was not there, and he moved westward, to the Rio Grande, where in the autumn (1540) he was joined by the rest of his force. Exploring parties visited Tusayan (the Hopi or Moqui country of northeastern Arizona), the Grand Canyon of the Colorado, and the Rio Grande (Tuguez). Having wintered here, the expedition, reinspirited by stories of an Eldorado called "Quivira" far to the northeast, advanced onto the plains of Texas in April, 1541. Finding nothing but prairie and bison, most of them retraced their steps, but Coronado with about 30 horsemen penetrated to the central part of Kansas, explored the misnamed Eldorado—a village of Wichita tepees—and in October rejoined his forces on the Rio Grande. In the spring of 1542 he led a tattered remnant of his army home, to taste the bitter cup of incompetence and failure. He nevertheless continued in his capacity of governor of New Galicia until 1544, when his *residencia* was taken and he was convicted of "general neglect of duty . . . rank favoritism and numerous irregularities," was fined and for a short time was actually imprisoned. He retired to Mexico City where he still held the post of *regidor,* and rose to petty prominence in the municipal routine. In 1549 he received a small *encomienda* (a grant of land and the Indians residing on it) in recognition of "meritorious services in discovery and conquest," but his health began to give way, and sometime about the first of November, 1554, he died. Though Coronado is one of the least of the conquistadors, his march looms up as one of the feats of the Spanish conquest in America, both on its own merits and by its consequences a tribute to the genius of Antonio de Mendoza. In connection with it, Hernando de Alarcon in 1540 ascended the Gulf of California to its head, and the Colorado river for a long distance above its mouth.

See G. P. Winship, "The Coronado Expedition" in the 14th *Report* of the U.S. Bureau of Ethnology (1896). (W. B. P.)

CORONATION, a solemnity whereby sovereigns are inaugurated in office. In pre-Christian times in Europe the king or ruler, upon his election, was raised on a shield, and, standing upon it, was borne on the shoulders of certain of the chief men of the tribe, or nation, round the assembled people. This was called the *gyratio,* and it was usually performed three times. At its conclusion a spear was placed in the king's hand, and the diadem, a richly wrought band of silk or linen, which must not be confused with the crown (*see* CROWN AND CORONET), was bound around his forehead. When Europe became Christian, a religious service of benediction was added to the older form, which, however, was not abandoned. Derived from the Teutons, the Franks continued the *gyratio,* and Clovis, Sigebert, Pippin and others were thus elevated to the royal estate. From a combination of the old custom with the religious service the later ceremonies were developed. In the procession of the English king from the Tower to Westminster (first abandoned at the coronation of James II.), in the subsequent elevation of the king into what was known as the marble chair in Westminster Hall, and in the showing of the king of France to the people, as also in the universal practice of delivering a sceptre to the new ruler, traces, it is thought, may be detected of the original function.

The added religious service was naturally derived from the Bible, where mention is frequently made, in the Old Testament, of the anointing and crowning of kings. The anointing of the king soon came to be regarded as the most important, if not essential, feature of the service. By virtue of the unction which he received, the sovereign was regarded, in the middle ages, as a *mixta persona,* in part a priest and in part a layman. It was a strange theory, and Lyndwode, the great English canonist, is cautious as to it, and was content to say that it was the opinion of some people. It gained wide acceptance, and the anointed sovereign was generally regarded as, in some degree, possessed of the priestly character. By virtue of the unction he had received, the emperor was made a canon of St. John Lateran and of St. Peter at Rome, and also of the collegiate church of Aachen, while the king of France was *premier chanoine* of the primatial church of Lyons, and held canonries at Embrun, Le Mans, Montpellier, St. Pol-de-Léon, Lodève, and other cathedral churches in France. There are, moreover, trustworthy records that, on more than one occasion, a king of France, habited in a surplice and choir robes, took part with the clergy in the services of some of those churches. Martène quotes an order, which directs that at the imperial coronation at Rome, the pope ought to sing the mass, the emperor read the gospel, and the king of Sicily, or, if present, the king of France, the epistle. Nothing like this was known in England, and a theory, which has prevailed of late, that the English sovereign is, in a personal sense, canon of St. David's, is based on a misconception. The canonry in question was attached to St. Mary's College at St. David's before the Reformation, and, at the dissolution of the college, became crown property; but the king of England is not, and never was personally, a canon of St. David's, nor did he ever perform any quasi-clerical function.

At first a single anointing on the head was the practice, but afterwards other parts of the body, as the breast, arms, shoulders and hands received the unction. From a very early period in the West three kinds of oil have been blessed each year on Maundy Thursday, the oil of the catechumens, the oil of the sick, and the chrism. The last, of olive oil and balsam, is only used for the most sacred purposes, and the oil of the catechumens was that used for the unction of kings. In France, however, a legend gained credence that the Holy Dove had descended from heaven, bearing a vessel (afterwards called the Sainte Ampoule), containing holy oil, and had placed it on the altar for the coronation of Clovis. A drop of oil from the Sainte Ampoule mixed with chrism was afterwards used for anointing the kings of France. Similarly the chrism was introduced into English coronations, for the first time probably at the coronation of Edward II. To rival the French story another miracle was related that the Virgin Mary had appeared to Thomas Becket, and had given him a vessel with holy oil, which at some future period was to be used for the sacring of the English king. A full account of this miracle, and the subsequent finding of the vessel, is contained in a letter written in 1318 by Pope John XXII. to Edward II. The chrism was used in addition to the holy oil. The king was first anointed with the oil, and then signed on the head with the chrism. In all other countries the oil of the catechumens was alone used. In consequence of the use of chrism the kings of England and France were thought to be able to cure scrofula by the imposition of their hands, and hence arose the practice in those countries of touching for the king's evil, as it was called. In England the chrism disappeared at the Reformation, but touching for the evil was continued till the accession of the house of Hanover in 1714.

The oldest existing ritual for the coronation of a king is contained in what is known as the Pontifical of Egbert, who was archbishop of York in the middle of the 8th century. The coronation service in it is entitled *Missa pro rege in die benedictionis ejus,* and the coronation ceremony is interpolated in the middle of the mass. After the Gospel the officiant recites some prayers of benediction and then pours oil from a horn on the king's head, while the anthem "Zadok the priest," etc., is sung. After this the assembled bishops and nobles place a sceptre in the king's hands, while a form of intercessory benediction is recited. Then the staff (*baculus*) is delivered to him, and finally a helmet (*galea*) is set upon his head, the whole assembly repeating thrice "May King N. live for ever. Amen. Amen. Amen." The enthronement follows, with the kisses of homage and of fealty, and the mass, with special prayers, is concluded.

Another service of Anglo-Saxon date bearing, but with no good reason, the name of Aethelred II., has also been preserved, and is of importance as it spread from England to the Continent, and was used for the coronations of the kings of France. It differs from the Egbert form as the coronation precedes the mass, while the use of a ring, and the definite allusion to a crown (*corona* not *galea*) occur in it. Joined to it is the form for the coronation of a queen consort. It may have been used for the crowning of Harold and of William the Conqueror.

A third English coronation form, of the 12th century, bears the name of Henry I., but also without good reason. The ceremonial is more fully developed, and the king is anointed on the head, breast, shoulders, and elbows. The royal mantle appears for the first time, as does the sceptre. The queen consort is to be crowned *secundum ordinem Romanum,* and the whole function precedes the mass.

The fourth and most important of all English coronation services is that of the *Liber Regalis,* a manuscript still in the keeping of the dean of Westminster. It was introduced in 1307, and continued in use till the Reformation, and, in an English translation and with the Communion service substituted for the Latin mass, it was used for the coronation of James I. In it the English coronation ceremonies reached their fullest development. The following is a bare outline of its main features:—

The ceremonies began the day before the coronation, the king being conducted in a procession from the Tower of London to Westminster. There he reposed for the night, and was instructed by the abbot as to the solemn obligations of the kingly office. Early next morning he went to Westminster Hall, and there, among other ceremonies, as *rex regnaturus* was elevated into a richly adorned seat on the king's bench, called the Marble Chair. Then a procession with the regalia was marshalled and led into the abbey church, the king wearing a cap of estate on his head, and supported by the bishops of Bath and Durham. A platform with thrones, etc., having been previously prepared under the crossing, the king ascended it, and, all being in order, the archbishop of Canterbury called for the Recognition, after which the king, approaching the high altar, offered a pall to cover it, and a pound of gold. Then a sermon appropriate to the occasion was preached by one of the bishops, the oath was administered by the archbishop, and the *Veni Creator* and a litany were sung. Then the king was anointed with oil on his hands, breast, between the shoulders, on the shoulders, on the elbows, and on the head; finally he was anointed with the chrism on his head. Thus blessed and anointed, the king was vested, first with a silk dalmatic, called the *colobium sindonis,* then a long tunic, reaching to the ankles and woven with great golden images before and behind, was put upon him. He then received the buskins, the sandals, and spurs, then the sword and its girdle; after this the stole, and finally the royal mantle, four-square in shape and woven throughout with golden eagles. Thus vested, the crown of St. Edward was set on his head, the ring placed on his wedding finger, the gloves drawn over his hands, and the golden sceptre, in form of an orb and cross, delivered to him. Lastly, the golden rod with the dove at the top was placed in the king's left hand. Thus consecrated, vested and crowned the king kissed the bishops who, assisted by the nobles, enthroned him, while the *Te Deum* was sung. When a queen consort was also crowned, that ceremony immediately followed, and the mass with special collect, epistle, gospel, and preface was said, and during it both king and queen received the sacrament in one kind. At the conclusion the king retired to a convenient place, surrounded with curtains, where the great chamberlain took off certain of the robes, and substituted others for them, and the archbishop, still wearing his mass vestments, set other crowns on the heads of the king and queen, and with these they left the church.

This service, in English, was used at the coronation of James I., Elizabeth having been crowned with the Latin service. Little change was made till 1685, when it was considerably altered for the coronation of James II. The Communion was necessarily omitted in the case of a Roman Catholic, but other changes were introduced quite needlessly by Archbishop Sancroft, and four years later the old order was still more seriously changed, with the result that the revisions of 1685 and 1689 have grievously mutilated the service by confusing the order of its different sections, while the meaning of the prayers has been completely changed for no apparent reason. Alterations since then have been verbal rather than essential, but at each subsequent coronation some feature has disappeared, the proper preface having been abandoned at the coronation of Edward VII.

In connection with the English coronation a number of claims to do certain services have sprung up, and before each coronation a court of claims is constituted, which investigates and adjudicates on the claims that are made. The most striking of all these services is that of the challenge made by the king's champion, a service in grand serjeantry attached to the manor of Scrivelsby for many centuries. Immediately following the service in the church a banquet was held in Westminster Hall, during the first course of which the champion entered the hall on horseback, armed *cap-à-pie,* with red, white, and blue feathers in his helmet. He was supported by the high constable on his right, and the earl marshal on his left, both of whom were also mounted. On his appearance in the hall a herald in front of him read the challenge, the words of which have not materially varied at any period, as follows: "If any person, of what degree soever, high or low, shall deny or gainsay our sovereign lord . . . , king of the United Kingdom of Great Britain and Ireland, defender of the faith, (son and) next heir unto our sovereign lord the last king deceased, to be the right heir to the imperial crown of this realm of Great Britain and Ireland, or that he ought not to enjoy the same; here is his champion, who saith that he lieth, and is a false traitor, being ready in person to combat with him; and in this quarrel will adventure his life against him, on what day soever he shall be appointed." The champion then threw down the gauntlet. The challenge was again made in the centre of the hall, and a third time before the high table, at which the king was seated. The king then drank to the champion out of a silver-gilt cup, with a cover, which he handed to him as his fee. The banquet was last held, and the challenge made, at the coronation of George IV. in 1821. The champion's claim was admitted in 1902, but as there was no banquet the duty of bearing the standard of England was assigned to him. There is no record of the challenge ever having been accepted.

The coronation form in France bore much resemblance, in its general features, to the English coronation, and was, it is believed, originally based on the English form. The unction was given, first on the top of the head in the form of a cross, on the breast, between the shoulders, and at the bending and joints of both arms. Then, standing up, the king was vested in the dalmatic, tunic, and royal robe, all of purple velvet sprinkled with fleurs-de-lys of gold, and representing, it was said, the three orders of subdeacon, deacon, and priest. Then, kneeling again, he was anointed in the palms of the hands, after which the gloves, ring, and sceptre were delivered. Then the peers were summoned by name to come near and assist, and the archbishop of Reims, taking the crown of Charlemagne from the altar, set it on the king's head. After which the enthronement and showing of the king to the people took place. All the unctions were made with the chrism, mixed with a drop of oil from the Sainte Ampoule. After the enthronement mass was said, and at its conclusion the king communicated in both kinds. The third day after the coronation the king touched for the evil.

On the "11 Frimaire, an 13," Napoleon and Josephine were jointly crowned at Paris by the pope. Napoleon entered Notre-Dame wearing a crown, and before him were carried the imperial ornaments, to wit: *"la couronne de l'empereur, l'épée, la main de justice, le sceptre, le manteau de l'empereur, son anneau, son collier, le globe impérial, la couronne de l'impératrice, son manteau, son anneau."* Each of these was blessed, and delivered with a benediction to the emperor and empress, kneeling side by side, to receive them, both having previously received the unction on the head and on each hand. Napoleon placed the crown on his head himself. Mass with special prayers followed.

In Spain the coronation ceremony never assumed the fullness or magnificence that might have been expected. It was usually performed at Toledo, or in the church of St. Jerome at Madrid, the king being anointed by the archbishop of Toledo. The royal ornaments were the sword, sceptre, crown of gold, and the apple of gold, which the king himself assumed after the unction. In recent years the unction and coronation have been disused.

In Sweden the king was anointed and crowned at Uppsala by the archbishop. The ceremony is now performed in the Storkyrka, at Stockholm, where the archbishop of Uppsala anoints the king on the breast, temples, forehead, and palms of both hands. The crown is placed on the king's head by the archbishop and the minister of justice jointly, whereupon the State marshal proclaims: "Now is crowned king of the Swedes, Goths and Wends, he and no other." When there is a queen consort she is then anointed, crowned, and proclaimed in the same manner.

In Norway, according to the law of 1814, the coronation is performed in the cathedral at Trondhjem, when the Lutheran superintendent, or bishop, anoints the king. The crown is placed on the king's head jointly by the bishop and the prime minister.

In Russia the coronation, celebrated at Moscow, was full of religious significance. The tsar was anointed by the metropolitan, but placed the crown on his head himself. He received the sacrament among the clergy, the priestly theory of his office being recognized. The coronation ceremony was also performed with much significant ritual in Austria and Hungary. In other countries, as Prussia, it was retained in a modified form; but in the remaining States such as Denmark, Belgium, Italy, etc., it has been abandoned, or never introduced.

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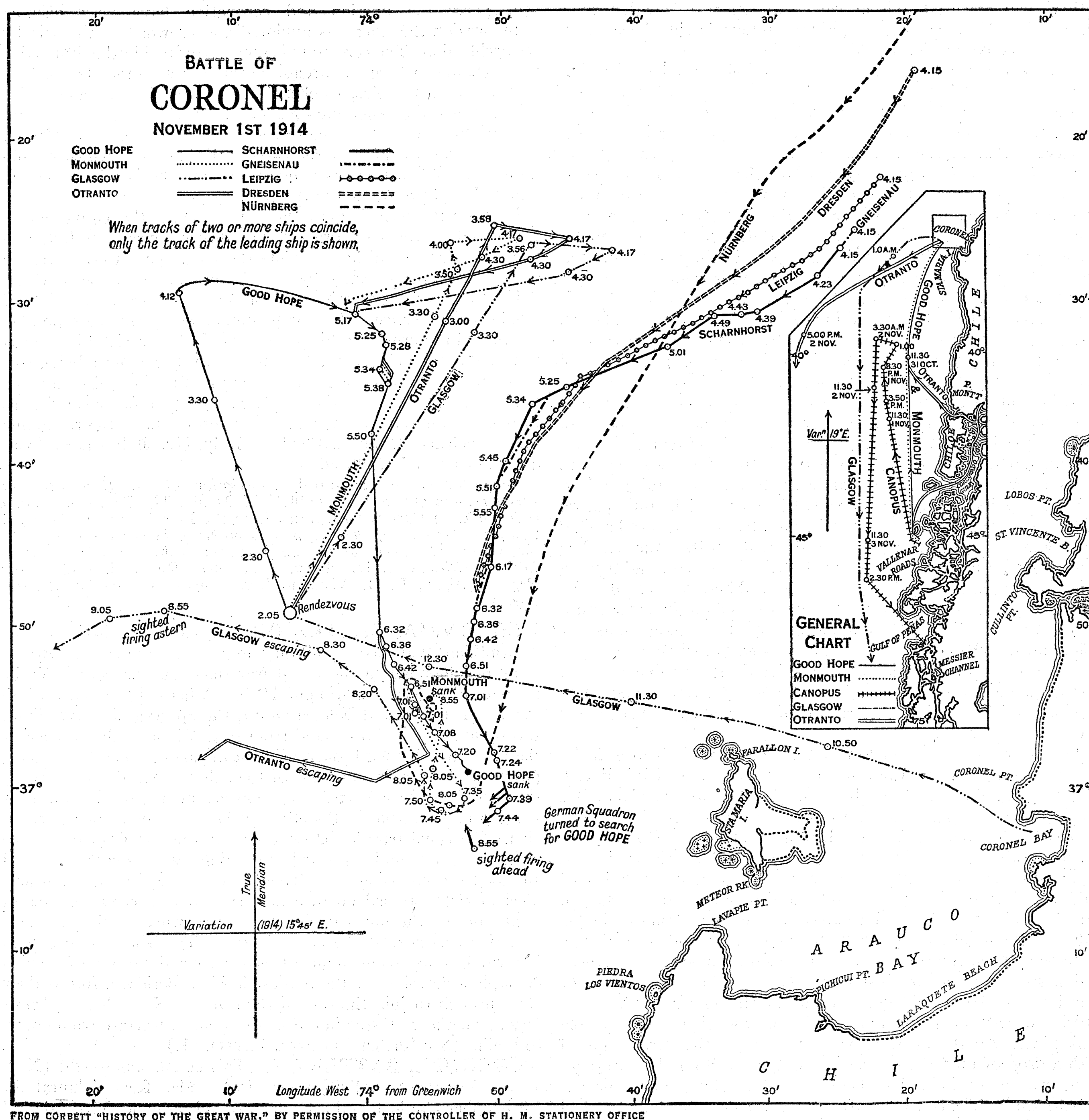
CORONEIA, BATTLE OF, 394 B.C. This battle of the "Corinthian War" is of military interest as showing a further small development in the art of war since Cunaxa (*q.v.*). While the offensive by the coalition of Thebes, Athens, Argos and Corinth was being stemmed at Nemea (*q.v.*), the Spartan king, Agesilaus, was on his way back overland from Asia Minor to the defence of the homeland, having broken off his campaign against the Persian power on the urgent summons of the ephors. After passing safely through Thessaly and gathering reinforcements, he was faced at the gap of Coroneia, in Boeotia, by the main forces of the coalition. The usual parallel battle followed, the usual "drift" to the right occurred, and as usual each right wing overlapped and smashed the opposing left. Then, however, while the victorious Theban right pressed on to attack the Spartan camp, Agesilaus, improving on the novel device of Nemea, wheeled his victorious right inwards against the enemy centre. The Thebans succeeded in forming a new front to meet this menace and, after a fight which Xenophon describes as the hardest in his experience, forced their way through to join the rest of their army. Nevertheless, Agesilaus had cut a fresh step in the steep ascent of warfare from brawn to brain. (*See* further LEUCTRA, BATTLE OF.)

CORONEL, BATTLE OF. This action was fought (Nov. 1, 1914) between a British squadron under Rear Admiral Sir Christopher Cradock and a German squadron under Vice Admiral Graf von Spee. Actually it took place in a position 41m. to the west of Coronel in Chile. The result was a severe defeat of the British forces, the flagship "Good Hope" and the cruiser "Monmouth" being sunk; while the two remaining ships escaped in the dark. The German ships were comparatively little damaged.

The causes which led up to the British defeat can be directly traced to a faulty appreciation by the Admiralty of the whole situation of Cradock *vis-à-vis* von Spee. In consequence of this Cradock had not been reinforced by a powerful modern cruiser for which he had urgently applied, while the instructions sent him were ambiguous, although their general tone was such that he could not have done otherwise than set out in search of an enemy which proved to be superior in every respect to his fighting strength. It has been argued that, having found the enemy, he should have avoided action, but he had specific orders "to be prepared to meet them" and "to protect trade." It has also been argued that he would have been safe if he had not pressed on without the old battleship "Canopus" and that he had been speci-



FROM CORBETT "HISTORY OF THE GREAT WAR," BY PERMISSION OF THE CONTROLLER OF H. M. STATIONERY OFFICE

FEELING COMPELLED BY HIS ORDERS TO FIGHT, DESPITE INFERIORITY IN GUN POWER, SPEED, AND TRAINED PERSONNEL, THE BRITISH ADMIRAL CLOSED, ON SIGHTING THE ENEMY, AND BY 6:25 P.M. THE ACTION HAD BEGUN. TACTICAL ADVANTAGE LAY WITH THE GERMANS. A HEAVY SEA RENDERED THE MAIN DECK GUNS OF THE ALMOST OBSOLETE BRITISH CRUISERS INEFFECTIVE, AND, SILHOUETTED AGAINST THE SETTING SUN, THEY PRESENTED EASY TARGETS FOR THE HEAVIER ARMAMENT OF THE GERMAN "GNEISENAU" AND "SCHARNHORST." THE "GOOD HOPE" WAS BLOWN IN TWO AT 7:20 P.M., AND THE "MONMOUTH" WAS SUNK AT 800 YARDS' RANGE AT 8:55 P.M. NOT A MAN WAS SAVED. THE "OTRANTO" AND "GLASGOW" ESCAPED

fically warned by the Admiralty that "'Canopus' should accompany 'Glasgow,' 'Monmouth' and 'Otranto'." To these latter instructions Admiral Cradock had, not unnaturally, replied that it was impossible to find and destroy the enemy's fast squadron with a ship of such slow speed as the "Canopus" in company. Moreover, the idea that this ship, because she was classed as a battleship, was something in the nature of an impregnable fortress, under whose shelter he could not come to any harm, was based on a complete fallacy as to her fighting efficiency. Her four old 12in. guns could have been out-ranged by the more modern 8in. guns of the German "Gneisenau" and "Scharnhorst." Her armoured belt was no thicker than that of the "Good Hope," while her crew was very largely untrained, whereas von Spee's two principal ships were the crack gunnery ships of the German Fleet in the eastern waters. There can be very little doubt that had the "Canopus" been present in the battle she would have been sunk as surely as were the "Good Hope" and "Monmouth."

Events Leading Up to the Action.—On Oct. 22 Admiral Cradock left Port Stanley in the Falkland islands by the route round the Horn. The "Canopus," which had just arrived at the Falklands, was told to follow immediately and meet him on the other side of the Straits of Magellan. He had sent instructions for the armoured cruiser "Defence" to join him, but these were cancelled by the Admiralty, who informed him that she was to

Ships engaged:

Ship.	Displacement.	Completed.	Guns.	Armour.	Max. speed.
British					
Good Hope (Flag)	14,100 tons	1902	2 9·2in. 16 6in.	6-in. belt, 5–6-in. on turrets	23·5kts.
Monmouth	9,800 tons	1903	14 6in.	4-in. belt, 6-in. on turrets	23kts.
Glasgow	4,800 tons	1911	2 6in. 10 4in.	Light protection only	25kts.
Otranto	Armed Merchant	Cruiser	4 4·7in.	Nil	16kts.
German					
Scharnhorst (Flag)	11,600 tons	1907	8 8·2in. 6 5·9in.	6-in. belt, 6–6¾-in. on turrets	24kts.
Gneisenau	do.	do.	do.	do.	22·5kts.
Leipzig	3,250 tons	1906	10 4·1in.	Light protection only	22 kts.
Nürnberg	3,450 tons	1908	10 4·1in.	do.	23·5kts.
Dresden	3,600 tons	1909	10 4·1in.	do.	24·5kts.

remain on the east coast of South America under Admiral Stoddart's orders. The "Glasgow" and "Monmouth" were already in the South Pacific, working from a secret base in the Chonos archipelago (lat. 45°24′ S., long. 74°18′ W.), where the "Good Hope" joined them on Oct. 26th. Here, too, was the armed merchant cruiser "Otranto."

At this time, Cradock had no very definite intelligence of the enemy on which to act. He therefore, on Oct. 27, despatched the "Glasgow" to Coronel to pick up what news she could and to cable to the Admiralty his dispositions and intention to move northward. These, his last messages, were duly despatched on Oct. 31 and reached the Admiralty just after Lord Fisher had been installed as the new first sea lord. The latter at once perceived the grave danger in which Cradock might find himself. He reversed the previous decision and gave immediate orders for the "Defence" to join him, while Cradock was instructed to keep his squadron concentrated and to effect a junction with the "Defence" at the earliest possible moment, but unhappily these orders never reached him. Meanwhile the "Glasgow" had reported wireless indications of the close proximity of German warships. On Oct. 30, therefore, Cradock set out from his base, leaving the "Canopus" behind to make good engine defects. His squadron consisted of the "Good Hope," "Monmouth" and "Otranto." The "Glasgow" met him at 1:30 P.M. on Nov 1.[1]

Von Spee, coming from the Far East, had crossed the Pacific and his last port of call had been Mas-a-Fuera. On Oct. 30 he had sent an armed merchantman, the "Prinz Eitel Friedrich," into Valparaiso and was cruising with the remainder of his squadron just out of sight of land. From this ship he learnt of the "Glasgow's" visit on Oct. 31. He therefore stood south with the object of finding her.

Meanwhile Cradock had ordered his ships to spread 15m. apart on a line of bearing north-east by east in the order "Good Hope," "Monmouth," "Otranto," "Glasgow"; "Good Hope" being to the westward, while a course was set north-west by north in the direction in which he expected to find the enemy. Before the ships could get into their stations, the "Glasgow" and "Otranto" sighted the smoke of von Spee's squadron, and by 4:10 P.M. the former ship sighted and reported the "Scharnhorst," "Gneisenau," and a light cruiser. The British ships at once closed on the "Good Hope." Three hundred miles to the southward the "Canopus" had just left harbour and was plodding along, escorting her colliers. Von Spee, on sighting the "Glasgow" to the westward, turned and worked his squadron up to full speed. It was blowing hard from the southward and there was a heavy sea running. Under such conditions it would have been impossible for the main deck guns of the "Good Hope" and "Monmouth" to have been fought, and the combined broadside of these ships was therefore reduced from two 9·2in. and 15 6in. to two 9·2in. and seven 6in. The 12 8in. guns, which formed the combined broadside of the two German armoured cruisers, were mounted on the upper deck, thus securing them an additional advantage in such weather.

By 5:20 P.M. the British squadron was on an easterly course, the "Good Hope" leading, followed by "Monmouth," Glasgow" and "Otranto," and heading direct for the enemy. About 5:25 Cradock altered to the southward, which brought him on a converging course to that of von Spee, who was then about 11m. on his bow, steering to the south-west. The British admiral was evidently determined to fight, and desired to close the range and to take full advantage of the sun while it was high enough to dazzle the enemy. But von Spee was no less determined not to be rushed and to fight under his own conditions. He therefore turned away when Cradock attempted to close. At 6:20, however, the sun having begun to dip below the horizon, he decided that his time had come. The British ships stood out, silhouetted against the red glow, while those of the German squadron were becoming more and more difficult to see against the approaching darkness to the eastward. A few minutes later the "Scharnhorst" opened fire at just over 11,000 yards. The third salvo hit the "Good Hope" between the conning tower and her fore-turret, starting a fire. Now the rest of the German ships joined in, the "Gneisenau" taking on the "Monmouth," the "Leipzig" the "Glasgow," and the "Dresden" the "Otranto." The "Good Hope" replied, but under the difficult conditions of light it is evident that her fire was very ineffective.

Cradock determined to close still further, and by 6:53 the range was down to 6,600 yards. The "Monmouth" was firing furiously, but the heavier German shells were finding their mark, and by 7 o'clock both the British ships were in great distress. The "Monmouth's" fore-turret, having been struck by a shell, caught fire and exploded, the gun-house being blown overboard. The "Good Hope" was badly hit and on fire. A quarter of an hour later, with the range down to only 5,000yd., she was rapidly losing speed, and about 7:20 a shell struck her amidships and a moment later a huge column of fire shot up. Firing a few last desperate shots, she disappeared, having been practically blown in two and gutted. At 7:20 the "Monmouth" ceased fire and proceeded to try and get her fires under, but already she was badly down by the bows and had a heavy list. She made vain efforts to work to the westward and get her stern to the sea. The "Glasgow" did what was possible to support her, but could only have offered a useless sacrifice by remaining. The "Otranto," wisely, had already made off.

By the light of the moon the "Nürnberg," which had been making great efforts to catch up and join in the fight, sighted the now almost completely crippled "Monmouth." She attacked her with a torpedo, but missed, and then opened fire with her guns at only 800yd. range. At 8:58 P.M. the "Monmouth," heeling over more and more, went down with her ensign still flying. Not a soul was saved from either her or the "Good Hope." The "Glasgow" eventually joined up with the "Canopus" and worked back to the Falkland islands via the Magellan straits, the "Otranto" taking the passage round the Horn.

The effect of the defeat at Coronel was for the time being most disconcerting to British trade and interests in South American waters. But von Spee, in the midst of the rejoicing by the German community at Valparaiso, had no illusions as to his ultimate fate and in fact retribution swift and complete was already being organized, and there was something of poetic justice in the selection of Rear Admiral Sturdee, the chief of the Naval staff at the time of the Coronel disaster, for the command of the squadron which was to avenge Cradock in the battle of the Falklands. (E. A.)

CORONER, an ancient office first referred to, as *custos placitorum*, in s. 20 of the Articles of Eyre (1194), though it was probably instituted before that date; possibly by Henry I. (1100–31). The coroner appears as a check on the sheriff in the royal

[1]Chilean time. 5 hours slow on Greenwich.

interest. Magna Carta (1215) prohibits both sheriff and coroner from holding pleas of the Crown. The king had a pecuniary interest if, for example, a dead man's Englishry (*q.v.*) could not be proved; in the deodand (*q.v.*), and in forfeiture (*q.v.*). Little is left of those duties which made the mediaeval coroner a considerable figure. The Eyre (*see* ASSIZE), the criminal appeal (*q.v.*), outlawry (*q.v.*), sanctuary (*q.v.*), abjuration (*q.v.*) are hardly more than names to us. Other powers already obsolescent were expressly taken away by the Coroners Act of 1887, s. 44, which section, interestingly enough, re-enacts the provision of Magna Carta above referred to.

The office was always elective, the appointment being made by the freeholders of the county assembled in the county court. The first statute of Westminster enacted that none but lawful and discreet knights should be chosen as coroners. Lands to the value of £20 per annum (the qualification for knighthood) were afterwards deemed sufficient. Blackstone complains that "through the culpable neglect of gentlemen of property, this office has been suffered to fall into disrepute and get into low and indigent hands."

The Coroners Amendment Act, 1926, requires that a coroner shall be a barrister, solicitor or legally qualified medical practitioner of not less than five years' standing in his profession, no property qualification being required. The practice of the London County Council is to appoint gentlemen possessing both legal and medical qualifications.

The judges of the high court are *ex officio* sovereign coroners: they may (but, in fact, do not) exercise their jurisdiction in any part of the realm.

The duties of a coroner are now limited to an enquiry (inquest) *super visum corporis* into the cause of all deaths occurring within his district by violent or unnatural means or from some unknown cause, or on anyone who has died in prison or in such place or under such circumstances as to require an inquest in pursuance of any act. The coroner must view the body, but since the Act of 1926 the jury need not. Evidence is given upon oath, but the procedure is somewhat informal, seeing that the proceedings are in the nature of an enquiry and not of a trial. If any person is found guilty of murder, manslaughter or infanticide, the coroner commits him for trial, but in practice since the Act of 1926 he seldom has to do this, as it is provided by s. 20 (1) that if the coroner is informed before the jury have given their verdict that some person has been charged with any of these crimes he shall adjourn the inquest until after the conclusion of the criminal proceedings. By the City of London Fire Inquests Act, 1888, the coroner for the City holds inquests in cases of loss or injury by fire in the City of London and the liberties thereof situated in the county of Middlesex. In Scotland the duties of a coroner are performed by an officer called a procurator-fiscal.

In the United States, coroners are generally elected by the qualified voters of the county. In some states they are appointed by the executive. No property qualification exists as to eligibility for the office; instead a bond with adequate sureties must be filed by the coroner on assuming office. The coroner's duties extend to the holding of an inquest *super visum corporis* whenever there is a reasonable suspicion attending the circumstances of death. Refusal by a physician of a death certificate requires the holding of an inquest. Autopsies are performable upon the coroner's order. The finding of the coroner's jury does not operate as an indictment but may lead to the procurement of an indictment, though in many states the finding itself is equivalent to an information upon which the magistrate may issue his summons.

See *Jervis on Coroners* (7th ed. by Danford Thomas, 1927); W. S. Holdsworth, *Hist. Eng. Law;* H. Gerland, *Die Englische Gerichtsverfassung* (1910). (F. T. G.)

CORONIUM, that constituent (otherwise unknown) of the sun's corona which emits the characteristic green coronal ray, of which the wave-length is 5303. It was first observed by Young in 1869.

COROT, JEAN-BAPTISTE CAMILLE (1796–1875), French landscape painter, was born in Paris, in a house on the Quai by the rue du Bac, now demolished, on July 16, 1796. His parents kept a successful millinery establishment, and under Napoleon I. Madame Corot was court modiste. Thus, he never, throughout his life, felt the want of money. He was educated at Rouen and was afterwards apprenticed to a draper, but hated commercial life. He remained in it, however, until he was 26, when his father at last consented to his adopting the profession of art. With Victor Bertin as teacher, he was trained in the classicist tradition. He visited Italy on three occasions: in 1825, 1835 and 1843. On his return from his third journey he came under the influence of the Barbizon school and his eyes were opened to the beauty of French landscape. He was a regular contributor to the Salon during his lifetime, and in 1846 was "decorated" with the cross of the Legion of Honour. He was promoted to be officer in 1867. His many friends in 1874, only a short time before his death, presented him with a gold medal. He died in Paris on Feb. 22, 1875, and was buried at Père Lachaise.

Of the painters classed in the Barbizon (*q.v.*) school Corot is the least realistic. He often painted landscapes from memory in his studio; his compositions are poems in tone-values. He preferred to paint in the hour of twilight, when all colours are merged into harmony.

Corot's works are somewhat arbitrarily divided into periods but the point of division is never certain, as he often completed a picture years after it had been begun. In his first style he painted with an eye to form and arrangement; he is reported to have said: *"Il ne faut laisser d'indecision dans aucune chose."* ("Vue du Colosée," 1825; "Le pont de Narni," 1827; "Chartres cathedral," 1830). After his 50th year his methods changed to breadth of tone and an approach to poetic power ("Dance of the Nymphs," 1849), and about 20 years later, say from 1865 onwards, his manner of painting became full of "mystery" and poetry ("Le beffroi de Douai," 1871). In the last ten years of his life he became the Père Corot of the artistic circles of Paris, in which he was regarded with personal affection. He earned large sums by his pictures, which became greatly sought after. In 1871 he gave £2,000 for the poor of Paris (where he remained during the siege), and his continued charity was long the subject of remark. Besides landscapes, of which he painted several hundred, Corot produced a number of figure pictures. These are mostly studio pieces. In his later work of this kind, which is now highly prized, he combined the simplified classical conception of form with a Rembrandtesque rendering of planes in colour remarkable for its strength and purity ("Femme à la Perle", 1870). Corot also executed a few etchings and pencil sketches. He also painted some decorative panels in the houses of his friends. At Mantes he composed six Italian landscapes for a small bathroom; at Ville d'Avray a similar decoration for a pavilion (1847). Here he also painted four frescoes for the church (1855). "The Baptism of Christ" in the church of St. Nicolas du Chardonnet at Paris (1844) is one of the few figure compositions of this master.

The works of Corot are scattered over France and the Netherlands, Great Britain and America. The following may be considered as the first half-dozen: "Une Matinée" (1850), in the Louvre, Paris; "Macbeth" (1859), in the Wallace collection, London; "Le Lac" (1861); "L'Arbre brisé" (1865); "Pastorale-Souvenir d'Italie" (1873), in the Glasgow Corporation Art Gallery; "Biblis" (1875). Corot had a number of followers who called themselves his pupils. The best known are Boudin, Lepine, Chintreuil, Français and Le Roux.

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CORPORAL. 1. An adjective used in such expressions as "corporal punishment" (*see* FLOGGING), "corporal works of mercy," acts of bodily kindness, such as feeding the hungry or clothing the naked, rescuing captives (Lat. *corporalis,* to the body). A "corporal oath" (one ratified by touching a sacred object, *see* OATH).

2. (Lat. *corporale* or *palla corporalis*), in the Roman Catholic Church, a small square linen cloth, on which the chalice and paten are placed on the altar at mass.

3. (Of uncertain derivation; the French form *caporal*, and Ital. *caporale*, point to an origin from *capo*, Italian for head; the *New English Dictionary*, however, favours the derivation from Lat. *corpus*, Ital. *corpo*, body), a non-commissioned officer of infantry, cavalry and artillery, ranking below a sergeant. This rank is almost universal in armies. In the 16th and 17th centuries there were corporals but no sergeants in the cavalry, and this custom is preserved in the three regiments of British household cavalry, the rank of sergeant being replaced by that of "corporal of horse," and that of sergeant-major by "corporal-major." In the 16th and early 17th centuries the title "corporal of the field" was often given to a superior officer who acted as a staff-officer to the sergeant-major-general. In the British navy a "ship's corporal" was formerly a semi-military instructor to the crew, but later became a petty officer charged with assisting the master-at-arms in police duties on board ship. The rating of Regulating Petty Officer has now superseded that of Ship's Corporal.

In the combat organizations of the United States Army the Corporal is the leader of the squad (Infantry and Cavalry) which operates in battle as a combat group. He is the gunner of the gun squad (Artillery) which operates the piece. He is responsible for the training and equipment of his unit and is appointed by the regimental commander who signs the warrant. The insignia of rank of the Corporal is a chevron of two stripes worn on the sleeves of the uniform.

CORPORAL PUNISHMENT: *see* FLOGGING.

CORPORATION, in English law, an association of persons which is treated in many respects as if it were itself a person. It has rights and duties of its own which are not the rights and duties of the individual members thereof. Thus a corporation may own land, but the individual members of the corporation have no rights therein. A corporation may owe money, but the corporators as individuals are under no obligation to pay the debt. The rights and duties descend to the successive members of the corporation. This capacity of perpetual succession is regarded as the distinguishing feature of corporations as compared with other societies. A corporation differs from a partnership (*q.v.*) in that it is a legal person distinct from the sum of its members and in that the members can escape personal liability.

Many of the legal attributes of an English corporation are to be found in the *universitas* and *collegium* of the law of Rome. In the later Roman law the distinction of corporations into civil and ecclesiastical, into lay and eleemosynary, is recognized. English law has invented another classification—corporations aggregate and sole. The normal corporation is aggregate, *i.e.*, it consists of several persons united in one society maintained by perpetual succession. Corporations sole consist of one person only and his successors; if a public officer in English law is a corporation sole, the rights acquired by him in that capacity devolve upon his successor in office, and not upon his ordinary legal representative. The best known instances of corporation sole are the king and the parson of a parish. The conception of the king as a corporation is the key to many of his paradoxical attributes in constitutional theory—his invisibility, immortality, etc. Parliament has found it convenient to confer the character of a corporation sole upon the official heads of departments which have rights and property—*e.g.*, the postmaster-general, the Ministries of Agriculture, Health and Transport, the Treasury solicitor and the public trustee.

The corporations known to the earlier English law were mainly the municipal, the ecclesiastical, and the educational and eleemosynary. To all of these the same principles, borrowed from Roman jurisprudence, were applied. The different purposes of these institutions brought about in course of time differences in the rules of the law applicable to each. In particular, the development of trading companies, checked by parliament after the South Sea Bubble crisis, produced in the 19th century a new class of special statutory corporations, differing widely from those formerly known to the law. The reform of municipal corporations, as well as the statutory incorporation of many units of local government, has also restricted the operation of the principles of the older corporation law. These principles, however, still apply when special statutes have not intervened.

The legal origin of corporation is usually ascribed to five sources, viz., common law, prescription, act of parliament, charter and implication. Prescription in legal theory implies a grant, so that corporations by prescription would be reducible to the class of chartered or statutory corporations. A corporation is said to exist by implication when the purposes of a legally constituted society cannot be carried out without corporate powers. Corporations are thus ultimately traceable to the authority of charters and acts of parliament. The power of creating corporations by charter is a prerogative of the Crown, nowadays exercised of course upon the advice of ministers responsible to parliament. The power of chartering corporations belonged also to subjects who had *jura regalia; e.g.*, the bishops of Durham granted a charter of incorporation to the city of Durham in 1565, 1602 and 1780. The charter of a corporation is regarded as being of the nature of a contract between the king and the corporation. It will be construed more favourably for the Crown, and more strictly as against the grantee. It cannot alter the law of the land, and it may be surrendered, so that, if the surrender is accepted by the Crown and enrolled in chancery, the corporation is thereby dissolved. Great use was made of this power of the Crown in the reigns of Charles II. and James II. (*See* CHARTER and CHARTERED COMPANIES.)

Every corporation, it is said, must have a name, and it may have more names than one, but two corporations cannot have the same name. And corporations cannot change their names save by charter or some equivalent authority.

The possession of a common seal, though not conclusive of the corporate character, is an incident of every corporation aggregate. The inns of courts (*q.v.*) have common seals, but they are only voluntary societies. Generally speaking, all corporate acts affecting strangers must be performed under the common seal; acts of internal administration affecting only the corporators, need not be under seal. The rule has been defended as following necessarily from the impersonal character of a corporation; either a seal or something equivalent must be fixed upon so that the act of the corporation may be recognized by all.

A corporation may be abolished by statute, but not by the mere authority of the Crown. It may also become extinct by the disappearance of all its members or of any integral part by surrender of charter if it is a chartered society, by process of law or by forfeiture of privileges.

The power of the majority to bind the society is one of the first principles of corporation law, even in cases where the corporation has a head. It is even said that only by an act of parliament can this rule be avoided. The binding majority is that of the number present at a corporate meeting duly summoned.

In corporations which have a head (*e.g.*, mayor and commonalty or dean and chapter), although the head cannot veto the resolution of the majority, he has been deemed an integral part of the society; his death was thought to suspend its existence, so that a head could not devise or bequeath to the corporation, nor could a grant be made to a corporation during vacancy of the headship. Doubts as to the effect of such a vacancy, or of a vacancy in the office of a corporation sole, are set at rest by sec. 180 of the Law of Property Act, 1925.

A corporation has power to make such regulations (by-laws) as are necessary for carrying out its purposes, and these are binding on its members and on persons within its local jurisdiction if it has any.

The power to acquire and hold land was incident to a corporation at common law, but its restriction by the statutes of mortmain (*q.v.*) dates from a very early period. The law was consolidated by the Mortmain and Charitable Uses Act, 1888, and the result is simply that corporations cannot take land for any purpose without a licence, and no licence in mortmain is granted by the Crown, except in certain statutory cases in the interests of religion, charity or other definite public object. The first statutes of mortmain were prompted by the vast increase in his lands of ecclesiastical corporations.

The power of corporations at common law to alienate their property is usually restricted, as is their power to lease it for more than a certain number of years, except by sanction of a public authority. The more important classes of corporations, however, are now governed by special statutes which exclude or modify the operation of the common law principles. The most considerable class of societies still unaffected by such special legislation are the livery companies (*q.v.*). Under COMPANY will be found an account of the important enactments regulating joint-stock companies.

Corporations, brought into being for definite purposes, are restricted to actions concerned in furthering those purposes; actions outside that field are *ultra vires* and can be restrained and declared void. This rule is most rigid when the purposes are defined in a memorandum of association under the Companies Acts (*see* COMPANY); it is based on public policy as well as on the protection of corporations themselves and those who deal with or belong to them.

The general capacity of a corporation has sometimes been enlarged by statute; thus a corporation can now be an executor and administrator. Mention may here be made of "trust corporations," an expression which appears in the Law of Property legislation of 1925. Though the Trustee Act of that year required that for many trust purposes there should be at least two trustees, an exception was made for "trust corporations," which are allowed to act alone. This expression (enlarged by statute in 1926) includes trustees in bankruptcy, the public trustee and other approved bodies and officials.

In its treatment of corporations, as elsewhere, English law has been inspired by convenience rather than dogma. Even the fundamental principle that a corporation is a person distinct from its members was somewhat shaken when in 1915 the national danger made the law-courts willing in the *Daimler* case to look through the screen of corporateness at the members behind it. The abstract nature of corporate personality has been discussed by Gierke, Maitland and others. To some the corporation is a fiction, a thing which cannot exist till the State creates it; to others it is a real person, a group-unit with a group-will, capable of existence even if the State does not concede life to it. Unconcerned with metaphysical speculation, English law has treated the corporate person as much as possible like an individual. The treatment is consonant with popular ideas and speech wherein corporate bodies are freely personified. The Interpretation Act of 1889 frankly declares that in any subsequent statute the word "person" shall, unless the contrary intention appears, include corporations. Plainly the assimilation of corporate and individual personality, however convenient and acceptable, has its limits; a corporation cannot marry or commit murder or be imprisoned or hanged. In 1245 the pope had said that it could not be excommunicated; having neither mind nor soul, it could not sin. But English law, by a simple extension of the legal principles of agency, has managed to hold a corporation liable for the wrongs committed by its servants—trespass, assault, negligence, false imprisonment and even libel and malicious prosecution. Criminal liability presented less difficulty because corporations had long been held indictable for non-repair of highways and bridges and because there are certain offences in which the existence of criminal intent is not an essential element. Difficulties of procedure and of punishment may be inevitable; the former were lightened in England by sec. 33 of the Criminal Justice Act of 1925; the latter are sometimes met (for example in the Official Secrets Act of 1920) by providing that, if a corporation is guilty of an offence under a particular statute, each of its directors and officers shall be deemed guilty unless he proves that the offence was committed without his knowledge or consent.

As corporate bodies escape death duties, an equivalent duty was imposed upon their property by the Customs and Inland Revenue Act of 1885. This must not be confused with the Wartime "corporation profits tax" imposed by the Finance Act of 1920 and terminated by that of 1924. (C. T. C.)

UNITED STATES

Corporation, in the law of the United States, has two accepted meanings. The term is used in a generic sense to indicate any body of persons treated in law as a unit; more commonly a company organized for profit, corresponding to the English joint-stock company. Corporations organized for profit are often referred to as stock corporations, because the interest of the shareholder is represented by shares of stock. Again, they are private corporations, since their object is gain for the individual as distinguished from the public corporation whose object is to serve the community. As in English law the corporation derives its existence from authority granted by the sovereign and may not exist without such authority. Sovereignty in this respect rests in the United States with the several States, though within a limited field the Federal Government may create corporations. This right was early exercised by Congress in the creation of the Bank of the United States. After the Civil War, many railroads sought Federal charters, some of which are still retained. More recent instances are the creation by Congress during the World War of the War Finance Corporation and the Emergency Fleet Corporation.

The State of New York was the pioneer in enacting a general corporation law eliminating the necessity of passing an act of the legislature for each new corporation. This act of 1811 antedates similar legislation in England. The method was rapidly adopted by the other States. Later, abuses in granting special charters led to amendments to the State Constitutions forbidding such charters except where the objects of the corporation could not be attained under the general law. Each State has its own corporation act and these often differ in many essentials. In general the law governing incorporation, promoters, directors, shares, allotment of shares, meetings of stockholders, payment for shares, and dividends is the same as for the English joint-stock company. The transfer of shares is regulated in an increasing number of States by the Uniform Stock Transfer Act. One of the most noteworthy provisions of this act is that one who has purchased shares without knowledge that the seller obtained them by fraud, may keep them as against the defrauded party. Recognition is thus given to the fact that in practice shares are freely traded in without inquiry as to the circumstances under which they were acquired by the seller.

The liability of the shareholder is ordinarily limited to the amount which he agreed to pay for the shares subscribed for by him. It is illegal, however, for a corporation to issue shares for less than par; *i.e.;* to issue a \$100 share for less than that sum or its equivalent in property. This requirement is often evaded by overvaluing contributions of property. Minnesota and California have unusual laws respecting shareholders' liability. In many of the other States the liability of shareholders of banking and insurance companies is not limited to the par value of the shares. Perhaps the most marked difference between the corporation laws of the United States and other countries is the share without par value. Although a share of stock is merely an aliquot part of the capital of a corporation the certificate issued by the corporation to the shareholder does not indicate that fact. The certificate states that the person named therein is the owner of so many \$100 shares or £5 shares or whatever unit may have been adopted by the company. The amount of money stated or the par value, represents the least amount which the law requires the shareholder to pay to the company. But the retention of this figure despite subsequent changes in the financial condition of the company makes possible the deception of future purchasers. To avoid this danger the share without par value was devised. Instead of stating that it represents an investment of so much money it states that it represents so many shares of the corporation out of a fixed total of shares which the corporation is authorized to issue. The laws of a majority of the States now allow the issuance of no par value shares. In most cases both ordinary shares and shares entitled to preferences may be without par value. In the case of preferred shares the dividend preference is expressed in a stated number of dollars rather than the percentage customary with par value shares. The price at which such shares may be issued is determined by the stockholders, though they may in most cases delegate the determination of the price to the directors.

As a rule the statutes do not require that a company issuing shares publish a prospectus. In practice, however, it is almost invariably the case that the bankers who underwrite the issue publish a statement giving the outstanding facts concerning the corporation's property and business. In doing so the bankers assume the grave risk that they may be held liable in case the statements are untrue. The bankers often seek to protect themselves by declaring that the representations made are believed by them but are not guaranteed, but the courts in recent decisions have shown an inclination to hold the bankers liable where they have been negligent in ascertaining the truth of the statements which they publish.

Because of the great diversity in the provisions of the various State laws regarding corporations there is a proposal that a uniform act be adopted by all the States. In the analogous fields of partnerships and limited partnerships such acts have been framed by the National Conference of Commissioners on Uniform Laws and have been adopted by numerous States. This Conference is now engaged (1928) in the preparation of a Uniform Business Corporation Act and has tentatively approved a draft which if finally accepted will be presented to the legislatures of the States for their adoption. It is likely that in the course of time uniform legislation on the subject may be secured. This is especially important since so many of the corporations do business in States other than those in which they are incorporated, often having their principal place of business elsewhere. In recent years a number of States have adopted liberal and what are supposed more desirable provisions for the regulation of corporations, and there is a widespread practice for promoters to select some such State as the place to incorporate, although the corporation to be formed is to transact no business there. The great weight attached to such laws is indicated by the fact that many corporations, hitherto organized elsewhere, have abandoned their charters and incorporated anew in one of the more liberal states, such as Delaware, Maryland and Maine. This movement is comparable to the organization of the "trusts" such as the United States Steel Corporation at the end of the last and beginning of the present century. At that time the State of New Jersey was almost invariably chosen as a domicile. However, the passage of more stringent laws in that State in 1913 has directed attention elsewhere.

In most States separate acts have been enacted to deal with companies organized not for profit and other acts to deal with transportation, insurance, banking corporations, and other special types. Corporations organized not for profit are frequently referred to as membership corporations because shares are dispensed with and the participants merely become members. In the case of membership corporations, as well as the other types covered by separate acts, special permission of some judicial or administrative authority is frequently required before incorporation is allowed. (J. L. WE.)

CORPORATION PROFITS TAX. A tax on the profits of companies enjoying limited liability was introduced in the British Parliament in the Finance bill, 1920, and was passed into law in the Finance Act of that year. It met with slight opposition, partly because of the modesty of the rate, but the arguments advanced in support of the proposals were not limited to their effect in the production of revenue. It was pointed out that as the State conferred certain privileges upon companies with limited liability, such companies could properly be called upon to pay something to the State in return. It was also indicated that the tax would act to some extent as a corrective of the practice of the evasion of the super tax (a tax payable only by individuals) by the placing by private companies of their profits to reserve, instead of distributing them. The tax, therefore, was levied solely upon limited liability companies; it was levied without reference to pre-war profits, and it was levied upon the profits whether those profits were distributed or not.

The provisions relating to the tax were contained in part V. of the Finance Act, 1920. The tax was charged as from Jan. 1, 1920, at the rate of *1s.* in the £ on the profits arising in any accounting period, of a British company carrying on any trade or business or any undertaking of a similar character, including the holding of investments. The tax was also imposed on the profits of foreign companies carrying on in the United Kingdom any trade or business, or any undertaking of a similar character, so far as those profits arose in the United Kingdom. The expression "company" was defined as "any body corporate so constituted that the liability of its members is limited," but was not to include a company formed before the commencement of the Act whose assets consisted wholly of securities issued by a public authority, and formerly held by the persons by whom the company was formed. No tax was charged on the first £500 a year of the profits. Mutual trading concerns, whose activities had not given rise to liability to income tax, were brought within the charge, but their taxable profits were to be ascertained on a special basis. Exemption for three years was given to building societies as well as to companies carrying on wholly in the United Kingdom gas, water, electricity, tramway, hydraulic power, docks, canal or railway undertakings, whose charges and dividends were limited by Act of Parliament. The amount of tax charged on any company was not to exceed *2s.* in the £ on what remained after deducting from the profit the amount paid out in interest or dividends on debentures, preference shares, or permanent loans secured by mortgage or debentures, and repayable at not less than three months' notice. No company was assessable on income received from another company liable to be assessed in respect of that income, and a company holding all the share capital of another company might elect to have the profits of the two companies assessed together.

Assessment.—Generally speaking, the profits for assessment were to be calculated on the same basis as that adopted for income tax, but the profits charged in each accounting period were to be the actual profits, and not the profits computed on an average of the previous three years, or on any other basis.

The Act made provision for certain deductions in arriving at the assessable profits, and also forbade certain deductions. Thus, interest on money borrowed for the business (except permanent loans and money borrowed from a person having a controlling interest in the company), rent of premises, royalties paid to a person who had not a controlling interest, shares of profits distributed to employees under a profit-sharing scheme, and not in respect to shares purchased by them, wear and tear, excess profits and mineral rights duty, and foreign and colonial taxes, were allowed as deductions. Royalties paid to a person having a controlling interest, interest on money borrowed from such a person, interest on permanent loans, dividends on distribution of profits, and remuneration in excess of £1,000 a year of directors and managers who had a controlling interest in the company, were not allowed as deductions, and no deduction could be made in respect of any transaction which artificially reduced the amount of the taxable profits. The penalty for entering into fictitious or artificial transactions with a view to evading the tax, was a fine not exceeding £500.

Unlike the income tax, which is assessed by bodies of local commissioners in the various districts throughout Great Britain, the Corporation Profits Tax was assessed by the commissioners of Inland Revenue, who were empowered, in the absence of a satisfactory return or information from the company, to make an assessment according to the best of their judgment. An appeal could be made against the amount of an assessment to the general or the special commissioners of income tax, at the option of the company assessed, and an appeal from the decision of the commissioners could be taken to the courts on a point of law. Where a company was being wound up, the liquidator was prohibited from distributing the assets until he had satisfied the commissioners of Inland Revenue that he had provided for the payment of any tax for which the company might be liable.

These provisions, like all revenue provisions, gave rise to legal questions as to the true construction of the words of the Act by which the charge was imposed, and the courts were called upon to give decisions on many points, notably as to whether certain companies were carrying on trade or business, or any undertaking of a similar character. But the tax had a short life. By section 36 of the Finance Act, 1923, the rate of tax was reduced to $2\frac{1}{2}\%$, and by section 34 of the Finance Act, 1924, the tax was brought to an end at June 30, 1924. (R. N.)

CORPS (pronounced *cor* as in French, from which it is taken, being a late spelling from Lat. *corpus,* a body; *cf.* "corpse"), a word in very general use since the 17th century to denote a body of troops, varying from a few hundred to the greater part of an army. In a special sense "corps" is used as synonymous with "army corps" (*corps d'armée*) a grouping of several divisions. (*See* ARMY.) The word is applied to any organized body, as in *corps diplomatique,* the general body of foreign diplomatic agents accredited to any government (*see* DIPLOMACY) or *corps de ballet,* the members of a troupe of dancers at a theatre; so in *esprit de corps,* the common spirit of loyalty which animates any body of associated persons.

CORPSE, a dead human body. By the common law of England a corpse is not the subject of property nor capable of holding property. It is not, therefore, larceny to steal a corpse, but any removal of the coffin or grave-cloths is otherwise, such remaining the property of the executors or administrators or of the persons who buried the body. It is a misdemeanour to expose a naked corpse to public view, to prevent the burial of a dead body, or to disinter it without authority; also to bury or otherwise dispose of a dead body on which an inquest ought to be held, without giving notice to a coroner. It is a like offence to remove unlawfully a corpse from a grave. Anyone who, having the means, neglects to bury a dead body which he is legally bound to bury, is guilty of a misdemeanour, but no one is bound to incur a debt for such a purpose. It is incumbent on the relatives and friends of a deceased person to provide Christian burial for him; failing relatives and friends, the duty devolves upon the parish. The burning of any human remains is dealt with by the Cremation Act 1902, and a breach of the regulations may be dealt with summarily. If the burning is to conceal an offence, it is indictable. (*See* further BODY-SNATCHING, and BURIAL.)

CORPULENCE or OBESITY, the over-accumulation of fat under the skin and around and throughout certain of the internal organs. The most celebrated case is that of Daniel Lambert (*q.v.*) who died in 1809 in his 40th year. He is said to have been the heaviest man that ever lived, his weight being 739lb. (52st 11lb.). Health cannot be long maintained under excessive obesity, for exercise is difficult and the thoracic and abdominal organs are embarrassed in their functions. Often mental activity is impaired.

Various factors operate in the production of corpulence. Sometimes it is an hereditary tendency, which no precautions as to living appear capable of averting. But certain habits favour its occurrence. Predisposing causes are a luxurious, inactive or sedentary life, with over-indulgence in sleep and absence of mental occupation, over-feeding (esp. carbohydrates and fats) and the large use of fluids (esp. beer and sweet wines). Its frequent occurrence in eunuchs and cretins, and in women after the menopause, suggests the importance of endocrine secretions; and the value of thyroid extract in reducing weight indicates that this gland is implicated. (*See* ENDOCRINOLOGY; METABOLIC DISEASES; NUTRITION.)

CORPUS CHRISTI, a city in southeastern Texas, U.S.A., on Corpus Christi bay, near the mouth of the Nueces river; a port of entry and the county seat of Nueces county. It is the southern terminus of federal highway 181; is served by the Missouri Pacific, the Southern Pacific, and the Texas-Mexican railways; is a modern deepwater port which in 1940 handled 6,794,887 tons of cargo, and is connected to the Gulf of Mexico by a 21-mi. channel, 200 ft. wide, 32 ft. deep. There is a municipal airport, with passenger and mail service. The population grew from 27,741 in 1930 to 57,301 in 1940. The U.S. navy air station, costing over $40,000,000, is there. Large crops of cotton, winter vegetables and livestock are grown in the county. In the county were more than 1,100 oil wells in 1940. Building permits in 1940 totalled more than $8,000,000. A two-mile sea wall, a bay front boulevard and three yacht basins were completed in 1941. There was a small Spanish settlement here at an early date, and from this base Gen. Zachary Taylor made his forward movement to the Rio Grande in 1846. After the Mexican War an American town grew up, which was chartered as a city in 1876.

CORPUS CHRISTI, FEAST OF, a festival of the Roman Catholic Church in honour of the Real Presence of Christ in the Eucharist, observed on the Thursday after Trinity Sunday (Lat. *festum corporis Christi,* Fr. *fête-Dieu* or *fête du saint-sacrement,* Ger. *Fronleichnamsfest*).

The institution of this feast is due to St. Juliana, prioress of Mont Cornillon near Liége (1222–58), whose veneration for the Blessed Sacrament was intensified by a vision, and who persuaded Robert de Torote, bishop of Liége, to order the festival for his diocese in 1246. It did not spread, however, until in 1261 Jacques Pantaléon, formerly archdeacon of Liége, became pope as Urban IV.

In 1264 Urban ordered the whole Church to observe the feast, for which a new office (still in use) was written by St. Thomas Aquinas; but the well-known story of the miracle of Bolsena, which is supposed to have hastened the pope's decision, is not supported by contemporary evidence, and is probably a later adaptation of a type of legend which occurs at least as early as the 12th century. Owing perhaps to Urban's death soon afterwards (Oct. 2, 1264), his order was ignored in most countries until after its confirmation by Clement V. at the council of Vienna in 1311.

By the middle of the 14th century the festival had found general acceptance; and in the 15th century it became in effect the principal feast of the Church.

The procession of the Host, its most prominent feature (though not part of the original ritual), became a gorgeous pageant in which sovereigns and princes took part, as well as magistrates and members of trade and craft gilds, and was followed by miracle plays and mysteries performed by members of the gilds.

The rejection of the doctrine of transubstantiation at the Reformation naturally involved the suppression of the festival, as a religious observance, in the reformed Churches; but the mystery plays survived for a time in places.

CORPUSCULAR THEORY OF LIGHT, the earliest theory of the nature of light (*q.v.*), also known as the *emission theory,* according to which luminous bodies emit minute particles capable of passing through transparent substances and producing the sensation of light.

CORRAL, a word used chiefly in Spanish America and the United States for an enclosure for cattle and horses, and also for a defensive circle (Sp. *corro,* a circle) formed of wagons against attacks from Indians. It is also used as a verb, meaning to drive into a corral, and so figuratively to enclose, hem in. The word is probably connected with the South African Dutch word *kraal* (*q.v.*).

In Ceylon it is especially used for an enclosure meant for the capture of wild elephants. The corresponding term in India is *keddah* (*q.v.*).

CORREA DA SERRA, JOSÉ FRANCISCO (1750–1823), Portuguese politician and man of science, was one of the founders of the Portuguese Academy of Sciences, of which he was named perpetual secretary.

Correa da Serra came into conflict with the Holy Office and had to leave the country, taking refuge in Paris, London and finally New York.

In 1816 he was made Portuguese minister-plenipotentiary at Washington, and in 1820 he was recalled home, appointed a member of the financial council and elected to a seat in the *cortes.*

Correa da Serra was a good botanist, but his principal claim to fame is the *Colecção de livros ineditos da historia Portugueza* (4 vols., 1790–1816), an invaluable selection of documents, exceedingly well edited.

CORREA GARÇÃO, PEDRO ANTONIO JOAQUIM (1724–1772), Portuguese lyric poet, was the son of a foreign office official; his mother was of French descent. The poet studied law at Coimbra. He took his degree in 1748, and two years later was created a knight of the Order of Christ. In 1751 his marriage with D. Maria Salema brought him a rich dower, but in later years a law-suit reduced him to poverty. From 1760 to 1762 he edited the *Lisbon Gazette*. In 1756, in conjunction with Cruz e Silva and others, he founded the *Arcadia Lusitana* to rid Portuguese literature of the affectations of *Seicentismo*, which delighted in conceits, windy words and rhetorical phrases. He was the chief contributor to its proceedings, bearing the name of "Corydon Erimantheo." He is supposed to have conceived a passion for an English married lady which completely absorbed him and contributed to his ruin. He was arrested on the night of April 9, 1771, and committed to prison by Pombal, whose displeasure he had incurred. The immediate cause seems to have been his connection with a love intrigue, but he was never brought to trial. He was released on Nov. 10, 1772, but died that very day.

Taking Horace as his model, and aided by sound judgment, scholarship and wide reading, Correa Garção adopted a classical simplicity of form and expression. His sonnets *ad sodales* show a charming personality; his odes and epistles are sententious in tone and reveal an inspired poet and a man chastened by suffering. His two comedies in hendecasyllables, the *Theatro Novo* (played in Jan. 1766) and the *Assemblêa,* are excellent satires on the social life of the capital; and in the *Cantata de Dido,* included in the latter piece, the spirit of Greek art is allied to perfection of form, making this composition perhaps the gem of Portuguese 18th century poetry.

His works were published posthumously in 1778, and the most complete and accessible edition is that of J. A. de Azevedo Castro (Rome, 1888). An English version of the *Cantata de Dido* appeared in the *Academy* (Jan. 19, 1895). *See* Innocencio da Silva, *Diccionario bibliographico Portuguez,* vol. vi. pp. 386–393, and vol. xvii. pp. 182–184; also Dr. Theophilo Braga, *A Arcadia Lusitana* (Oporto, 1899).

CORREGGIO or **COREGGIO,** the name given to Antonio Allegri (1494–1534), Italian painter, one of the most vivid and impulsive inventors in expression and pose and the most consummate executants. His father was Pellegrino Allegri of Correggio, a small city in the territory of Modena; his mother Bernardina Piazzoli degli Aromani. Antonio was born in Correggio. He studied anatomy under Dr. Giovanni Battista Lombardi, whom he is believed to have represented in the portrait currently named "Il Medico del Correggio" (Correggio's physician). It is concluded that he learned the first elements of design from his uncle, Lorenzo Allegri, at Correggio, and from Antonio Bartolotti, named Tognino, and that he afterwards went to the school of Francesco Ferrari Bianchi (named Frarè), and perhaps to that of the successors of Andrea Mantegna in Mantua. He is said to have learned modelling along with the celebrated Begarelli at Parma.

One of his early pictures, painted in 1514 when he was 19 or 20 years old, is a large altar-piece commissioned for the Franciscan convent at Carpi, representing the Virgin enthroned, with saints; it indicates a predilection for the style of Leonardo da Vinci. This picture is now in the Dresden gallery. Another painting of Correggio's youth is the "Arrest of Christ." A third is an Ancona (or triple altar-piece—the "Repose in Egypt, with Sts. Bartholomew and John") in the church of the Conventuali at Correggio, showing the transition from the painter's first to his second style. In 1521 he began his famous fresco of the "Ascension of Christ," on the cupola of the Benedictine church of San Giovanni in Parma. This he finished in 1524, and soon afterwards undertook his still vaster work on another cupola, that of the cathedral of the same city, presenting the "Assumption of the Virgin," which occupied him up to 1530. He was the first Italian artist who ever undertook the painting of a large cupola and went at once to the extreme of what can be adventured in fore-shortening, even forestalling in this attempt the mightiest geniuses of an older generation—the "Last Judgment" of Michelangelo, for instance, not having been begun earlier than 1533 (although the ceiling of the Sistine chapel, in which fore-shortening plays a comparatively small part, dates from 1508 to 1512).

Other leading works by Correggio are: the frescoes in the Camera di San Paolo (the abbess's salon) in the monastery of St. Lodovico at Parma, painted towards 1519 in fresco—"Diana returning from the Chase," with auxiliary groups of lovely and vivacious boys of more than life size, in 16 oval compartments. In the National Gallery, London, the "Ecce Homo," painted probably towards 1520, and "Cupid, Mercury and Venus," the latter a fine example. The oil-painting of the Nativity named "Night" ("La Notte"), undertaken at Reggio in 1522 for Alberto Pratoneris, now in the Dresden gallery. The oil-painting of St. Jerome, termed also "Day" ("Il Giorno"), as contrasting with the above-named "Night." Jerome is here with the Madonna and Child, the Magdalene, and two angels. This was painted for Briseida Bergonzi from 1527 onwards, and is now in the gallery at Parma. The "Magdalene lying at the entrance of her Cavern": this small picture (only 18in. wide) was bought by Augustus III. of Saxony for 6,000 louis d'or, and is in Dresden. In the same gallery, the two works designated "St. George" (painted towards 1532) and "St. Sebastian." In the Parma gallery, the Madonna named "della Scala," a fresco which was originally in a recess of the Porta Romana, Parma; also the Madonna "della Scodella" (of the bowl, which is held by the Virgin—the subject being the Repose in Egypt): it was executed for the church of San Sepolcro. Both these works date towards 1526. In the church of the Annunciation, Parma, a fresco of the Annunciation. Five celebrated pictures painted or begun in 1532—"Venus," "Leda," "Danaë," "Vice," and "Virtue": the "Leda," with figures of charming girls bathing, is now in the Berlin gallery. In the Louvre, "Jupiter and Antiope," and the "Mystic Marriage of St. Catharine." In the Naples museum, the "Madonna Reposing," commonly named "La Zingarella," or the "Madonna del Coniglio" (Gipsy-girl, or Madonna of the Rabbit). On some of his pictures Correggio signed "Lieto," as a synonym of "Allegri." About 40 works can be confidently assigned to him, apart from a multitude of others probably or manifestly spurious.

In 1520 Correggio married Girolama Merlino of Mantua. She was but 16 years of age and is said by tradition to have been the model of his Zingarella. They had four children; she died in 1529. Correggio died at his native place on March 5, 1534, and was buried with some pomp in the Arrivabene chapel, in the cloister of the Franciscan church at Correggio.

Correggio was the head of the school of painting of Parma, which forms one main division of the Lombardic school. Of his pupils one can name with certainty only his son Pomponio, who was born in 1521 and died at an advanced age; Francesco Capelli; Giovanni Giarola; Antonio Bernieri (who, being also a native of the town of Correggio, has sometimes been confounded with Allegri); and Bernardo Gatti, who ranks as the best of all.

Bibliography.—*See* Pungileoni *Memorie storiche di Antonio Allegri* (1817); Colnaghi *Correggio Frescoes at Parma* (1845); Fagan *Works of Correggio* (1873); Julius Meyer *Antonio Allegri* (1870, Eng. trans. 1876); Conrado Ricci *Life and Times of Correggio* (1896); H. Thode *Correggio* (1898); T. Sturge Moore *Correggio* (1906), which includes some adverse criticism on the views of Bernhard Berenson in his *Study of Italian Art,* and elsewhere.

CORRELATIVE generally denotes the terms or partners of a relationship. A relationship requires at least two terms between which it holds, and they are said to be correlative terms. Thus, *e.g.,* "cause" and "effect" exemplify one kind of relationship, "teacher" and "pupil" another, "north" and "south" yet another relationship. The terms in each of these pairs are accordingly called, in logic, "correlative" terms. The expression has also been extended to propositions which express the same relationship from different points of view. Thus, *e.g., S is North of P* implies *P is South of S.* They are simply correlative propositions.

See A. Wolf; *Essentials of Logic* (1926).

CORRENTI, CESARE (1815–1888), Italian revolutionist and pamphleteer, was born at Milan on Jan. 3, 1815, and made his name by writing revolutionary pamphlets exciting the people against the Austrian rule. He took a prominent part in the insurrection of the Five Days, and in 1849 became a deputy. He supported Cavour, and in 1860 became a councillor of state. Later he became less radical in his opinions, and in 1867 and 1869 was minister for education. He helped to draft the Law of Guarantees, and played a conspicuous part in the occupation of Rome. His return to the Radical fold in 1876 assured the advent to power of the Left, and he was Depretis's chief adviser until the latter's death. Although he frequently refused ministerial office, he accepted in 1877 the lucrative post of secretary of the order of Saints Maurice and Lazarus, and in 1886 he was made a senator. He died at Rome on Oct. 4, 1888.

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CORRESPONDENCE, a mutual agreement or fitness of parts or character (Lat. *cum,* with, *respondere,* to answer; *cf.* Fr. *correspondance*). In the 17th and 18th centuries the word was applied to relations and communications between states. It is now chiefly used of the interchange of communications by letter or of the letters themselves. The "doctrine of correspondence or correspondences," one of the leading tenets of Swedenborgianism, is that every natural object corresponds to and typifies some spiritual principle or truth, this being the only key to the true interpretation of Scripture. In mathematics (*see* MATHEMATICS, NATURE OF) "correspondence" denotes the relation between members of two groups of objects. (*See* CURVE.)

CORRESPONDENCE SCHOOLS. Correspondence instruction in its modern form originated in the last quarter of the 19th century. In 1856 Toussaint and Langenscheidt founded a school in Berlin to teach languages by correspondence. In 1868 the University Extension movement in England introduced correspondence instruction, but its development was left largely to American initiative. The "Society to Encourage Study at Home" was organized at Boston in 1873, but the first formal American attempt in this field was launched at Ithaca, N.Y., by the "Correspondence university" in 1883. Its purpose was to supplement the work of other educational institutions. In 1892 William Rainey Harper became president of the new University of Chicago and established a correspondence department therein. This venture proved successful and during the following two decades spread to a number of other universities throughout the country. In 1928 there were 154 resident institutions of higher learning offering correspondence instruction and enrolling annually 45,000 students. The correspondence courses offered by these institutions, for the most part, presuppose that the student has an educational background comparable to that of the college student. The granting and exchange of credit for correspondence work have not been standardized.

There is another distinct source of the modern correspondence school. In the '80's an editor of a Pennsylvania newspaper began to publish questions and answers concerning coal mining. In 1891 he prepared a course covering this field to be offered by the correspondence method. Other cognate courses were soon added and within a decade this organization grew into the International Correspondence Schools, offering about 300 courses and enrolling approximately 100,000 students annually. Many private ventures in the field of correspondence instruction rapidly followed, until in 1928 there were 498 private correspondence schools in the United States, enrolling annually more than 1,500,000 students. In many instances these schools uphold high educational standards, while others are little more than book selling concerns. The courses offered are, for the most part, vocational and technical, the texts being written in non-technical language with copious illustrations and drawings, to enable the average adult worker to comprehend readily. Some of the best vocational literature in the English language is found in these correspondence school texts, but since there was no accrediting agency in the correspondence school field during the first 35 years of its existence, a certain amount of mediocre educational material and unethical practices became current. To meet this situation the National Home Study council, Washington, D.C., was organized in 1926 to serve as an inspecting and accrediting agency for the proprietary home study schools.

The U.S. Government endorsed the value of correspondence instruction when in 1920 the U.S. Marine Corps institute offered 225 courses to members of the Marine Corps. There were 36,700 students enrolling for these courses in 1928. In 1921 the U.S. department of war established 342 correspondence courses in military tactics for reserve officers.

Other ventures in this field are as follows:

1. The insular department of education in Porto Rico offers free correspondence instruction in high school subjects.
2. Several communities in Michigan are supplementing high school work by enrolling vocational students in private correspondence schools.
3. In sparsely settled provinces of western Canada children are being taught elementary school subjects by correspondence.

Students and Courses.—More than 85% of the 1,500,000 correspondence students enrolled annually in the United States pursue vocational courses, of which 60% are in the field of "job-improvement." The typical correspondence school student may be described as an adult 26 years old. He has had two years in high school and ten years' experience in the semi-skilled trades or vocations, and lives in a community of less than 100,000 population, where vocational training looking toward job-improvement is available for adults only through home study. Since three-fourths of the population of the United States live in smaller communities, it is evident that the correspondence schools fill a definite need in American life. Many correspondence schools have invested as much as $100,000 in perfecting the teaching technique, etc., of single courses. The correspondence school movement is rapidly reaching a recognized stage of permanency and is forming a valuable supplement to the public educational system. (J. S. No.)

CORRESPONDING STATES, LAW OF: *see* LIQUEFACTION OF GASES.

CORRÈZE, a department of south-central France, formed from the southern portion of the old province of Limousin, bounded north by the departments of Haute-Vienne and Creuse, east by Puy-de-Dôme, south-east by Cantal, south by Lot, and west by Dordogne. Area, 2,273 square miles. Pop. (1936) 262,770. It is situated on the western fringe of the Plateau Central and consists largely of high tracts of crystalline schists and granitic intrusions. The highest points, many over 3,000 ft., are found in the north, where the Plateau de Millevaches, separating the basins of the Loire and the Garonne, provides good sheep-pasture. Except for a small district in the extreme north drained by the Vienne, Corrèze has rivers flowing south-westwards to the basin of the Garonne. The Dordogne drains the south-eastern portion and the Corrèze joins the Vézère to the west of Brive. These river valleys and the lower land of the south-west are given over to agriculture. Rye, buckwheat and wheat are the chief cereals and hemp, flax and tobacco are also grown. Pigs and goats are reared on the valley slopes and poultry-farming and cheese-making are much practised. The vineyards around Brive produce wine of medium quality. Chestnuts, largely used as an article of food, walnuts and cider-apples are the chief fruits.

Coal in small quantities, slate, building-stone and pottery clay are worked. The government manufactory of fire-arms is at Tulle. There are flour-mills, oil-works, saw-mills and dye-works; and hats (Bort), coarse woollens, silk, preserved foods, wooden shoes, chairs, paper and leather are manufactured. Coal and raw materials for textile industries are leading imports; live stock and agricultural products are the chief exports.

The department is served by the Orléans railway, and the Dordogne is navigable. It is divided into the arrondissements of Tulle and Brive, containing 29 cantons and 289 communes. It belongs to the archdiocese of Bourges, the region of the XII. army corps, and the *Académie* (educational division) of Clermont-Ferrand. Its court of appeal is at Limoges. Tulle, the capital, and Brive are the principal towns. Uzerche, on the Vézère, has a Romanesque church and remains of mediaeval fortifications. There are Romanesque churches at Aubazine (or Obazine), Beaulieu, Meymac and Vigeois. Treignac, with its church, bridge and ramparts of the 15th century, and Turenne, dominated by the ruins of its castle, are interesting towns. The dolmen at Espartignac and the cromlech of Aubazine are the chief megalithic remains in the department. A Roman eagle and other antiquities were found close to Ussel, which became the centre of the duchy of Ventadour at the end of the 16th century.

CORRIB, LOUGH, a lake of western Ireland, in the counties Galway and Mayo. It lies north-west and south-east and is

27 mi. long. The extreme breadth is 7 mi., but the lough narrows near the centre to a few hundred yards. Lough Corrib hardly exceeds 30 ft. in depth at any point, and is dotted with islands. It lies 29 ft. above sea level and drains by the short river Corrib to Galway bay. Lough Mask lies to its north and is connected with it by a partly subterranean channel.

CORRIDOR, a main passage in a large building, on which various apartments open (Med. Lat. *corridorium,* a "running-place," from *currere,* to run). In public offices, prisons, hospitals, etc., the corridors are usually of severe simplicity; but in mansions and palaces large corridors (galleries) are often adorned with works of art, whence comes the term "picture gallery." The term "corridor carriage" is applied to the modern European style of railway carriage in which a narrow passage connects the separate compartments.

CORRIE, a term used in the highlands of Scotland and elsewhere for a steep-sided, rounded hollow in a mountainside, from the lower part of which a stream usually issues as the outlet of a small lake ponded by glacial debris. It is from Gaelic *coire,* cauldron; hence whirlpool, or circular hollow. (*See* CIRQUE.)

CORRIENTES, a northeastern province of the Argentine republic situated between 27° and 31° S. lat. and 56° and 60° W. longitude. It is bounded north and west by the Paraná river which separates it from Paraguay in the north and from the territory of the Chaco and the province of Santa Fé in the west; in the northeast by the territory Misiones; east by the river Uruguay, which separates it from Brazil and Uruguay; and south by the province of Entre Ríos. Its area is about 34,500 sq.mi., of which at least one-eighth is water surface. Pop. (1943 est.) 553,013.

The surface of the province, broadly speaking, is an extensive plain covered by swamps and lagoons in the north, undulating in the south and broken by ranges of hills in the northeast. The low-lying areas about the lagoons are practically unfit for permanent settlement unless drained. The southern districts of the province are high and rolling with woods alternating with natural pasture lands, and are admirably adapted to grazing and agriculture. The northeastern corner is also high, some of the hills reaching an elevation of 650 ft., and is heavily forested, like the adjacent territory of Misiones. The province is divided into two water sheds, those of the Paraná and the Uruguay. The principal lagoons, which are the sources for several of the rivers, are the Iberá in the central and northeastern section and the Maloya in the northwestern section. The climate on the higher plains is sub-tropical, but in the northern swamps it is exceedingly humid and hot. Its annual mean temperature of about 71° F. makes Corrientes the hottest province of Argentina.

The principal industry of Corrientes is the raising of livestock. In 1940 there were within the province 3,279,859 cattle, 2,396,842 sheep and 48,355 swine. Agriculture is also of great importance; however, it has not been developed as extensively as conditions would permit. The chief crops are Indian corn (maize), cotton, rice, tobacco, sugar cane, yerba maté, sweet potatoes, manioc, peanuts, fruits and melons. The province is especially noted for its citrus fruits. The area sown in crops in 1940, exclusive of the area devoted to fruits, was 422,389 ac. The forest lands, estimated at 5,000,000 ac., are covered chiefly with hardwoods, many of which are suitable for cabinetwork. In 1939 there were 623 manufacturing establishments in the province, a large number of which were sawmills, tanneries and sugar mills. The exports include cattle, horses, hides, forest products, yerba maté, cereals, tapioca, oranges and quarried stone.

The principal cities are Corrientes, capital (pop., 1941 est., 59,323), on the left bank of the Paraná and an important port of call for steamers trading between Buenos Aires and the upper reaches of the Paraná; Goya (1941 est., 23,170), a flourishing commercial centre on a side channel of the Paraná, handling agricultural and pastoral products; Mercedes (1940 est., 15,000) and Curuzú-Cuatiá (15,000), inland towns; Bella Vista, on the Paraná, the commercial centre of a large district; Esquina on the Paraná at the mouth of the Corrientes river, which exports timber and firewood; Empedrado, also on the Paraná; and Monte Caseros, Paso de los Libres and Santo Tomé, all ports on the Uruguay. Although rivers continue to provide the principal means of communication, there are about 750 mi. of railway and nearly 650 mi. of road in the province. The *Nordeste Argentino* railway (596 mi.) crosses the province in a S.E. direction from Corrientes to Monte Caseros, its junction with the branch that leads south to Entre Ríos and north to Posadas, Misiones. The *Económico Correntino* railway of the *Compañía General de Ferrocarriles Económicos* (155 mi.) connects the city of Corrientes with Lomas de Vallejos, from which point a branch line leads to General Paz and another to Mburucuyá, all located in one of the most fertile and productive regions of the province. Between 1933, the year in which the *Dirección Nacional de Vialidad* was created, and 1940, 637 mi. of road were built in Corrientes.

CORRIENTES. A city and river port, and the capital of the province of the same name, in the north of the Argentine republic, on the left bank of the Paraná river, 25 mi. below the junction of the upper Paraná and Paraguay, and 667 mi. by rail N. of Buenos Aires. Pop. (1941 est.) 59,323. The city was founded in 1588 by Torres de Vera who built a fort bearing the name of *San Juan de Vera de las Siete Corrientes* (seven currents) for the seven rapids in the river just above the town. The commercial importance of Corrientes results from its unusually favourable situation near the confluence of the Upper Paraná and Paraguay, and a short distance below the mouth of the Bermejo. The navigation of the Upper Paraná and Bermejo rivers begins there, and freight for the Upper Paraná and Chaco rivers is transshipped at Corrientes, which practically controls the trade of the extensive regions tributary to them. Corrientes is the western terminus of the *Nordeste Argentino* railway, which crosses the province southeast to Monte Caseros, where it connects with the line running south to Entre Ríos and north to Posadas. The *Económico Correntino* railway connects Corrientes with Lomas de Vallejos, General Paz, Mburucuyá and other centres in the fertile and highly productive region to the east of the city. The principal exports are beef, hides, cereals, yerba maté, sugar, rice, tobacco, citrus fruits, quebracho and timber. The city has four churches, a national college, normal school, library, three hospitals, a fine government palace, several plazas and a beautiful park overlooking the river.

CORRIGAN, MICHAEL AUGUSTINE (1839–1902), American prelate, was born in Newark, N.J., on Aug. 13, 1839. In 1859 he graduated at Mount St. Mary's college, Emmittsburg, Md., and began his studies for the priesthood at the American college in Rome. After his return to the U.S., he was successively professor of dogmatic theology and sacred scripture, and director of the ecclesiastical seminary of Seton Hall college at South Orange, N.J., vice-president of the institution and president (1868–76). In Oct. 1868, Corrigan became vicar general of Newark, and in 1873 bishop. In 1880 he was made coadjutor, with the right of succession, to Cardinal McCloskey, archbishop of New York, and on the cardinal's death in 1885 he became metropolitan of New York. He died May 5, 1902. He was a scholar with great power of administrative organization, simple, generous and kindly.

See *Michael Augustine Corrigan: A Memorial,* with biographical sketch by J. A. Mooney (1902); and *The Catholic Encyclopaedia.*

CORROSION AND RUSTING. Many metals of industrial importance undergo a chemical change when exposed to the action of air and water or salt solutions. This change often results in the production of spots of differently coloured material scattered over the surface of the metal, *e.g.,* brown rust on iron and steel, white specks on aluminum, and blue or green layers on copper. The change not only spoils the appearance of the metal but sometimes penetrates so deeply into it that its mechanical properties are seriously impaired. Recent calculations of Sir Robert Hadfield suggest that the world-loss of iron and steel alone, due to corrosion, must be valued at many millions of pounds sterling every year.

Corrosion is essentially a process of oxidation. Metals are usually found in nature in an oxidized state as ores, and in order to fit them for industrial use they must be "reduced" from the ore, *i.e.,* oxygen, water and other substances must be separated from the metal by chemical and physical processes. But when the metal has been so obtained it will tend to reassociate with oxygen and other substances whenever it comes into contact with them in suitable conditions: thus, iron tends to react with water and oxygen to form rust which is similar in composition to certain kinds of iron ore. The rusting of iron is a typical example of the process of corrosion whereby metals tend to return to an oxidized condition.

The process of oxidation was formerly thought to be usually a direct union between the metal, oxygen gas and sometimes traces of sulphur compounds occurring in the atmosphere. It is probable that this kind of action does take place in certain cases, such as atmospheric corrosion which can occur in the presence of mere traces or very thin films of moisture—the tarnishing of silver is an example. But it is not usually this kind of action which results in the formation of rust and the other conspicuous corrosion products mentioned above on metals immersed in liquids.

When a "base" metal is placed in water or in a salt solution, which can conduct electricity, it tends to dissolve as electrically charged metal atoms or "ions," displacing a proportionate number of charged hydrogen atoms which are constituents of water. With some metals, such as sodium, the hydrogen may appear as gas bubbles; with other metals, such as iron and copper, little or no gas appears; nevertheless the hydrogen is present as an invisible, probably atomic, film at the surface of the metal, and may completely cover it. Unless this film is removed the corrosion process is greatly retarded at this stage and no change may be visible; this may happen in the absence of oxygen; but oxygen has the property of uniting with hydrogen to form water, and so destroying the interfering film of hydrogen. Hence in the presence of air, which contains oxygen, a gas soluble in water, the process can continue, *i.e.*, more hydrogen can be displaced by metal to replace that which has been oxidized. Thus the action of oxygen in corrosion is usually indirect: it unites with hydrogen, the metal reacts with the water. This may be expressed in equations thus (neglecting electrical effects for the present):

$$(1)\quad \underset{\text{(Metal)}}{M} + \underset{\text{(Water)}}{HOH} \text{ yields } \underset{\substack{\text{(Metallic}\\ \text{hydroxide)}}}{MOH} + \underset{\substack{\text{(Hydrogen atom, called}\\ \text{an ion when in solution)}}}{H^{\cdot}}$$

$$(2)\ (a)\quad \underset{\substack{\text{(2 Hydrogen}\\ \text{atoms)}}}{2H^{\cdot}} + \underset{\substack{\text{(Oxygen}\\ \text{atom)}}}{O} \text{ yield } \underset{\substack{\text{(Water}\\ \text{molecule)}}}{HOH}$$

$$(2)\ (b)\quad 2\,H\ \text{(atomic)} = H_2\ \text{(molecular gas)}$$

It will be seen that the result of these reactions is the conversion of the metal into an oxidized product, called an hydroxide. Metallic hydroxide is a typical product of corrosion, but it may undergo further changes, *e.g.*, it may react with carbon dioxide from the atmosphere and finally form a complicated body; such a body is rust which usually contains ferrous and ferric hydroxide and carbonate and is practically insoluble in water. Some hydroxides, such as those of calcium and sodium, are soluble in water, in which case little or no solid corrosion product will appear till the water becomes saturated after long periods of corrosion.

If corrosion occurs in a solution of a salt such as sodium chloride the reactions are a little more complicated and may be summarized thus:

$$(3)\quad \underset{\text{(Metal)}}{M} + \underset{\text{(Water)}}{HOH} + \underset{\substack{\text{(Sodium}\\ \text{chloride)}}}{Na\,Cl} \text{ yields } \underset{\substack{\text{(Metal}\\ \text{chloride)}}}{MCl} + \underset{\text{(Hydrogen)}}{H^{\cdot}} + \underset{\substack{\text{(Sodium}\\ \text{hydroxide)}}}{Na\,OH}$$

$$(4)\quad \underset{\substack{\text{(Metal chlor-}\\ \text{ide)}}}{MCl} + NaOH \text{ yields } \underset{\substack{\text{(Metal hy-}\\ \text{droxide)}}}{MOH} + \underset{\substack{\text{(Sodium}\\ \text{chloride)}}}{Na\,Cl}$$

The hydrogen will react with oxygen as before. It will be noticed that the corrosion product is a metallic hydroxide, as in the case of water, but formed indirectly, and that the sodium chloride is regenerated—not always completely for it may be partly carried out of solution as a complex compound such as a so-called "oxychloride."

A remarkable feature of corrosion in water and salt solutions is its concentration at certain isolated spots or areas at which the metal is sometimes deeply pitted, the surrounding metal being scarcely attacked at all. This is due to the fact that such corrosion is mainly a "galvanic" or electrolytic action and is concentrated on areas representing the negative, anodic or zinc pole of a primary battery, such as is used for electric bells; the surrounding, relatively slightly attacked, areas correspond to the positive or carbon pole; ordinary water and salt solutions, which are electrolytes, and therefore conduct electricity, correspond to the sal ammoniac solution in the battery.

A primary battery operates largely because there is an electrical difference, a difference of potential, between the zinc and carbon when plunged in the same electrolyte. If the analogy be trustworthy, the conclusion is reached that there must be differences of electric potential between different parts of the same piece of metal when localized corrosion takes place. Such differences may be due to actual physical or chemical variations in the metal itself which are not readily discernible (such as local strains, segregation of impurities, or presence of second metals or "phases" such as carbon in cast iron), or more often to variations in the conditions external to the metal, such as differences of oxygen or metal-ion concentration. Differences of oxygen concentration are particularly important and may be due to convection currents in the liquid, or to pores in the metal into which dissolved oxygen cannot easily penetrate; in all cases the metal forms a negative pole, and is corroded, where the oxygen concentration is *least*; where the oxygen concentration is greatest the hydrogen will be most rapidly removed according to equation (2) given above, which together with (4) states the typical reactions at a positive pole. Thus metals tend to be corroded most at crevices of all kinds.

The actual rate of corrosion in any particular case is determined by more than a dozen factors the interaction of which makes the subject exceedingly complicated. Some of these factors are tabulated below.

Factors which influence the Rate of Corrosion

Relating to the metal	*Relating to external conditions*
1. Electrode potential.	8. Temperature.
2. State of aggregation.	9. Pressure of oxygen.
3. Presence of internal stresses.	10. Rate of supply and distribution of oxygen.
4. Overpotential.	11. Hydrogen-ion concentration.
5. Nature and concentration of metals in solid solution.	12. Nature and distribution of corrosion products.
6. Nature, amount and distribution of second phases.	13. Conductivity of the liquid.
7. Chemical reactivity.	14. Metal-ion concentration.
	15. Specific nature of the ions present.

In many industrial waters and salt solutions, factor no. 12 becomes very important since films and mounds of corrosion products may form at the metal surface and affect other factors in a complicated manner.

For a detailed account of the way these factors operate, and for many other important aspects of corrosion, the reader should consult U. R. Evans, *The Corrosion of Metals* (1926); F. N. Speller, *Corrosion: Causes and Prevention* (1926), McGraw-Hill Book Co., New York. (G. D. B.)

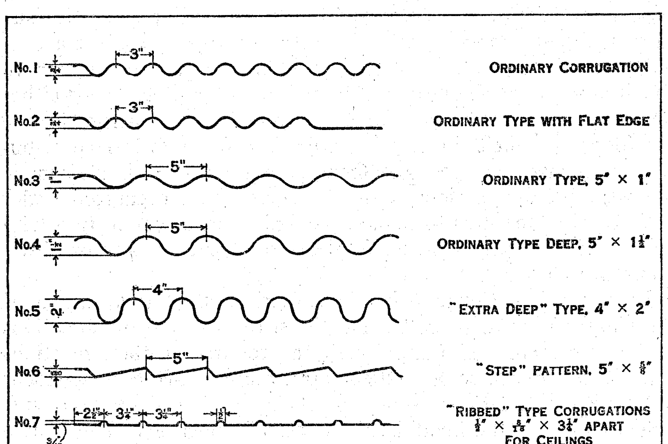
CORROSIVE SUBLIMATE, a white solid, melting at 288° C and boiling at 303° C. It is sparingly soluble in cold, and more so in hot water, and very soluble in alcohol and ether. Chemically it is mercuric chloride (perchloride of mercury), $HgCl_2$, and it is obtained by the action of chlorine on mercury or calomel (*q.v.*), by the addition of hydrochloric acid to a hot, strong solution of $Hg_2(NO_3)_2 + 4HCl = 2HgCl_2 + 2H_2O + 2NO_2$, mercurous nitrate, and, commercially, by heating a mixture of mercuric sulphate and common salt, the mercuric chloride subliming and being condensed in the form of small rhombic crystals. When treated with hydrochloric acid, it dissolves and forms compounds such as $HgCl_2 \cdot 2HCl$, $3HgCl_2 \cdot 4HCl$, $2HgCl_2 \cdot HCl$, according to the temperature and concentration; it also forms double salts with many chlorides; *sal alembroth,* $2NH_4Cl, HgCl_2, H_2O$, is the compound with ammonium chloride. It absorbs ammonia to form $HgCl_2, NH_3$, which may be distilled without decomposition. Various oxychlorides are formed by digesting corrosive sublimate with mercuric oxide. Corrosive sublimate has important applications in medicine—as an astringent, stimulant, caustic and antiseptic (*see* MERCURY).

CORRUGATED IRON. Although many millions of galvanized corrugated sheets are now in use all over the world, this industry is less than 100 years old. British makers were the pioneers. At first the sheets were made from wrought or puddled iron (not steel), and corrugated in the black, then galvanized by hand dipping in an open bath of molten zinc. The output naturally was small, and the cost high, but the quality was excellent, so much so that galvanized corrugated iron sheets are known to be still in use although they were fixed in position 50 years ago.

After the steel making process became a commercial proposition about 1860, steel sheets were produced in the heavier gauges but it was not until about 30 years later that they were made successfully in the lighter gauges. The output per shift was so much larger and the cost so much lower than iron, that steel sheets very quickly ousted the old-fashioned iron sheets. But it must be admitted that the life of ordinary quality galvanized corrugated steel sheets is only about 25% that of the original iron sheets. Iron sheets, of higher purity than ever, are being made not only in Great Britain but on the Continent and in America, for those who see the wisdom of paying a higher price for an article of longer life, but 95% of the so called "corrugated iron" is really steel. The corrugating process enables much lighter gauges of sheets to be used because it makes them very rigid and portable.

The Object of Galvanizing.—The galvanizing or zincing process is to prevent corrosion or rusting, and if the sheet is properly coated it adds very considerably to its life. With the use of machinery, outputs have been tremendously increased and costs very much lowered. The demand for cheaper goods leads to the zinc coating, which can be regulated by mechanical rollers, being sometimes brought down to a dangerously low limit. The life of a galvanized sheet depends upon its zinc coating. An imperfectly or insufficiently coated sheet is worse than a black or ungalvanized sheet. Leading consulting engineers know the importance of this, and many of them in their specifications call for a coating of from 2oz. to $2\frac{1}{2}$oz. per square foot which is considerably higher than the ordinary merchant quality.

Production in Great Britain.—The British corrugated sheet industry had small beginnings, but by 1891 the total production



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SHAPES AND MEASUREMENTS OF PATTERNS OF CORRUGATED STEEL SHEETS

exceeded 200,000 tons and by 1927 the production was nearly 1,000,000 tons. Only about 25% of the sheets are used in Great Britain, while fully 75% are exported to India, Australia, New Zealand, Canada, South Africa, Japan, Argentina and other parts of the world. These British exports have been steadily expanding. In 1901 the quantity shipped was 250,287 tons, and in 1910 it was 596,949 tons, while in 1913 it rose to 762,075 tons. During the war period and up till 1924 the shipments naturally declined, but in 1927 they again reached the 1913 standard and the figures are growing monthly.

Production in America.—The production of galvanized sheets in America reached a total of 881,720 tons in 1913, but has since declined slightly. The American exports during 1915–27 averaged about 120,000 tons per annum. The general steel production in America reached the enormous total of 45,000,000 tons in 1927, but less than 2% of this consisted of galvanized corrugated sheets.

Exact figures of output of corrugated sheets in other countries are not obtainable, but the tonnage as yet is comparatively small. A few years ago Germany was exporting 3,000 to 4,000 tons monthly but in 1927 this had fallen to about 500 tons monthly. Belgium, however, since she entered the corrugated sheet business has made fairly rapid progress, and in 1928 was producing at the rate of 75,000 tons per annum. Japan, which formerly bought her galvanized corrugated sheets principally from Great Britain, is now buying the bulk of her sheets in the black condition from Britain and America and doing the galvanizing and corrugating in Japan. These sheets are specially light, namely 28 to 31 gauge, which is only about half the thickness used in other countries.

Galvanizing and Corrugating.—The black sheets are first put through the pickling process. This is done in a stone or timber tank which is filled either with sulphuric or hydrochloric acid to remove all scale, oxide or rust. This operation can be carried out either by hand pokers or by an automatic pickling machine. After being cleansed in a water tank, the flat sheets are then fed into the galvanizing bath either by hand or by an automatic feeder, one at a time. The galvanizing bath is made of steel plates from 1in. to $1\frac{1}{2}$in. thick and of a size to suit the width of sheets to be treated. Inside the bath there is the galvanizing machine with rollers which revolve in the molten spelter or zinc which is heated to 850° F. The sheets pass rapidly through the zinc and emerge at the other side of the bath through two exit rollers; these rollers, together with the speed of the machine and temperature of the bath, regulate the quantity of zinc covering, viz., from $1\frac{1}{4}$ to $2\frac{1}{2}$oz. per square foot. A flux is used in the process made from muriate of ammonia and this causes the zinc to flow freely and gives the sheet a smooth surface. When sheets are wanted with a bright flowery spangle, it is necessary to add a small proportion of tin to mix with the zinc. The sheets automatically pass through a tank of hot water to wash off any flux stains and then they pass on to a drying fire and finally they are examined by inspectors.

The sheets then pass to the corrugating department. The galvanized flat sheets are here corrugated to the size of corrugation required, either by powerful presses when several sheets are corrugated at a time or in rotary corrugated rollers usually doing one sheet at a time. In either case the process is rapid and a large tonnage is obtained. The corrugated sheets are then weighed up, bundled or packed for shipment; or they are put into store in their various sizes and gauges.

Laying Corrugated Sheets.—For roofs the sheets should have end laps of not less than 6in. The usual side lap for ordinary purposes is half a corrugation, that is to say, the last corrugation in each sheet overlaps. This is known as "single side lap." For special purposes such as stores, warehouses and dwelling-houses, the last two corrugations in each sheet should be overlapped, otherwise termed "double side laps." Sheets for sides of buildings can be laid with 3 or 4in. end laps, and half corrugation or single side laps.

Bolts, nails or screws should always be placed in the top corrugation. Wood screws or nails should be placed 6in. apart. Bolts for fixing sheets together should be about 15in. apart along the side corrugation. Hook bolts for iron framed buildings should be about 12in. apart. All screws and sheet bolts should have at least one iron or lead washer under the head; one of each is recommended. Hook bolts should have curved washers, either round or diamond shaped. In laying sheets the workman should begin at the bottom row, and work towards the ridge of roof.

Galvanized sheets should be stored very carefully in a dry, well-ventilated place, and any sheets which have become damp or wet in transit should be wiped thoroughly dry before storing. On no account should they be stored in bundles in a damp atmosphere. If sheets must be stored in the open air or under poor conditions, they should be stacked in such a manner as to allow a good air space between them. (*See* also GALVANIZED IRON AND STEEL.) (D. McM.)

CORRUPT PRACTICES is a general term including bribery (*q.v.*), undue influence, etc., but has specific reference to electoral systems (*q.v.*); in England, as defined by the Corrupt and Illegal Practices Prevention Act, 1883, and the Representation of the People Act, 1918, the object of which is to prevent improper interference with the freedom of elections and in certain cases to avoid the election in question.

UNITED STATES

While all of the American States and Territories have, from the time of their creation, had laws against bribery in elections, corrupt practices legislation was not enacted until after England set the example. The States first sought to control nominating conventions, direct primaries and elections. In this they were followed later by Congress.

Colorado and Michigan enacted corrupt practices laws in 1891, and Massachusetts and New York in 1892, the last-named State having defined corrupt practices in 1890. Since that time, all of the States except Illinois, Mississippi, Rhode Island, South Carolina and Tennessee have adopted such laws. These laws define numerous election offences, including bribery, coercion, intimidation and treating, and generally set forth in detail purposes for which money may be legally expended in campaigns by candidates, their agents and political committees. Such expenditures permitted in State, district, county and municipal campaigns ordinarily include those for travelling, telegraph, telephone, postage, messenger service, halls and rooms, payment of speakers and musicians, lists of candidates and sample ballots, pamphlets, newspapers, cards, polling lists, canvassing and challenging, stationery, clerical hire, literature and advertising. In some States the furnishing of conveyances for carrying other than the aged and infirm to the polls is prohibited, and others prohibit salaries for speakers. Candidates and committees are often limited in the amounts of expenditures. Such amounts are restricted to one of three limitations, as the statute may provide; a percentage of the salary of the office involved, a sum proportionate to the number of voters in the area in which the candidacy is made, or an arbitrary amount named. Candidates, agents and committee treasurers are required to file with officers designated by law sworn statements of campaign receipts and expenditures, including amounts, names and addresses and purposes, in all cases after the nominating convention or direct primary or election, and in some at a specified time before the campaign closes. Corporations are prohibited from contributing to campaign funds. As a means of protection to candidates, they may not contribute or be requested to contribute to organizations of a religious, charitable or educational character, unless they have regularly aided such institutions; likewise they may not contribute toward the expenses of entertainments, balls, picnics or other outings. The circulation of untruths concerning candidates is prohibited in many States. The penalty for violation of the statutes may be fine or imprisonment or both or, where the successful candidate has profited from the illegality, invalidation of the nomination or election.

Federal action came in 1907 when Congress prohibited national banks and corporations organized by authority of Congress from contributing to political campaigns, and also prohibited any other corporations from contributing in campaigns where presidential electors and representatives in Congress were chosen and when U.S. senators were chosen by the legislatures. Federal officials were prohibited in 1909 from soliciting campaign funds from any officer, clerk or employé of the Government. The publication of campaign expenditures after the election by political committees with activities in more than two States at elections in which representatives in Congress were chosen was required in 1910. An amendment was adopted in 1911 by which publication of campaign expenditures both before and after the election was required, and candidates for representative and senator in Congress were similarly required to file statements of expenditures, both before and after the nominating agencies and the elections. Such statements were required by a law of 1912 to be under oath and sent by registered mail to officials of Congress. Promises and offers for votes and the withholding of votes on behalf of candidates for both houses of Congress were prohibited in 1918, both as regards direct primaries and elections.

Act of 1925.—In 1925 Congress passed a new Corrupt Practices Act in which no attempt was made to control direct primaries or nominating conventions. It specifically repealed all the previous Federal laws, but provided in general: (1) That the treasurer of every political committee having activities in two or more States must file with the clerk of the House of Representatives between the 1st and 10th days of March, June and September in each year, and also between the 10th and 15th days and on the 5th day next preceding the date on which a general election is to be held at which candidates are to be elected in two or more States, and also on the 1st day of January following, sworn statements showing the names and addresses of contributors of $100 or more, together with amounts and dates, and the total sum of other and all contributions, as well as the names and addresses of persons to whom expenditures of $10 or more are paid, with amounts, dates and purposes, and the total sum of other and all payments. Every person likewise expending money other than through contributions to political committees in two or more States must file similar statements. (2) That every candidate for senator must file with the secretary of the Senate, and every candidate for representative, delegate or resident commissioner must file with the clerk of the House, not less than ten nor more than 15 days before and also within 30 days after the election, itemized sworn statements of all contributions to his campaign and expenditures in his behalf, as well as promises or pledges made by him and in his behalf.

If a State prescribes a maximum amount to be expended by the candidate, this must be observed, unless it is more than the amount fixed by the act, viz., $10,000 by a candidate for the Senate, $2,500 by a candidate for the House, or an amount equal to the amount obtained by multiplying three cents by the total number of votes cast at the last general election for the office the candidate seeks, but in no event exceeding $25,000 for the Senate or $10,000 for the House. The act makes it unlawful to pledge appointment or employment for the purpose of procuring support and for any person to make an expenditure or cause one to be made or offered to any person to vote for or against a candidate or to withhold his vote, and likewise for any person to solicit any such expenditure. Members of or candidates for either house or any other officer or employé of the Government are forbidden to solicit directly or indirectly any political contribution from any such person, officer or employé. It is also made unlawful for any national bank or corporation organized under authority of Congress to make a contribution in connection with any election at which presidential electors or members of either house are chosen.

Each house of Congress is empowered under Article i., s. 4 of the Constitution to judge the elections, returns and qualifications of its own members, and through the reports of their elections committees they have defined corrupt practices, often independent of statutory violations, which in their opinion have been sufficient cause for the invalidation of certain elections. The Senate has established the precedent of considering corrupt practices in direct primaries, even where there has been no charge of statutory violation.

See C. H. Rowell, *Historical and Legal Digest of all the Contested Election Cases in the House of Representatives of the United States, 1789–1901* (1901); R. C. Brooks, *Corruption in American Politics and Life,* chap. vi. (1910); "Compilation of Senate Election Cases from 1789 to 1913" in *Senate Document No. 1036,* 62nd Cong., 3rd sess. (1913); A. C. McLaughlin and A. B. Hart, *Cyclopedia of American Government,* vol. i. p. 480 *seq.* (1914); Merrill Moores, *Contested Election Cases in the House of Representatives, 1901–1917* (1917); P. Orman Ray, *An Introduction to Political Parties and Practical Politics,* chap. xi. (1917); J. K. Pollock, *Party Campaign Funds* (1926); E. N. Sait, *American Parties and Elections,* chap. xx. (1927); Perry Belmont, *Return to Secret Party Funds* (1927); R. C. Brooks, *Political Parties and Electoral Problems,* chap. xiii. (rev. ed. 1927); Stuart Lewis, *Party Principles and Practical Politics,* chap. xix. (1928). (S. LE.)

CORRY, a city of Erie county, Pennsylvania, U.S.A., in the northwest part of the state, 25 mi. from Lake Erie, at an elevation of 1,431 ft. It is on federal highway 6, and is served by the Erie and the Pennsylvania railways. Pop. in 1940 was 6,935. It is the centre of a farming and industrial district, producing machine and motor vehicle parts, springs, steel cabinets and oil-drilling engines. Natural gas is used. One mile west is a state fish hatchery, and there are fine trout streams in the neighbourhood.

Corry was settled about 1860, soon after oil was discovered in this region, and was named after Hiram Corry, through whose influence a railroad was built to the town.

Corry was incorporated as a city in 1866.

CORSAIR, the name given by the Mediterranean peoples to the privateers of the Barbary coast who plundered the shipping of Christian nations. (*See* PIRATE AND PIRACY; BARBARY PIRATES.)

CORSELET. Ancient and mediaeval body armour. Originally the term referred to the armour which covered the whole body (from Latin *corpus* and O.Fr. *cors,* body) but later it was restricted to that which covered the body between the neck and the thighs.

The ancient Egyptians and Persians had corselets of linen. In the middle ages the corselet was made of metal, and was distinguishable from the cuirass in that the former had a back-plate as well as a breast-plate.

Corselets were worn by infantry during the 17th century.

CORSICA, an island in the Mediterranean sea, forming a department of France. The island lies between 41° 20′ and 43° N. latitude and between 8° 30′ and 9° 30′ E. longitude. It has a north-south length of 110 mi. and a maximum width of 50 mi. Area 3,367 sq.mi. Pop. (1936) 322,854. Directly N. of Sardinia, from which it is separated by the 7 mi.-wide Strait of Bonifacio, Corsica lies 55 mi. S.W. of Livorno (Leghorn), Italy and 115 mi. E.S.E. of Nice, France.

Corsica is shaped roughly like an oval, on the N.E. side of which a massive, rectangular peninsula points toward the mainland to the N. The framework of the island is formed by two mountain ranges. One extends from N.N.W. to S.S.E. across the island; the other lies to the E. of the first range and juts northward 20 mi. beyond the main body of the island to end in Cape Corse, northernmost point of Corsica. The highest elevation is attained in the western range about 10 mi. inland and at the northern end, where Mt. Cinto rises to 8,881 ft. Several other peaks exceed 7,500 ft. On the western flank, secondary ridges reach out to the sea, ending in precipitously sloped promontories and thus forming a series of gulfs along the western shore. The four most prominent (from N. to S., Porto, Sagone, Ajaccio and Valinco) are deep enough so that the largest vessels can come close inshore. The eastern flank is less broken and descends over steep slopes directly to the sea at the S.E. Between the two main ranges, a zone of relatively low mountain-fringed basins stretches diagonally from the central E. coast to the central N. coast, forming a nearly continuous furrow across the island. Along the central part of the E. coast for 40 mi. the marshy, lagoon-fringed plain of Aleria, varying in width up to 8 mi., forms the most extensive lowland. This plain has been formed by the deposits of the two largest rivers, the Golo in the N. and the Tavignano farther S., and by those of numerous secondary streams which flow down the eastern mountain sides. The upper courses of most of the rivers are flat-floored, high basins just below the mountain crests. From them the streams descend their rapid-filled middle courses through gorges. On the W., they flow to the heads of the gulfs where they have formed small, isolated plains at the sea's edge, each one separated from that at the mouth of the next stream by cliffed promontories.

The climate of Corsica varies with elevation and exposure. Near the coast, summers are hot and dry while winters are very mild and rainy. The average temperature of the warmest month is about 75° F. while that of the coldest month approximates 50° F. Rainfall is somewhat higher on the W. than on the E., and in the mountains than along the coasts. Lower temperatures, especially in winter, occur inland. The peaks are snow-covered for more than half the year. The lower uncultivated slopes are mantled with a thick brush growth, known as *maquis,* which includes such plants as scrub oak, myrtle, broom, honeysuckle, thyme and rosemary. On some of the poorer soils, a thinner cover with scattered grassy plants is common.

The *maquis* gives way to forests of chestnut, oak and beech on the intermediate slopes and in the mountain basins, and to fir still higher. Above the forests, grassy areas extend to the bare surface of the higher mountain peaks.

Population is not evenly spread over the island. It is concentrated in the less marshy lowlands with their fringing slopes and in the mountain basins. Because it is malarial, the plain of Aleria is only sparsely populated. The zone of basins between the main mountain ranges is more densely peopled than most parts of the island.

The ties between the coastal and interior settlements are still weak, for there are few good roads. A motorable road completely encircling the island connects the coastal towns; a narrow-gauge railroad follows a tortuous route across the island from Ajaccio in the S.W. to Bastia in the N.E. with one branch to Île Rousse and Calvi on the N. coast and another to Ghisonaccia on the E. coast. Otherwise, communications are poorly developed; roads are little more than trails.

Agriculture suffers from lack of cultivable land, of labour and of capital. Because of the summer drought and the consequent difficulty of obtaining water for some of the crops, much of the farming is pastoral. Cereal cultivation is neglected despite the suitability of the climate and the fertility of much of the soil.

The culture of the vine, citrons and olives, of vegetables and tobacco, and the rearing of sheep and goats are the main rural industries. To these may be added the rearing of silkworms. The chestnut forests provide both a food for the inhabitants and an item of export.

Most of the inhabitants are proprietors of land. Holdings are scattered to include vineyard or olive grove, cultivable land on one of the plains, and a chestnut woods in the interior. Game and freshwater fish are abundant.

The moufflon, a wild sheep, inhabits the less accessible parts of the mountains.

Industries include the extraction of gallic acid from chestnut bark, the preservation of citrons, the preparation of macaroni and similar foods, and the manufacture of cigars. There are mines of anthracite, antimony and copper; granite, marble and asbestos are quarried; and there are salt marshes and mineral springs.

In general, lack of means of communication as well as of capital is a barrier to commercial activity. The coastal towns, of which Bastia, Ajaccio, Île Rousse, Calvi and Bonifacio are the most important, export early vegetables, fresh and preserved fruits, olive oil, wood, charcoal, tanning bark, gallic acid, mineral waters, game, fish, skins and cheese. The main interior production centres are Corte, Venaco, Vezzani and Sartène. (H. M. KL.)

ARCHAEOLOGY

Although as an archaeological field Corsica is little explored, the excavations of C. J. Forsyth Major, E. Passemard and H. Obermaier have been sufficiently thorough to demonstrate that it is in a high degree improbable that man existed in Corsica before the late Stone Age (neolithic) or even the beginning of the Metal Era. The first civilization that can be recognized has marked Ligurian affinities and was probably derived from across the Gulf of Genoa. It is represented by a meagre outfit of small stone tools (including some of jasper and obsidian), ornaments of stone, shell and bone, and occasional bronze weapons and trinkets. Finds of this nature occur, although rarely, in rock-shelters and caves; thus, near Bonifacio contracted skeletons with a stone slab over the head only (a Ligurian burial-fashion) were accompanied by obsidian scrapers and potsherds. Probably the megalithic burial-places (*stazzone*), rectangular stone cists about 10 ft. in length and roofed by a single slab, belong to this same culture; but although about 15 are known and although stone implements have been picked up near them, their exact chronological position is unknown. These cists are all ruined; one is situated a little to the west of Corte, but the remainder are grouped either in the extreme north, or in the south-west, of the island. A large number (over 40) of menhirs (*stantari*), sometimes grouped in alignments, are also found in the same districts as the cists, and are probably contemporary with the tombs. A "camp" with a massive stone rampart is also recorded at Ficciaggola near Ajaccio; but its date is uncertain.

The sculptured menhirs, of which four or five are known, are of considerable interest. They are distinguished from the French series of statue-menhirs by the fact that the head, chin, and neck, are shaped, though often very roughly. The best known is the Statue d' Apricciani, which has been called Phoenician; but the most interesting is the Statue of Petra-Pinzuta, for this shows a version of the girdle and baldrick common in the French carvings.

The Ligurian civilization was probably long-lived. There is evidence, however, of the altered Iron Age (Hallstatt) fashions in the important Gravona hoard of bronzes, and in the Cagnano cemetery near Luri that probably dates from 700–600 B.C. Moreover, about 560 B.C. the Phocaean Greeks founded a colony at Alalia; but the Greek occupation was not a long one, and after the naval battle in 535 between the Greeks and the allied fleets of Carthage and Etruria, the colony was abandoned. Some red-figure pottery found in the island may date from the Greek settlement; there is also enough Etruscan ware to suggest that after the Greeks left Alalia the Etruscans to a certain extent took their place, though Carthage thenceforward claimed the island until it was ceded to Rome in the early part of the 3rd century B.C. The Roman occupation had doubtless a larger general effect on native life, and a number of Roman buildings are still to be seen, particularly at Aleria.

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HISTORY

The earliest inhabitants of Corsica were probably Ligurian, but the Phocaeans of Ionia were the first civilized people to establish settlements. About 560 B.C. they landed on the island and founded the town of Alalia. Their power soon dwindled before that of the Etruscans, who were in their turn driven out by the Carthaginians. The latter were followed by the Romans, who gained a footing in the island at the time of the First Punic War, but did not establish themselves there till the middle of the 2nd century B.C. In the early centuries of the Christian era Corsica formed one of the senatorial provinces of the empire, and was used as a place of banishment for political offenders. One of the most distinguished of those was the younger Seneca, who spent in exile there the eight years ending A.D. 49.

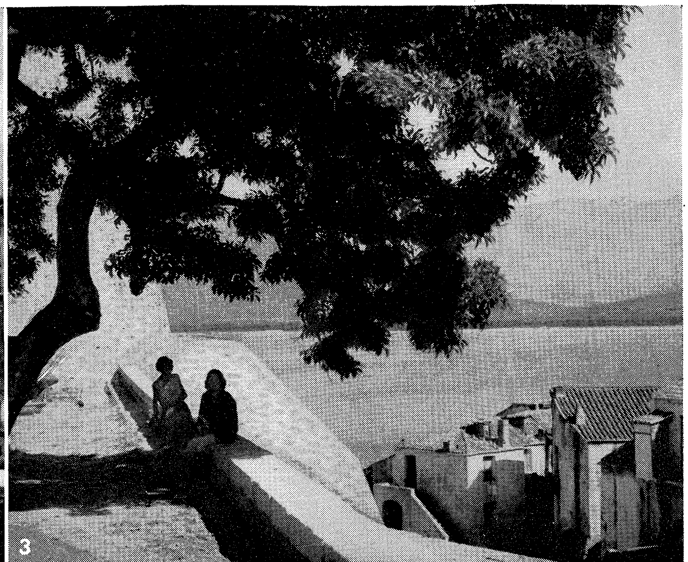
During the break-up of the Roman empire in the West, Corsica was disputed between the Vandals and the Gothic allies of the Roman emperors, until in 469 Gaiseric finally made himself master of the island. For 65 years the Vandals maintained their domination, the Corsican forests supplying the wood for the fleets with which they terrorized the Mediterranean. After the destruction of the Vandal power Corsica became part of the East Roman empire. Thereafter Goths and Lombards in turn ravaged the island, the rule of the Byzantines being effective only in grinding excessive taxes out of the wretched population; to crown all, in 713 the Muslims from the northern coast of Africa made their first descent. Corsica remained nominally attached to the East Roman empire until Charlemagne conquered it. Moorish incursions from Spain soon followed, and in 810 the Moors gained temporary possession. Though expelled they returned again and again, and in 828 the defence of Corsica was entrusted to Boniface II., count of the Tuscan march. He built a fortress in the south of the island which formed the nucleus of the town (Bonifacio) that bears his name. Boniface's war against the Saracens was continued by his son, but the Muslims seem to have remained in possession of part of the island until about 930.

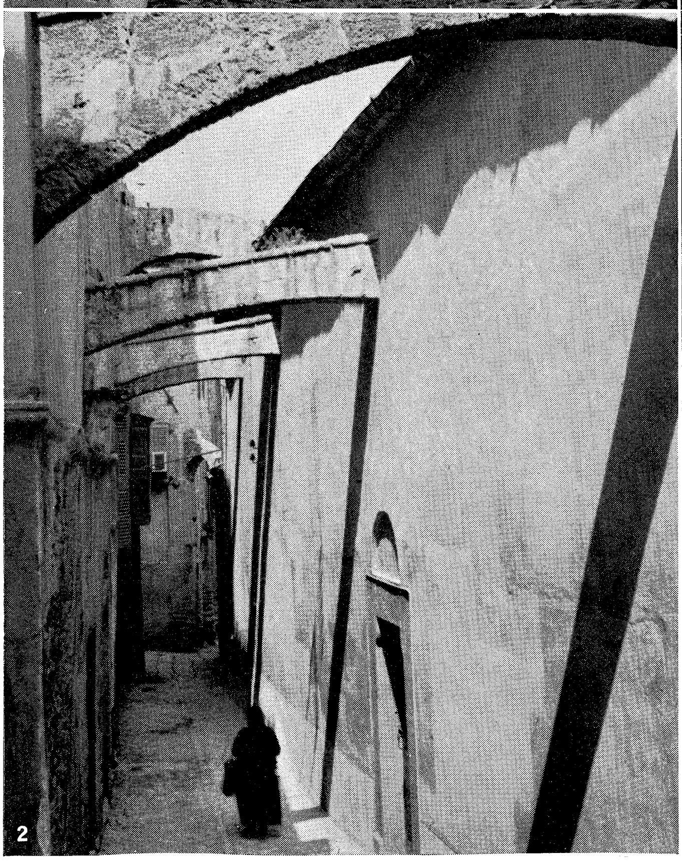
Terra di Comune.—Later the period of feudal anarchy began, a general conflict of petty lords each eager to expand his domain. The counts of Cinarca (to the north-east of Ajaccio), especially aimed at establishing their supremacy over the whole island. To counteract this and similar ambitions, in the 11th century, a sort of national diet was held, and Sambucuccio, lord of Alando, put himself at the head of a movement which resulted in confining the feudal lords to the southern part of the island and in establishing in the rest, henceforth known as the Terra di Comune, a sort of republic composed of autonomous parishes. Each parish or commune nominated a certain number of councillors who, under the name of "fathers of the commune," were charged with the administration of justice under the direction of a *podestà,* who was as it were their president. The podestas of each of the States or enfranchised districts chose a member of the supreme council charged with the making of laws and regulations for the Terra di Comune. This council or magistracy was called the Twelve, from the number of districts taking a share in its nomination. In each district the fathers of the commune elected a magistrate who, under the name of *caporale,* was entrusted with the defense of the interests of the poor and weak. The constitution thus established has never lost its hold on the affections of the people.

Ecclesiastical Jurisdiction.—Meanwhile the south remained under the sway of the counts of Cinarca, while in the north feudal barons maintained their independence in the promontory of Cape Corso. Towards the end of the century the popes laid claim to the island; the Corsican clergy supported the claim, and in 1077 the Corsicans declared themselves subjects of the Holy See in the presence of the apostolic legate Landolfo, bishop of Pisa. Pope Gregory VII. thereupon invested the bishop and his successors with the island and the Pisans took solemn possession, their "grand judges" (*judices*) replacing the papal legates. Corsica, valued by the Pisans as by the Vandals as an inexhaustible storehouse of materials for their fleet, flourished exceedingly under the enlightened rule of the great commercial republic. Causes of dissension, however, remained abundant. The Corsican bishops repented their subjection to the Pisan archbishop; the Genoese intrigued at Rome to obtain a reversal of the papal gift to the rivals with whom they were disputing the supremacy of the seas. In 1138 Innocent II. divided the ecclesiastical jurisdiction of the island between the archbishops of Pisa and Genoa. This gave the Genoese great influence in Corsica, and the contest between the Pisans and Genoese began. It was not, however, till 1195 that the Genoese, by capturing Bonifacio—a nest of pirates preying on the commerce of both republics—actually gained a footing in the country.

Throughout the 13th century the struggle between Pisans and Genoese continued, reproducing in the island the feud of Ghibellines and Guelphs that was desolating Italy. Pope Boniface VIII. added to the complication by investing King James of Aragon with the sovereignty of Corsica and of Sardinia. In 1325 the Aragonese attacked and reduced Sardinia, with the result that the Pisans, their sea-power shattered, were unable to hold their own in Corsica. A fresh period of anarchy followed until, in 1347, a great assembly of *caporali* and barons decided to offer the sovereignty of the island to Genoa. A regular tribute was to be paid to the republic; the Corsicans were to preserve their laws and customs, under the Council of Twelve in the north and a Council of Six in the south; Corsican interests were to be represented at Genoa by an *orator.*

Genoese Domination.—The Genoese domination thus inaugurated began under evil auspices—for the Black Death killed off some two-thirds of the population—and was not destined to





PHOTOGRAPHS, FRITZ HENLE

THE CITIES OF CORSICA

1. The harbour of Bastia, largest city and former capital of Corsica. The towers are those of the church of San Giovanni Battista
2. A narrow street in Ajaccio. Buttresses support the buildings on both sides
3. View from the walls of the old fort of Calvi
4. General view of Ajaccio, the capital, and its harbour, which is accessible to the largest ships
5. The water front at Calvi, on the north-west coast

bring peace. The feudal barons of the south and the hereditary *caporali* of the north alike resisted the authority of the Genoese governors; and King Peter of Aragon took advantage of their feuds to reassert his claims. Among the events of a confused and troubled period may be mentioned the founding of Bastia, in 1383, by Leonello Lomellino, a Genoese governor and count of Corsica. This, with other coastal strong places, such as Calvi and Bonifacio, was a bulwark of Genoese power, though it was lost to the Aragonese at times. By 1447 the position was that the Genoese were masters of the strongholds, the lords of Cinarca held the lands in the south, under the nominal suzerainty of Aragon, and Galeazzo da Campo Fregoso, a member of a powerful Genoese family, was supreme in the Terra di Comune.

The Bank of San Giorgio.—An assembly of the chiefs of the Terra di Comune decided to offer the government of the island to the Company or Bank of San Giorgio, a powerful commercial corporation established at Genoa in the 14th century. The bank accepted; the Spaniards were driven from the country; and a government was organized. Further trouble soon broke out, however, with conflicts between rival lords, and it was not till 1511 that the bank could consider itself in secure possession of the island.

If the character of the Corsicans has been distinguished in modern times for a certain wild intractableness and ferocity, the cause lies in their unhappy past, and not least in the character of the rule established by the Bank of San Giorgio. The power which the bank had won by ruthless cruelty, it exercised in the spirit of the narrowest and most short-sighted selfishness. Only a shadow of the native institutions was suffered to survive, and no adequate system of administration was set up in the place of that which had been suppressed. In the absence of justice the blood-feud or *vendetta* grew and took root in Corsica just at the time when, elsewhere in Europe, the progress of civilization was making an end of private war. The agents of the bank, so far from discouraging these internecine quarrels, looked on them as the surest means for preventing a general rising. Concerned, moreover, only with squeezing taxes out of a recalcitrant population, they neglected the defence of the coast, along which the Barbary pirates harried and looted at will; and to all these woes were added, in the 16th century, pestilences and disastrous floods, which tended still further to impoverish and barbarize the country.

In these circumstances King Henry II. of France conceived the project of conquering the island. Three years' confused fighting from 1553 to 1556 ended in the conclusion of a truce which left Corsica—with the exception of Bastia—in the hands of the French, who proceeded to set up a tolerable government. In 1559, however, the island was restored to the Bank of San Giorgio, from which it was at once taken over by the Genoese republic.

Genoese Rule Restored.—Trouble at once began again. The Genoese attempted to levy a tax which the Corsicans refused to pay; and in violation of the terms of the treaty they confiscated the property of Sampiero da Bastelica, the Corsican national hero, who had put himself at the head of the national movement. The suzerainty of the Turk seemed preferable to that of Genoa, and, with letters from the king of France, Sampiero went to Constantinople to ask the aid of a fleet for the purpose of reducing Corsica to the status of an Ottoman province. All his efforts to secure foreign help were, however, vain: he determined to act alone, and in June 1564 landed at Valinco with only 50 followers. His success was at first extraordinary, and he was soon at the head of 8,000 men; but ultimate victory was rendered impossible by the internecine feuds of which the Genoese well knew how to take advantage. For over two years a war was waged in which quarter was given on neither side; but after the assassination of Sampiero in 1567 the spirit of the insurgents was broken, and peace was declared in 1568.

From this time until 1729 Corsica remained under the government of Genoa, in a peace due to lassitude and despair rather than contentment. The settlement of 1568 had reserved a large measure of autonomy to the Corsicans; during the years that followed this was withdrawn piecemeal, until, disarmed and powerless, they were excluded from every office in the Administration. The *vendetta* increased; in the absence of effective protection the sea-board was exposed to the ravages of the Barbary pirates, so that the coastal villages and towns were abandoned and the inhabitants withdrew into the interior, leaving the most fertile part of the country to fall into the condition of a malarious waste. To add to all this, in 1576 the population had been decimated by a pestilence. Emigration *en masse* continued, and an attempt to remedy this by introducing a colony of Greeks in 1688 only added one more element of discord to the luckless island. To the Genoese Corsica continued to be merely an area to be exploited for their profit; they monopolized its trade; they taxed it up to and beyond its capacity; they made the issue of licences to carry firearms a source of revenue, and therefore studiously avoided interfering with the custom of the *vendetta.*

King Theodore of Corsica.—In 1729 the Corsicans, irritated by a new hearth-tax, rose in revolt. As usual, the Genoese were soon confined to a few coast towns; but the intervention of the emperor Charles VI. and the despatch of a large force of German mercenaries turned the tide of war, and the authority of Genoa was temporarily re-established. A fresh outbreak soon took place, but lack of arms and provisions made any decisive success of the insurgents impossible, and when, on March 12, 1736, the German adventurer Baron Theodor von Neuhof arrived with a shipload of muskets and stores and the assurance of further help to come, leaders and people were glad to accept his aid on his own conditions, namely that he should be acknowledged as king of Corsica. The new king's reign was not fated to last long. The *opéra bouffe* nature of his entry on the stage—he was clad in a scarlet caftan, Turkish trousers and a Spanish hat and feather, and girt with a scimitar—did not, indeed, offend the unsophisticated islanders; they were even ready to take seriously his lavish bestowal of titles and his knightly order "della Liberazione"; they appreciated his personal bravery; and the fact that the Genoese Government denounced him as an impostor and set a price on his head only confirmed him in their affection. But it was otherwise when the European help that he had promised failed to arrive, and, the Governments with which he had boasted his influence disclaimed him. In November he left the island, never to return. The Corsicans, weary of the war, opened negotiations with the Genoese; but the refusal of the latter to regard the islanders as other than rebels made a mutual agreement impossible. Finally Genoa decided to seek the aid of France.

Sardinian and British Intervention, 1746.—The object of the French in assisting the Genoese was not the acquisition of the island for themselves so much as to obviate the danger, of which they had long been aware, of its falling into the hands of another Power, notably Great Britain. The Corsicans, on the other hand, though ready enough to come to terms with the French king, refused to acknowledge the sovereignty of Genoa even when backed by the power of France. The French did, however, succeed in restoring order. But this depended on the presence of their troops which were withdrawn in 1740, leaving the Genoese and Corsicans to begin the perennial struggle anew.

The Corsicans made a vigorous onslaught on the Genoese strongholds, helped by the sympathy and active aid of European Powers. In 1746 Count Domenico Rivarola, a Corsican in Sardinian service, succeeded in capturing Bastia and San Fiorenzo with the aid of a British squadron and Sardinian troops. The factious spirit of the Corsicans themselves was, however, their worst enemy. The British commander judged it inexpedient to intervene in the affairs of a country of which the leaders were at loggerheads; Rivarola, left to himself, was unable to hold Bastia—a place of Genoese sympathies—and in spite of the collapse of Genoa itself, now in Austrian hands, the Genoese governor succeeded in maintaining himself in the island. By the time of the signature of the Peace of Aix-la-Chapelle, in 1748, the situation of the island had again changed. Owing to a report that the king of Sardinia was meditating a fresh attempt to conquer the island, a strong French expedition had, at the request of the republic, occupied Calvi, Bonifacio, Ajaccio and Bastia. By the terms of the treaty Corsica was once more assigned to Genoa, but the French garrison remained, pending a settlement between the republic and the islanders. In view of the intractable temper of the two parties no agreement could be reached, and the withdrawal of the French troops was the signal for a fresh rising. The usual faction disputes followed till, in 1755, the Corsican hero Pasquale Paoli was invited to come from Naples and assume the command.

Pasquale Paoli.—The first task of Paoli, elected general in April at an assembly at San Antonio della Casabianca, was to suppress a rival faction. By the spring of 1756 this was done, and the Corsicans were able to turn a united front against the Genoese. At this juncture the French, alarmed by a supposed understanding between Paoli and the British, once more intervened, and occupied Calvi, Ajaccio and San Fiorenzo until 1757. In 1758 Paoli renewed the attack on the Genoese, founding the new port of Isola Rossa as a centre whence the Corsican ships could attack the trading vessels of Genoa. The republic, indeed, was now too weak to attempt seriously to reassert its sway over the island, which, with the exception of the coast towns, Paoli ruled with absolute authority and with conspicuous wisdom. In the intervals of fighting he was occupied in reducing Corsican anarchy into some sort of civilized order. The *vendetta* was put down, partly by religious influence, partly with a stern hand; the surviving oppressive rights of the feudal lords were abolished; and the traditional institutions of the Terra di Comune were made the basis of a democratic constitution for the whole island.

All now depended on the attitude of France to which Power both Paoli and the republic made overtures. In 1764 a French expedition arrived, and garrisoned three of the Genoese fortresses. French and Corsicans remained on amicable terms, and the inhabitants of the nominally Genoese towns actually sent representatives to the national *consulta* or parliament. In 1767 the Corsicans captured the Genoese island of Capraja, and occupied Ajaccio and other places evacuated by the French as a protest against the asylum given to the Jesuits exiled from France. Genoa now recognized that she had been worsted in the long contest, and on May 15, 1768, signed a treaty selling the sovereignty of the island to France.

The Corsicans, intent on independence, were now faced with a more formidable enemy than the decrepit republic of Genoa. A section of the people, indeed, were in favour of submission; but Paoli himself declared for resistance; and among those who supported him at the *consulta* summoned to discuss the question was his secretary Carlo Buonaparte, father of Napoleon Bonaparte, the future emperor of the French. In the absence of the hoped-for help from Great Britain the issue of the resultant war could not be doubtful; and by the summer of 1769 the French were masters of the island. On June 16 Paoli and his brother with some 400 of their followers embarked on a British ship for Leghorn. On Sept. 15, 1770, a general assembly of the Corsicans was called, the deputies swearing allegiance to King Louis XV.

Corsica and the Revolution of 1789.—For 20 years Corsica, while preserving many of its old institutions, remained a dependency of the French Crown. Then came the Revolution, and the island was incorporated in France as a separate department. Paoli, recalled from exile by the National Assembly on the motion of Mirabeau, after a visit to Paris, where he was acclaimed as "the hero and martyr of liberty," returned in 1790 to Corsica, where he was received with immense enthusiasm as 'father of the country." With the new order in the island, however, he was in little sympathy. In the towns branches of the Jacobin Club had been established, and these tended to usurp the functions of the regular organs of government and to introduce a new element of discord into a country which it had been Paoli's life's work to unify. Suspicions of his loyalty to revolutionary principles had been spread at Paris so early as 1791; yet in 1792 he was appointed lieutenant-general of the forces and governor (*capo comandante*) of the island. With the men and methods of the Terror, however, he was wholly out of sympathy. Called, in 1793, to the bar of the Convention, he replied by summoning the representatives of the communes to meet in diet at Corte on May 27, when he stated that he was rebelling, not against France, but against the dominant faction of whose actions the majority of Frenchmen disapproved. In consequence Paoli and his sympathizers were declared by the Convention *hors la loi* (June 26).

Paoli had already made up his mind to raise the standard of revolt against France. But though the *consulta* at Corte elected him president, Corsican opinion was by no means united. Napoleon Bonaparte indignantly rejected the idea of a breach with France, and the Bonapartes were henceforth ranked with his enemies. Paoli now appealed for assistance to the British Government, which despatched a considerable force. By the summer of 1794, after hard fighting, the island was reduced, and in June the Corsican assembly formally offered the sovereignty to King George III. The British occupation lasted two years, the island being administered by Sir Gilbert Elliot. Paoli, whose presence was considered inexpedient, was invited to return to England, where he remained till his death. In 1796 Bonaparte, after his victorious Italian campaign, sent an expedition against Corsica. The British, weary of a somewhat thankless task, made no great resistance, and in October the island was once more in French hands. It was again occupied by Great Britain for a short time in 1814, but in the settlement of 1815 was restored to the French Crown. Its history henceforth was part of that of France.

Corsica remained under the jurisdiction of Vichy France after the German occupation of France, until 1943, when troops of Gen. Charles de Gaulle, aided by a powerful revolt of native resistance elements, overwhelmed the axis garrison and established Allied control of the island.

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CORSICANA, a city of Texas, U.S.A., the county seat of Navarro county, 55 mi. S. by E. of Dallas. It is on federal highways 75 and 287 and state highways 31 and 22, and is served by the Saint Louis Southwestern, the Southern Pacific, the Fort Worth and Denver and the Cotton Belt railways. Pop. (1940) 15,232. There are many "stripper" oil wells in the vicinity producing about $1,000,000 annual income; cotton production ranges about 60,000 bales annually. The county is noted for its Hereford beef cattle breeders. Small grains, fruit, sheep, poultry and dairy cattle are other sources of income. A cotton mill, an oil well machinery company, a chili manufacturing plant and two machine shops are among the city's largest industries. The Corsicana Fair and Rodeo is an annual exhibition. A state orphans' home and an Oddfellows' orphans' home are there. Corsicana was settled in 1848, incorporated as a village in 1850 and chartered as a city in 1871. The name was given by J. Antonio Navarro, pioneer statesman, to honour his father, who came from the isle of Corsica.

CORSINI, a Florentine princely family, of which the founder is said to be Neri Corsini, who flourished about the year 1170. The emperor Charles IV created the head of the house a count palatine in 1371; in 1730 Lorenzo Corsini was elected pope as Clement XII, and conferred the rank of Roman princes and the duchy of Casigliano on his family, and in 1732 they were created grandees of Spain.

CORSSEN, WILHELM PAUL (1820–1875), German philologist, was born at Bremen on Jan. 20, 1820, and studied at Berlin under Böckh and Lachmann. From 1846 to 1866 he lectured in the royal academy at Pforta (commonly called Schulpforta). In 1854 his work on the pronunciation and accent of Latin, *Über Aussprache, Vocalismus, und Betonung der lateinischen Sprache* (1858–59) gained the prize offered by the Royal Prussian Academy of Sciences. He died on June 18, 1875.

CORT, CORNELIS (1536–1578), Dutch engraver, was born at Horn in Holland and studied engraving under Hieronymus Cockx of Antwerp. About 1565 he went to Venice, where he executed for Titian the well-known copperplates of St. Jerome in the Desert, the Magdalen, Prometheus, Diana and Actaeon, and Diana and Calisto. From Venice he proceeded to Bologna and Rome, where he produced engravings from all the great masters of the time. At Rome he founded the school in which, as Bartsch tells us, the simple line of Marcantonio was modified by a brilliant touch of the burin, afterwards imitated and perfected by Agostino Carracci in Italy and Nicolas de Bruyn in the Netherlands. Before visiting Italy, Cort had been content to copy Michael Coxcie, F. Floris, Heemskerk, G. Mostaert, Bartholomäus Spranger, and Stradan. In Italy he gave circulation to the works of Raphael, Titian, Polidoro da Caravaggio, Baroccio, Giulio Clovio, Muziano, and the Zuccari. Cort is said to have engraved upwards of 151 plates. In Italy he was known as Cornelio Fiammingo.

CORTE, capital of an arrondissement of central Corsica, 52 mi. N.E. of Ajaccio by rail. Pop. (1936) 5,674. The upper town is situated on a precipitous rock on the summit of which stands a citadel built by Vincentello d'Istria (*see* CORSICA). Other interesting buildings are the house in which Pasquale Paoli lived while Corte was the seat of his government (1755 to 1769), and the house of another patriot, Giampietro Gaffori, whose wife defended it from the Genoese in 1750. The town has a subprefecture and a tribunal of first instance. There are marble quarries in the vicinity, and the town has trade in wine. In the 18th century Corte was the centre of the resistance to the Genoese, and the seat of a university erected by Paoli.

CORTE-REAL, JERONYMO (1533–1588), Portuguese epic poet, came of a noble Portuguese stock. Of the same family were Gaspar Corte-Real, who in 1500 and 1501 sailed to Labrador and the Arctic seas, and his brothers Miguel and Vasco. Their voyages opened the way for important Portuguese fisheries on the Newfoundland coast (*see* Henry Harisse, *Les Corte-Real et leurs voyages au Nouveau-Monde,* and *Gaspar Corte-Real; la date exacte de sa dernière expedition au Nouveau-Monde,* 1883). In his youth Jeronymo fought in Africa and Asia, according to the custom of noblemen in that age. In 1578 he volunteered for the fatal expedition to Africa, but King Sebastian dispensed him from the journey (it is said) on account of his age, and in 1586 we find him acting as *provedor* of the *Misericordia* of Evora. Corte-Real was painter as well as soldier and poet, and one of his pictures is still preserved in the church of S. Antão at Evora. His *O Segundo cerco de Diu* (pr. 1574), an epic in 21 cantos, deals with the historic siege of that Indian island-fortress of the Portuguese. *Austriada* (pr. 1578), an epic in 15 cantos celebrating the victory of Don John of Austria over the Turks at Lepanto, was written in Spanish and dedicated to Philip II. of Spain. *Naufragio de Sepulveda,* an epic in 17 cantos, was published posthumously and was translated into Spanish and French. Except the *Naufragio de Sepulveda,* which is highly considered in Portugal, Corte-Real's poetry has hardly stood the test of time.

See *Subsidios para a biographia do poeta Jeronymo Corte-Real* (Evora, 1899); also Ernesto do Canto's Memoir on the family in Nos. 23 and 24 of the *Archivo dos Azores,* and F. M. Sousa Viterbo's *Trabalhos nauticos dos Portuguezes,* ii. 153 *et seq.* (1900).

CORTES, HERNAN or **HERNANDO** (1485–1547), Spanish soldier, conqueror of Mexico, born at Medellin, Estremadura, in 1485. He studied law at the University of Salamanca, but returned home in 1501 resolved to seek a life of adventure. Accidents frustrated his first attempts to see foreign service, but in 1504 he went to San Domingo. There Ovando, who was in command, kept him in his service till 1511, when he accompanied Diego Velasquez in his expedition to Cuba, where he was alcalde of Santiago. Juan Grijalva, who had just discovered Mexico, had not attempted to effect a settlement, so Velasquez entrusted Cortes with the conquest of the country. On Nov. 18, 1518, Cortes set out with 11 vessels, 600 foot, 16 horse and some artillery. In spite of the almost instant cancellation of his commission by Velasquez, he went on, and on March 4, 1519, landed in Mexico. He took possession at once of the town of Tabasco. His artillery, his ships and his horses, all new to the natives, filled them with awe; they regarded the Spaniards as gods, and sent them ambassadors with presents. From them Cortes learnt something of the empire he was to conquer, and its ruler Montezuma. He founded Vera Cruz, had himself elected captain-general of the new colony, and burnt his ships behind him. He then set out for the interior and started operations by allying himself with several caciques hostile to Montezuma. The republic of Tlaxcala, which was at war with Montezuma, resisted him. He defeated its army, dictated a moderate peace, and enlisted it as an ally. With 600 natives as well as his small force of Spaniards he reached the capital, the city of Mexico. He was believed to be a descendant of the sun, and Montezuma received him with great honour. Bernal Díaz, who accompanied Cortes, gives a vivid picture of the wealth of the city, the horrors of its human sacrifices, and the magnificence of the emperor. Cortes had just fortified himself in one of the palaces when news reached him that the emperor had sent one of his generals secret orders to attack Vera Cruz. The head of one of the Spaniards was sent to the capital. This shattered the legend of their immortality and instantly made Cortes' position critical. He accordingly acted boldly and at once. Going with his officers to the palace he seized Montezuma and extorted from him the surrender of the force which had attacked Vera Cruz. These men he had burned alive before the palace gates. Meanwhile Cortes loaded Montezuma with irons and forced him to acknowledge the sovereignty of Charles V. and ransom himself with an enormous sum in gold and jewels. At this point Cortes heard of the arrival of a Spanish force under Narvaez sent by Velasquez to deprive him of his command. Leaving 200 men at Mexico city, he marched against Narvaez, defeated him and enlisted his army in his own forces. On his return he found that the Mexicans had revolted. Montezuma, attempting to address the Mexicans, was killed, and under a new emperor they attacked Cortes' headquarters and drove him out of the city with the loss of his whole rear guard. After six days of retreat, during which the Spaniards suffered severely, the Mexicans offered battle in the plain of Otumba. The battle was fought on July 7, 1520 and resulted in a decisive victory for Cortes. He recruited an auxiliary army of natives from Tlaxcala, subdued the neighbouring provinces, and recaptured the city of Mexico after a stubborn defence on Aug. 13, 1521.

The fame that Cortes was achieving in Spain as a result of these conquests overshadowed the irregularity of his methods; Charles V., in deference to public opinion, overruled Velasquez and appointed Cortes governor of Mexico and made him marquis of Oaxaca (1529). But the methods he followed in consolidating his conquests reduced the natives to despair and revolt. The revolt was crushed and the leaders publicly executed with great cruelty. Meanwhile, the court of Madrid, fearing his ambition and popularity, was doing its best to thwart his efforts; his goods were seized by order of the Council of the Indies and his retainers imprisoned. Cortes returned to Spain to appeal to the emperor. He was received honourably, and returned to Mexico with new honours and diminished authority, having a viceroy put in charge of the civil administration. This division of powers frustrated his later enterprises. In 1536 he discovered the peninsula of Lower California and surveyed part of the gulf between it and Mexico.

Tired of struggling with adversaries that the court encouraged, he returned to Europe again, to be received coldly. He attended the emperor assiduously, and served as volunteer in his disastrous expedition against the pirates of Algiers in 1541, which Cortes' advice, if followed, might have converted into a success. After this he was completely neglected. There is a story that he forced his way through the crowd round the emperor's carriage and mounted the doorstep. Charles asked who he was. "I am a man," Cortes replied, "who has given you more provinces than your ancestors left you cities." This is not the way to ingratiate oneself with princes. Eventually he retired from court and died near Seville on Dec. 2, 1547.

The only writings of Cortes are five letters on the subject of his conquests, which he addressed to Charles V. The best edition of them is that of Don Francisco Antonio Lorenzana, archbishop of Mexico, entitled *Historia de Nueva-España escrita por su esclarecido conquistador, Hernan Cortes, aumentada con otros documientos y notas* (Mexico, 1770, 4to), a work the noble simplicity of which attests the truth of the recital it contains. An English translation of the letters, edited by Francis A. MacNutt, was published in 1908. The conquests of Cortes have been described by Antonio de Solis in his *Historia de la conquista de Mejico* (1684), and by Bernardo Diaz del Castillo in his work under the same title (1632); trans. by Prof. Maudslay, "The Broadway Travellers," (1928). *See* also Sir Arthur Helps's *Life of Hernando Cortes* (1871); F. A. MacNutt's *Fernando Cortes*, "Heroes of the Nations" Series (1909); H. D. Sedgwick, *Cortes the Conqueror* (1927); and bibliography to MEXICO.

CORTES, a Spanish term literally signifying the "courts," and applied to the states, or assembly of the states, of the kingdom. (*See* SPAIN and PORTUGAL.)

CORTEX (derived from the Latin, meaning *bark*). In botany, the bark of an exogenous plant, as the bark of a tree. In physiology, the outer layers of tissue, or outside section of a part of the brain, or of some internal organ, or gland. The cerebral cortex is the corresponding portion of the cerebellum. The grey matter of both brain and spinal cord is chiefly characterized by synaptic connections between different neurones, and systems of neurones. Hence the cerebral cortex has been generally regarded as the principal "switchboard," or central correlation area for nervous impulses. In acerebrate human monsters (children born without cerebral hemispheres), the cortex of the suprarenal glands has also been found missing (W. Timme, *Lectures on Endocrinology*). The suprarenal cortex in man is about nine times the size of the suprarenal medulla; while in lower animals the suprarenal cortex is notably smaller in proportion to the medulla than in man. The cerebral cortex, correspondingly, in man, is much more highly developed than in the lower animals.

CORTI, LODOVICO, COUNT (1823–1888), Italian diplomatist, was born at Gambarano on Oct. 28, 1823. Early involved with Benedetto Cairoli in anti-Austrian conspiracies, he was exiled to Turin, where he entered the Piedmontese foreign office. After serving in the campaign of 1848, he was in 1850 appointed secretary of legation in London, whence he was promoted minister to various capitals, and in 1875 ambassador to Constantinople. Called by Cairoli to the direction of foreign affairs in 1878, he took part in the Congress of Berlin, but declined Lord Derby's offer for an Anglo-Italian agreement in defence of common interests. At Berlin he sustained the cause of Greek independence, but in all other respects remained isolated, and excited the wrath of his countrymen by returning to Italy with "clean hands." In 1881 he was again sent to Constantinople by Cairoli, where he presided over the futile conference of ambassadors upon the Egyptian question. In 1886 he was transferred to the London embassy, but was recalled by Crispi in the following year through a misunderstanding. He died in Rome on April 9, 1888.

CORTLAND, a city of New York, U.S.A., midway between Syracuse and Binghamton, on the Tioughnioga river, at the meeting-point of seven valleys; the county seat of Cortland county. It is on Federal highway 11, and is served by the Lackawanna and the Lehigh Valley railways. The population in 1930 was 15,043; and in 1940 was 15,881 by the federal census. Dairying and the breeding of Holstein cattle are the principal industries of the surrounding country.

The city has important manufactures, notably wire cloth and wire netting. A State normal and training school (established 1869) is located here. The site of Cortland was part of the Phelps and Gorham purchase. It was settled in 1792. The city was chartered in 1900.

CORTONA, a town and episcopal see of Italy, in the province of Arezzo, 18m. S. by E. from the town of Arezzo by rail. Pop. (1936) 3,736 (town), 31,518 (commune). The highest point of Cortona, a mediaeval castle (Fortezza), is 2,130ft. above sea-level on a hill commanding a splendid view. It is surrounded by fairly well-preserved Etruscan walls constructed of parallelepipedal blocks of limestone, finely jointed and arranged in regular courses which vary in size in different parts. Near the north-west angle some of the blocks are 7 to 8½ft. long and 2½ft. high. Within the town are various Etruscan walls in good masonry, of uncertain nature, under modern buildings and a concrete ruin called the "Bagni di Bacco." A reservoir about 60ft. square is the only building of Roman date now visible. The museum of the Accademia Etrusca (a learned body founded by Ridolfino Venuti in 1726), in the Palazzo Pretorio, contains a magnificent bronze lamp with 16 lights, of remarkably fine workmanship. The cathedral, originally a Tuscan Romanesque building of the 11th–12th centuries, is now a fine Renaissance basilica restored in the 18th century, containing some paintings by Luca Signorelli, a native of the place. Opposite is the baptistery, with three fine pictures by Fra Angelico. Other works by Signorelli are to be seen elsewhere in the town, especially in S. Domenico. Pietro Berettini (Pietro da Cortona, 1596–1669) is hardly represented here at all. Below the town is the massive tomb chamber (originally subterranean, but now lacking the mound of the earth which covered it) known as the Grotta di Pitagora (grotto of Pythagoras). To the east is the church of S. Maria del Calcinaio, by Francesco di Giorgio Martini of Siena, with fine stained glass windows. Cortona appears in history as one of the strongholds of the Etruscan power; but in Roman times it is hardly mentioned.

See G. Mancini, *Cortona* (Bergamo, Arti Grafiche, 1909), well illustrated; A. Neppi Modona, *Cortona* (Florence, 1925).

CORT VAN DER LINDEN, PIETER WILLEM ADRIAN (1846–1935), Dutch politician, until 1897 followed an academic career, mainly interesting himself in economics. In that year he became minister of justice and he retained this post until 1901, when he was appointed a member of the State Council. In 1913, after the Social Democrats had refused to co-operate with the Liberal parties, thus creating a parliamentary deadlock, Dr. Cort van der Linden formed an extra-parliamentary cabinet, which during the World War assumed the character of a national cabinet. In virtue of this he succeeded in bringing about a revision of the Constitution, which put an end to both the electoral "war" and the schools "war," which for half a century had dominated politics in the Netherlands. Bills were passed providing for proportional representation, universal manhood suffrage, which gave a prospect of extending the franchise to women. A bill was also passed by which denominational schools were placed upon an equal financial basis with the schools provided by public authority. After his cabinet had resigned in 1918 Dr. Cort van der Linden was again appointed a member of the State Council.

CORUMBÁ, a town and river port in the state of Mato Grosso, Brazil, on the right bank of the Paraguay river near the Bolivian frontier. The population of the *município* (1940) was 30,051, of whom perhaps not more than one-half live in the town. Corumbá is the leading commercial city in Mato Grosso. The surrounding country is devoted principally to cattle raising, and the chief exports of Corumbá are hides and xarque (jerked beef). Steamers run to Pôrto Esperança on the Paraguay river, where connection is made with the North-Western railway leading to São Paulo, and the town is served regularly by transcontinental planes.

CORUNDUM, a mineral of the composition Al_2O_3, remarkable for its hardness and forming in its finer varieties a valuable gem-stone (Germ. *Korund*, Fr. *Corindon*). The name is believed to be derived from *Kurund* (Hindi) or *Kurundam* (Tamil), the native name of the stone in India whence specimens were first sent to England. The transparent coloured varieties are known as ruby and sapphire, whilst the impure massive forms are known as emery (*q.v.*). Corundum crystallizes in the rhombohedral system and shows some variety of habit, the commonest being acute hexagonal bipyramids, sometimes in barrel-shaped forms, or tabular owing to the predominance of the basal plane. Corundum has no true cleavage but a parting parallel to the base and the rhombohedron, the latter a plane of lamellar twinning, sometimes secondarily developed due to pressure.

Next to diamond, corundum is the hardest known mineral (9 on Mohs' scale), this property being sufficient to distinguish it from all other minerals. The pure mineral is colourless, small quantities of impurities (iron, chromium, titanium) being responsible for the wide range of colours observed in natural crystals. Alteration products such as gibbsite, diaspore, margarite and bauxite often accompany corundum. It is used largely for watch jewels, bearings in electrical apparatus and, as emery, extensively as a polishing substance. Corundums fit for gem-stones come principally from Ceylon, Burma, Siam and Montana; they are largely recovered from gravels and residual surface deposits. Crystalline Al_2O_3 is dimorphous, a second hexagonal form βAl_2O_3 occurring as a phase in investigations on the system $MgO-Al_2O_3$. βAl_2O_3 is not convertible into corundum (αAl_2O_3).

Alumina melts have a great power of crystallization, rendering it difficult to preserve glasses of this composition. The melting point of the artificial corundum is 2,050° C. As substitutes for natural gems, synthetic rubies and sapphires are manufactured, many of which are distinguishable only by the expert.

Corundum is of widespread distribution and occurs both in igneous and metamorphic rocks.

CORUNDUM, ARTIFICIAL. Artificial corundum (H. 9+; G. 3·95) is known by various trade-names such as alundum, aloxite, lionite, borolon and oxaluma. Probably the most important advance in the abrasive field was the development of artificial corundum or manufactured aluminous abrasive, which is essentially crystalline alumina (Al_2O_3). After small scale experiments by Henri Moissan and others, the early development of artificial corundum can be followed through patents granted to the following inventors: Ivan Werlein of France in 1894; Franz Hasslacher of Germany in 1896; C. B. Jacobs of New Jersey, U.S.A., in 1900; and C. M. Hall of Niagara Falls, N.Y., U.S.A., in 1901.

Artificial corundum is made by melting calcined bauxite (*q.v.*), with coke and iron borings, in an electric arc furnace at a temperature of about 2,200° C. Hanging carbon or graphite electrodes are used to carry the electric current into the melt. The power used is about 500kw. at 100 volts, alternating current. Most of the furnaces are operated on a periodic basis and consist of a removable conical steel shell on a flat carbon lined car.

The shell is cooled and protected from the molten material by a spray of water which runs down the outside. The function of the coke in the mixture is to reduce or deoxidize the major portion of the impurities to the elementary form. The carbon is eliminated as carbon monoxide (CO) which burns to carbon dioxide (CO_2) as it leaves the furnace. The reduced metals unite with the added iron to form a magnetic alloy called ferrosilicon, which settles to the bottom of the melt, leaving the alumina in a purified condition. By close control of the mixture and furnace operation the composition of the alumina product is maintained as follows: alumina 95%, silica 1·5%, iron oxide 0·5% and titania 3%. In about 24 hours, when the furnace is full of melted material, the electrodes are withdrawn. A few hours later the shell can be lifted off and the 5-ton ingot set aside to cool. As the alumina solidifies it crystallizes into a solid structure of crystals of irregular shape. After cooling the material for at least a full week the ingot is broken up and cleaned. Some abrasive manufacturers make for special uses an artificial corundum containing over 99% alumina by melting chemically purified alumina.

The lump abrasive is passed through jaw crushers, then through a series of rolls or some other type of crushing equipment until it has been reduced to the desired grain sizes. The grains are run over powerful electromagnetic machines which remove any of the metallic alloy left in the abrasive, and are then usually roasted in a rotary cylinder of the cement kiln type in order to prepare better the grains for the various types of bonding. The product is then washed, dried and graded into upwards of 24 grain sizes ranging from 8 to 240 meshes per inch and even finer. This sifting operation is done on a series of flat screens of silk or wire of the desired mesh agitated by eccentrics. The wire screens are ordinarily used for the coarser sizes only.

Artificial corundum is commonly reddish brown and translucent, but the special pure varieties are white to pink. In addition to being very hard it is the strongest abrasive with the single exception of steel shot. It fractures in such a way that new and sharp cutting points are formed when the original points are dulled through use. These properties adapt it particularly to the working of materials of high tensile strength, such as the various steels, which is the largest and most important use for abrasives. The grains are used extensively in all kinds of grinding and polishing wheels, coated paper, cloth and disks, and to a less extent as loose grains. The specific applications of these are far too numerous to catalogue completely, but include automatic and hand-grinding operations such as snagging steel castings, surface grinding, cylindrical grinding, internal grinding and honing, tool and cutter-grinding, polishing articles such as ploughs and cutlery, and in preparing automobile bodies for painting. The loose grains are used to polish plate-glass.

See F. B. Jacobs, *The Abrasive Handbook* (1928). (R. MacD.)

CORUNNA (*La Coruña*), a province in northwest Spain, forming part of Galicia, and bounded on the east by Lugo, south by Pontevedra, west and north by the Atlantic ocean. Pop. (1940) 883,090; area, 3,051 sq.mi. The coast of Corunna is broken by a series of promontories separated by bays and estuaries which often extend for many miles inland. These afford sites for sheltered ports but the coast, though well lighted, is dangerous owing to frequent gales and fogs in winter and spring. The chief headlands are Cape Ortegal and Cape de Vares, the most northerly points in Spain, and Capes Finisterre and Toriñana in the west. The principal bays are those of Santa Marta, Ferrol and Corunna, on the north; Corcubión, Muros y Noya and Arosa, on the west. The interior of the province, though mountainous, is not high and the climate is singularly mild and equable, but the rainfall is very heavy. The slopes are covered with woods and pastures and in the valleys beans, onions, potatoes and fruit are grown for export. The broken nature of the country discourages cereal growing, but in limited areas heavy crops of maize, wheat and rye are obtained.

The wines of Corunna are heady and of inferior flavour. Cattle-breeding is important, though the export of livestock, once considerable, declined, owing to foreign competition. Along the coast there are valuable fisheries of sardines, lobsters, hake and other fish. A little tin, tungsten, iron and copper are mined. The chief exports ordinarily are farm produce and fish; the imports, coal and manufactured goods from England, petroleum from the United States, salt fish from Norway and Newfoundland, and timber, hides, colonial produce and salt. Means of communication are very inadequate. A main railway line links Corunna with Lugo and Madrid, with a branch to El Ferrol in the north and a line running south through Santiago to Vigo and Oporto. Elsewhere inhabitants are dependent on indifferent roads. Corunna was occupied by insurgent troops early in the Civil War (1936–39).

The principal ports are Corunna (pop. 1940, 92,189) and El Ferrol (40,664); the chief inland towns, Santiago de Compostela (30,127), Ortigueira (1,479), Ribeira (mun., 18,760), Carballo (1,584). These are described in separate articles. Muros (2,045), Noya (3,149), Serantes are minor trading and fishing ports and Corcubión (1,073) is a small coaling station. (For a description of the peasantry, who are distinguished in many respects from those inhabiting other parts of Spain, *see* Galicia.)

CORUNNA (Span. *La Coruña;* Fr. *La Corogne;* Eng. formerly often *The Groyne*), capital of the Spanish province described above; on Corunna bay, an inlet of the Atlantic ocean and connected by rail with Madrid and Oporto. Pop. (1940) 92,189 (mun., 104,220). It consists of an upper and a lower town, built respectively on the S.E. slope of a small peninsula, and on the low isthmus connecting the peninsula with the mainland. The old, closely-built upper town overlooks the harbour formed by the bay east of the peninsula and was once strongly fortified. With the growth of the port, however, it became too restricted and the population expanded over the former fishing settlement of La Pescadería, now a modern, fairly well built town on the shores of the harbour. Corunna has an electric tram service, two hospitals, theatres, a school of navigation, a school of agriculture, an arsenal and barracks. A characteristic feature of the houses, especially those overlooking the harbour, is their balconies enclosed with glazed windows for protection against the wind. In the old quarter there are convents and the churches of Santiago and the Colegiata, dating respectively from the 12th and 13th centuries. The walls have largely been demolished and the harbour forts dismantled as useless in modern times, being overlooked by a hill behind the town. That on San Anton island is now a prison and San Diego on the mainland has been converted into a factory. The so-called tower of Hercules on the north is now a lighthouse. Corunna, owing to its position near a great sea route between north-west Europe and South and Central America, the Mediterranean and beyond, is one of the chief ports of north Spain. The sheltered harbour, facing north-east and protected by a breakwater, has an easy entrance and is deep and safe, accommodating vessels of 22ft. draught, with an inner dock for smaller ships. Many foreign merchant and mail steamers call here and it is the chief Spanish port for passengers for Cuba and South America. Corunna is a great fishing centre for sardines, herrings, haddock and conger-eels with an important salting and canning industry. It exports agricultural products, especially onions and potatoes, and fish, and imports coal, colonial produce, salt and manufactured goods. It has a state tobacco factory and yards for building sailing vessels and steam trawlers.

Corunna, possibly at first a Phoenician settlement, is usually identified with the ancient *Ardobrica.* Its present name is probably derived from that of *Caronium* by which it was known in the Middle Ages, rather than from the Latin Columna. The harbour has always been of considerable importance, but it is only in comparatively modern times that it has made a figure in history. In 1588 it gave shelter to the Armada; in 1598 it was burned by the British under Drake and Norris. Nationalist troops captured it early in the Civil War of 1936–39. (X.)

CAMPAIGN OF 1808

For the objects and early course of Sir John Moore's campaign in 1808, *see* PENINSULAR WAR. Having, by his bold thrust at the French line of communication, through Burgoe, drawn Napoleon from his intended advance against Lisbon and Andalusia, Moore with his small force of 25,000 men began, on Dec. 25, to fall back upon his new base at Corunna. Napoleon, with 70,000 followed hard upon his trail but his advanced cavalry reached the vital crossings of the Esla only in time to see the bridges destroyed by the British rear-guard. Moore had 36 hours' start; it should have been enough, but at Astorga he found the town full of demoralized Spaniards, so that the billeting of the troops and the issue of supplies were thrown into confusion; infuriated by the irritation of countermarching and the disappointment of retreat, his men broke through the thin shell of their discipline, burst open the wine stores, and within a short time a large part of the army was in no condition to move. With great difficulty the bulk of the drunkards were collected and driven forward by the rearguard, Paget's Reserve Division, who throughout the retreat combined that duty with the less irksome one of repelling the enemy. It must be remembered that the majority of British regiments at this period were not bound by the "tradition of discipline" that obtains to-day. The officers were often ill-chosen and badly trained and, worst of all, the system of supply and transport was hopelessly inadequate. At Astorga, on Jan. 1, 1809, Napoleon, believing Moore's army to be beyond his grasp, handed over the command to Soult and returned to Paris. Day by day the two armies, pursuers and pursued, plodded doggedly westward through the bitter winter weather, the British losing hundred of prisoners by sickness and straggling every day. At Lugo Moore made a stand, hoping to revive the *moral* of his troops by action. Instantly the spirits of his men responded to the prospect, but Soult would not attack and the retreat began again, discipline breaking down more completely than before. Supplies now were terribly scarce; boots were worn out, so that men and even officers marched barefoot over the rough mountain roads. The cold became even more intense, so that many died from this cause alone. Straggling increased daily and bands of soldiers wandered into the mountains, plundering the villages for food and loot. Amidst all this demoralization a few units maintained their discipline throughout: the guards, alone among the main body; the Light Brigades of Craufurd and Alten, which acted as left flank guard on the Orense road, and Paget's Reserve Division, which had successfully held off the pursuit in a series of fierce rearguard actions. At last, on Jan. 11, Moore reached Corunna, only to find that the fleet had not arrived. After embarking his sick in such ships as were in the harbour, the British commander turned his attention to the battle that was now inevitable. Two miles south of the harbour and astride the road by which Soult must approach lay a ridge known as the Monte Mero; Moore chose this as his main position. Its left was protected by the estuary of the river Mero, but its right was open and could easily be turned. On this ridge Moore stationed the divisions of Baird and Hope, with Paget echeloned to their right rear in the valley of the Monelos at Oza and Frazer farther back still on the heights of Santa Margarita above the town; about 15,000 men in all. On Jan. 14 Soult was in touch with this position and on the 16th he attacked it, employing 16,000 men and 20 guns. He concentrated his attack on Monte Mero, Delaborde's division on the right being directed along the main road, Merle's in the centre against the summit of the hill, and Mermet on the left against the village of Elvina on its western slopes. La Houssaye's cavalry protected Mermet's left flank and a second cavalry division under Longe was in reserve. Baird, on the right of the Monte Mero position, had the brigades of Bentinck and Manning up in the front line, with the Guards Brigade in reserve; Hope, on the left, had Leith and Hill in front, and Craufurd in reserve. Mermet's advance soon drove the British skirmishers out of Elvina and, overlapping Bentinck's right, threatened to turn his flank. To meet this danger Moore brought Paget up the valley of the Monelos and ordered Baird to retake Elvina. By this time Merle and Delaborde had joined in the attack on the right of Mermet, the action becoming general. Baird now sent forward two of Bentinck's battalions, which retook Elvina and even advanced beyond it. Had Moore remained in command it is probable that he would have pressed this advantage to its fullest extent, for he had already ordered up a Guards battalion to join in the counter-attack, while Paget's advance was beginning to make itself felt on the French left. Unfortunately, at this critical moment Moore's left arm was carried away by a round shot and, knowing his wound to be mortal, he handed over the command to Hope and allowed himself to be carried from the field. The change of command and weakness on the part of Bentinck resulted in the failure of the British counter-stroke. The French retook Elvina but were again checked before the main position, Merle and Delaborde on the right also failing to make any impression upon Manningham, Leith and Hill. By this time darkness was beginning to fall and the fight gradually flicked out. Neither side could claim a victory (each had lost about 900 men), but the British were able to embark next day unmolested in the fleet which had at last arrived. At the dawn of that day, Sir John Moore, his task accomplished, was buried on the ramparts of Corunna; a monument in the Jardin de San Carlos commemorates his death.

The town joined the revolutionary movement of 1820, but in 1823 it was forced to capitulate by French troops. In 1836 it was captured by the Carlists. Corunna suffered heavily when Spain was deprived of Cuba and Porto Rico by the Spanish-American War of 1898, for it had hitherto had a thriving trade with these colonies. (H. L. A.-F.; X.)

CORVALLIS, a city in the western part of Oregon, U.S.A., at the head of navigation on the Willamette river, 75 mi. S. by W. of Portland; the county seat of Benton county. It is served by the Southern Pacific railway. The population in 1930 was 7,585; in 1940 it was 8,392 by federal census.

The fertile Willamette valley produces large quantities of small fruits and berries. Among the city's industries are canneries, flour and sawmills, sash and door factories. It is the seat of the state agricultural college (established 1868) which gives degrees in ten technical schools and had an enrolment in 1940–41 of 3,100 men and 1,300 women in the regular session and 1,050 in the summer school. The instruction includes courses in logging engineering, home economics, journalism, physical education, teacher training, architecture, music, lumber manufacture and commercial canning. The college campus and farms at Corvallis occupy 547 ac. and 814 ac. in addition are leased for institutional purposes. The school of forestry has an arboretum of 341 ac. besides 75,000 ac. of state forest which is under its scientific management. The agricultural experiment station maintains branches at seven points in the state, on lands of 1,221 acres. Corvallis was settled in 1846 and incorporated in 1857.

CORVÉE, in feudal law, the term used to designate the unpaid labour due from tenants, whether free or unfree, to their lord; hence any forced labour, especially that exacted by the State, the word being applied both to each particular service and to the system generally. Though the corvée formed a characteristic feature of the feudal system, it was, as an institution, much older than feudalism, and was already developed in its main features under the Roman empire. Thus, under the Roman system, personal services (*operae*) were due from certain classes of the population not only to the State but to private proprietors. Apart from the obligations (*operae officiales*) imposed on freedmen as a condition of their enfranchisement, which in the country usually took the form of unpaid work on the landlord's domain, the semi-servile *coloni* were bound, besides paying rent in money or kind, to do a certain number of days' unremunerated labour on that part of the estate reserved by the landed proprietor. The State also exacted personal labour (*operae publicae*), in lieu of taxes, from certain classes for such purposes as the upkeep of roads, bridges and dikes; while the inhabitants of the various regions were responsible for the maintenance of the posting system (*cursus publicus*), for which horses, carts or labour would be requisitioned.

Under the Frankish kings, who in their administration followed the Roman tradition, this system was preserved. The economic revolution which between the 6th and 10th centuries converted the Gallo-Roman estates into the feudal model, and the political conditions under which the officials of the Frankish empire developed into hereditary feudal nobles, who evolved the system of the corvée as it existed throughout the middle ages and, in some countries, survived far into the 19th century.

In his *Manuel,* p. 346, Luchaire divides all corvées into two broad categories, (1) corvées properly so called, (2) military services. The second of these, so far as the obligation to serve in the host (*Hostis et equitatus*) is concerned, was common to all classes of feudal society; though the obligation of villeins to keep watch and ward (*gueta, warda*) and to labour at the building or strengthening of fortifications (*muragium, munitio castri*) are special corvées. We are, however, mainly concerned with the first category, which may again be subdivided into two main groups, (1) personal service of men and women (*manoperae, manuum operae,* Fr. *manoeuvres,* manual labour), (2) carriage (*carroperae, carragia, carrata,* etc., Fr. *charrois*), *i.e.,* service rendered by means of carts, barrows or draught animals. These again were divided into fixed services (*operae rigae*) and exceptional services, demanded when the others proved insufficient. To these latter was given in the 8th century the name of *operae corrogatae* (*i.e.,* requisitioned works, from *rogare,* to request). From this term, corrupted to *corvatae, curvadae, corveiae,* etc., is derived the word corvée, which was gradually applied as a general term for all the various services.

FEUDAL LORDS AND FORCED LABOUR

As to the nature of these corvées it must be noted that in the middle ages the feudal lords had replaced the centralized state for all administrative purposes, and the services due to them by their tenants and serfs were partly in the nature of rent in the form of labour, partly those which under the Roman and Frankish monarchs had been exacted in lieu of taxes, and which the feudal lords continued to impose as sovereigns of their domains. To the former class belonged the service of personal labour in fields, of repairing buildings, felling trees, threshing corn, and the like, as well as the hauling of corn, wine or wood; to the latter belonged that of labouring on the roads, of building and repairing bridges, castles and churches, and of carrying letters and dispatches. Corvées were further distinguished as *real; i.e.,* attached to certain parcels of land, and *personal; i.e.,* due from certain persons.

In spite of the fact that the corvées were usually strictly defined by local custom and by the contracts of tenancy, and that, in an age when currency was rare, payment in personal labour was a convenience to the poor, the system was open to obvious abuses. With the growth of communal life in the towns the townsmen early managed to rid themselves of these burdensome obligations either by purchase, or by exchanging the obligation of personal work for that of supplying carts, draught animals and the like. In the country, however, the system survived all but intact; and, so far as it was modified, was modified for the worse. Whatever safeguards the free cultivators may have possessed, the serfs were almost everywhere—especially in the 10th and 11th centuries—actually as well as nominally in this respect at the mercy of their lords (*corvéables à merci*), there being no limit to the amount of money or work that could be demanded of them. The system was oppressive even when the nobles to whom these services were paid gave something in return, namely, protection to the cultivator, his family and his land; they became intolerable when the development of the modern state deprived the land-owners of their duties, but not of their rights.

In the case of France, in the 17th century the so-called *corvée royale* was added to the burden of the peasants; *i.e.,* the obligation to do unpaid labour on the public roads, an obligation made general in 1738; and this, together with the natural resentment of men at the fact that the land which their ancestors had bought was still subject to burdensome personal obligations in favour of people whom they rarely saw and from whom they derived no benefit, was one of the most potent causes of the Revolution. By the Constituent Assembly personal corvées were abolished altogether, while owners of land were allowed the choice of continuing real corvées or commuting them for money. The corvée as an incident of land tenure has thus disappeared in France. The *corvée royale* of repairing the roads, however, abolished in 1789, was revived, under the name of *prestation,* under the Consulate, by the law of 4 Thermidor an X., modified by subsequent legislation in 1824, 1836 and 1871. Under these laws the duty of keeping the roads in repair is still vested in the local communities, and all able-bodied men are called upon either to give three days' work or its equivalent in money to this purpose. It is precisely the same system as that in force under the Roman empire, and if it differs from the corvée it is mainly in the fact that the burden is equitably distributed, and that the work done is of actual value to those who do it. The introduction of this system into the African colonies has since been subjected to some criticism.

SURVIVAL OF CORVÉE

As regards other countries, the corvée was everywhere, sooner or later, abolished with the serfdom of which it was the principal incident (*see* SERFDOM). It survived longest in the Austrian empire, being finally abolished by the revolution of 1848.

See Du Cange, *Glossarium inf. et med. Lat. s.v.* "Corvatae"; A. Luchaire, *Manuel des institutions françaises* (Paris, 1892), pp. 346–49; *La Grande Encyclopédie, s.v.* with bibliography. For further works *see* the bibliography to the article SERFDOM.

CORVIDAE: *see* CROW; JAY; MAGPIE.

CORVINUS, JÁNOS (JOHN) (1473–1504), illegitimate son of Matthias Hunyadi, king of Hungary. He took his name from the raven (*corvus*) in his father's escutcheon. Matthias, on losing all hope of offspring from his consort, Queen Beatrice, determined, towards the end of his life, to make the youth his successor on the throne. He publicly declared him his successor, created him a prince with vast apanages in Silesia, and made the commandants of all the fortresses of the kingdom take an oath of allegiance to him. His sudden death left the recognition of János as prince royal of Hungary by the emperor Frederick still pending, and the young prince suddenly found himself alone in the midst of enemies. After being made to resign his claim to the Crown, he was robbed of the royal treasures, which Matthias had confided to him. He accepted the election of Vladislav of Bohemia as king of Hungary (July 15, 1490), but his enemies poisoned the king's mind against him, and he lost nearly all his estates. In 1496 Corvinus married Beatrice, the daughter of Bernard Frangepan. His prospects now improved, and in 1498 he was created perpetual *ban* of Croatia and Slavonia. From 1499 to 1502 he successfully defended Bosnia against the Turks, and in the following year aspired to the dignity of palatine, but was defeated by a combination of Queen Beatrice and his other enemies. He died on Oct. 12, 1504, leaving one son, Prince Christopher, who died on March 17, 1505. (*See* HUNGARY: *History*).

See Gyula Schönherr, *János Corvinus Hunyadi* (Hung.) (Budapest, 1894).

CORVUS, MARCUS VALERIUS (*c.* 370–270 B.C.), Roman general. According to the legend a raven settled on his helmet during his combat with a gigantic Gaul, and distracted the enemy's attention by flying in his face. He was twice dictator and six times consul, and occupied the curule chair (*see* CURULE) 21 times. In his various campaigns he defeated successively the Gauls, the Volscians, the Samnites, the Etruscans and the Marsians. His most important victory (343) was over the Samnites at Mount Gaurus.

See Livy vii. 26–42, x. 2–11.

CORWEN ("the white choir"), a market town and civil parish of Merionethshire, Wales, on the Dee, a little below its confluence with the Alwen, 10 mi. W. of Llangollen. Pop. (1931) 2,534. The Berwyn range rises steeply to the south, so that the town is confined between wooded cliffs and the swift-flowing Dee. Telford's Holyhead road through the Bala cleft, the successor of hillside tracts of prehistoric date, opens up the district to tourists. The town is also a favourite angling centre. There are many associations with the Welsh chieftain, Owen Glendower; it was here that he had his headquarters before the battle of Shrewsbury (1403). The much-restored parish church dates in part from the 13th century. At Corwen the L.M.S.R. from Denbigh joins the G.W.R. from Llangollen to Dolgelley.

CORWIN, THOMAS (1794–1865), American statesman and orator, was born in Bourbon county, Ky., on July 29, 1794. In 1798 his father, Matthias Corwin (1761–1829), removed to what later became Lebanon, O., where the son worked on a farm, read much, and in 1817 was admitted to the bar. As an advocate he was at once successful, but after 1831 he devoted his attention chiefly to politics, identifying himself first with the Whig and after 1858 with the Republican Party. He was a member of the National House of Representatives in 1831–40; governor of Ohio in 1840–42; served in the United States Senate 1845–50; was secretary of the Treasury in the cabinet of President Fillmore in 1850–53; was again a member of the National House of Representatives in 1859–61. As a legislator he spoke seldom, but always with great ability, his most famous speech being that of Feb. 11, 1847 opposing the Mexican War. He died at Washington, D.C., Dec. 18, 1865.

See the *Life and Speeches of Thomas Corwin* (Cincinnati, 1896), edited by Josiah Morrow; and an excellent character sketch, *Thomas Corwin* (Cincinnati, 1881), by A. P. Russell. *See* also L. Belle Hamlin (ed.), "Selections from the William Greene Papers, Letters of Thos. Corwin to William Greene, 1841–51," *Hist. and Philos. Soc. of Ohio, Surv. Publ.*, vol. xiii., No. 1 (1918).

CORY, WILLIAM JOHNSON (1823–1892), English schoolmaster and author, son of Charles Johnson of Torrington, Devonshire. He was educated at Eton and at King's college, Cambridge, where he gained the chancellor's medal for an English poem on Plato in 1843, and the Craven Scholarship in 1844. In 1845 he was made an assistant master at Eton, where he remained for some 26 years. He has been called "the most brilliant Eton tutor of his day." In 1872, having inherited an estate at Halsdon and assumed the name of Cory, he left Eton. He married late in life, and after four years spent in Madeira he settled in 1882 at Hampstead. He proved his genuine lyrical power in *Ionica* (1858), which was republished with some additional poems in 1891. Other works are: *Lucretilis* (1871), on the writing of Latin verses; *Iophon* (1873), on Greek Iambics; and *Guide to Modern History from 1815 to 1835* (1882). Extracts from the *Letters and Journals of William Cory,* which contain much paradoxical and suggestive criticism, were edited by F. W. Cornish and published by private subscription in 1897.

CORYATE, THOMAS (1577?–1617), English traveller and writer, was born at Odcombe, Somersetshire, where his father, the Rev. George Coryate, prebendary of York cathedral, was rector. Educated at Westminster school and at Oxford, he became a kind of court fool, eventually entering the household of Prince Henry, the eldest son of James I. In 1611 he published an account of a prolonged walking tour undertaken in 1608, under the title of *Coryate's Crudities hastily gobbled up in Five Months' Travels in France, Italy, etc.*

At the command of Prince Henry, verses in mock praise of the author were added to the volume. These commendatory verses, written in a number of languages, and some in a mixture of languages, by Ben Jonson, Donne, Chapman, Drayton and others, were afterwards published (1611) by themselves as the *Odcombian Banquet.* The book is now very rare, and the copy in the Chetham Library, Manchester, is said to be the only perfect one. In the same year was published a second volume of a similar kind, *Coryats Crambe, or his Coleworte twice Sodden.* In 1612 he set out on another journey, which also was mostly performed on foot. He visited Greece, the Holy Land, Persia and India; from Agra and Ajmir he sent home an account of his adventures.

Some of his letters were published in 1616 under the title of *Letters from Asmere, the Court of the Great Mogul, to several Persons of Quality in England,* and some fragments of his writings were included in *Purchas his Pilgrimes* in 1625. Coryate acquired a knowledge of Turkish, Persian and Hindustani in the course of his travels, and on being presented by the English ambassador, Sir Thomas Roe, to the Great Mogul, he delivered a speech in Persian. He says that he spent only £3 between Aleppo and Agra, and often lived "competently" for a penny a day. Coryate died at Surat in 1617.

BIBLIOGRAPHY.—*Coryate's Crudities,* with his letters from India, was reprinted from the edition of 1611 in 1776, and at Glasgow University Press (1905). The *Odcombian Banquet* was ridiculed by John Taylor, the Water Poet, in his *Laugh and be Fat, or a Commentary on the Odcombian Banket* (1613) and two other satires.

CORYBANTES, spiritual powers, with the same relation to the Asiatic Great Mother of the Gods as the Curetes bear to Zeus. From their first appearance in literature, they are already often identified or confused with them, and are distinguished only by their Asiatic origin and by the more pronouncedly orgiastic nature of their rites. Various accounts of their origin are given: they were earth-born, sons of Cronus, sons of Zeus and Calliope, sons of Rhea, of the Great Mother and a mystic father, of Apollo and Thalia, of Athena and Helios. Their names and number are vague, and vary from one authority to another. We know that they had a mystic cult, and that a prominent feature of their ritual was a wild dance, which was claimed to have powers of healing mental disorder. It seems possible that originally they were priests or medicine-men of ancient times, later thought of as superhuman.

In art the Corybantes appear, usually not more than two or three in number, fully armed and executing their orgiastic dance.

CORYDON, a town of southern Indiana, U.S.A., on Indian creek, 20 mi. W. by S. of Louisville, Ky.; the first capital of the state and the county seat of Harrison county. It is served by the Louisville, New Albany and Corydon railway, which connects at Corydon Junction, 8 mi. N., with the Southern railway. The population in 1940 was 1,865. Wheat, fruit and dairy cattle are raised in the region. Natural gas is available, and there are lumber mills and valuable quarries near by. Wyandotte cave is about 10 mi. west. The town has chicken hatcheries, glass, refrigerator, furniture and wagon factories. Corydon was settled about 1805, and was the capital of Indiana Territory (1813–16) and of the state until 1824. The convention which framed the first state constitution met there in June 1816. The original statehouse, a two-story stone building, has been bought by the state, to be preserved as a memorial. The town was captured by the Confederates during Gen. Morgan's raid on July 9, 1863.

COS or **STANKO,** an island not far from the southwestern corner of Asia Minor, the second largest of the Dodecanese. Area 111 sq.mi. Pop. (1936) 19,731, nearly all Greek. The island consists of three regions, an abrupt limestone ridge (anc. Prion, "the saw" from its jagged profile) along the eastern half of the south coast, a rugged peninsula (Kephala) at the west end, and a central lowland of fertile marls prolonged along the north coast to the ancient capital facing the mainland. Along the north slope of the Prion ridge copious deep-seated springs provide water for the town and for extensive irrigation. The Cos lettuce is well known. The principal resources of Cos are its vineyards, figs and olives; wheat, barley and maize are grown, though a considerable proportion of the arable land is left untouched. Melons, grapes and other summer fruits are exported in large quantities to Egypt, mostly in local sailing boats. Cotton, tobacco, sesame and silk are grown in small quantities. The capital, Cos, pop. (1936) 9,852, was, under Italian administration, seat of an autonomous municipality and of a civil and penal tribunal of first instance and of the regent representing the governor residing in Rhodes.

The mediaeval harbour is fit only for quite small vessels, but the roadstead is safe in most weathers and steamers call here. The ancient and mediaeval town round the harbour has a well-preserved fortress, founded by the Knights of Rhodes: in its walls are interesting architectural fragments. The famous plane-tree in the market-square has a circumference of about 30 ft., and its huge branches have to be supported by pillars. Of its age there is no certain knowledge; the popular tradition connects it with Hippocrates. The town is supplied by an aqueduct, about 4 m. in length from the fine ancient wellhouse of Borinna high on Mt. Prion. The village of Pyli has the fine Greek tomb of Charmylos, and at Kephala is an outlying castle of the knights of St. John: numerous inscriptions prove that it occupies the site of the ancient township of Isthmos. The prosperous village of Antimachia is the corn-market of the central lowland. The precinct of Asclepius (excavated in 1900–1904) about 2 m. from the town of Cos, consists of three terraces, containing temples, an altar, porticoes and other buildings and a medicinal spring; below is a large enclosure with porticoes. The earliest buildings on the middle terrace date from the 6th century B.C. The temple on the upper terrace, with an imposing flight of steps, is of the 2nd century B.C. After a destructive earthquake, the whole site was remodelled by Xenophon, the physician who poisoned the emperor Claudius. The sanctuary was desolated by the earthquake of A.D. 554.

History.—Cos was settled by Dorian colonists from Epidaurus who worshipped Asclepius, whose sanctuary became a health-resort and the first school of scientific medicine. In the 5th century it joined the Delian League. Usually its government was aristocratic, but in 366 a democracy was instituted. In 357–355 it resisted Athenian aggression; then fell for a few years into the power of Mausolus, prince of Halicarnassus. In the Hellenistic age Cos owed its prosperity to the friendship of the Greek dynasty of Egypt, who valued it as a naval outpost. As a seat of learning it was adopted for the education of Ptolemaic princes; amongst its most famous men were the physician Hippocrates, the painter Apelles, the poets Philetas and Theocritus (*q.v.*). Like its neighbour Rhodes, Cos generally supported the Romans. In A.D. 53 it was made a free city. In A.D. 1315 it was occupied by the Knights of St. John, its castle, with that at Halicarnassus (Budrum) serving as outer-guard to Rhodes; in 1523 it passed under Ottoman sway and in 1912 was occupied by Italy during the Tripoli war. The full sovereignty of Cos and other Aegean islands was formally ceded to Italy by Turkey in the Treaty of Lausanne, 1924.

BIBLIOGRAPHY.—L. Ross, *Reisen nach Kos*, etc. (Halle, 1852), pp. 11–29, and *Reisen auf den griechischen Inseln* (Stuttgart, 1840–45), ii. 86 ff.; O. Rayet, *Mémoire sur l'île de Cos* (Paris, 1876); M. Dubois, *De Co Insula* (Paris and Nancy, 1884); W. Paton and E. Hicks, *The Inscriptions of Cos* (Oxford, 1891); B. V. Head, *Historia Numorum* (Oxford, 1887), pp. 535–537; *Archäol. Anzeiger*, 1905, i.

COSA, an ancient city of Etruria, on the south-west coast of Italy, close to the Via Aurelia, 4½m. E.S.E. of the modern town of Orbetello on a promontory above the sea. Evidence of the occupation of the site in prehistoric times has recently come to light. When it became a Roman colony in 273 B.C., the town was strongly fortified and the walls, about a mile in circuit, with three gates, and seventeen projecting rectangular towers at intervals, are preserved in places to a height of over 30ft. on the outside, and 15 on the inside. Within the city no remains are visible. The place was approached by a branch road which diverged from the Via Aurelia at the post station of Succosa, at the foot of the hill on which the town stood. The harbour was of some importance. In the 5th century we hear of it as deserted. There is a remarkable Etruscan cutting through the east end of the promontory, for the purpose of draining an adjacent lagoon.

See D. Levi in *Studi Etruschi* i. 477, and references.

COSENZ, ENRICO (1812–1898), Italian soldier, born at Gaeta on Jan. 12, 1812, served in the Neapolitan artillery against the Austrians in 1848. Subsequently he aided in the defence of Venice, and in 1859 became commander of a Garibaldian regiment. In the following year he led the third Garibaldian expedition to Sicily, defeated two Neapolitan brigades at Piale (Aug. 23), and marched upon Naples, where he was appointed minister for war and helped to organize the *plebiscite*. During the war of 1866 he commanded a division. He became chief of the general staff in 1881, and held that post until shortly before his death at Rome on Aug. 7, 1898.

COSENZA, a town and archiepiscopal see of Calabria, Italy (anc. *Consentia*), capital of a province, 755 ft. above sea-level, 43 mi. S.W. of Sibari, on the East coast railway and 37 mi. S.E. of Paola on the west coast line. Pop. (1936) 30,038 (town), 40,032 (commune). It is on the slope of a hill between the Crati and Busento, just above the junction, and is commanded by a castle (1,250 ft.). The ancient Consentia is first named as the burial place of Alexander of Epirus in about 330 B.C. In 204 it became Roman, though it was more under the influence of Greek culture. It is mentioned by Strabo as the chief town of the Bruttii, and frequently spoken of in classical authors as an important place. It lay on the Via Popilia. Varro speaks of its apple trees which gave fruit twice in the year and Pliny praises its wine. Cosenza became an archbishopric in the 11th century. The Gothic cathedral, consecrated in 1222, goes back to French models in Champagne, and is unique in Italy. It contains the Gothic tomb of Isabella of Aragon, wife of Philip III. of France, and also the tomb of Louis III., duke of Anjou. In 1461 Cosenza was taken by Roberto Orsini, and suffered severely. It was the home of a scientific academy founded by the philosopher Bernardino Telesio (1509–88). In 1555–61 it was the centre of the persecution by the Inquisition of the Waldenses who had settled there towards the end of the 14th century. The Palazzo del Tribunale (law courts) is a fine building, and the upper town contains several good houses. Railways run south-east from Cosenza into the Sila district, to Decollatura (44 m.) and San Pietro in Guarano (19 m.). There is some trade in wool.

COSGRAVE, WILLIAM THOMAS (1880–), Irish politician, was born in Dublin, and educated at a school of the Christian Brothers. His father, Thomas Cosgrave, was at one time a town councillor and poor-law guardian. William Cosgrave entered the grocery trade at an early age, and there was nothing in his life to indicate a career of importance. But, like most thoughtful young Irishmen who came of age about the turn of the century, he was attracted by the Sinn Fein movement. In 1913 he won a seat on the Dublin corporation in the Sinn Fein interest. Here he distinguished himself on the financial side and in 1916 was chosen chairman of the finance committee.

In 1913 he became a member of the Irish Volunteers, and when that body divided in Aug. 1914, he was with the minority who refused to follow John Redmond. At the Easter rising, 1916, he was again in an extremist minority, for he joined the section which, against the order of Prof. MacNeill, then head of the organization, went out to fight under Pearse. Afterwards, with other prisoners, he was detained at Frongoch in Wales until the general liberation in July 1917.

Mr. de Valera having, immediately on his release, won a seat vacant in Clare, another vacancy soon occurred in Kilkenny city. Mr. Cosgrave was nominated and elected by a large majority. Re-elected in Dec. 1918, this time for Kilkenny co., he was a member of the first Dail Eireann which declared for an Irish republic and was Minister for Local Government in the first Republican Ministry. During the struggle with the British, his task was to organize the refusal of local bodies to co-operate with Dublin Castle. Like all other members of this illegal Ministry, he was the object of pursuit by the law and was more than once in prison.

During the debate in the Dail in Dec. 1921, on the newly signed treaty with Great Britain, Cosgrave's speech was one of the few that attracted attention. Later he became Minister of

Local Government in the newly formed Provisional Government. In the summer of 1922 President Griffith, obliged to go to London for the negotiations concerning the treaty clauses, appointed Cosgrave as his deputy, and when, on Aug. 12, Griffith suddenly died and Collins was chosen President in his place, Cosgrave became acting chairman of the Provisional Government. Ten days later Collins was shot, and Cosgrave, a simple Dublin business man, was placed by force of circumstances at the head of a state fighting for bare life. Never was promotion more sudden or more accidental. Griffith and Collins had, in their different ways, a strong hold on the popular mind; Cosgrave was unknown as a personality and barely recognized as a name.

As soon as the newly elected Dail could be summoned, and it could meet only behind closed doors and strongly guarded entrances, he made clear his view that the day of individual leadership was over and team work must take its place. In that anxious period he left much of the work, especially the carrying of the draft constitution through the House, to younger and more brilliant subordinates. But he captained his team, and was always ready to shoulder responsibility. When tempers were roused he introduced a conciliatory spirit. He showed both breadth of view and a sense of humour, and endeavoured to make the Protestant minority at home in the Free State. The appointments made by his Government, especially to judicial office and the first Senate, recognized merit and capability irrespective of either politics or religion.

As President of the Irish Free State he represented Ireland when she first appeared at a conference of the Dominions in Oct. 1923; and a month earlier he was welcomed as her first spokesman at the Assembly of the League of Nations. He saw the country pass from anarchy to a state of complete order. The Ministry of Finance, which he took over at the outset, was transferred in 1923 to Mr. Blythe who proved a success; the Ministry of Defence, which he took over in April 1924, in face of a threatened mutiny in the army, was handed over easily and without comment a few months later to a new minister. In his political career Cosgrave has not been ambitious. He has never sought to thrust his personality into the forefront, but in Ireland, as well as overseas, he has won a reputation for good sense and moral courage.

Under his guidance the country moved steadily to settled order; great industrial enterprises were launched with State aid, of which the Shannon electricity scheme was chief. In the Dail there was no serious opposition, since the party headed by Mr. de Valera which refused to accept the Treaty abstained from attendance. But neither Cosgrave nor his ministry enjoyed much popularity. Order is not enforced after a revolution without drastic measures, and the taxation was heavy and sharply collected. Cosgrave seemed secure of a long tenure only because there was no alternative in sight. In July 1927, shortly before a general election was due, the assassination of Mr. O'Higgins, the Vice President, produced a crisis. Very severe legislation against political associations of an unconstitutional character was introduced and a bill declaring that no candidature for the Dail should be accepted unless the candidate declared himself willing to sit and to take the oath of allegiance. The result of this measure was that de Valera and his party decided to come in and, since this revolutionized the parliamentary situation, Cosgrave obtained leave to dissolve. The new election in Oct. 1927 left his party numerically the largest in the Dail but liable to defeat by a combination of the rest. A coalition with the Farmers' group followed, but even after this Cosgrave had only a majority of a few votes in the full House. Nevertheless he carried on confidently and at the opening of 1928 made a journey to America, where he was received in the most flattering manner by the President of the United States, was invited to address the Senate at Washington, and, on the urgent request of the Dominion Government, extended his tour to Canada. His return to Dublin was triumphant and marked for himself a degree of general recognition which he had never before attained: for it was now plain even to the most unwilling minds that Ireland's place as one of the free nations in the British Commonwealth was recognized throughout the world. Cosgrave remained president until his party's defeat in 1932. (S. G.)

COSHOCTON, a city of Ohio, U.S.A., 70 mi. E.N.E. of Columbus, at the confluence of the Tuscarawas and the Walhonding rivers which form the Muskingum; the county seat of Coshocton county. It is served by the Pennsylvania and the Wheeling and Lake Erie railways. Pop. in 1930 was 10,908; in 1940, 11,509 by federal census. The city is built on a series of four broad terraces, rising to 824 ft. above sea level and commanding fine views of the valley. It ships coal, grain, flour, livestock and wool in large quantities, and has important manufactures, especially of advertising novelties. The factory output in 1937 was valued at $9,312,364. Coshocton occupies the site of an Indian village of the same name which was destroyed by the whites in 1781. It was founded in 1801; became the county seat in 1811; and was incorporated in 1833. Until 1811 it was called Tuscarawas.

COSIN, JOHN (1594–1672), English divine, born in Norwich on Nov. 30, 1594, was educated at Norwich grammar school and Caius college, Cambridge. In 1624 he became prebendary of Durham and in the following year archdeacon of the East Riding of Yorkshire. His *Collection of Private Devotions* (1627), which he is said to have prepared by command of Charles I., and his known friendship for Laud brought him under suspicion with the Puritan party.

Cosin was appointed master of Peterhouse, Cambridge (1634), vice-chancellor of the university (1640), and dean of Peterborough (Oct. 1640). While he had been prebendary of Durham he had in 1628 taken part in the prosecution of a brother prebendary, Peter Smart, for delivering a sermon against High Church practices. Smart had been deprived. On Cosin's presentation to the deanery of Peterborough Smart petitioned the Long Parliament against the new dean, and early in 1641 Cosin was sequestered from his benefices. Articles of impeachment were presented against him, but he was dismissed on bail. In 1642 he was deprived of the mastership of Peterhouse, and joined the royal family in France, where he remained until the Restoration. He was then raised to the see of Durham (Dec. 1660). He was one of the revisers of the Prayer Book (1661). He died in London on Jan. 16, 1672.

Among his writings (most of which were published posthumously) are a *Historia Transubstantiationis Papalis* (1675), *Notes and Collections on the Book of Common Prayer* (1710) and *A Scholastical History of the Canon of Holy Scripture* (1657). A collected edition of his works, forming 5 vols. of the Oxford *Library of Anglo-Catholic Theology*, was published between 1843 and 1855; and his *Correspondence* was edited by Canon Ornsby for the Surtees Society (1868–70). *See* P. H. Osmond, *Life of John Cosin* (1913).

COSMAS, of Alexandria, surnamed from his maritime experience *Indicopleustes*, merchant and traveller, flourished during the 6th century A.D. In his earlier days he had sailed on the Red sea and the Indian ocean, visiting Abyssinia and Socotra and apparently also the Persian gulf, western India and Ceylon. He subsequently became a monk, and about 548, in the retirement of a Sinai cloister, wrote a work called *Topographia Christiana*. Its chief object is to denounce the false and heathen doctrine of the rotundity of the earth, and to vindicate the scriptural account of the world. According to Cosmas the earth is a rectangular plane, covered by the vaulted roof of the firmament, above which lies heaven. In the centre of the plane is the inhabited earth, surrounded by ocean, beyond which lies the paradise of Adam. The sun revolves round a conical mountain to the north—round the summit in summer, round the base in winter, which accounts for the difference in the length of the day. Cosmas is supposed by some to have been a Nestorian. The *Topographia* contains some curious information. Especially to be noticed is the description of a marble seat discovered by him at Adulis (Zula) in Abyssinia, with two inscriptions recounting the heroic deeds and military successes of Ptolemy Euergetes and an Axumitic king. It also contains in all probability the oldest Christian maps. From allusions in the *Topographia* Cosmas seems to have been the author of a larger cosmography, a treatise on the motions of the stars, and commentaries on the Psalms and Canticles.

The *Topographia* will be found in Migne, *Patrologia Graeca*, lxxxviii.; ed. with geographical notes by Winstedt (1909). *See* H. Gelzer, "Kosmas der Indienfahrer," in *Jahrbücher für protestantische*

Theologie, ix. (1883) and C. R. Beazley, *The Dawn of Modern Geography*, i. (1897). There is an English translation, with introduction and notes, by J. W. McCrindle (1897), published by the Hakluyt Society.

COSMAS, of Prague (1045–1125), dean of the cathedral and the earliest Bohemian historian. His *Chronicae Bohemorum libri iii.*, which contains the history and traditions of Bohemia up to nearly the time of his death, has earned him the title of the Herodotus of his country.

See A. Potthast, *Bibliotheca Hist. Med. Aevi;* J. Loserth, *Studien zu Cosmas von Prag* (Vienna, 1880, etc.).

COSMATI, the name of a Roman family, seven members of which, for four generations, were skilful architects, sculptors, and workers in mosaic. The following are known from existing inscriptions:—

Lorenzo (born in the second half of the 12th century).
|
Jacopo (dated works 1205 and 1210).
|
Cosimo (dated works 1210–1235).

Luca	Jacopo	Adeodato	Giovanni
(1231 and 1235).	(1231–1293).	(1294).	(1296 and 1303).

Their principal works in Rome are: ambones of S. Maria in Ara Coeli (Lorenzo); door of S. Saba, 1205, and door with mosaics of S. Tommaso in Formis (Jacopo); chapel of the Sancta Sanctorum, by the Lateran (Cosimo); pavement of S. Jacopo alla Lungara, and (probably) the magnificent episcopal throne and choir-screen in S. Lorenzo fuori le Mura, of 1254 (Jacopo the younger); baldacchino of the Lateran and of S. Maria in Cosmedin, *c.* 1294 (Adeodato); tombs in S. Maria sopra Minerva (*c.* 1296), in S. Maria Maggiore, and in S. Balbina (Giovanni). The chief signed works by Jacopo the younger and his brother Luca are at Anagni and Subiaco. A large number of other works by members and pupils of the same family, but unsigned, exist in Rome. These are mainly altars and baldacchini, choir-screens, paschal candlesticks, ambones, tombs, and the like, all enriched with sculpture and glass mosaic of great brilliance and decorative effect.

Besides mosaic patterns and architectural decoration, they also produced mosaic pictures and sculpture of very high merit, especially the recumbent effigies, with angels standing at the head and foot, in the tombs of Ara Coeli, S. Maria Maggiore and elsewhere. One of their finest works is in S. Cesareo; this is a marble altar richly decorated with mosaic in sculptured panels. The magnificent cloisters of S. Paolo fuori le Mura, built about 1285 by Giovanni, the youngest of the Cosmati, are one of the most beautiful works of this school, whose style is Gothic in its main lines. The equally magnificent cloisters of the Lateran, of about the same date, are very similar in design; both have slender marble columns, twisted or straight, richly inlaid with bands of glass mosaic in delicate and brilliant patterns. The shrine of the Confessor at Westminster is a work of this school, executed about 1268.

An excellent account of the Cosmati is given by Boito, *Architettura del medio evo* (1880), pp. 117–182.

COSMETICS. Substances of diverse origin scientifically compounded and used (1) to cleanse, (2) to allay skin troubles, (3) to cover up imperfections and (4) to beautify. They have been used in crude forms by both men and women since the earliest times. It is quite probable that cosmetics had their origin in the East, but it is necessary to turn to Egypt for the earliest records of these substances and their application.

The 1st (Thinite) dynasty is variously placed at 3,500 to 5,000 years B.C., when it was customary to bury comforts and luxuries with the dead kings. Toilet articles and unguents were included in these luxuries, and in the British Museum there are many beautifully carved unguent vases in alabaster which authorities have dated about 3500 B.C. Other interesting specimens are: Mirrors used in the 6th dynasty 2800 B.C.; kohl vases in glass and stibium pencils used in the 18th dynasty 1500 B.C.; papyrus showing men and women having lumps of nard fixed on top of the head—1500 B.C. The opening by Mr. Howard Carter of the tomb of Tutankhamun, who ruled about 1350 B.C., has brought to light many excellent specimens of the early art of the cosmetician. According to eye-witnesses, the unguent vases, exquisitely executed in alabaster, contained quantities of aromatics which were still elusively fragrant.

On other monuments and tombs in Egypt there is still ample evidence of past great esteem for these substances. For instance, on the large granite tablet inserted in the breast of the Sphinx, King Thothmes IV. (about 1600 B.C.) is portrayed making an offering of incense and of fragrant oil or unguent. At this period it is probable that the priests made most of these compounds; they were therefore the perfumers of their time, and the pursuit was considered a mysterious and much esteemed art. The containers were beautifully executed in all kinds of valuable materials. Ivory and alabaster were the principal substances used, while frequently carved wood, onyx and porphyry were fashioned into pots and vases. The constituents were naturally comparatively limited in both numbers and variety. For instance, some were grown in Egypt, while the greater proportion were most probably imported from Arabia. Amongst the former may be mentioned thyme and origanum, together with a substance called *balanos* which appears to have been extracted from the shells of some unidentified fruit, while of the latter, myrrh, frankincense and spikenard were of great importance. Sesame oil appears to have been one of the most favoured vehicles for the aromatics, although both almond and olive oils were undoubtedly used.

The ancient Egyptians were probably the inventors of the artificial bath, which habit, in later years, was treated on a much more elaborate scale by the Greeks and Romans. This form of ablution was probably necessitated by the terrific heat of the Egyptian land; it was followed by the liberal application of perfumed oils and unguents. Doubtless these were employed to give the skin more elasticity, as well as to impart a balmy and pleasing effect. The use of cosmetics had not escaped the attention of the Egyptian ladies, who enhanced their personal beauty by the employment of somewhat crude paints. These practices reached their zenith in the time of Cleopatra. It seems probable, from discoveries in Egyptian tombs, that the highest degree of cosmetic art was attained in the embellishment of the eyes. This effect was produced by painting the under side of the eye green, and the lid, lashes and eyebrows black by the application of *kohol*—the product being made from antimony (sulphide?) and applied with an ivory or wooden stick. Combs and polished metal mirrors were also used by the Egyptian ladies. Henna was, and still is, much favoured for dyeing the finger nails, palms of the hands and soles of the feet. Good and well preserved specimens can be seen to-day in the British Museum.

Cosmetics were also used by Jewish women, for it is written (II Kings ix. 30) that "when Jehu was come to Jezreel, Jezebel heard of it; and *she painted her face,* and tired her head, and looked out at a window." This is explained more clearly in the following passage: "Thou didst wash thyself, paintedst thine eyes (probably with kohol), and deckedst thyself with ornaments" (Ezek. xxiii. 40, and *see* also Jer. iv. 30). In the Koran aromatics play an important part. The use of eye paint is suggested by *Sura* lvi., "And theirs shall be the Houris with *large dark eyes* like pearls hidden in their shells."

The Romans, during their early history, showed very little interest in enhancing their personal appearance, and it was only after their migrations into Southern Italy, then occupied by the Greeks, that they acquired a more intimate knowledge of the aesthetic side of life. Nero became emperor of Rome in A.D. 54, and by this time both cosmetics and perfumes had assumed an important rôle at his court. He personally used cosmetics liberally, and his wife, Poppaea, made no secret of the artificiality of her toilet. Among the many things they used were white lead, and chalk to whiten the skin; Egyptian kohol for the eyelids and lashes; *fucus,* a sort of rouge, for the cheeks and lips; *psilotrum,* a species of depilatory; barley-flour and butter as a cure for pimples and skin eruptions; and pumice-stone for whitening the teeth. The ultra-fashionable ladies of the Roman Court devised a method for bleaching their hair by means of a kind of soap which came from Gaul. The Romans made all sorts of pretty containers for their perfumes and cosmetics, of which there were three principal kinds: (1) solid unguents or *ledysmata;* (2) liquid unguents or *stymmata;* (3) powder perfumes or *diapasmata.* The solid unguents were generally of one specific perfume such as almond, rose or quince. The liquid unguents were most frequently compounds containing flowers, spices and gums, these substances being digested in either olive, ben or sesame oil. (Frangipanni was invented by one of the Roman nobles.)

The early inhabitants of Britain appear to have derived much pleasure from the use of crude cosmetics. Importation of toilet articles from the East dates from the time of the Crusades when the knights brought back many of the cosmetics prized by ladies of the harem. Until the reign of Queen Elizabeth these substances became more and more popular. The toilet preparations employed by the ladies of the court were kept in strongly perfumed boxes called "sweet coffers." These were considered a necessary part of the furniture of their bedrooms. A recipe for making a beautiful complexion at the time of Elizabeth was to take first a very hot bath to induce excessive perspiration, and to follow this up by washing the face with plenty of wine, to make it fair and ruddy. This latter treatment was even in those days fairly expensive, and Mary Queen of Scots is alleged to have even *bathed* in wine, on which account she applied for an increased allowance. This luxurious habit was not uncommon with the elder ladies of the court, but the younger ones had to be content with milk! Both sexes adorned themselves with cosmetics at the court and powder and patches were fancied. With the advent of the Commonwealth all these luxuries were discarded, but as soon as Charles II. was restored to the throne they became popular again. Milk baths were indispensable to beauty, and in later years the ladies of the Court adapted a new practice of powdering their hair, but this soon fell into disuse. By the 17th century cosmetics were used to such an extent by nearly all classes that in 1770, according to G. V. Septimus Piesse in his "Art of Perfumery" (1879), a bill was introduced into the English Parliament which contained the following drastic provision:—"That all women of whatever age, rank, profession, or degree, whether virgins, maids, or widows, that shall, from and after such Act, impose upon, seduce, and betray into matrimony, any of His Majesty's subjects, by the scents, paints, cosmetic washes, artificial teeth, false hair, Spanish wool, iron stays, hoops, high heeled shoes, bolstered hips, shall incur the penalty of the law in force against witchcraft and like misdemeanors and that the marriage, upon conviction, shall stand null and void."

This vogue was not confined to England, but spread equally quickly throughout France and Italy. Cosmetics were much favoured at the court of Louis XIII. and one of the greatest users was the beautiful Anne of Austria. From Spain were imported creams of vanilla and cacao and almond paste, all being used liberally to whiten the skin of the fair ladies of the court. Louis XIV. did not approve of the artificial enhancement of the courtesans and consequently cosmetics fell into disuse, but were again revived under the Regency when the "Poudre à la Maréchale" was in vogue. The Emperor Napoleon I. was very susceptible to the artistic refinements of his time, and the Empress Josephine brought from Martinique cosmetics which she always continued to use. The French at this period made a definite move to place the manufacture of these artistic aids to beauty upon a scientific basis, and to-day throughout both Europe and America the production of cosmetics is one of the most interesting, scientific and remunerative businesses.

MODERN ASPECT

Cosmetics are used mainly to finish artistically what nature has left undone, and while the indifferent products of a few years ago were shunned owing to their crude colours and texture, they are now of such great purity and artistic finish that there are preparations to suit all types of skins and colourings. Harmful raw materials are eliminated by the chemist, and it is true to say that the best makes of cosmetics are prepared under scrupulously clean and antiseptic conditions, and that there is practically no risk of damaging even the most delicate skin by using them. The old argument that it is unhealthy to clog the pores of the skin no longer holds water, because, just as a man removes with soap and water the dirty dust of the street, so a lady removes clean cosmetics from her skin with creams a few hours after their application. Moreover, while they are in use they form an excellent protecting agent against adverse atmospheric conditions. Facial massage is much appreciated by those who desire to retain a clean, supple and unwrinkled complexion, but modern surgical science has evolved a treatment known as *face lifting,* by which wrinkles can be removed or filled up, the shape of the nose improved, and defects of the chin or ears eliminated. The operation is performed with local anaesthetics, under highly antiseptic conditions, and without danger. This method of rejuvenescence does not, however, pretend to dispense with the use of cosmetics, since plastic surgery only improves contour.

Bath preparations consist mainly of crystalline carbonate or sesquicarbonate of soda together with borax, sodium phosphate and bay salt. Water softeners contain the dried carbonates of soda and of ammonia. They are fragrantly perfumed, and when added to the bath make the ablutions more pleasant, and by softening the water make soap lather more easily.

Dental preparations comprise tooth powders and pastes together with liquid dentrifices. The former contain among other substances precipitated chalk, calcium phosphate, magnesium carbonate, soap and pumice. The pastes are made from the powders by the addition of glycerine and water. The antiseptic substances include thymol, eucalyptus oil and carbolic acid. The liquid preparations contain these antiseptics, together with tinctures of myrrh and rhatany.

Hair preparations are more numerous. Bay rum is made from oil of bay, rum and industrial alcohol. Brilliantines contain liquid paraffin or a good vegetable oil, and the solid ones a substance akin to vaseline. Non-greasy hair fixers generally contain tragacanth, glycerine and water. Depilatories are based upon the sulphides of the alkaline earths. Hair tonics contain jaborandi, cantharides or quinine. Shampoos contain soap and borax, together with henna (for brunettes) or camomile (for blondes).

Lipsticks are quite harmless when made from almond oil, lanoline, white paraffin jelly and cocoa butter. The colouring matters vary, but are generally carmine with one or other of the harmless lakes.

Manicure preparations include nail polishes; the solid blocks contain tin oxide and waxes, and the liquid enamels celluloid with a solvent and colour.

Rouges contain carmine, eosine or one of the harmless lakes, together with starch, kaolin or zinc oxide.

Shaving preparations are based upon soap (with brush) or stearic acid (without brush). Shaving powders contain Castile soap and starch. Shaving blocks are either potash alum or fused boracic acid.

Skin creams cover a very wide selection. Cold cream is a finely divided emulsion of oil and wax with water. Vanishing creams are largely stearic acid emulsified with soap, and sometimes containing glycerine or lanoline. Massage creams may be prepared from "skinned" milk; virginal milk from tincture of benzoin and glycerine of borax. Astringent lotions are based upon alum and alcohol. Sunburn lotions contain calamine and zinc oxide. Mud packs are made from fuller's earth, glycerine and benzoin.

Smelling salts contain liquid ammonia or its carbonate.

Soaps are made by boiling tallow, coconut oil or palm-kernel oil to neutralization with an alkali. The resultant soap is salted out and converted into chips. These are milled by passing through granite or steel rollers, when they become strips and are subsequently forced through a plodder at tremendous pressure. The long bars which come out are automatically cut into sizes, and are stamped by machines into the dainty tablets used in the bath-room.

	1925	1923	1921	1919
Perfumery, cosmetics and toilet preparations:	$	$	$	$
Creams, rouges, etc.	35,548,920	Not reported separately	Not reported separately	Not reported separately
Dentifrices	25,736,068			
Talcum and other toilet powders	21,377,529			
Perfumery and toilet waters	20,357,539			
Hair tonics	9,990,986			
Hair dyes	2,581,862			
Other cosmetics and toilet preparations	23,698,412			
Perfumery, cosmetics and toilet preparations not reported by class or kind	8,101,418			
Total	147,392,734	119,237,000	90,756,063	82,084,262

Toilet powders are of diverse composition, but generally contain zinc oxide, talcum, one of the starches and a stearate of magnesium. The colouring matter in face powders may be of either organic or inorganic origin (yellow ochre, etc.). Talcum powders contain a much higher percentage of French chalk, and sometimes a little boracic acid. They are all sieved through very fine-mesh silk.

All the above cosmetics are perfumed, but this aspect of the subject is dealt with in the article: PERFUMES.

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UNITED STATES

The history of the use of cosmetics in America closely parallels that of Europe. Amongst the aboriginal Indians we observe a widespread and highly developed technique of body painting and knowledge of dyes and pigments. Branegan (*Jour. of Chem. Education*), points out that "some of the (Indian) dyes were very fast, particularly when a metallic mordant, such as iron salts (from fruit juices and oxides of iron), was used in conjunction with vegetable extracts." These dyes were for the most part utilized for facial and bodily adornment; "war paint," in particular, being an essential component of the brave's military equipment. However, the significance of this form of decoration has doubtless been over-estimated, especially by early students; certainly the purposes of symbolism were never so assiduously served as those of simple decoration. And, after due consideration, Eugene Rimmel wrote (*Book of Perfumes,* 3rd ed., London, 1865) more than 60 years ago that "some *pretend* there is a certain symbolism in the various colours they use."

In the same place Rimmel calls our attention to another Indian cosmetic custom which has a definite survival amongst civilized people. The Indians, he says, "greased the whole body with fat to serve as a ground for the paint." It seems evident that cold creams were used in Europe, where they had been manufactured since the 1st century A.D., almost exclusively in connection with massage or as cleansing agents. Their use, not only as a foundation for "make-up," but also as a protection against cold weather, would appear to have originated amongst the North American Indians.

There is no reason to suppose that European cosmetics did not make their first appearance in America with the first women colonists. During colonial times, and later, the use and ethics of cosmetics varied enormously, from Puritan New England to cavalier Virginia. In the southern colonies cosmetics flourished. Even in Quaker Pennsylvania, which occupied a middle ground between the "liberal" South and the "puritan" North, cosmetics were in use; and we find on the statute books of that colony the notorious act of 1770, by virtue of which a marriage might be annulled if it could be proven that the wife had, in courtship, deceived and misled her prospective husband by using cosmetics. Even where there was no social ban on them, but where living conditions made them too great a luxury, cosmetics were not unknown. Some of these early subterfuges and substitutes still survive in rural America. Powdered chalk and fresh cut beetroot are used to enhance the complexion; and there is a superstition that the juice of the petals of certain varieties (dependent on the locality) of roses will impart a permanent rose bloom to the cheeks and lips.

With the growth of population and wealth, cosmetics have played an ever increasingly important rôle in America. The fundamental reason for this can be found in the climate. American women require more cosmetics than Europeans because the brilliant sunlight of the Western continents tends to burn all the colour out of the skin.

Hence American women will try almost any kind of preparation in the hope that it will improve their complexions. As one consequence of this, it is far easier to introduce a novelty in America than in Europe. Some idea of the significance of this craving for novelty may be gathered from the fact that there are over a thousand different "brands" of face powder registered with the national trade association and the trade-mark bureau at Washington. However, a consideration of the history of cosmetics in America must be made—with due allowance for the factors of climate and the American proclivity to "try anything once"—in the light of the fact that American cosmetic habits and usages are, in the main, identical with those of Europe. Europe has always set the styles in cosmetics in America; and the conviction persists throughout America that European cosmetics are innately and inherently superior to those of domestic manufacture. While this is true of perfumes, it is not so of cosmetics.

The keystone of the cosmetics industry is face powder (rouge is only face powder with deeper colouring). In the early days of the republic face powders were made, occasionally, with bases of lead or arsenic salts, but most commonly with a bismuth base. Bismuth was preferable for hygienic reasons. But it was disadvantageous in that it would discolour grey or brown in the fumes of candle or gas light, and it was expensive. In 1866 new impetus was given the industry, not only in America but all over the world, by Henry Tetlow's discovery that oxide of zinc made a satisfactory face powder base. It is harmless when applied externally (*cf.* "zinc ointment"), it will not discolour with oxidization, and, compared to bismuth, it is cheap—cheap enough to put face powder and rouge within the reach of every pocketbook. This formula remains the formula of most reputable face powders in the world to-day. It is the accepted formula of the British and United States pharmacopoeias.

There were no further important developments in the field of American cosmetics until the appearance of talcum powder in the last decade of the last century. Talcum powder is simply powdered magnesium silicate, perfumed and put up in tins. It is used for dusting and drying the body, either after bathing or independently of the bath. Again, the climatic factor favoured the reception of the article. Enormous quantities of talcum powder are consumed in the Americas, yet talcum powder has never attained a vogue in Europe.

The outbreak of the World War found the American cosmetics industry prepared to take advantage of the unusual situation. It can hardly be said that European importations into America declined in the war years; but the tremendous increases in wages and number of female wage earners, together with the inflation of money and the concurrent tendency to extravagance, opened a market for American cosmeticians many times greater than that which existed before the war. Pre-war census statistics of the industry are apt to be misleading, as they were not very carefully analysed and classified. It is safe to assume, however, that the annual pre-war turn-over in cosmetics of all kinds, exclusive of soaps, was never more than 24 million dollars a year. The latest census bulletin issued by the Department of Commerce (*Census of Manufactures, 1925: The Drug Industries,* Washington, 1927), gives a comprehensive view of the development of the industry since the war. *See* table on p. 487.

It must be borne in mind that considerable weight is given these figures by the fact that several important foreign manufacturers whose goods enjoyed a wide sale in the United States have, since the war, to escape the high import tariffs, set up their own manufactories in America, thus bringing their output under the registration of the U.S. census. To this indeterminate extent the figures quoted above do not represent either increased consumption or price rises.

Exportations, begun 70 years ago, but scarcely important prior to the World War, have increased proportionately. American exporters of cosmetics find Great Britain and the Colonies their best market. The growth of this trade with South and Central American countries has been greatly handicapped by high and, in some instances, preferential import tariffs.

Various efforts have been made to "regulate" the cosmetics industry in America. As a large user of industrial alcohol it has always come under the surveillance of the Internal Revenue Department. Since the passage of the 18th Amendment, the Volstead Act, and the various State "enforcement" acts, its difficulties under this head have increased; although, in 1928, a certain level of order and stability has been reached. Cosmetics were brought, quite ineffectually, under the Pure Food and Drug Act of 1906. In the two years, 1926 and 1927, more attention has been given cosmetics by State legislatures. This interest can be attributed to (*a*) the example of New Hampshire, whose legislators first tried to pass a law prohibiting the use of certain cosmetics within the State, and (*b*) to the studies of the compositions of cosmetics conducted by the American Medical Association, with a view to determining what effects, harmful or otherwise, they might have. (H. T.)

COSMIC, pertaining to the universe, universal or orderly. (From Gr. κόσμος, order or universe.) In ancient astronomy, the word "cosmical" means occurring at sunrise, and designates especially the rising or setting of the stars at that time. "Cosmical physics" is a term broadly applied to the totality of those branches of science which treat of cosmical phenomena and their explanation by the laws of physics. It includes terrestrial magnetism, seismology, the tides, meteorology as related to cosmical causes, the aurora, meteoric phenomena and the physical constitution of the heavenly bodies generally.

COSMIC RADIATION: *see* ELECTRICITY, ATMOSPHERIC.

COSMOGONY is in common language a theory, hypothesis or speculation as to the origin of the earth, sun, moon and stars. Such speculations are frequently produced by primitive races in their myth-making stage of development, and may be subsequently expanded and systematized by poets, priests and philosophers. In more scientific language cosmogony is the science which studies the formation of the earth, sun, moon and stars under the action of natural laws. Astronomy gathers information as to the structure of the heavens and the present state of the heavenly bodies; the province of cosmogony is to explain how these heavenly bodies come to be where they are and as they are; it takes the still photograph presented by astronomy and tries to develop it into a cinematograph film which shall exhibit the universe being born, developing, passing through its present stage, ageing and decaying before our eyes, the relation of each picture to the succeeding one being that of cause and effect.

Ancient Cosmogonies.—In contrast with modern scientific cosmogony, the crude cosmogonies of primitive races generally contain no conception of gradual or evolutionary change. For the most part they postulate a simple creative act; a crow or a raven or a tortoise or a magnified old man takes raw material and, as the result of a single effort, fashions the earth and the heavenly bodies in precisely the shape and form in which they exist to-day. At the best the act of the creator is merely that of shaping, carving and building; at the worst it may be even less than this, as for instance in the cosmogony of the Thlinkit Indians, where the creator-hero steals the sun, moon and stars out of a box in which they had lain hidden, and hangs them up so that they illuminate the earth. In the cosmogonies of more reflective races, especially those of India, the act of creation may be accomplished by a mere thought of the creator; from being a vision in his mind the world suddenly bursts into being as a material fact. The Iranian account of creation was especially interesting and somewhat akin to that in Genesis.

We owe to the Greeks the most beautiful, richest and most imaginative cosmogony that existed before science came to replace poetic imaginings by an effort to unravel the actual facts of creation. Uranus, the most ancient of all the gods, founded a dynasty in heaven, and he and his sons and his sons' sons through three generations took part in creating the world and peopling it with the minor immortals whose function was to help the world on its way in the events of everyday life.

Six centuries before Christ, Thales of Miletus challenged this mythology, which he derided as being too anthropomorphic, and cosmogony passed from the province of the poets and mystics to that of the philosophers. Two centuries later Empedocles taught that all things were formed out of the union in different proportions of the four eternal, indestructible and unchangeable elements of fire, air, earth and water, and Plato wrote that the heavenly bodies, the earth, sun, moon and stars, as well as all animals and plants, have been created out of those four absolutely inanimate elements, "not from any action of mind or of any god, or by any art, but by the action of chance and of the forces arising out of certain inherent affinities among the natural bodies, hot tending to combine with cold, dry with moist, soft with hard and so on."

Newton's Cosmogony.—Cosmogony advanced but little beyond the stage of philosophic speculation until Newton taught to the world the meaning of the universal applicability of natural laws. The force which causes the apple to fall to the ground also keeps the moon in its orbit, and the forces which govern the simple phenomena of our daily lives must have acted at, and may alone have sufficed for, the creation of the earth and the heavenly bodies. In 1692 we find him writing to Bentley, Master of Trinity college, Cambridge, as to the possible influence of gravitation in the formation of worlds:

"It seems to me that if the matter of our sun and planets, and all the matter of the universe, were evenly scattered throughout all the heavens, and every particle had an innate gravity towards all the rest, and the whole space throughout which this matter was scattered was finite, the matter on the outside of this space would, by its gravity, tend towards all the matter on the inside, and by consequence fall down into the middle of the whole space, and there compose one great spherical mass. But if the matter were evenly disposed throughout an infinite space, it could never convene into one mass, but some of it would convene into one mass and some into another, so as to make an infinite number of great masses, scattered great distances from one another throughout all that infinite space. And thus might the sun and fixed stars be formed, supposing the matter were of a lucid nature."

Kant's Cosmogony.—In 1755 Kant followed Newton in regarding a limitless waste of chaotic primordial matter as the raw material out of which the universe has been formed, as also in supposing gravity to be the agency through which this formation took place. He imagined that, as a result of their mutual gravitational attractions, the primaeval atoms continually fell in upon one another, and in so doing became hotter just as the bullet becomes hot on striking the target.

This is in keeping with modern scientific knowledge, but Kant's next step was not. For he imagined that the collisions of his atoms generated not only heat but also rotation. As the atoms collided the nebula not only got hotter and hotter, but also, he thought, began to rotate and spun faster and faster until at last splashes of matter were thrown off from its equator much in the manner in which splashes of mud are thrown off a bicycle wheel. These splashes of matter formed a continuous rotating ring which encircled the nebula just as Saturn's rings encircle Saturn. The ring finally condensed into a planet and by many repetitions of the process the sun's family of planets was born out of his body.

Laplace's Nebular Hypothesis.—In 1796 Laplace propounded the system of cosmogony which, under the general name of the "nebular hypothesis," held the field for a full century. Laplace's cosmogony may be briefly described as that of Kant with the mistakes left out. Apart from these, the two theories are almost identical, although Laplace seems to have written in complete ignorance of the earlier speculations of Kant. Avoiding Kant's error of imagining that rotation could be generated out of no rotation, Laplace took as his raw material a nebula which was already endowed with a certain amount of rotation. He imagined this nebula to be continually emitting radiation, and therefore to cool and to shrink as it cooled. By a well-known scientific principle, "the Conservation of Angular momentum," a body which is spinning and at the same time shrinking in size must spin faster as it shrinks, at any rate unless some outside agency is at work checking or inhibiting the increase in its rate of spin. Laplace accordingly supposed the nebula to rotate ever faster and faster about its axis.

The theory of the dynamics of rotating bodies makes it clear that a mass of either liquid or gas in rotation cannot rest in the spherical shape which it would assume if it were not rotating. Under slow rotation such a mass assumes the shape of a slightly flattened oblate spheroid, or, if we prefer so to describe it, a body which differs from a sphere only in bulging a bit round its equator and being a bit flattened at its poles—an orange-shaped figure. The shape is that of the earth and the other planets, which have assumed this shape precisely on account of their rotation. A ship at the earth's equator is farther from the centre of the earth than a ship at the north pole, and if the earth's rotation were suddenly checked, the path from equator to pole would be seen to be a downhill path, down which not only ships, but also oceans, cities and continents would start to slide, and would continue sliding until the earth's equatorial bulge disappeared and the earth's shape had become entirely spherical. Thus it is the earth's rotation which keeps its equatorial bulge in existence.

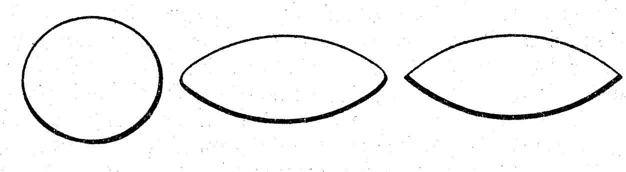
In the same way if the earth's present speed of rotation were increased, ice, water, earth and other bodies would start to slide from the poles to the equator, thereby increasing the equatorial bulge, so that the earth's figure would become more flattened than it now is. Mathematical analysis shows that any increase in the speed with which a gravitating mass of liquid or gas rotates increases its flatness of figure. So long as the rotation is slow, this figure has the shape of an oblate spheroid such as the earth, but with faster rotation the spheroidal shape is lost.

When this occurs, it can be shown that the increased rotation produces changes which are of the same general nature in all bodies, provided only that their mass is sufficiently condensed towards the centre. As the spheroidal shape is departed from, the equator of such bodies pulls out into a pronounced edge which ultimately becomes perfectly sharp, so that the body acquires the shape of a double convex lens. The sequence of figures is shown in figs. 1–3.

Mathematical theory further shows that when once the lens-shaped figure has been attained, any further increase in the speed of rotation results in matter being thrown off from the sharp equator. The mass is now rotating so fast that its gravitational attraction is inadequate to retain the outermost particles on the equator against the centrifugal tendency set up by rotation, and they are thrown off into space. No matter how much the rotation is increased, the sequence of events remains the same. At each stage the sharp edge acts like a safety-valve, ejecting just so much matter as is necessary in order that the remainder may be able to rotate as a lenticular mass with a sharp edge.

A fair analogy is to be found in the sequence of events when a tumbler partially filled with water is placed on a rotating table, which is then made to spin faster and faster. As the speed of rotation increases the water creeps up the side of the glass until it reaches the rim, after which any further increase of rotation is accommodated by the water spilling over the edge of the glass. In the cosmogonical problem the lens-shaped figure corresponds to the glass with water exactly up to its rim; the matter ejected from the sharp equator of the lens is the matter spilled out when the rotation became too great for all the matter to stay inside the lens-shaped boundary. After this spilling-out process has once begun the sequence of figures is that shown on p. 490, fig. 4, which is identical with the previous fig. 3, being repeated for the sake of continuity.

Laplace believed that stars such as the sun which have given birth to families of planets had at some stage of their existence passed through the sequence of configurations just described, and supposed the planets to have been formed by the condensation



FIGS. 1–3.—EFFECT OF ROTATION ON A SPHERE OF GAS

of the matter which had been spilled out in the equatorial plane. This, of course, explained why the planets all moved in approximately the same plane and revolved in the same direction round the sun. He further supposed that when once the planets had condensed and been set free as independent bodies they went through precisely the same process in their turn, thus becoming surrounded with families of satellites, which necessarily revolved in the equatorial planes of the planets in the same direction in which they themselves revolved round the sun.

For a long time this hypothesis appeared to give the most likely explanation of the origin of the solar system, but to-day the available evidence both of observational astronomy and of mathematical theory is unfavourable to the explanation. The sky provides a great number of examples of the fate awaiting stars which rotate too fast for safety; it is not to found a family but to break in two. And when the mathematician follows out the details of the process imagined by Laplace with reference to the special case of the solar system, he finds that there is nothing wrong with the general mathematical theory, but that its application to the solar system leads to numerical values which cannot possibly be reconciled with those observed. Thus there is a consensus of opinion that Laplace's hypothesis must be abandoned as an explanation of the origin of the solar system, not because it is wrong in theory, but because it fails in practice.

If, however, the process imagined by Laplace is correct in theory it may be that it occurs elsewhere in the universe; if it has not formed the solar system it may perchance have been responsible for some other formation known to the astronomer. In actual fact it seems almost certain that the process imagined by Laplace is continually in progress, but on a stupendous scale which is incomparably greater than any of which Laplace ever dreamed.

Gravitational Instability.—Let us return to Newton's conception of an enormous mass of nebular matter scattered, in the first instance, uniformly through space. Newton conjectured that distinct condensations would form in such a medium, and that in time all the nebular matter would settle round these condensations under the influence of gravity. The problem has been discussed mathematically by Jeans, who has confirmed the general accuracy of Newton's conjecture, and has also obtained a formula from which it is possible to calculate the average distance apart at which the condensations will form in any given nebular medium, and the average mass that will ultimately settle down round each.

When a disturbance is produced in the earth's atmosphere, as for instance by firing a gun, waves of sound carry the energy of the disturbance to great distances in the form of waves of alternate condensation and rarefaction, the rate of travel being the same for waves of all wave-lengths. Let us now imagine an atmosphere or other mass of gas extending for millions of millions of miles, and disturbances of wave-length millions and millions of times as great as that of terrestrial sounds—let us, in brief, imagine phenomena on the astronomical instead of on the terrestrial scale of magnitude. The gravitational attraction of the various parts of the atmosphere on one another now becomes very important, and shows its importance by causing waves of different wave-lengths to travel at different speeds. The waves of short wave-length all travel at the same speed, this being the speed at which they would travel if gravitation were non-existent, but the longer waves find their speed of travel retarded by the gravitational forces produced by the waves themselves; wherever there is a condensation of the atmosphere the gravitational forces are stronger than elsewhere and resist the spreading out of the condensation. Finally waves whose length is greater than a certain calculable length do not travel at all; the gravitational forces resulting from the accumulation of matter in one neighbourhood are so great as to draw more and more matter in from outside, so that a small accumulation tends to form into a big one, and the whole medium tends to condense round clots or condensations. The medium may appropriately be described as being "gravitationally unstable" for all waves whose length is greater than the critical calculable length.

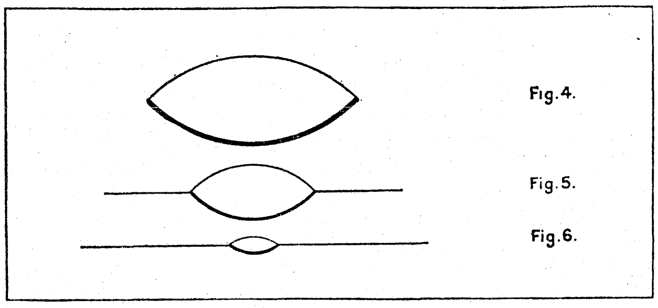
The average distance apart of the clots which will form in such a medium is equal to the wave-length of the shortest waves which are gravitationally unstable. This distance can be calculated when two quantities are known, namely, the density and the temperature of the gaseous or nebular medium. Now if, as Newton imagined, "all the matter of the universe were evenly scattered throughout the heavens," we should obtain a medium whose density Dr. Edwin Hubble of Mount Wilson observatory has recently estimated would be of the order of 10^{-31} grammes per cu. centimetre, a density at which there would only be about one molecule to every 1,000cu.yd. The principle of gravitational instability shows that such a medium would condense into clots, but if the gas were initially at a fairly high temperature the average amount of matter in each clot would be hundreds or even thousands of millions of times as great as the amount of matter in the sun or in the average star.

The process cannot, then, result as Newton thought in the formation of the sun and fixed stars; it must produce bodies on an altogether grander scale.

Spiral and other Extra-galactic Nebulae.—The astronomer is familiar with bodies of the required size; they are the spiral and other extra-galactic nebulae. The sun and all the stars we can see with the naked eye belong to a single colony of stars, the "galactic system," which is bounded by the milky way altogether. Outside this system lie the bodies known as "extra-galactic nebulae," at distances so great that light from even the nearest of them, although covering 186,000m. every second of its journey, takes something like 1,000,000 years to reach us. The masses of these nebulae are of the order of 100 or 1,000 million times the mass of the sun, and so are of precisely the magnitude required by the hypothesis that they have been formed by gravitational instability out of a continuous primaeval gaseous medium. Their dimensions are comparable with the dimensions of the whole galactic system, and are so enormous that, in spite of their immense distance, the astronomer can study their shapes and photograph their general appearance with comparative ease. A selection of photographs is shown in Plate II.

It will be seen that the sequence of figures shown in the first four examples is precisely that shown in the theoretical figs. 4 to 6. The series could easily be extended to include observed nebulae of the shapes shown in the theoretical diagrams 1 and 2, but such nebulae are not interesting objects photographically. Statistical researches by Hubble make it highly probable that there is a continuous sequence of nebulae having the shapes shown in the theoretical diagrams 1 to 6, only the last half of this series being exemplified by the photographs shown in Plate I. The last photograph of all on this plate shows a nebula of the same general type viewed from another angle; there is little room for doubt that this nebula is physically very similar to that shown in fig. 5, the difference in appearance arising solely from the different angle of view.

The parallelism in the two sets of figures is so marked that it seems clear that the extra-galactic nebulae must be rotating masses of the general type discussed by Laplace, except for being on an immeasurably greater scale. This interpretation is confirmed by the fact that a number of these nebulae have been found observationally to be in rotation about their shorter axes,



FIGS. 4–6.—MODE OF BREAK-UP OF A ROTATING MASS OF GAS

precisely as demanded by theory. We may suppose that the original primaeval nebular medium was not completely at rest but was disturbed by currents; as it condensed into detached nebulae the motion of the currents would persist in the form of rotation of the nebulae, the different shapes of the present nebulae representing different degrees of rotation.

The Birth of Stars.—The amount of rotation of some of the nebulae is so great that, at some stage of their shrinkage, matter was spilled out into their equatorial plane and has remained in this plane ever since; *see* Plate II. for a number of instances of this formation. The matter left behind in this way would at first form a continuous nebular medium, a sort of counterpart of the parent medium out of which all the nebulae were formed, except that its density must have been some 10,000 million times as great, being of the order of 10^{-21} instead of 10^{-31} grammes per cubic centimetre. The process of gravitational instability must operate in this medium also, but as a consequence of the far greater density, the masses of the resulting condensations must be far less. Calculation indicates that the amount of matter in each condensation must be about equal to that in a newly-born star.

This suggests very forcibly that the outer regions of the nebulae are the birth-places of the stars. Condensations in process of forming may be seen in the outer regions of the nebulae shown in Plate I., and at various times actual unmistakable stars have been photographed in the outer regions of the nearer of the extra-galactic nebulae, although it is significant that all efforts to find them in the inner regions of the same nebulae have failed.

The Development of Rotating Stars.—The sequence of events after a star has come into being is still a matter of debate (*see* STELLAR EVOLUTION). There is, however, general agreement that a newly-born star must contract. According to Jeans, this contraction must continue until a comparatively firm unyielding base has been formed at the centre of the star, through the atoms, nuclei and electrons being so congested that the ordinary gas laws are entirely out of operation; he finds that in the central regions at least of the star, the density of matter must be so great that its state approximates more nearly to the liquid than to the gaseous state.

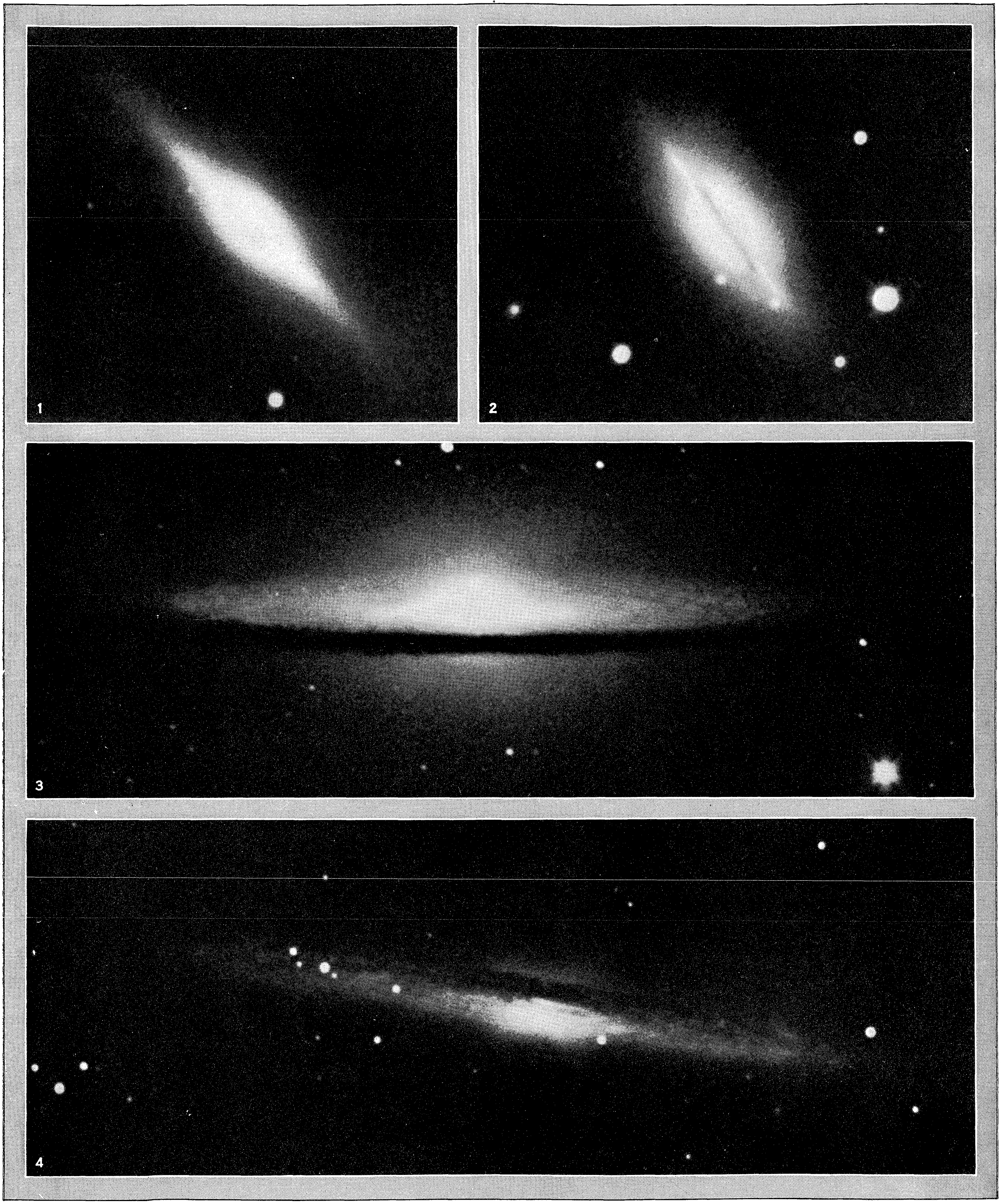
The first products of gravitational instability, the extra-galactic nebulae, proved to be incomparably greater in size than Laplace's imaginary rotating nebula, but each of the smaller masses of gas formed by condensation out of the outlying parts of these nebulae is in effect a gaseous nebula of just about the size and mass imagined by Laplace. If, then, the younger generation of nebulae, as they rotate and shrink, meet with the same sequence of experiences as their parents before them, we have the course of events postulated by Laplace taking place on the scale imagined by Laplace, and we need not look farther for the mode of birth of the solar system. But mathematical theory prohibits such a simple solution to the problem.

The gas set free from a nozzle in the laboratory does not form

BY COURTESY OF THE MT. WILSON OBSERVATORY

SPIRAL NEBULAE IN THE STAGES OF CONDENSATION

1. Spiral nebula in Ursa Major, showing condensation taking place **2.** Spiral nebula seen edge-on, with condensation well advanced



BY COURTESY OF THE MT. WILSON OBSERVATORY

TYPES OF REGULAR-SHAPED NEBULAE

1. Regular-shaped nebula. This nebula (N.G.C. 3115) is similar to a great number of observed nebulae, which have the shape of a huge mass of gas in rotation

2. Regular-shaped nebula with dark matter on equator. The appearance of this nebula (N.G.C. 5866) suggests that the equatorial ejection of matter is beginning in accordance with the mathematical theory

3. Regular-shaped nebula with ring of dark matter surrounding equator. This nebula (N.G.C. 4594) appears to be a rotating mass, in which the equatorial ejection of matter is well advanced

4. Nebula with condensation in equatorial plane. This nebula (N.G.C. 5746) is similar to that shown in Fig. 3, except that the gas in the equatorial plane has begun to break up into condensations

condensations under its own gravitation, the reason being that the mass of matter involved is so small that the gravitational attraction of the matter on itself is inappreciable; it is only when matter is set free on a colossal scale that gravitational instability can come into operation. The scale of the galactic nebulae is amply big enough, but that of jets of gas in the laboratory is too small. Calculation shows that any ejection of gas from the equator of a rotating star is also on too small a scale for gravitational instability to get any grip, so that the ejected gas must just scatter into space like gas out of a tap.

When the star has shrunk so far that its centre approximates to the liquid state, a new set of factors comes into play. The behaviour of a mass of shrinking and rotating liquid has formed the subject of investigations by many of the most eminent of mathematicians, including Maclaurin, Jacobi, Kelvin, Poincaré and G. H. Darwin, and the sequence of events is now well-known. So long as the speed of rotation is low, the mass assumes the flattened orange shape already discussed. With increasing rotation the degree of flattening increases, until a stage is reached at which the shortest axis is only seven-twelfths of the longer axes. Beyond this, further shrinkage does not accentuate the flattening; instead the mass assumes the shape of an ellipsoid with three unequal axes (Jacobian ellipsoid) which continually elongates until it is shaped almost like a cigar, its length being nearly three times its shortest diameter. After passing this stage, violent fluctuations are found to be set up in the mass. It develops a waist somewhere near, but not quite at, the middle of its figure, and after a succession of oscillations in which this waist alternately expands and contracts, the mass ends by breaking into two.

The sequence of events is indicated in figs. 7–11, although it must be added that the last two of these figures are largely conjectural, and take us entirely beyond the reach of exact mathematics. But there would seem to be little room for doubt that the final product of a liquid star which has shrunk while rotating is a system of two liquid stars which revolve about each other in nearly circular orbits.

Binary Stars.—Many binary systems of this type are known to astronomers, and provide confirmation of the sequence of events predicted by theory. The mere existence of systems which have broken up in the way described may be taken as evidence that the parent star was largely in a liquid state before fission occurred, since Jeans has shown that a purely gaseous star could not divide by fission into a binary system. The further development of such a binary system can be calculated theoretically and can also be traced observationally. Three separate tendencies are at work, each acting in the direction of increasing

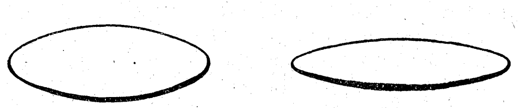


FIG. 7 FIG. 8

FIGS. 7–8.—EFFECT OF ROTATION ON A MASS OF LIQUID
Fig. 7 shows the Maclaurin spheroid, or flattened-orange, configuration for a rotating liquid; fig. 8 shows the Jacobian ellipsoid, so elongated as to be almost cigar-shaped

the size of the orbit. In the first place, so long as the two components are fairly near to each other, each raises substantial tides on the other, and G. H. Darwin showed that the inter-action of these tides must cause the two masses to recede from each other. Simultaneously with this, the emission of radiation from the two stars is accompanied by a loss of mass to each, and Jeans has shown that the effect of this also is to increase the dimensions of the orbit. Neither of these two agencies can produce more than a strictly limited increase in the size of the orbit. A third agency, to whose activities there is almost no limit, consists of the gravitational forces from passing stars. These tend to increase the size of orbit of the binary, at any rate until it is of the order of 100,000,000m. or so in diameter.

The Ages of the Stars.—This last agency acts very slowly, but its effects are cumulative, and given sufficient time, it so easily overpowers the two first mentioned, that they may be disregarded by comparison. Knowing the density with which stars are scattered in the sky, it is easy to calculate the rate at which their gravitational pulls increase the orbits of binary stars, so that the size of the orbit of a binary star gives a rough indication of its age. For most of the binaries which have been formed by fission in the way just described, this age must be reckoned in millions of millions of years.

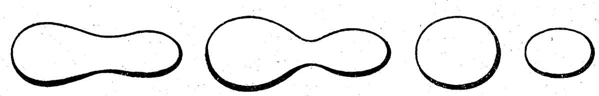


FIG. 9 FIG. 10 FIG. 11

FIGS. 9–11.—THE MODE OF BREAK-UP OF A ROTATING MASS OF LIQUID
The pear-shaped form of figure 9 is produced by furrowing the cigar-shaped form shown in figure 8. Figures 10 and 11 exhibit its further development into two detached masses

The binary systems which can be said with fair certainty to have been formed by fission due to rapid rotation are mainly of the class known as spectroscopic binaries. The telescope generally shows these as a single point of light, but the evidence of the spectroscope reveals the fact that the apparent point of light really represents two stars describing orbits about one another. Another class of binary systems, which outnumbers these by perhaps 20 to one, consists of pairs of stars which describe orbits about each other and show visually as two distinct points of light. These are known as visual binaries. The dimensions of the orbits of many of these are so great that they can hardly have been formed by the fission of a single star and it is more likely that they are the remains of independent but adjacent condensations in the nebula from which they were born. These visual binaries provide evidence as to their ages which is in general agreement with the story told by the spectroscopic binaries.

As a rule the more massive constituent of a binary is not only brighter than the smaller constituent, but also emits more light in proportion to its mass. It is easily shown that this results in a tendency for the two masses to equalize as they diminish together under their emissions of radiation. Actually it is found that the constituents of older binaries approximate more closely to equality of mass than the constituents of younger binaries, and the observed ratio of mass in different types of systems gives an indication of their actual ages. Again calculation shows that average stellar ages must be reckoned in millions of millions of years.

THE GENESIS OF THE SOLAR SYSTEM

The various transformations of astronomical matter which have so far been discussed have given no clue to the origin of the solar system. The sun and planets can hardly represent the remains of independent condensations in a primaeval nebula, their masses being too unequal to admit of any such explanation. For the same reason they can hardly be the remains of a single star which has broken up by rotational fission. The greatest observed inequality of mass in the constituents of binary stars is about four to one, whereas the sun has more than 1,000 times the mass of the largest planet (Jupiter) and something like 8,000,000 times the mass of the smallest (Mercury), even when the asteroids, of smaller mass still, are left out of account. Moreover, as Babinet first pointed out, the total rotational momentum in the whole solar system is so slight that it is practically inconceivable that this amount of rotation could have caused it to break up. For these and other reasons there is now fairly general agreement that excess of rotation cannot have caused the birth of the solar system.

The stars are so remote from one another that in general the influence of a star even on its nearest neighbour is entirely infinitesimal. The moon on account of its extreme nearness raises tides on the earth which are a few feet in height, this being, roughly speaking, a 10,000,000th part of the earth's radius. But the star Proxima Centauri does not raise tides of this height on the surface of the sun, or even of a 1,000,000th or 1,000,000-1,000,000th part of this height; the average height of tide which Proxima Centauri raises on the sun is about one-50th of the radius of an electron. If, however, as we have to suppose, the sun has wandered at random among the stars for a period measured in millions and millions of years, it must at times have had nearer neighbours than Proxima Centauri, and we are free to imagine that at times stars must have passed so near to it as to have raised tides of substantial height on its surface.

The Tidal Theory.—According to the tidal theory, which at present seems to hold out most promise of explaining the origin of the solar system, the planets and their satellites owe their existence to an exceptionally close approach between our sun, then a normal single star unaccompanied by planets, and a passing star. The closer the approach of a wandering star, other things being equal, the higher would be the tides raised on the surface of the sun; but unless the approach was very close indeed, the tides would subside as the star which caused them receded. Jeans, who has studied the question mathematically, has however found that if the passing star came to within a distance of a few radii, generally about three, of the sun, the tides would take the form of two long arms of gas ejected from opposite points of the sun's surface, and these would not necessarily subside as the disturbing star receded. Under the action of gravitational instability, condensations would form in these long gaseous arms, and calculation shows that the masses of these condensations would be of just about the order of magnitude of the observed masses of the planets.

If a tidal cataclysm of this kind can explain the birth of the planets it can obviously, in general terms at least, explain the birth of satellites out of these planets. For immediately upon the birth of any planet, say Jupiter, the original situation recurs but on a miniature scale. Jupiter now plays the part originally played by the sun, while the sun, or possibly the sun and the wandering star in conjunction, plays the tide-raising part originally assigned to the wandering star. Again we can imagine the ejection of tidal filaments of gas, and again the formation of condensations in these filaments, each condensation ultimately forming a satellite.

So long as the matter is discussed in general terms, it may look as though the process just described might continue endlessly through generation after generation. But actually the question of scale is found again to intervene and fix a limit. Bodies below a certain size cannot be born by condensation, again for the reason that small amounts of gas do not condense at all, but scatter into space like a puff of gas out of a gas-tap. Calculation indicates that the smallest of the known satellites can only have escaped this fate by liquefying or solidifying immediately after birth, and makes it clear that there is no room for a generation junior to the satellites of the planets.

Not all the gas which is ejected at a tidal disruption will immediately condense into planets and satellites. Some at least must remain scattered in space, forming a resisting medium which will impede the motions of the planets and satellites. The effect of resistance of this kind is to make an orbit assume a circular shape, and in this way the approximate circularity of the orbits, both of the planets and their satellites, is readily accounted for. Ultimately this stray gas would either fall back into the sun or condense round the planets or scatter into space, leaving interplanetary space clear of matter.

Jeffreys has calculated that this whole process would require a period of the order of 7,000 million years. As regards order of magnitude, this is in general agreement with Holmes's estimate, made from a study of the composition of radioactive rocks, that 1,500 million years have elapsed since the solidification of the earth. Quite possibly, the interplanetary medium has not yet entirely disappeared; the particles which reflect the zodiacal light may well be its last surviving vestiges.

While the theory just sketched out shows many points of agreement with observation, it cannot be denied that it also encounters formidable difficulties. Still, compared with other theories which have so far been suggested, it may fairly be said to show the greatest capacity for accounting for observed facts, and to be free, so far as is at present known, from any insuperable objections.

The Earth-moon System.—Whatever hypothesis we hold as to the origin of the solar system, the earth-moon system presents a rather special problem, since the ratio of the masses of the earth and the moon (about 81 to one) is nearer to equality than any other ratio of masses in the system. Mathematical discussion of the tidal theory shows that the more liquid a planet is when a satellite is born, the greater will be the mass of the satellite in proportion to that of the planet; a satellite born out of a wholly liquid planet would have a mass comparable with that of the planet itself. Thus on the tidal theory the abnormal ratio of mass in the earth-moon system can be explained merely by supposing that the earth was rather more liquid at the time of the birth of the moon than the other planets were when their satellites were born.

An alternative suggestion, put forward by G. H. Darwin, is that the natural period of vibration of the earth was in some past epoch exactly equal to the period of its revolution round the sun, so that, as a result of resonance, the sun raised enormous tides in the earth, which ultimately caused it to divide into two parts. Jeffreys, who has studied this hypothesis in some detail, finds that it gives a reasonable explanation of the existence of the earth-moon system. G. H. Darwin also studied the separation of the earth and moon under the influence of the forces arising from the lunar tides, and found that these were adequate to account for the present distance between the earth and the moon.

Although these alternative rather special hypotheses are available, it remains simplest and most natural to suppose that the moon was born out of the earth in the general cataclysm which tore the planets out of the sun, and the other satellites out of the planets around which they revolve.

Frequency of Genesis of Solar Systems.—The tidal theory of the genesis of the solar system which has just been explained, postulates a very close meeting of two stars in space. A quite simple discussion shows that meetings of the required closeness are necessarily very rare occurrences, and that even in the lifetime of millions of millions of years which we have found it necessary to allot to the stars, only a very few stars can have experienced such close encounters. A calculation which allows as best we can for all the factors within our knowledge suggests that the proportion can hardly be greater than about one in a million. It follows that very few stars can be surrounded by systems of planets as our sun is, so that the solar system is somewhat of the nature of a "freak-formation."

This brings about a reversion from the view somewhat widely held last century that every star was the centre of a family of planets; it now seems more likely that for every star which is attended by planets, 1,000,000 or more aimlessly radiate light and heat into vacant space. The possible abodes of life in the universe are correspondingly restricted, and terrestrial life is seen to form a larger proportion of the total life of the universe than was at one time imagined.

Our sun is a member of a colony of some thousands of millions of stars, the galactic stellar system. We do not know much about the number or arrangement of stars in the outlying parts of this system, but only in the dense central regions are stars at all likely to pass close enough to one another to produce planets. And here calculation shows that under present conditions planetary systems are only likely to be produced at the rate of about one in 6,000 million years. Thus our solar system with its age of only a few thousand million years is very possibly the youngest planetary system in the whole colony. Our terrestrial civilization, with only some 6,000 years of existence behind it, is almost certainly the youngest civilization.

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COSMOLOGY means a theory of the world or of the world-order. The term "cosmos" is mostly used in the sense of an orderly world, or a world-order, in contrast with chaos or disorder. Sometimes the expression cosmology is used as a variant for cosmogony (*q.v.*) to denote an account of the origin of the world or of its development out of an original chaos. It is more usual, however, to restrict the term cosmogony to early mythological accounts, which are of anthropological or historical interest, rather than of scientific or philosophical value. "Cosmology," on the other hand, is applied more extensively to any kind of rational attempt to deal with the ultimate problems of Nature. It includes such attempts as that of Descartes to show how an orderly world like ours might have evolved out of an original chaotic collocation of matter and motion, such speculations as those of Herschel, Kant and Laplace about the origin of the solar system, and more generally all that is usually included under the name of philosophy of Nature (as distinguished from natural philosophy, which is only another name for physics). The extravagances of Schelling (*q.v.*) in the early part of the 19th century tended to discredit the philosophy of Nature by trespassing rashly on the domain of physics. Cosmological speculations have, indeed, not been entirely abandoned, and are not likely to be so long as there is such a thing as philosophy at all. One may instance the speculations of Samuel Alexander about the "emergence" of our world-order out of a more primitive space-time matrix, and the neutral monism of J. Dewey and others. In the main, however, the prevailing tendency in present-day cosmology as a philosophy of Nature is to make explicit and to examine critically all the concepts and assumptions which are employed in the popular and scientific accounts (whether merely descriptive or explanatory) of the phenomena of Nature, using the term Nature in the restricted sense of the material world (as contrasted with the Spinozistic use of the term for the entire universe, in its spiritual as well as in its material character). A. E. Taylor (*Elements of Metaphysics,* book 3, ch. i.) regards the following as the fundamental problems of cosmology: (1) The real nature of material existence, *i.e.,* the ultimate significance of the distinction between physical and mental or spiritual existence, and the possibility of reducing them to one; (2) the justification for the distinction between mechanical and teleological processes, and for the conception of the physical order as rigidly conforming to uniform law; (3) the leading difficulties of the conception of space and time, and their bearing on the degree of reality to be ascribed to the physical order; (4) the philosophical implications of the application of the idea of evolution to the events of the physical order; (5) finally, the problem of the real position of descriptive physical science as a whole. (*See* COSMOGONY; PHILOSOPHY, HISTORY OF.)

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COSMOPOLITAN, of or belonging to a "citizen of the world" (Gr. κόσμος, world, and πολίτης, citizen), *i.e.,* one whose sympathies, interests and culture are not confined to his own race or country.

COSMOS, a genus of tropical American herbs of the family Compositae, comprising about 20 species chiefly Mexican. They are late-flowering annuals or perennials with long-stalked showy flower-heads borne singly or in clusters. Several species are in cultivation as ornamental annuals. Of these the best known is the common cosmos (*C. bipinnatus*), 7 ft. to 10 ft. high, extensively grown in gardens. It has a smoothish stem bearing much-cut, narrowly-lobed leaves and flower-heads with a yellow centre (disk) encircled by pink, crimson or white rays. The plant thrives best in sandy, not too rich, soil and germinates readily; in the northeastern United States the best results are attained by sowing the seed indoors in April and transplanting when danger of frost is past.

COSNE, a town of central France in the department of Nièvre, on the Loire at its junction with the Nohain, 37 mi. N.N.W. of Nevers by the P.L.M. railway. Pop. (1936) 6,988. It is mentioned in the Antonine Itinerary under the name of *Condate,* but it was not till the middle ages that it rose into importance as a military post. In the 12th century the bishop of Auxerre and the count of Nevers agreed to a division of the supremacy over the town and its territory. The church of St. Aignan (12th cent.) was restored in the 16th and 18th centuries; the only portions in the Romanesque style are the apse and the northwest portal. It formerly belonged to a Benedictine priory depending on the abbey of La Charité (Nièvre). The chief industries are the manufacture of files and flour milling.

COSSA, FRANCESCO DEL (*c.* 1435–1477), Italian painter, born in Ferrara, a leading master of the Ferrarese school during the middle of the 15th century, and the founder of the old Bolognese school of painting. His name first occurs in 1456 in a contract, by which he undertook to decorate the wall around the high altar of the cathedral of Ferrara with a representation of the "Pieta" and with paintings imitating marble. This document was signed by his father Cristofano, who was a builder. Cossa's chief works at Ferrara were frescoes painted in the Palazzo Schifanoia, a summer residence of Borso d'Este. They form part of a series intended to represent the blissful state of a country ruled by a benevolent sovereign. In three superimposed zones, which originally went all round the chief hall of the palace, these frescoes set forth the twelve months, figured in signs of the zodiac and allegorical figures, and illustrated in the occupations of men and women, with scenes from the daily life of Borso, in which he is glorified as the ideal ruler of his people. The whole scheme was evidently devised by one of the humanists of the court, probably by Pellegrino Prisciano, astrologer and poet. When first recovered from under whitewash in 1840 the frescoes were attributed to Cosimo Tura, Cossa's contemporary, with whom he exhibits affinities of style. The frescoes on one of the walls are now given to Cossa, for authentic proof was found in a letter addressed to Duke Borso by the artist stating that he painted the three fields representing March, April and May, that is the whole eastern wall, and complaining of the inadequate payment received. The letter is dated March 25, 1470, and as Borso's answer was in effect that he must be contented with the tariff fixed, it may be assumed that he left Ferrara for Bologna soon after. Here he found employment under the Bentivoglios. In 1472 he was asked to restore a miraculous Madonna fresco (by Lippo Dalmasio?) in the church of Madonna del Baraccano. The most noteworthy production of Cossa at Bologna and in many respects his most important work is the altar-piece painted in 1474 by order of Domenico de Amorini and Alberti de Catanei for the Mercanzea. This picture is now in the Pinacoteca at Bologna. It represents the Virgin and Child Enthroned with two saints and a Portrait of a Donor. It is a balanced composition, stately and austere. The tendency is realistic, the types are somewhat grim, the forms are searchingly defined, and the modelling is plastic, relief being obtained by light and shade and the play of reflections. The folds of drapery are heavy and tortuous; the colour of the Corte Vecchia and Sant Agostino is strong and fine.

Besides the pictures mentioned above the following are generally recognized as works of Cossa. The National Gallery, London, possesses the centre panel of an altar-piece representing "Vincent Ferrer," a Dominican saint, of which the wings, with "St. Peter" and "John the Baptist," are in the Brera at Milan; and the predella, representing the miracles of the saint, is in the Vatican Gallery. The Dresden Gallery has an "Annunciation," the Metropolitan Museum, the "Profile of a Boy," formerly in the Drury Lowe Collection; the Berlin Museum, "Allegory of Autumn"; the Budapest Gallery, "Two Angels," wings of an organ.

In the entrance wall of San Giovanni in Monte at Bologna is a circular window with a representation of St. John at Patmos, bearing Cossa's signature; and in the south aisle of the same church a window with the Virgin and Child with angels also by Cossa.

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COSSA, PIETRO (1830–1881), Italian dramatist, was born at Rome. After fighting for the Roman republic in 1849, he emigrated to South America, but soon returned to Italy, and lived precariously as a literary man until 1870, when his reputation was established by the unexpected success of his first acted tragedy, *Nerone.* From this time to his death in 1881 Cossa continued to produce a tragedy a year, always upon some historical subject. His last piece, *I Napolitani nel 1799,* was produced in 1880.

COSSACK POST, a military term to indicate a small party of mounted men, usually three to six, under a non-commissioned officer or senior soldier, which supplies its own sentries.

COSSACKS, the name given to considerable portions of the population of the Russian empire, endowed with certain special privileges, and bound in return to give military service, all at a certain age, under special conditions (Russ. Kazak, perhaps from the Turki, *quzzāq,* adventurer). They constituted 11 separate *voiskos,* settled along the frontiers: Don, Kuban, Terek, Astrakhan, Ural, Orenburg, Siberian, Semiryechensk, Amur, Usuri and Zabaykalye. The primary unit of this organization was the *stanitsa,* or village, which held its land as a commune. The assembly of all householders in villages of less than 30 households and of 30 elected men in villages having from 30 to 300 households (one from each 10 households in the more populous ones), constituted the village assembly. Military service was obligatory for all men, for 20 years, beginning with the age of 18.

The cohesion and solidarity among the Cossack armies in the various regions was perhaps damaged by the Statute of 1869, which endowed the officers and civil servants with landed property. The rank and file remained under the communal system, the legal owners of the land being the various degrees of the community, from the *stanitsa* up to the region. The allotments were larger than those of the ordinary peasants, and outsiders, tenants of Cossack land (*inogorodnie*), or peasant owners, were envious and eager for equal opportunities. The decree of Dec. 12, 1917, had already altered the terms of military service. The decree of June 1, 1918, levelled the Cossack community with the rest of the population. But the land tenure introduced by the Soviet Government was much the same as that familiar to the Cossacks, combining individual management with State ownership. During the civil war 1919–21 the Bolshevik power revived extinct Cossack traditions in the Ukraine, forming red (*chervonny*) Cossack units. Elsewhere the Cossacks fought on both sides and about 30,000 left Russia with the remainder of the defeated white army. Information about the Cossack peoples in the various regions which have become merged into ordinary administrative divisions under Soviet rule is very scarce. (*See* also Poland: *History;* Razin, Stenka; Mazepa-Koledinsky, Ivan Stepanovich.

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COSSIMBAZAR or **KASIMBAZAR,** a decayed town on the river Bhagirathi in the Murshidabad district of Bengal, India, now included in the Berhampore municipality. Though the history of the place cannot be traced back earlier than the 17th century, it was of importance long before Murshidabad was made the capital of Bengal. In that century it became the great trading centre of Bengal. In 1658 an English factory was established at Cossimbazar, which soon became the chief commercial agency of the East India company in Bengal. French and Dutch factories were also set up in the second half of the 17th century, and the Armenians had a settlement in a suburb of the town. The proximity of the English factory to Murshidabad, the Mohammedan capital, while it was the main source of its wealth and political importance, exposed it to constant danger. Thus, in 1757, it was the first to be taken by Siraj-ud-daula, the nawab of Bengal; and the resident, with his assistant (Warren Hastings), were taken as prisoners to Murshidabad.

After the famine of 1770 the cultivated area in its neighbourhood shrank and the greater part of the surrounding country was described as "a wilderness inhabited only by beasts of prey." In 1813 its ruin was completed by a sudden change in the course of the Bhagirathi, which formed a new channel 3m. from the old town. Virulent epidemics broke out which swept away three-fourths of the inhabitants, and loss of population was followed by dilapidation of buildings. The first wife of Warren Hastings was buried at Cossimbazar, where her tomb, with its inscription, still remains.

COSTA, GIOVANNI (1826–1903), Italian painter, was born in Rome. He became known as a landscape-painter of remarkable originality, and of great influence in the return to minute observation of nature. He had many English friends and followers, notably Matthew Ridley Corbet (1850–1902), and Lord Carlisle, and was closely associated with Corot and the Barbizon school. An exhibition of his pictures was held in London in 1904, and he is represented in the Tate Gallery. He died in Rome in 1903.

See Madame Agresti's *Giovanni Costa* (1904).

COSTA, LORENZO (1460–1535), Italian painter, was born at Ferrara, but went in early life to Bologna and ranks with the Bolognese school. In 1488 he painted his famous "Madonna and Child with the Bentivoglio family," and other frescoes, on the walls of the Bentivoglio chapel in San Giacomo Maggiore, and he followed this with many other works. He was a great friend of Francia, who was much influenced by him. In 1509 he went to Mantua, where his patron was the Marquis Francesco Gonzaga, and he eventually died there. His "Madonna and Child enthroned" is in the National Gallery, London, but his chief works are at Bologna. His sons, Ippolito (1506–61) and Girolamo, as well as Girolamo's son, Lorenzo the younger (1537–1583), were also painters.

COSTA, SIR MICHAEL ANDREW AGNUS (1808–1884), was the leading conductor in England and a notable figure in the musical life of his day. Born at Naples, he settled in London (1830), conducted the opera at Her Majesty's from 1832 till 1846, then seceded to the Italian Opera at Covent Garden; conducted the Philharmonic Society from 1846 to 1854, the Sacred Harmonic Society from 1848, and the Birmingham festival from 1849. Meanwhile he had conducted the Bradford (1853) and Handel festivals (1857–80), and the Leeds festivals from 1874 to 1880. As a composer he produced a number of operas and oratorios of no importance. He became a naturalized Englishman and received the honour of knighthood in 1869. He died at Brighton April 29, 1884.

COST ACCOUNTING. A system of accounting designed to show the actual cost of each separate article produced or service rendered from time to time, as distinguished from the ordinary system of accounting which aims only at showing the working results of a business as a whole, or sometimes of each separate department of a business. The two systems of accounting are usually compiled independently of each other by different staffs, but if satisfactory results are to be reached these must work in co-operation, and the results produced must be reconcilable and mutually explanatory.

Early History.—The origin of cost accounting, like the origin of book-keeping itself, is unknown; but possibly the first attempts in this direction were made in connection with the tin mines of Cornwall, as under the ancient Stannary courts of Cornwall tin-mining companies were formed, called *cost book companies,* a form of organization very similar to the *no-liability company* still extant in Australia. However that may be, systematic costing was usual in mining concerns long before anyone thought of extending it to manufacture generally.

Necessity of Costing.—The necessity for cost accounting arose out of the direction in which ordinary accounting methods developed to meet the growing requirements of modern business. In mediaeval times trade consisted mainly of a series of separate ventures, or voyages, for each of which a separate account was kept, so that at the end the actual result of that particular venture or voyage was shown by the account. When commerce assumed the form of continuous trading, however, the method adopted was to merge everything into a single *trading account* which showed the results of the trading as a whole, but no details. In the nature of things, such a method of accounting could only be satisfactory so long as it was reasonable to assume that all the business undertaken contributed *pro rata* to the final result. In some cases (*e.g.*, in many department stores and wholesale warehouses) this assumption may be sufficiently near the truth for practical purposes, but it is never even approximately true in a manufacturing concern. Indeed, it seems safe to say that in almost every business some lines are more profitable than others, and that (whether it be recognized or not) some lines are quite unprofitable. Hence the need for a system of accounting that will give detailed information as to the exact cost of each separate thing sold, or each service rendered, especially in cases where the selling price has of necessity to be determined in advance.

Costing Methods.—Because cost accounting is in the main a search for detailed information, it follows that the most convenient and suitable methods will be found to vary in almost each individual case. Accordingly, only the barest outline of a system of cost accounting can be indicated here. The first step is to determine the number of separate cost accounts that are to be kept. In some businesses where production is continuous, these individual cost accounts would also be continuous and balanced periodically like *trading accounts*, but in the case of contract work the number of accounts will vary from time to time according to the number of contracts then in progress. Each separate cost account may be (and often is) sub-divided, so as to show the work performed by each separate department thereon. The other broad basis of division is to separate the outlays chargeable against each separate cost account (or sub-account) into (*a*) labour, (*b*) materials, (*c*) overhead. Each of these will again be subject to sub-division.

Labour Costs.—*Labour* represents the cost of work done directly for, and in connection with, any particular cost account. It is not, therefore, quite the same thing as wages paid; as lost time, time occupied upon spoilt work, idle time, and cost of supervision are not directly chargeable against any particular piece of work, and have therefore to be transferred to overhead charges. (Loss arising from spoilt work should be treated as part of the overhead charges of the department where the "spoil" occurs.) Everything that has been paid away has to be charged up somewhere, and an agreement of totals is an essential part of a satisfactory costing system. If suitable office machinery be employed it is quite practicable to effect this agreement before the wages are paid, and therefore in time to prevent any overpayment of wages.

Materials Costs.—*Materials* represents the cost of all materials directly used in connection with work for which any cost account is opened. Some of these materials will be purchased specially for a particular job and can therefore be charged direct to that job, others will be issued from store; but the total value of materials charged against cost must agree with the total value credited to suppliers of direct purchases and to the stores department. In connection with the stores records a great deal of detailed work is necessarily involved, and here again office machinery is essential in a concern of any magnitude. In order to reach really satisfactory results, stores records should be kept in both quantities and money values, otherwise no effective check on quantities is available. The same exact agreement of totals that was practicable as regards wages is not practicable as regards stores, partly because of discrepancies in weight, etc., owing to inevitable waste or alterations in atmospheric conditions; partly because when materials have been in store for a considerable time it does not at all follow that their original cost is a fair price at which to charge them out against current jobs. Such discrepancies, as well as the general expenses of the stores department, are usually included in the overhead, but they need careful watching. *Labour* and *materials* together constitute *prime cost.*

Overhead Costs.—*Overhead* consists of every kind of working cost not comprised in one or other of the previous headings. According to the nature of the business it may be anything between (say) 5% and 80% of the total cost, but in any event it represents outlays which by their nature cannot be regarded as directly chargeable against any particular item of output. The total must therefore be spread over the whole output as equitably as possible, according to some preconceived formula. Herein lies the weakness of many costing systems. Formerly, overhead used to be dealt with by adding a pre-arranged percentage to prime cost. This of course assumes that the actual use made by the different jobs of the services comprised under "overhead" is, in fact, in proportion to their respective prime costs. In fact, it is quite as often in an inverse ratio. No treatment of overhead can ever be satisfactory that does not aim at sub-dividing the overhead as a whole into the overhead of each separate department; the burden of the overhead expenses of each department may then be distributed over the output of that department week by week, or month by month, with some approach to fairness. But even then, the method of distribution should be elastic rather than rigid; that is to say, week by week, or month by month, someone in authority with a knowledge of the facts should approve the proposed distribution before it is given effect to. It is moreover important to see that the total amount distributed is reconcilable with the total amount of expenses incurred; otherwise, the aggregate costing results at the end of the year cannot agree with the results shown by the *profit and loss account.*

Absolute agreement is impracticable, but a reconciliation of the two totals is at least essential. Absolute agreement may be impracticable because, in order to arrive at the true cost, it may be necessary to include items which have not in fact had to be paid away. For instance, the fact that a manufacturer owns the freehold of his works is no reason why a fair charge for the rent of those works should not be included as part of his working costs; the fact that a manufacturer is paying interest on borrowed money because he is working with insufficient capital is no reason for saying that his operative costs are therefore higher; the fact that a manufacturer has for prudential reasons written down his plant and machinery far below their true value is no reason why a proper figure, representing the actual depreciation for the current period, should not be charged against the current output. Similarly, such items as bad debts, interest on investments, etc., while necessarily coming into the profit and loss account, have no bearing upon the practical working of the business, and are therefore quite properly omitted from the costing records.

Uses of Cost Accounts.—To sum up, it may be said that a satisfactory system of cost accounting assists the management to reduce working costs by pointing out waste and avoidable delay; to select its output wisely, and to vary the quantity of output as circumstances may require; to choose wisely between alternative methods of operation or production; to check quotations, by comparing estimates of cost made in advance with actual costs as subsequently ascertained. Cost accounting also provides the only reliable means of estimating the value of work in progress; of determining the extent to which sub-contracting is desirable; of deciding when to buy and when to manufacture where each alternative is possible. In addition, a proper system of cost accounts provides an effective check upon the stores department, and upon each operative department. It is the best possible safeguard against wages frauds or leakages of any kind, because every outlay has to be charged up to some cost account, and every cost account is being closely watched by interested parties who may be relied upon to challenge any but the most trifling overcharges. Every cost account (or sub-account) represents the results achieved by someone, be he works manager or foreman, or someone intermediate, who may be relied upon to see that his results are not belittled by improper charges. If manufacturers were to pool their results, a comparison of the working costs of similar undertakings would undoubtedly be generally beneficial; but, outside of public service undertakings, such comparisons are not at present available.

Bibliography.—In the nature of things the most useful books on cost accounting deal with its application to one particular set of

circumstances, and are of but little use elsewhere. The chief books dealing with general principles are: Dicksee, *The Fundamentals of Manufacturing Costs* (1917); Dicksee, *Book-keeping for Accountant Students* (1921); Dicksee, *Advanced Accounting* (1921); Cathles, *The Principles of Costing* (1924); Hawkins, *Cost Accounts* (1927); A. H. Church, *Manufacturing Costs and Accounts* (1917); E. M. Taylor, *The Principles of Cost Accounting* (1936). (L. R. D.)

UNITED STATES

Some features of Cost Accounting which have been developing rather rapidly in the United States are: (1) retail cost accounting; (2) bank cost accounting; (3) sales cost accounting; (4) uniform cost accounting; and (5) standard costs.

Retail Cost Accounting.—This is a term applied particularly in department stores where probably the most important problem of management is that of determining the profitableness of each of the departments. The department store being similar to a collection of individual stores, it is particularly essential that each be conducted so as to return a profit on the capital invested in it. The problem of cost accounting in this connection is essentially that of the distribution of overhead expenses. The merchandise accounts, sales and purchases are segregated by departments in order to give the proper control over merchandising activities. Similarly the salaries of assistants whose time is employed fully by a given department are without difficulty segregated as charges against that department. Practically no other costs can be charged directly to a department because they are for the most part shared jointly by several; *e.g.*, the general expenses of the buying department are incurred for the benefit of the entire store, stock clerks may serve several departments, all of the general housing expenses—light, heat, janitor service, repairs, rent, etc.—are for the benefit of all departments, as are the stores' delivery service costs and the newspaper advertising and other publicity expenses, which include the operating expenses of the advertising department; as well as the general administrative expense covering the management of the store as a whole. If accurate profit results are to be computed for each department, all of these expenses must be prorated on some equitable basis over the departments receiving the benefit of the service. Some of the bases adopted for the distribution of these expenses are as follows: buying expenses are prorated on the basis of the net purchases in each department; the space advertising on the basis of space used by each department; general advertising, general selling expenses, and general administrative expense of the whole organization on the basis of the sales of each department; delivery expense on the percentage of packages delivered for each department; rent, maintenance and operation on the basis of floor area occupied by each. In this way the net profit operating results of each department are determined on very much the same basis as would be the case were each an independent unit.

Bank Cost Accounting.—The banks have long recognized that the services rendered customers growing out of the bank's deposit function are quite costly to the bank and are of real value to customers. Only recently has any attempt been made to evaluate the cost of these services as compared with the value of the customer's deposit to the bank. In attacking the problem the bank has been desirous of determining the minimum balance which it should require each depositor to maintain, in order to cover the cost of the bank's services rendered to that depositor. The problem is a particularly complicated one because of the difference in activity of the various depositors' accounts, some depositors drawing many cheques during the month, others only a few. The more active accounts, requiring the handling of more cheques naturally are more expensive to the bank than the inactive. Similarly, from the deposit standpoint, the customer who makes many deposits in his account, many being cheques which his own bank will have to collect, receives more service from the bank than the one who is relatively inactive in this regard. No entirely satisfactory solution of this cost accounting problem in the bank has yet been reached. Working methods are, however, being employed by a great many banks to the extent, at any rate, that most have adopted a minimum balance which must be maintained by all depositors in order to entitle them to free service, those customers whose balances fall below this being charged a service fee.

Sales Cost Accounting.—As distribution costs increase, manufacturers and wholesalers give them an increasing amount of attention, the problem being investigated along two main lines. In the first place an attempt is being made to discover an equitable basis for pro-rating over the product the general selling expenses, which is essentially the same problem as the distribution of overhead expenses in the factory. In order to determine the full cost of placing the product in the hands of the customer it is necessary to distribute on an equitable basis the selling expense incurred. Sales salaries, travelling expense, entertainment, advertising, both national and local, delivery expenses, general head office selling expense, including the salaries of sales manager and his staff, clerical expenses and supplies—all of these things must be distributed over the various products sold before it is known which are profitable and which are not. An investigation of this kind will have a direct bearing on the sales policies of the company as indicating the products the sale of which should be pushed and those which should be entirely cut off, or be carried merely as a convenience to customers with a recognition of what such a policy costs. The second line of investigation, viz., the determination of which customers are profitable, is closely related to this. It has been found, for example, in a given manufacturing concern that 90% of its total sale volume was sold to 10% of the total customers at a cost of 5% of its total selling expense. This means that 10% of its total sales volume was sold to 90% of its customers and that the cost of increasing its sales volume by this 10% was 95% of its entire selling expense. Certainly had no effort been made to sell to these customers—90% of the total number—the net profit of the company would have been much larger. An investigation of this kind requires a very careful allocation of selling expenses on the basis of the business done with each customer rather than on the basis of the unit or kind of products sold, although a knowledge of the manufacturing and selling cost of each may be necessary in determining the profitableness of the business done with each customer. Investigations of this kind are very enlightening and absolutely necessary, in order to give a factual basis for the formulation of intelligent sales policies.

Uniform Cost Accounting.—Reference is made under BALANCE SHEET to a trend toward the development of uniform systems of accounting in trade association work. Particularly in those trades where competition is keen and net profit results from the point of view of the marginal unit of business are apt to be unsatisfactory, it is essential for a business man to know his costs. The trade association has recognized this and has tried to bring sharply to the attention of all of its members the absolute necessity of a system of accounts which will give him the necessary information to determine a selling price adequate to cover all costs and leave a margin of profit. Many trade associations have secured the co-operation of a large proportion of their members in reporting their business costs under the uniform accounting titles adopted by the association; these have been handled confidentially and from them averages have been built up sometimes for the trade as a whole and frequently also in classified groups by businesses, localities, etc. These averages have provided norms or standards by comparison with which the individual merchant or manufacturer is able to judge his relative efficiency. Some of these uniform systems of accounting have been developed through accounting committees within the organization itself, while in other cases the professional services of public accountants have been utilized.

Standard Costs.—The standard costs system, also known as predetermined or budget costs, is one of the most recent movements in cost accounting; its chief point is estimating the cost of the product before it is produced. This estimate is frequently made by the engineering department, and consists of estimates of the cost of materials to be used, of the direct labour involved, and of the overhead expenses. For proper efficiency these estimates should be made in very great detail, in accordance with the plan or process of manufacture of the product. The costs of actual manufacture are then gathered by the accounting system under the same titles as were used in the making of the estimate; these are compared with the estimated or standard costs and the variations, or variances, as they are usually called, are noted and the attention of the responsible executive is given particularly to those items where these are greatest. In this way, so long as the costs of manufacture fall within the limits set by the estimated manufacturing standards, the results are considered satisfactory and no special attention from executives will be required, and hence they can devote their undivided attention to conditions shown to be unsatisfactory. As yet there is no uniform accounting technique for this method, but its basic idea has gained rather wide acceptance owing to its great value from the standpoint of management.

The National Association of Cost Accountants, which operates through some 30 or more chapters in manufacturing centres of the United States, is the leading professional society in this field. *See* also Scientific Management.

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(R. B. K.)

COSTANZO, ANGELO DI (*c.* 1507–1591), Italian historian and poet, was a Neapolitan. He was an ardent admirer of the beautiful poetess Vittoria Colonna (*q.v.*). He spent over 40 years on his great work, *Le Istorie del regno di Napoli dal 1250 fino al 1498* (Naples, 1572; completed work, Aquila, 1581). It is still one of the best histories of Naples, and the style is clear, simple and elegant.

See B. Croce, *Vomini e cose della vecchia Italia* (Bari, 1927).

COSTA RICA, a republic of Central America, lying between Nicaragua and Panama and between the Caribbean sea and the Pacific ocean, and known chiefly in the markets of the world for its high quality of coffee and, politically for its record of peace and general prosperity. Costa Rica's boundaries are, on the north, Nicaragua, on the east, the Caribbean sea, on the south-east and east, Panama, on the west, the Pacific ocean.

The total area of Costa Rica is approximately 23,000 sq.mi., its population (*see* below) being about 26.4 to the square mile. The coast line, on the Caribbean sea is about 181 mi., and on the Pacific, which is broken by deep bays and many inlets, about 360 miles.

Physical Description.—The larger portion of the territory of Costa Rica is an elevated table-land of from 3,000 to 6,000ft. above the sea. The country is traversed by the main cordillera of the American continent, with its two characteristic ranges with the wide plateau between. The chief mountains are mostly volcanic, rising above the main ranges of the cordillera, the highest peaks being Chirripo Grande, 11,485ft., Irazú, 11,200ft., Turrialba, 11,350ft., Buena Vista, 10,820ft., Pico Blanco, 9,645ft., and Poás, 8,895 feet. The slopes to the Caribbean and Pacific shores are sharp, and the lowlands narrow on the Pacific and fairly broad on the Caribbean littoral. However, while the Caribbean shore is broken by relatively few inlets or rivers, and even the salt water lagoons that skirt the other Central American countries and Panama are less in evidence, the Pacific shore is broken by great bays and swift rivers. These include three gulfs and bays of prime importance, the Gulf of Nicoya, the Golfo Dulce, and Coronada bay. The Gulf of Nicoya is a charming, landlocked bay filled with tiny islands and dominated by the hills rising sharply behind it on the mainland. The Golfo Dulce, on the other hand, is sharply cut, averaging 100 fathoms in depth and entirely without islands.

The chief river of Costa Rica is the San Juan, which has its origin in Lake Nicaragua and, flowing for most of its length through Nicaragua, forms the international boundary for a considerable distance. The Río Colorado, the most important of its many mouths, lies wholly within Costa Rican territory. The Reventazón, called the Parisimina through a part of its course, is the chief river entirely within Costa Rica. Rising in the foothills around the volcano Irazú, it flows through the central plateau and coastal lowlands to the Caribbean. Its picturesque valley is the route of the old Spanish highway from the coast, and, now, of the railway which connects the capital, San José, with the country's chief port, Puerto Limón. The Río Frío flows northward into Lake Nicaragua. On the Pacific slope, the Tempisque runs in a southerly direction into the Gulf of Nicoya. The Tarcoles, like the Reventazón, rises on the slopes of Irazú, the tip of the watershed between the Pacific and the Caribbean, and flows westward into the Pacific at the head of the Gulf of Nicoya. Toward the southeast, on the Pacific slope are the Río Naranjos, rising near the volcano Chirripo Grande, and beyond it the Río Grande de Terraba empties into Coronada bay. The latter river has its headwaters in the mountains near the border of Panama. None of the rivers is long, nor is any one of them, except the San Juan, navigable for boats of any size.

The flora, fauna, and the general geological features are similar to those of the other countries of Central America.

Cocos Island.—Included under Costa Rican sovereignty is Cocos island, a jungly uninhabited tropical island lying in latitude 5° 32′ N., longitude 87° 2′ W. in the Pacific some 300m. from the mainland. For over a century Cocos has been frequently visited by treasure-hunters seeking gold bullion buried there in 1821. Cocos is about 4m. long and 2m. wide, and has two fair harbours. The highest elevation is 2,788 feet. In recent years, particularly since 1939, there has been agitation in the United States for the lease or purchase of Cocos from Costa Rica for use in strengthening the Panama canal defences.

Climate.—The climate of Costa Rica differs but little from that of other Central American countries. There are sharp contrasts, however, due to altitude and the uncertainty of the winds at this point on the earth's surface, and to the fact that some authorities hold that the thermal equator in reality passes through or near San José de Costa Rica. The highland climate of the plateau renders the weather cool and refreshing, however, and San José has been becoming more and more the summer resort, or the resort for relief from the continued heat, to the foreign residents of Panama and the Canal Zone, which is only 24 hours by sea and rail from the capital of Costa Rica. On the plateau the altitude is from 3,000 to 5,000ft. and the mean temperature is 68° F. On the coasts, the mean annual temperature is around 82° F. In both the coastal regions and the highlands the rainy season is generally expected from April or May to December, although the Caribbean coast often has rain during the dry season when the trade-winds bring rain clouds out of the Atlantic and precipitation on their coming in contact with the cooler air currents from the highlands of Costa Rica.

Costa Rican woman going to market

Inhabitants—The population was officially estimated at 656,129 on Dec. 31, 1940. The overwhelming bulk of the residents of the highlands are of almost pure Spanish descent, little affected by immigration since the close of the colonial period a century ago, and yet steadily increasing in numbers and apparently losing little if any vigour under the tropical sun. The original stock was largely from Galicia and Andalusia, and this peasantry now makes up the bulk of the small property owners and also of the labouring classes on the coffee plantations. The next most important element in the population is the Negro, although this is confined almost entirely to the Caribbean coast. There, imported labourers from the British West Indies have formed the bulk of the workers on the banana plantations founded and operated by large American companies, a single one of these companies employing over 6,000 of these Negroes, many of whom are accompanied by their families. The Negroes virtually never penetrate to the highlands. There is, also, a very small proportion of other foreigners, the total probably not exceeding 8,000. Mosquito Indians come every summer to fish off the Atlantic Coast.

The chief centres of population are on the central plateau in four cities within a few miles of one another. These four cities are the capital, San José, with 68,465 inhabitants; Cartago, with 8,786, Alajuela, with 9,232 and Heredia, with 9,610. Puntarenas, the chief port on the Pacific, possessed 7,722 inhabitants; Puerto Limón, on the Caribbean sea, has grown rapidly and in 1940 numbered 9,129 inhabitants.

Government.—Costa Rica is governed by its Constitution of 1871, one of the oldest in Spanish America, and the third adopted by the country. It describes the government as "popular, representative, alternative and responsible," vesting the authority in the three usual branches, executive, legislative and judicial. Civil rights are guaranteed, but subject to suspension by the legislature or by the executive in time of war; there is freedom of worship, although the Roman Catholic Apostolic religion is that of the State and is supported by the Government. There is a single legislative chamber, called the Constitutional Congress, consisting of 44 deputies, one for every 15,000 inhabitants, elected for four years, half being renewed every two years. The president is elected by direct vote for four years and is eligible for another term after one term has intervened. His council of ministers may attend the meetings of congress and take part in the deliberations, although without vote. The judiciary consists of a supreme court of eight members elected by congress, and appellate and inferior courts whose judges are named by the supreme court. The administration of the country is divided into seven provinces, which in turn comprise cantons and districts. The governors of the provinces are appointed by the president, but the capitals of the provinces are self-governing municipalities with officers elected by the inhabitants.

The functioning of the government in Costa Rica follows closely the constitutional provisions set down, and the popular suffrage, which in some countries on the Caribbean region is more an ideal than a reality, functions smoothly and effectively in Costa Rica. There is a high standard of public trust; the courts are independent of the executive; the highest offices are, in practice, confined closely to a group of the capable aristocracy and there is a very high feeling of public duty in the men holding such offices.

Education.—The concentration of population in the highlands favours a centralized and efficient school system, with the result that Costa Rica ranks among the leading nations of the world in public education. Illiteracy is the lowest in Hispanic America (less than 23%). The educational system is administered by the secretary of public education, aided by technical supervisors, 640 provincial and district boards of education, and local boards.


HOME OF A NEGRO LABOURER ON A BANANA PLANTATION

Elementary education, which is compulsory for children between the ages of 7 and 14 years, is offered by 671 public elementary schools, with an enrolment of 64,594 children (1939). Pre-school education is available through several elementary schools which have opened kindergarten classes, and at the normal school at Heredia, and several private institutions. A five-year course is offered by eight secondary schools enrolling over 2,000 students. The normal school, which in 1937 had an enrolment of nearly 500 students, offers a curriculum of teacher training, and usually meets the demands of the communities for teachers. Professional education is offered in the fields of law, pharmacy, dentistry, nursing, engineering and agriculture. The budget for 1937 allotted $921,816 for education, out of a total of $7,080,000.

San José is the site of a handsome opera house and of a national museum, where much of the prehistoric and recent Indian work of the aborigines is on exhibition, and where the collection of ancient pottery and of the fine gold ornaments for which Costa Rica is famous is a thoroughly representative one. A zoological exhibit is maintained in connection with the museum.


WOMAN CARRYING THE "METATE" OF BLACK VOLCANIC STONE ON WHICH SHE GRINDS LYE-SOAKED MAIZE FOR BREAD

Finance.—The currency unit is the colón. This was formerly stabilized at 24.97¢ U.S., but since 1932 has gradually shaded off in terms of U.S. money. The average exchange value through the year 1939 was 17.61¢ U.S. Its value is regulated through exchange control.

National revenues are derived from customs, liquor taxes, export taxes on coffee and bananas, State monopolies, including the Pacific railway, and miscellaneous sources. Customs receipts account for around 40% of the total, liquor taxes around 15%.

The 1939 budget called for a total expenditure of 31,299,000 colones, with an estimated deficit of 549,000 colones. Public works and agriculture were allotted 22%; education, 17%; public security, 9%; debt service, 17·9%; miscellaneous, 34·1%.

The public debt was $25,696,000 (1939), including an external debt of $8,131,720, £1,513,177, and 5,811,000 French francs. The external debt was in default beginning in 1932 and 1933. Government offers of a readjustment have been made, the last in March 1939, but have been rejected as unsatisfactory. Approximately $11,000,000 value of the Costa Rican national bonds was estimated to be held in the U.S. in 1939. U.S. direct investments in Costa Rica were estimated at $20,000,000 in 1933.

The Banco Internacional has resources totalling 28,259,890 colones, and a capital of 2,792,471 colones. The Banco de Costa Rica, founded in 1877, has a capital of 2,000,000 colones and resources of 16,679,479 colones. The Banco Anglo-Costarricense, founded in 1863, has a capital of 1,200,000 colones and resources of 4,110,000 colones.

Defence.—Costa Rica has constitutional provisions for the compulsory service of all able-bodied male citizens between 18 and 50, in time of war. Its army numbers some 2,500, but the militia has an active service branch, and the national guard includes all able-bodied males. This is estimated to number about 36,000 on a war footing. There is a naval unit and a skeleton navy on paper.

Agriculture.—Coffee, bananas, and cacao are the basic agricultural products, and comprise around 95% of the country's exports. The total area devoted to agriculture is estimated at over a million acres. A distinctive feature of Costa Rican agriculture is the prevalence of small landholdings.

Costa Rican coffee is regarded as being the highest quality, and commands a better price than do the coffees of most other countries. It is grown in the highland areas. The greater part of it, until very recently, was exported to Great Britain. Until the beginning of the present century coffee was the country's leading product, but with the development of bananas it fell to second place. More recently it has regained a precarious leadership, due to a decline in banana production. The 1938–39 coffee crop was officially valued at $4,644,301.

Costa Rica was the first Central American country to produce bananas for export, and formerly it was the leading producer in the Western Hemisphere. Development of plantations elsewhere and, since the 1920's, the ravages of the Panamá disease, which attacks the banana plant, reduced export production from a record of 11,170,812 stems in 1913 and 8,500,000 in 1926 to 3,000,000 in 1935. In 1938 5,011,000 stems were exported, and 3,429,787 in

1939. Recent increase is due to extensive development of new plantations on the Pacific slope, supplementing those on the Caribbean. The latter, however, still produce the great bulk of the supply. Plantations are located on the coastal lowlands.

Cacao production is still relatively small despite considerable recent impetus. Many abandoned banana plantations have been turned to cacao. Production in 1939 was 7,672,375kg. (1938, 5,533,016kg.).

Subsidiary crops are sugar cane, corn, beans, potatoes, and rice. Some miscellaneous tropical fruits are raised in small quantities.

Government policy is to encourage agricultural improvement by admitting new seeds and plants free of customs duty, and through scientific study. The cattle industry has been given similar encouragement. Cattle are raised chiefly for dairying purposes.

Mining and Manufacturing.—Mining is almost the only industry besides agriculture. Gold is by far the most important mineral, although some silver, manganese, mercury, and sulphur exist. Late in 1937 discovery of rich and extensive additional deposits of manganese was made in Guanacaste, the most westerly part of the country. The greater part of mining activity is in Guanacaste, where the important Abangárez gold fields are located. In 1934 the value of the gold produced was $436,510; and by 1938 it was in excess of $500,000. The mining industry is encouraged by the Government, which permits the importation of machinery, tools, and other equipment free of duty.

Some indications of petroleum have been found near Talamanca and Tilarán in the southern part of the country.

Manufacturing is confined almost entirely to articles of domestic consumption. There are approximately 6,500 industrial establishments, nearly all of them small. Their products include furniture and fine woodwork, tobaccos, and miscellaneous articles.

Foreign Trade.—The most important exports are, in order, coffee, bananas, and cacao. In 1938 total exports were $10,145,614 (U.S.), including 21,873,891kg. of coffee, $4,938,053; 5,033,424 stems of bananas, $2,808,547; 5,533,016kg. cacao, $829,955. Great Britain was formerly the heaviest purchaser of Costa Rican goods, taking an average of slightly over half in the period 1931–33, but the proportion of British purchases has now declined to an average of 20 to 25%.

Costa Rica's total imports in 1938 were valued at $12,621,000, with 49·1% from the United States and 19·8% from Germany. Great Britain's proportion, which was 15% in 1926, was 6·6%. Foodstuffs (largely wheat flour), textiles, and miscellaneous manufactured goods make up the bulk of the imports.

Foreign Trade of Costa Rica, 1931–33, 1937, and 1938
(values in 000's of dollars)

Country of origin or destination	Imports			Exports		
	1931–33 (average)	1937	1938	1931–33 (average)	1937	1938
United States	3,476	5,048	6,195	3,441	5,189	4,628
Germany	780	2,748	2,496	1,291	2,240	1,945
United Kingdom	806	927	831	5,739	2,306	2,477
France	179	159	165	55	299	113
Italy	161	301	286	25	228	..
Japan	113	977	782	..	72	119
Other countries	1,310	1,719	1,866	611	1,178	864
Total	6,825	11,879	12,621	11,162	11,512	10,146

Under pressure of wartime conditions exports in 1939 dropped to $9,086,000 (United States, 45·6%; Germany, 25·1%; Great Britain, 16·9%), while imports rose to $16,885,000 (United States, 58·8%; Germany, 17·7%; Japan, 5·1%; Great Britain, 4%).

Communications.—There are two principal ports, Puerto Limón on the Caribbean, centre of the banana traffic and terminus of the Costa Rica railway, and Puntarenas, on the Pacific, terminus of the electrified Pacific railway. Puerto Limón handles 60% of the export and 45% of the import traffic.

There are two principal railroad systems, the Northern, which controls the Costa Rica through lease, and the Pacific. The main line of the Northern system, the Costa Rica, connects Puerto Limón with San José, the capital, a distance of 103 miles. Various branches serve principally the banana area. The Pacific Electric railway, built and owned by the Government, provides communication from San José to the Pacific at Puntarenas, 73m. away.

In common with other countries of Central America, Costa Rica has been putting emphasis on highways during recent years. More than 1,800m. of roads serve to link together various parts of the country and are of increasing importance in the transportation of produce.

Important not only as an aid to transportation of goods, but for the possibilities it offers for a development of tourist trade, is the Inter American highway, which traverses the country. The highway, much of it at an elevation of around 10,000ft., is in process of improvement and completion. In 1939, 47m. were paved, and 66m. open during dry weather. An additional 243m. was still unimproved trail.

Air transport service to foreign countries is provided by the Pan American Airways system. Within the country regular lines connect San José with Puerto Limón, Puntarenas, and other cities.

The telegraphs are operated by the Government and reach virtually every town of the country, and connect with the services of the other countries of Central America, which can be communicated with at the low domestic rate. The Tropical Radio Corporation has a station at Puerto Limón, and the All America Cable reaches San José via both Puerto Limón and Puntarenas. There is an efficient telephone service in San José and between San José and Puntarenas. One of the banana companies maintains a private telephone line between San José and Puerto Limón and the local telephone service in the latter city.

History.—Costa Rica was discovered and probably named by Christopher Columbus, on his fourth and last voyage to America. On the Caribbean shore of Costa Rica the Spaniards found the first traces of the gold they sought, in the ear-rings and other ornaments of gold worn by the natives—ornaments that are still prizes for archaeologists and the subject of a long controversy as to origin and design. A settlement was planned, and a small group of Spaniards, headed by Bartholomew Columbus, brother of Christopher, was landed. It remained only a short time, however, and after attack by the Indians and the loss of a number of men, set sail and joined Columbus farther down the coast. The name of the country, Costa Rica, or "Rich Shore," was possibly the result of Columbus's discovery of gold, or of ear-rings, as a corruption of *Costa de oreja* might, as suggested by Col. G. E. Church (*q.v.*), well be the origin of the phrase "Costa Rica."

Costa Rica was, however, first called Nueva Cartago, prior to becoming a province of the captaincy-general of Guatemala, but, by 1540, the name Costa Rica had been generally adopted. The country had been conquered and pacified by the Spaniards by 1530, became a province in 1540, and its limits were surveyed and fixed between 1560 and 1573, under Juan Vásquez de Coronado, one of the few able and conscientious Spanish governors in the long history of the province. During the Spanish régime Costa Rica did not prosper, for the search for gold went on, and the Indians, enslaved and ill-used, died off rapidly.

Costa Rican independence dates from Sept. 15, 1821, and follows the general history of Central America in this regard, as in the various efforts at union (*see* CENTRAL AMERICA). The only serious external problems of Costa Rica since the independence have been its boundary disputes with its two neighbours. That with Nicaragua was finally submitted to the arbitration of the president of the United States in 1888, and the lines were finally settled by treaty in 1896 on the basis of his award. The charges of Costa Rica that the Bryan-Chamorro treaty between the United States and Nicaragua in 1916 violated its rights to the San Juan river (*see* CENTRAL AMERICA and NICARAGUA) were not based on a question of boundary lines but on Costa Rica's feeling that its rights to the river had not been taken into consideration when the United States paid Nicaragua alone the sum of $3,000,000 (U.S. cy.) for an option to a canal site utilizing that river. The boundary with Panama (originally with Colombia) is still in strong dispute. An arbitration award by the President of France in 1900, confirmed by the Chief Justice of the United States in 1914, was generally favourable to Costa Rica, but was rejected by Panama, which continued to hold part of the disputed area.

Finally, in 1921, Costa Rica attempted forcible occupation of the Coto region (on the Pacific coast), which had been adjudicated to her. Large scale hostilities were averted only by the intervention of the United States in support of Costa Rica's claim. Panama thereupon evacuated the Coto area, but relations between the two countries were broken until 1928, and the dispute continued. A treaty of settlement was made in 1938, but opposition in Costa Rica was so strong that it was withdrawn from congressional consideration unratified.

The internal political situation of Costa Rica has been almost uniformly peaceful, the exception being in 1917–19. In January of the former year, Federico Tinoco, by a *coup d'état,* forced out of office President Alfredo González, whose election had been so close that it had been decided by the congress. A new constitution was promulgated in June 1917 and Tinoco assumed the presidency under this new constitution. His Government severed relations with Germany September 21, and declared war in the following April. The United States, however, consistently refused to recognize the Tinoco Government, holding such action to be contrary to the Washington conference treaty of 1907, which pledged nonrecognition of revolutionary governments, and succeeded in having Costa Rica barred from the League of Nations for a time.

In 1919 a counter-revolution overthrew Tinoco. Julio Acosta was chosen president at the succeeding election, and was promptly accorded recognition by the United States. Under Acosta and subsequent presidents, Costa Rica acquired the reputation of being the most democratic and orderly republic of Central America, and one of the most democratic in the Americas. In 20th century Costa Rica, in striking contrast to other Central American States, military men as presidents have been the decided exception. President Acosta was followed in orderly succession by Dr. Ricardo Jiménez Oreamuno (1924–28), who had served one previous term, Cleto Gonzales Víquez (1928–32), Dr. Jiménez for a third term (1932–36), Dr. León Cortés (1936–40), and Rafael Calderón Guardia (1940–44). A literacy test for voters was adopted in 1920 and the secret ballot in 1925. At the outbreak of the European War in 1939, Costa Rica proclaimed her neutrality, but on Dec. 7, 1941, declared war on Japan, and followed on Dec. 11 with declaration of war against Germany and Italy.

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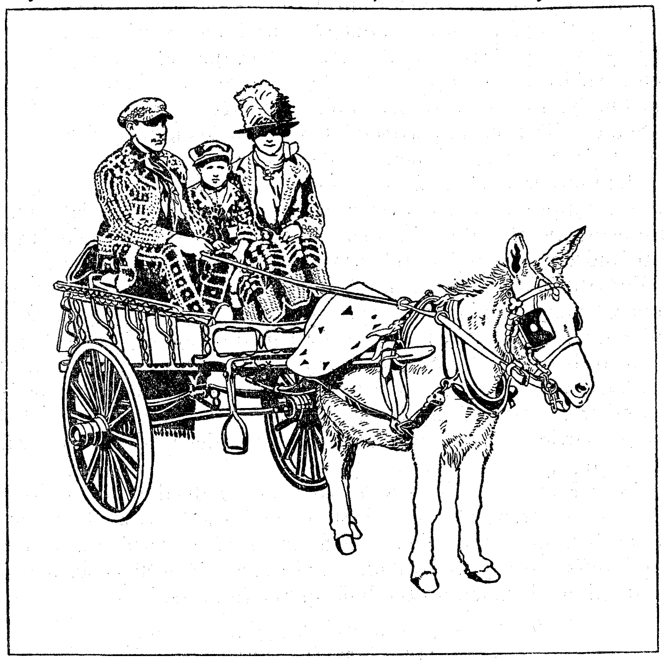
COSTELLO, LOUISA STUART (1799–1870), author and miniature painter, was born in Ireland in 1799. Her father died while she was young, and Louisa, who removed to Paris with her mother in 1814, helped to support her mother and brother by her skill as an artist. At 16 she published *The Maid of the Cyprus Isle, and other Poems,* and in 1825 *Songs of a Stranger.* Ten years later appeared her *Specimens of the Early Poetry of France,* illustrated by beautifully executed illuminations. In this she had the assistance of her brother, DUDLEY COSTELLO (1808–65), a well-known journalist and the author of several novels and books of travel.

It was dedicated to Tom Moore, and procured her his friendship as well as that of Sir Walter Scott. Among her numerous works are: *The Rose Garden of Persia* (1845), a series of translations from Persian poets, with illuminations by herself and her brother; *Clara Fane* (1848), a novel, and many excellent books of travel. She died in Boulogne April 24 1870.

COSTER, CHARLES THEODORE HENRI DE (1827–1879), Belgian writer, was born at Munich on Aug. 20, 1827. His father, Augustin de Coster, was a native of Liége, who was attached to the household of the papal nuncio at Munich, but soon returned to Belgium. Charles studied at the University of Brussels. Believing that Flemish manners and speech could not be rendered faithfully in modern French, he wrote his best works in the old tongue. The success of his *Légendes flamandes* (1857, 2nd ed., with preface by E. Deschanel, 1861) was increased by the illustrations of Félicien Rops and other friends (Eng. trans. by H. Taylor with wood cuts by Albert Destanche, 1920). In 1861 he published his *Contes brabançons,* in modern French. His masterpiece is his *Légende de Thyl Uylenspiegel et de Lamme Goedzak* (1867), a 16th-century romance, in which Belgian patriotism found its fullest expression. Uylenspiegel (Eulenspiegel) has been compared to Don Quixote, and even to Panurge. He is the type of the 16th-century Fleming, and the history of his resurrection from the grave itself was accepted as an allegory of the destiny of the race. The exploits of himself and his friend form the thread of a semi-historical narrative, full of racy humour, in spite of the barbarities that find a place in it. This book also was illustrated by Rops and others. There are English translations by G. Whitworth (1918) and by F. M. Atkinson (1922). In 1870 de Coster became professor of general history and of French literature at the military school. He died on May 7, 1879, at Ixelles, Brussels.

See C. Potvin, *Charles de Coster. Sa biographie, lettres à Elisa* (1894); H. Liebrecht, *La Vie et le rêve de Charles de Coster* (1927). In 1927 *Stephanie,* a drama in 5 acts, by De Coster, was published for the first time, with a preface by Camille Huysmans; it is dated 1878, but was probably a revision of an early play *Crescentius,* written in 1853.

COSTERMONGER, a street-trader who usually displays his wares on a barrow, but who sometimes uses a cart or "donkey-shay." In the London street markets, which are many and varied,



LONDON COSTERMONGER FAMILY OF THE VICTORIAN AGE
These costumes, with their rich embroidery of pearl buttons or "pearlies," are now used rarely, and only on festive occasions

the goods sold by costermongers cover a very wide range, including fruit, vegetables, fish, flowers, crockery, glassware, ironmongery, and even clothing and furs. In 1927 a licensing system was introduced to prevent abuses.

In familiar parlance, a costermonger is a "coster." The derivation is from costard-monger, one who in the old days sold costards, a species of large ribbed apple.

COST OF LIVING. Until recently the phrase "Cost of Living" was used only loosely by economists when the relation between movements of wages and prices was in question, but from 1914 onwards during the World War the need of a measurement of the rise of prices gradually resulted in making the expression prominent in industrial and statistical discussions. It has frequently been assumed that the term "Cost of Living" has a unique and definite meaning, and that accurate measurements can be applied to it, but in fact the meaning is vague and the statistical methods appropriate to it are complex and lead to results whose precision is not of a high order.

The phrase may be regarded as an abbreviation for "the cost in a defined region to persons of a defined social or industrial class of goods of a kind usually purchased at frequent intervals, by the consumption of which a certain standard of economic welfare is reached." We may usefully distinguish four cases:—(*a*) Where the standard is the physiological minimum necessary to maintain life, health and strength; (*b*) where some customary or average budget of expenditure is taken and the cost of the items in it is measured at different times or places; (*c*) where the items are varied but the whole contents of the budget result in an unchanged standard of welfare; (*d*) where both the contents of the budget are modified and the standard is raised or lowered. Case (*b*) is that which has in recent years been the subject of measurement, but case (*c*) is that which is in reality appropriate to the problem of measuring or adjusting real wages. Case (*d*) confuses two factors, the change of price and the change of standard.

I. GENERAL CONSIDERATIONS

The Physiological Minimum.—(Case *a.*)—Attention was directed by Mr. Seebohm Rowntree (*Poverty, A Study of Town Life,* 2nd ed. 1902) to the cost of obtaining in York (England) and elsewhere food, clothing, heat, light and shelter sufficient for a family to maintain itself in health and efficiency for work, when all possible economy was practised, subject to the availability of commodities and the legal requirements for housing, decency, etc. The minimum of food was computed in relation to the quantity of calories (or units of energy produced by the digestion of food), carbohydrates (heat-giving compounds), and protein (body-building compounds) calculated by Atwater and others as necessary for maintaining health and vigour under various conditions of life, and dietaries were drawn up which contained the necessary constituents at the minimum aggregate cost; to this cost was added the expenditure on clothing, fuel, cleansing materials, etc., and rent, which was found to be customary among persons in regular work at the lowest rates of wages for adult men. The most natural meaning of the cost of living is perhaps the cost of maintaining the minimum standard thus described, or a similarly computed minimum in other countries.

The standard is, however, not scientifically definite; apart from questions as to the validity and applicability of the measurement by calories, it is clear that there must be a great difference between the amount of food necessary for work of low and of high efficiency. For example, the Indian, Chinese and Japanese peasants live on a sparser diet and produce a lower output than English or American workmen. Two definable points are where efficiency is a maximum, which needs a more liberal diet than that considered by Mr. Rowntree, and where the value of additional efficiency exactly equals the cost of the additional food, etc., necessary, for whose ascertainment there are no observations; and Atwater's standard is in fact lacking in precision of definition, an arbitrary one (*see* Bowley, *Measurement of Social Phenomena,* chap. viii., 1915). If we drop the word "minimum" and speak of Mr. Rowntree's as a convenient and intelligible standard for demarcating poverty, we can properly measure the change in the cost of living at this standard (if the facts are ascertainable). The varying cost of the official civilian rations, computed in Germany *circa* 1919, gave a measurement similar to that described. The cost of Mr. Rowntree's standard, and one modified by Bowley, so as to correspond more closely with the dietary ordinarily followed by urban workmen (without increasing the "calorie" value) was worked out for certain English towns in 1913 (*Livelihood and Poverty*), 1915 and 1924 (*Has Poverty Diminished?* 1925). A legal minimum wage could be based on a standard thus defined, but in fact it is generally related to a higher conventional standard.

The Customary or Average Budget.—(Case *b.*)—The usual method of measuring the change of cost of living during and since the World War has been as follows: Detailed statements of expenditure having been obtained from a number of working-class households (in most countries at some date prior to 1914), an average budget is formed showing so many pounds of meat, bread, etc., with the prices and expenditure in considerable detail. The average prices of the same foods are ascertained from time to time, and the expenditure necessary to purchase the former quantities at the new prices is computed. The cost of living (so far as food is concerned) is then taken as having increased or decreased in the same ratio as this standard budget. In many countries a standard of the same kind is established for clothing, fuel, light, rent, cleansing materials and some other articles, and the cost of the aggregate, including food, is computed from time to time. The result obtained (if the process were complete) would be the relative cost of maintaining a defined standard constant in every detail. It is generally expressed as a percentage; thus if the costs were 25s. and 30s. at the two dates, the ratio is 100: 120, the index number at the second date is 120 and the percentage increase 20.

This method cannot be carried out in its entirety for two reasons, namely, lack of information and change of quality of the commodities in the market. In most countries data of expenditure and prices are only obtained for principal commodities (meat, bread, etc.), and not for those on which little is spent (currants, pepper, etc.), or in which the unit is variable (fruit, vegetables, etc.); but unless owing to shortage of supplies there is a run on the articles not included, these omissions cannot affect the result significantly. In some countries the expenditure is not known, but only prices; then the resulting calculation is generally valueless; and in others currency has been so variable that the computation has been meaningless. In nearly all cases there is no sufficient knowledge of expenditure on clothing either in total or in detail, and it is often difficult to obtain adequate data for fuel and light or for miscellaneous items. The sums included in the calculations, in fact, account for only a part of ordinary household expenditure, but where most care has been given to the question the part is a large proportion of the whole. Classes of expenditure that are not strictly necessary, such as amusements, tobacco, alcohol, etc., are generally omitted, as are occasional expenses (doctors, purchase of furniture, etc.), but in some cases subscriptions to trade unions, etc., insurance payments and travelling to work are included. The miscellaneous expenses omitted become a larger proportion of total expenditure as we go up the scale of incomes.

The difficulty due to the change of quality of goods which has been so marked since 1914 is even more fundamental. Over any long period the actual constituents and quality of a pound of bread, a cut of meat, a pair of boots, change considerably. From some points of view these gradual changes are not important; during the war, however, substitution of one commodity or ingredient for another was sudden and common, and the pre-War quality was unobtainable at any price, or if obtainable had a quite altered position in domestic economy. Consequently the prices included in the calculations were frequently not for the same things at different dates, and the precision of the measurement was greatly diminished. After the Armistice there was some return to former qualities, but the change has been sufficient to undermine the foundation of the numbers, and it is very desirable that a new investigation should be made to ascertain what modification in the basis is expedient.

It should be added that separate budgets ought to be formed (and in some countries have been formed) for different grades of income and for different classes of occupation, and also for single persons and for married persons with dependants.

The structure of the index-numbers of the cost of living on this basis may be illustrated by the details of the retail food index-number of Great Britain, whose origin and method are described in Section II., p. 503. In the table on p. 502 the first two columns give the commodities and quantities in the weekly budget which forms the basis, and the third column the basic prices. The next column (E) shows the cost of these quantities (Q) at these prices (P). The next (p) are the prices at a later date, which applied to the original quantities (Q) give the cost (e) of the same quantities at the new prices.

The total of the column E is the whole cost of the budget in July 1914, viz.: 216·4d.; the total of the column e is the cost of the same budget at the prices of October 1927, viz.: 343·3d. Since $\frac{343\cdot3}{216\cdot4}\times 100 = 159$ approximately, the latter cost is 159 per cent. of the former, that is 59 per cent. greater. The food index number for October 1927 is written 159, and frequently quoted as $\times$ 59.

The method is clearly exhibited by algebraic symbols. Write

TABLE I.—*Construction of Retail Food Price Index-number*

Article.	Basic quantities.	Average price, July, 1914.	Expenditure, 1914.	Average price, October, 1927.	Expenditure, 1927.	1927 price as % of 1914 price.	Relative expenditure, 1914.	
	Q	P	Q×P=E	p	Q×p=e	100p÷P=r	E÷216·4= E′	E′×r
Beef								
British	2·0 lbs.	8·1d.	16·2d.	12·3d.	24·6d.	152	·075	11·4
Imported	2·7 "	6·0d.	16·2d.	7·4d.	20·0d.	123	·075	9·2
Mutton								
British	1·0 "	8·4d.	8·4d.	13·4d.	13·4d.	160	·039	6·2
Imported	1·5 "	5·4d.	8·1d.	7·6d.	11·4d.	141	·037	5·2
Bacon	1·1 "	11·3d.	12·4d.	17·4d.	19·1d.	154	·057	8·8
Flour	9·0 "	1·5d.	13·5d.	2·5d.	22·5d.	167	·062	10·4
Bread	23·5 "	1·4d.	32·9d.	2·3d.	54·0d.	164	·152	24·9
Tea	0·8 "	18·5d.	14·8d.	29·0d.	23·2d.	157	·069	10·8
Sugar	6·1 "	2·1d.	12·8d.	3·8d.	23·2d.	181	·059	10·7
Milk	4·7 qts.	3·6d.	16·9d.	6·3d.	29·6d.	175	·078	13·7
Butter								
Fresh	0·9 lbs.	14·5d.	13·0d.	23·5d.	21·1d.	160	·060	9·6
Salt	1·0 "	14·0d.	14·0d.	22·3d.	22·3d.	159	·065	10·3
Cheese	0·8 "	8·8d.	7·0d.	13·9d.	11·1d.	159	·032	5·1
Margarine	0·9 "	7·0d.	6·3d.	7·6d.	6·8d.	109	·029	3·2
Eggs	10 (No.)	1·2d.	12·0d.	2·4d.	24·0d.	200	·056	11·2
Potatoes	17 lbs.	·7d.	11·9d.	1·0d.	17·0d.	143	·055	7·9
			216·4d.		343·3d.		1·000	158·6

Some of the entries above are approximate, and the Ministry of Labour also includes fish, whose price ratio (r) was 2·16, and arrives at the index-number 161 (to the nearest integer)

$Q, Q_2 \ldots$ for the number of lbs. of British beef, imported beef . . . , and $P_1P_2 \ldots$ for the number of pence per lb. Then $Q_1 \times P_1, Q_2 \times P_2 \ldots$ are the numbers of pence spent on these commodities, and $E = Q_1 \times P_1 + Q_2 \times P_2 + \ldots = 16{\cdot}2 + 16{\cdot}2 + \ldots = 216{\cdot}4$ pence is the total expenditure in 1914. Similarly, if $p_1, p_2 \ldots$ are the price in pence in 1927, $e = Q_1 \times p_1 + Q_2 \times p_2 + \ldots = 24{\cdot}6 + 20{\cdot}0 + \ldots = 343{\cdot}3$ pence is the total expenditure in 1927. Then $(e \div E) \times 100$ is the index-number (158·6). In fact the number is more readily computed by working in price-percentages, r. Express p_1 as a percentage of P_1, thus $r_1 = 100p_1 \div P_1$ and so for each commodity. Also express each item of the expenditure in 1914 proportionately to a total 1, so that the column E is obtained, where the first entry is $16{\cdot}2 \div 216{\cdot}4 = {\cdot}075 = E_1$, the second $16{\cdot}2 \div 216{\cdot}4 = E_2$, etc.

Then the index-number $\frac{e}{E} \times 100 = \frac{Q_1 \times 100p_1 + Q_2 \times 100p_2 + \ldots}{Q_1 \times P_1 + Q_2 \times P_2 +}$.

But $100p_1 = P_1 \times r_1$, $100p_2 = P_2 \times r_2 \ldots$ $\therefore$ The index-number $=$

$$\frac{Q_1 \times P_1 \times r_1 + Q_2 \times P_2 \times r_2 + \ldots}{Q_1 \times P_1 + Q_2 \times P_2 + \ldots} = \frac{E_1 \times r_1 + E_2 \times r_2 + \ldots}{E} =$$

$$E_1 \times r_1 + E_2 \times r_2 + \ldots = 158{\cdot}6, \text{ since } \frac{E_1}{E} = \frac{16{\cdot}2}{216{\cdot}4} = E_1, \text{ etc.}$$

By this method the quantities $E'_1, E'_2 \ldots$ are computed once and for all, and the price-percentages being obtained for each month the index number is very rapidly calculated.

In the official measurement in Great Britain only the quantities E′ and r are in fact used; this method is very convenient in dealing with rent (for which there is no natural unit of quantity) and with clothing (for which a general price ratio is obtained without any definition of unit). The general theory of weighted averages shows that a considerable roughness in the estimation of the smaller expenditures is smoothed out in the process of averaging, but that it is important to obtain precision in the case of large items, such as clothing, treated in a single entry, and rent. It is important, however, that the r's should be accurately known when they differ much from one another, and the quality of the commodities that are priced should be the same at both dates.

The index number for the second date is $\frac{e}{E} \times 100$, and the percentage increase is $\left(\frac{e}{E} - 1\right) \times 100$.

Variation in Detail on an Unchanged Standard.—(Case *c.*)—It must be granted that when the cost of living is compared at two places or at two dates we ought not to assume that it is possible to purchase the same quantities of commodities of precisely the same quality in both cases, and in order to make a strict numerical comparison we need a test of equality of standard, and it is also expedient to devise a method of measuring the relation between two standards. The problem so stated has not yet been completely solved. A measurement could be made on a strictly nutritive basis and the cost of purchasing in the most economic way the amount of calories (including the necessary protein) considered proper to health and efficiency could be ascertained in both countries or at both periods; but this would only give a theoretic solution, since it ignores the influence of custom and taste in diet, and, in fact, in developed countries relatively few people have been compelled to purchase their nutriment in the cheapest possible way. The actual practical question in Britain in 1921 was, what was the cost of maintaining the pre-War standard of living in nutritive power and in satisfaction or pleasure derived from food and clothing, allowance being made for changes in prices and available qualities. This statement introduces the vague word *satisfaction,* which it is not practicable to define exactly, though some mathematical methods based on economic principles have been suggested for ascertaining its equality in two cases.

One method would be to frame a new budget of goods obtainable and in fact purchased by housekeepers with the same skill of adjusting purchases to desires as in the case of the earlier budgets. This would mean obtaining from representative working-class women a budget which in their opinion would now give the same variety and pleasure as a selected budget of 1914, care being taken that the energy value is the same. The result would be a new conventional budget, the ratio of whose cost to that of the pre-War budget would give a rough measure of the cost of living (*cf.* Bowley, "Measurement of cost of living," *Journal of the Royal Statistical Society,* May 1919, p. 354; and "Cost of living and wage determination," *Economic Journal,* March 1920, p. 117).

Another method was used in the British Board of Trade's investigation into the cost of living in Great Britain, United States, France, Belgium and Germany, which was initiated in 1905 (*cf.* official papers Cd. 3864, Cd. 4032, Cd. 4512, Cd. 5065, Cd. 5609). A comparison was made of the cost of living in Great Britain and in each other country on a double basis as follows: It was found that an English housewife purchasing in 1909 in the United States a week's supply of food as customary in England, would have spent 38% more in the first-named country, the ratio of the costs of living being on this basis 100:138; on the other hand, an American housewife purchasing in England a week's supply of food as customary in the United States would have found her expenses reduced in the ratio 125:100 (Cd. 5609, pp. lxvi., lxvii.). If these ratios had been reciprocal either would measure the differences in the cost of living (so far as food is concerned); as it is, their divergence illustrates the want of definiteness in the problem.

Another method gives, perhaps, the most practical solution, and its theoretic basis is shown in the *Economic Journal,* June, 1928 (Notes on Index Numbers). Obtain typical budgets of expenditure at two dates; compile a new or mean standard of quantities which, item by item, are the averages of the entries in the budgets. Thus, if in one the consumption of 33 lb. of bread is stated, in the other 35 lb., enter 34 lb. in the mean standard; now find the cost of the mean standard at each date and take the ratio of these costs as the measurement of the change in the cost of living.

If all prices rose in the same ratio the methods now described would necessarily yield the same results; the need for choice arises from inequalities of increase, which in some cases are very wide. Now if at one date purchases are made so as to maximise the satisfaction in the outlay of the week's housekeeping allowance, as we may reasonably assume, and prices rise irregularly, it is evident that somewhat less will be bought of the commodities which have risen most and more of those which have risen least if a maximum is still obtained, and that consequently the increase in the expenditure necessary to obtain the same satisfaction as before is less than the increase if exactly the same quantities had been purchased. For example, if oranges are doubled in price and bananas increased only one-half, more bananas and fewer oranges will be purchased.

Variations in Content and in Standard.—(Case *d.*)—The problem with which many countries were faced in 1920 and 1921 was in reality not that of preserving a standard of living on the level of 1914, but of adapting themselves to a lower average standard, whatever the fortunes of favoured classes. This may be illustrated by the arrangement of the salaries of civil servants in England in Feb. 1920. At that date the official measurement (on method *b*) of the increase in the cost of living over 1914 was 130%. The full increase of 130% was awarded to persons with a wage of 35s. weekly (£91 5s. per annum) or less, 60% was added to any excess of salary up to £200, and 45% to any excess over £200. Thus a man whose salary was £400 on the pre-War basis received an addition of £273⅞ (130% on £91 5s. = £118⅝, 60% on £108 15s. = £65¼, 45% on £200 = £90), about 68% in all. This increment was increased or decreased by one twenty-sixth part for every complete movement of five points in the official index number averaged over certain periods. It appears to have been assumed on the one hand that the expenses of the middle class had not increased so much as indicated by the index number based on working-class expenditure, and on the other that the standard of living must be lowered—the higher the income the greater the fall. A similar scale was adopted at nearly the same date for railway officials.

In this way we are led to consider a conventional standard of living which changes from time to time. When there is no reference to a physiological minimum, the cost of living may be regarded as the cost of maintaining the standard customary to the social or occupational class concerned at a given time and place. In this sense the cost of living of Chinese labourers is lower than that of the Americans, though they pay the same prices for commodities. When "cost of living" is used in this sense it should always be accompanied by a description of the standard attained. Thus the British Committee on the Cost of Living in 1918 (Cd. 8980) estimated the average expenditure of working-class families in 1914 and 1918, and at the same time reported on the change of standard. In some of the statistics quoted below a conception of this kind is involved in the figures.

II. CONDITIONS IN VARIOUS COUNTRIES

Great Britain.—Throughout Great Britain the basis of the official measurement of the cost of living is that of finding the cost of a standard budget of expenditure at various dates (see *Report on Working-Class Rents and Retail Prices,* Cd. 6955 of 1913, pp. 299, *et seq.,* and *Labour Gazette,* Feb. 1921). The standard budget was obtained from a collection of 1,944 records of weekly expenditure made in 1904; the average weekly family expenditure was 36s. 10d., of this 22s. 6d. was spent on food, and of the food 18s. 6d. is accounted for in the standard used prior to the War. A somewhat altered basis was taken in 1914. Rice, tapioca, oatmeal, pork, coffee, cocoa, jam, treacle, marmalade, currants and raisins (the expenditure on all of which was about 2s. 1d. in 1904) were omitted and fish and margarine added (an addition equivalent to 6d. in each case). It was assumed that, though prices had increased between 1904 and 1914, the relative expenditure (which alone enters into the computation) on the different commodities was unchanged; this assumption is too rigid but not unreasonable, and the facts otherwise known about price movements and consumption show that the error introduced is insignificant.

Relative importance being determined, the next step was to ascertain the movement of prices. Prior to 1914 the records were obtained exclusively for London, but it was shown (Cd. 6955, pp. 299 and 306) that from 1907 to 1912 the average movement was very nearly the same in provincial towns as in London. From Aug. 1914 statements of prices were obtained for 650 towns and villages.

The index numbers of the cost of living, so far as food is concerned, were then obtained by the method *b* described above; prior to 1914, the year 1900 was taken as base, and the prices then equated to 100; from the beginning of the War, July 1914 was taken as base.

There are certain weaknesses in the method. It is assumed, without explicit evidence, that expenditure on meat was in the proportion 2s. on beef to 1s. on mutton, and that British and foreign meat were of equal importance, while the price ratios taken for meat are for four selected joints only; during the period 1915 to 1919, when the relative quantities available varied and relative prices were altered, these assumptions affect the index numbers. The weight assigned to margarine is arbitrary. The number of eggs consumed (about 12 per household per week) is based on summer records and is no doubt higher than the average for the year.

Rent, Clothing, etc.—Next in importance to food comes rent. The figure included in the index number allows for such increases for rates, repairs, etc., as are legally permissible and is accurate for persons who by remaining in the same house since 1914 have the benefit of the Rents Restriction Acts; the increase for those who have moved must have been variable and for it no estimate is available.

The cost of clothing, which ranks next to rent in expenditure, is always awkward to measure owing to the difficulty of defining the garments or stuffs purchased, and of assigning their relative importance in the budget, and also there was great variability in the qualities in the shops during the period 1921. The difficulties can be understood by comparing the estimates and method of the Cost of Living Committee (*loc. cit.,* pp. 21–3) with those of the official index number described in the *Labour Gazette,* April 1921, pp. 178–79; the former found an increase of 96% between July 1914 and the summer of 1918, the latter reached increases of 210% in June and 240% in Sept. 1918. The differences are partly attributable to the great variability of the increases among the articles in consequence of which the relative importance given to each has great effect, and in this respect the committee's measurement was the more systematic; and partly due to the difficulty of obtaining quotations for the same qualities of goods or in allowing for substitution. The question is too intricate to discuss here; it can only be suggested that the results have little precision, and that the process of obtaining an estimate based on a new budget in which modifications of custom are allowed for is even more necessary than in the case of food.

Fuel and light present little difficulty when a general average for the country is in question since the retail prices of coal and of gas are ascertainable. The variations from north to south in price and consumption and that between winter and summer are not very important, since where coal is dear gas is used for cooking, and in working-class households one fire is necessary throughout the year for cooking and this also provides heat.

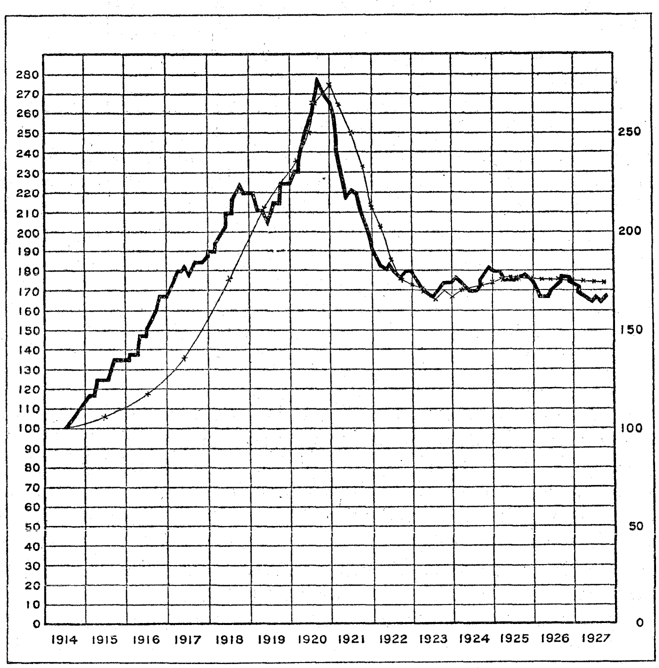
The official index number allows only one-twelfth of the weekly expenditure for all items not already included, or about 1s. 6d.

TABLE II.—*Structure of Cost of Living Index-number. October 1927*

	Relative importance.	Index-numbers October 1927 (July 1914=100).	Products.	Illustrative working in money. Weekly expenditure in 1914.	Per cent increase.	Weekly expenditure in 1927.
				s. d.		s. d.
Food	60	161	9,660	22 6	61	36 2½
Rent	16	151	2,416	6 0	51	9 1½
Clothing	12	215	2,580	4 6	115	9 8
Fuel and light	8	170	1,360	3 0	70	5 1
Sundries	4	180	720	1 6	80	2 8
	100	167	16,736	37 6	67·4	62 9

per household in 1914. This sum is exhausted by cleansing materials with a very small margin for tobacco, newspapers, household replacements and fares. Insurance and trade-union subscriptions are not included, nor is alcohol.

The five classes of expenditure now named are combined in



COST OF LIVING AND WAGE-RATES IN GREAT BRITAIN, 1914–1927
The heavy line shows the Ministry of Labour's cost of living index-number. The light line represents approximate index-numbers of average rates of wages for the normal week. Actual earnings, including overtime and other additional payments, rose more than wage-rates during the war

the following proportions, stated for clearness on the basis of a pre-War urban weekly expenditure of 37s. 6d. Food 22s. 6d., rent (including rates) 6s., clothing 4s. 6d., fuel and light 3s., sundries 1s. 6d. Here the proportions on food, rent and light rest on good evidence; that on clothing, for which the expenditures vary greatly according to the income and personnel of the family and for which there has never been a satisfactory investigation, is little more than a guess based on vague estimates; that on sundries is the residuum when other expenses are met and is probably too low.

The results for selected dates are as follows:—

TABLE III.—*Official Measurement of Cost of Living in Great Britain*

	Food.	Rent.	Clothing.	Fuel and light.	Sundries.	All combined.
Relative importance.	60	16	12	8	4	100
July 1914	100	100	100	100	100	100
July 1919	209	(*)	(*)	(*)	(*)	207
Dec. 1919	234	(*)	(*)	185	(*)	225
July 1920	258	117	430	230	220	252
Dec. 1920	282	142	305	240	230	269
July 1921	220	145	290	260	210	219
Dec. 1921	195	155	255	230	200	199
July 1922	180	153	240	190	195	184
Dec. 1922	178	150	225	187	180	180
July 1923	162	147	220	182	185	169
Dec. 1923	176	147	220	180	180	177
July 1924	162	147	225	185	180	170
Dec. 1924	180	147	227	185	180	181
July 1925	167	147	230	180	180	173
Dec. 1925	174	148	225	180	180	177
July 1926	161	150	220	195	180	170
Dec. 1926	169	150	217	250	180	179
July 1927	159	151	212	170	180	166
Dec. 1927	163	151	215	170	180	169

*Not stated separately at these dates.
The statistics are for the beginning of each month.

These numbers, corresponding to those in the last column month by month are shown in the diagram, and with them a rough index of average wage movements. The latter differs in many ways from a complete account of earnings, which should allow for many other factors, but serves to show the relation of the movements of time-wages (and some price-earnings) in the normal working week.

It is probable that the increase in cost was exaggerated, at least to the end of 1920, owing to evasion of the higher prices by the substitution of cheaper articles, without lowering the general standard obtained. From 1921, however, supplies have been adequate and the final change in the composition of the budget can hardly have reduced the number effectively by more than five points. The winter is higher than the summer number, partly owing to seasonal dearness, partly owing to the assumption that eggs, etc., are bought in the same quantities winter and summer. On the average the July number is about 2% below the average for the year. For fine measurements this variation should be taken into account, but in fact the index-number is not

TABLE IV.—*Index-number of Retail Prices of Food, Expressed in the Currencies of the Countries*

	1914.	1919.		1920.		1921.		1922.		1923.		1924.		1925.		1926.		1927.
	July.	July	Dec.	July	Dec.	July	Dec.	July	Dec.	July	Dec.	July	Dec.	July	Dec.	July	Dec.	July.
Great Britain	100	209	234	258	282	220	195	180	178	162	176	162	180	167	174	161	169	159
France, Paris*	100	261	285	373	424	306	323	397	305	321	365	360	404	421	463	574	599	557
Italy, Milan	100	310	395	445	535	506	567	492	513†	496	500	508	579	602	660	654	631	524
Switzerland	100	..	..	..	..	210	189	157	155	164	167	168	170	167	163	157	157	155
Denmark	100	212	..	253	..	236	191	184	180	188	194	200	215	210	177†	159	156†	153
Sweden	100	310	..	297	..	252	..	179	168	160	164	159	172	169	164	156	157	151
Norway	100	289	299	319	334	295	268	233	215	228	226	248	274	260	221	198	184	175
United States	100	186	193	215	175	145	147	139	144	144	147	140	149	159	163	154	159	150
Canada	100	186	199	227	200	148	148	138	140	137	145	134	142	141	161	151**	153†	149
British India, Bombay	100	..	..	188	..	174	176	160	157	148	152	151	156	152	151	155	154	154
South Africa	100	139	170	197	188	139	125	116	118	116	118	117	121	120	116	116	117	119
Australia	100	147	158	194	184	161	143	148	146	164	156	149**	148	156	156	159	158	152
New Zealand	100	144	155	167	179	164	150	144	139†	142	147	148	150	151	154†	149	149	144

*Fuel and lighting included. †These numbers refer to the Jan. following. **For June.

precise within, say, five points, even for the most general purposes, and still less is it a perfectly accurate measurement of the change in the cost of living in particular localities or occupations.

Other Countries.—It is only possible in the space available to state without analysis the official statistics of the movements of retail prices of food. In other countries, the numbers are subject to the same want of precision as in Great Britain and are compiled in a similar way. They represent the cost of purchasing from time to time a defined and unchanged ration estimated as typical of pre-War working-class consumption. These numbers are currently summarised in the *Ministry of Labour Gazette* (London), the *Labor Review* (Washington), and the *International Labour Review* (Geneva), and for each country in its official publication.

The prices are, of course, strongly affected by the relative value of the currencies in the countries. The result of expressing them on a gold basis may be illustrated as follows, July 1920 being selected as near the date of the maximum of prices:—

TABLE V.—*Retail Food Index Numbers*

	July 1920.			July 1927.		
	Index in Currency.	Currency as % of par.	Index in gold.	Index in Currency.	Currency as % of par.	Index in gold.
Great Britain	258	76·6	198	167	100	167
Paris	373	39·4	146	557	20·3	113
Milan	445	27·6	123	524	29·0	152
Sweden	297	79	234	151	100	151
United States	215	100	215	150	100	150

Thus, if an American had gone to Paris in July 1927 with $113 he could have converted them into as many francs as would buy the food that cost $100 in Paris in July 1914. In New York he would have needed $150 to purchase food that cost $100 in July 1914. The great variation in the index from country to country, even after conversion to a gold basis, is noticeable. The increase is generally the less the greater the depreciation of currency. (*See* INDEX NUMBERS; PRICES; WAGES.) (A. L. B.)

UNITED STATES

History.—The first comprehensive cost of living study made in the United States was carried out by the U.S. Bureau of Labor in 1890 (see *Sixth Annual Report of the Commissioner of Labor, 1890*, Washington, D.C., 1891). Information relating to incomes and expenditures was collected from 3,260 families, including 16,581 persons. The heads of the families studied were employed in the iron, steel and related industries. In the year 1891 another cost of living study was carried out by the bureau (see *Seventh Annual Report of the Commissioner of Labor, 1891*, Washington, D.C., 1892). This study included 5,284 families, with 27,577 members. The cotton, woollen and glass industries were covered. In 1901 and 1902 the U.S. Department of Labor, as it was then called, made another study of the cost of living, dealing with 25,440 workingmen's families, with 124,188 members. The leading industries in all the principal industrial centres of 33 States were covered.

During the first half of 1916, the Bureau of Labor Statistics, by direction of Congress, made a study of the cost of living of wage earners in the District of Columbia. The results of this study, showing incomes and expenditures of workers' families and of single women workers, were published in a series of articles appearing in the *Monthly Labor Review* of the U.S. Bureau of Labor Statistics, Oct. 1917 to April 1918. The latest comprehensive study of the cost of living by the bureau was begun in 1917 for the Emergency Fleet Corporation of the U.S. Shipping Board. This study covered 35 ship-building centres, and was extended during 1918 and 1919, for the use of the War Industries Board, to include 92 cities and towns in 42 States. The results of these latest studies by the bureau were published as soon as completed in the *Monthly Labor Review* (March 1918 to Aug. 1919). *Bulletin No. 357* of the bureau gives the tabulations of incomes and expenditures by income groups for 12,096 families of 59,270 persons. The quantity as well as the cost of every item purchased by each family for an entire year was obtained. The average quantity of each item purchased was computed for all families in all the cities.

These average quantities, classified into six major groups, constitute the average quantity family budget for the 92 cities studied in 1917–19. This quantity budget was and still is the basis for calculating the bureau's index numbers of costs of living and changes therein.

In 1934 to 1938 the bureau completed two country-wide studies of incomes and expenditures of wage earners and lower-salaried workers. One included some 16,000 families in 55 cities; the other covered more comprehensively 32 cities. Only three cities were included in both studies. Several important special studies of expenditures and budget costs have also been made. In 1935 the bureau co-operated with the Works Progress Administration in compiling the monograph, *Intercity Differences in Costs of Living*, based on the pricing of a theoretical "maintenance budget" in 59 cities. These later studies have apparently been used to supplement, not to supersede, the studies of 1917–18. The bureau still uses, with some necessary modifications, the average quantities of 1917–18.

The aim is to price a list of goods as nearly identical as possible at different times so as to show by index numbers relative changes in *costs* of goods and not relative changes in *quantities, qualities* and *kinds* of goods.

However, new qualities of goods are substituted for those displaced and new articles, such as automobiles, radios, electric refrigerators, rayon garments, are added to bring the workers' budget up to date.

During and immediately following the World War, many companies established systems of wage adjustments on the basis of changes in the cost of living. Some of these companies made more or less complete surveys periodically in order to determine the extent of changes in the cost of living. Since the crisis and depression of 1920–21, most of these cost of living wage systems were given up, partly because of the difficulty of persuading the workers that the cost of living had fallen and that therefore their wage rates should be correspondingly reduced, but principally because employers felt that "wages should be deflated" and that wage rates could again be determined by "supply and demand" with little regard for cost of living. One of the most successful of these wage adjustment plans based on cost of living was established in 1925 for the employees of the Philadelphia Rapid Transit company and operated satisfactorily for several years.

Methods of Collection.—Both the intensive method and the extensive method have been employed to gather cost of living data. (1) By the intensive method a small number of families is selected and their incomes and expenditures are studied with great particularity over a few weeks or, at most, a month or two. (2) By the extensive method a large number of families are included, and an estimate of their expenditures for different items over a period of an entire year is secured so as to get the variations in expenditures from season to season.

The first method has the great advantage of greater intimacy of contact and therefore greater accuracy for each budget. Its great disadvantage is that it is unavoidably very limited in the number taken as a sample to represent the whole. It is likely to misrepresent the incomes and expenditures of the classes and occupations it purports to represent, not only because the number studied is small but also because the period covered by the study is so short. Families which are willing and able to report detailed information over a considerable period are hardly typical of workers or any other class. The advantages of the second method consist in the larger numbers included and the longer period of time covered by the budgets. The different classes and occupations in the community and country are, therefore, better represented, as also the variations in incomes and expenditures in winter as compared with spring, summer and autumn. The great disadvantage of this method is the impossibility of securing accurate records of expenditures over so long a period as one year. There is no apparent reason why errors in estimates of expenditures should counterbalance each other. Intensive studies and checks made by the U.S. Bureau of Labor Statistics, however, show that these errors do cancel to a large extent, so that the results shown by the extensive budget studies made by that bureau may be taken with confidence as truly representative of the incomes and expenditures of working-class families of the income groups specified in the different cities studied.

Purposes.—The earlier cost of living studies, in America as elsewhere, were made primarily for the purpose of ascertaining the actual amounts expended by workers' families for food, clothing, rent and other necessaries and comforts; the degree of well-being enjoyed by the workers, and the adequacy or inadequacy of the wages of the principal bread-winner to pay for the things needed to maintain his family at the standard of comfort commonly accepted by the workers in his craft or class. The "fair living wage" was the goal sought by all these investigations. In the United States the competition of various races caused a good deal of attention to be directed to the study of differences in racial standards of consumption. These studies showed what was already known, that a living wage to a foreign-born family was not a living wage to an American family and that the living standards of the earlier immigrant races were higher than those of the later arrivals.

The cost of living studies made before the World War supplied some valuable information as to the conditions of life among the labouring classes. Above all, they blazed the trail and made possible the more detailed and specific studies which have followed. The obvious criticism which applies to them all is that the information obtained was inadequate for the accurate determination of the degree of comfort and well-being enjoyed by the workers in the different income groups. Furthermore, these early studies supplied the quantities and descriptions of things consumed only in the case of foods. It was, therefore, impossible to calculate accurately changes in the cost of living. An average cost of living budget, expressed in dollars instead of physical units of quantity, is of little value for determining whether the lot of the workers has improved or sunk lower with changing prices, wage rates and incomes. In fact, very little use was made of these studies in wage disputes.

During the period of rising prices from 1897 onward, the demands of the workers for increased wages to offset increases in prices were frequently met by the statement that the workers' difficulties in making both ends meet were due not so much to the "high cost of living" as to the "cost of high living." This assertion that family expenditures were increasing because of the growing and extravagant demands of the workers and their families could not be answered by any cost of living data at that time existing. In the study made by the U.S. Bureau of Labor in 1900 and 1901, the food budget was itemized and the actual quantities purchased by each family were ascertained for nearly 80% of the total spent for food. From these facts a quantity food budget for the average workingman's family was compiled. Beginning with 1904 retail prices of food commodities have been published by the Bureau of Labor. These prices were weighted by the quantities of each article consumed by the average family as shown by the 1901 study. Thus a fairly accurate measure of the change in the cost of the food budget as it existed in 1901 was obtained.

The other items of the family budget, however, were not given quantitatively, so that changes in the cost of living could only be estimated from changes in the cost of the food budget alone. In making such estimates, some assumed that the cost of all items in the family budget changed in the same degree and in the same direction as food prices; others assumed that only food prices changed and that all other items in the worker's family budget remained stationary; still others assumed that food prices increased more rapidly than the prices of other articles of consumption, and compromised by assuming that all items other than food increased only half as much as food.

The Quantity Budget.—As a result of the price upheavals of the World War, measurement of changes in the cost of living became of first importance. As a foundation from which to calculate these changes, it was necessary, of course, to make a new budget study which would give, accurately enough for statistical purposes, actual quantities of the different kinds of food, clothing, houses, fuel and lighting, furniture and house furnishings and miscellaneous items consumed by workers' families in the different income groups. Starting with this quantity budget representing consumption by the average worker's family, it is possible to calculate the effect upon the cost of the total budget of changes in the prices of the various items which constitute this budget.

The facts were gathered through personal visits by experienced agents. The schedules of inquiry listed the articles of family consumption in minutest detail. Quantities, costs and prices were obtained for all articles, so far as possible. The costs of clothing, furniture and other durable articles were distributed over the entire lifetime of the articles and the annual costs computed. For example, a suit of clothes costing $30.00, estimated to last three years, would be entered as an annual charge of $10.00. The food schedule contained approximately 150 separate articles of food. Annual rents or costs of occupancy of all varieties of dwellings were obtained. Probably not less than 40 different types of house or flat were scheduled. One hundred and forty-four types of articles of wearing apparel were listed on the schedule of inquiry. Of course a much larger number of specific grades and qualities were recorded by the agents in the survey. The quantities and costs of all kinds of fuel and lighting consumed were scheduled. Probably not less than 20 specific varieties of coal, coke, wood, gas and electricity were included. Sixty-two classes of household furniture and furnishings were designated in the schedule. The cost of probably more than 150 different grades and qualities of these articles was obtained. Sixty-two different items were included in the miscellaneous schedule. The cost of many of these items can be expressed only as a lump sum of money. No quantity figure is obtainable. For example, school expenses, medicines and most other expenses for health, vacations, travel, church, charity and various kinds of contributions can be expressed only as specific sums of money or fractional parts of the total expenditure of a family.

All told, the prices, quantities consumed, and annual costs were obtained for approximately 550 to 600 different grades or descriptions of articles and services consumed in 12,096 workers' families.

Changes in the Cost of Living.—It is not necessary to make a new budget study in order to ascertain percentage changes in the cost of living. Once a representative average quantity budget is established, it is theoretically easy to compute changes in the cost of such a budget by collecting, for a given date, the retail prices of all the articles making up the budget, weighting each price by the quantity of the article consumed and adding these products to get the cost of the total budget for the given date. Practically, there are many difficulties. First, the cost in time and money would be prohibitive if retail prices of every article in the budget were to be obtained. Hence, only the more important articles in each group are selected to represent family consumption for the whole group. For example, prices of 84 standard articles of food, weighted by expenditure for 126 different foods, are now taken to represent the food budget; only 68 different articles of clothing represent more than 140 types of clothing used. Instead of going to the expense of pricing some 600 separate budget items, it has been found sufficient to gather prices for only 218 items, exclusive of rentals.

The price of each of these representative articles is weighted by the quantities which the given article represents in the total average family budget.

Second, it is not practical, because of expense, to include all of the 92 cities and towns covered by the budget survey of 1918. Food prices are obtained from 51 cities while prices of other budget items are obtained from only 32 cities. To obtain group aggregates, the average cost of each of the six groups, as found by the periodic retail price surveys, is multiplied by the percentage which the given group bears to the cost of the complete budget of 1917–19. These six group aggregates are totaled to obtain the aggregate average cost of the entire budget as of the date of the retail price survey. These budget aggregates are converted into cost of living index numbers on the base 1923–25, by dividing each aggregate by the aggregate for 1923–25.

Revised Methods of Computation.—To make the budget more representative of present day consumption by workers, the bureau in 1935 introduced certain changes in the method of computing cost of living indexes based on the obsolete data gathered 20 years ago under war conditions. (See *Monthly Labor Review*, September 1935, pp. 819–837.)

First, the food budget has been revised by securing retail prices for some additional foods, mostly fruits and vegetables. An improvement has also been made in the method of distributing the consumption weights of the entire 1917–19 food budget (consisting of 126 items) among the 84 foods priced in the monthly retail price survey.

Second, the weights ascribed to the six major groups have been revised with the view of representing more accurately the percentage distribution of the cost of each group in the year 1913, the base year for the cost of living indexes.

The percentages for the several groups are computed from the aggregate costs of the articles in the groups. The old and the new weights are given in Table VI.

TABLE VI.—*Percentage Distribution of Cost of Goods Purchased by Wage Earners and Lower-Salaried Workers in the United States*

	Percentage distribution of cost of goods purchased in—	
	1913[1]	1917–19[2]
Food	34·8	38·2
Clothing	13·7	16·6
Rent	21·2	13·4
Fuel and light	5·6	5·3
House-furnishing goods	4·0	5·1
Miscellaneous items	20·7	21·3
All items	100·0	100·0

[1]Computed from expenditures shown by the investigation of 1917–19 and changes in costs between 1913 and the time of that investigation.

[2]As previously used in weighting the cost-of-living indexes.

Compiled from *Monthly Labor Review*, Sept. 1935, p. 826.

Third, a new and commendable system of weighting costs for different geographical areas according to the population of each area was introduced. Aggregate costs for each group are computed for the principal cities and these group costs are multiplied by figures representing the population, not of the particular city, but of the adjacent area in which prices are assumed to move similarly. The base period of reference has been changed from 1913 to the period 1923–25.

Table VII gives the revised indexes. Between 1913 and 1938 the food index advanced 25%; clothing, 48%; fuel and light, 61%; house furnishings, 77%, miscellaneous, 77%; rents only 13%, and the entire budget, 45%.

These average changes in the cost of the different groups and of the entire budget have all the demerits of averages made from such divergent data. The accuracy of the calculations is unquestioned. Whether any one series of indexes based on data collected from only 32 cities can be assumed to represent costs of living in such a vast and variegated area as the United States may well be questioned.

The Minimum Quantity Health and Decency Budget.—Very soon after wage adjustments began to be made on the basis of changes in the cost of living, calculated as above outlined, the workers began to demand higher standards of living. In order to ascertain whether the workers' demands were just and reasonable it became necessary to set up a more precise standard of measurement of changes in the cost of living. A budget made by averaging the total incomes of all workers' families, the sources from which the incomes are derived, the amounts expended for different items, and the surpluses saved or the deficits incurred, tells us little or nothing as to the adequacy of the income received by any worker's family.

TABLE VII.—*Estimated* Annual Average Indexes of Cost of Goods Purchased by Wage Earners and Lower-Salaried Workers in 32 Large Cities Combined, 1913 Through 1938*

[Average 1923–25 = 100]

Year	All items	Food†	Clothing	Rent	Fuel and light	House-furnishing goods	Miscellaneous
1913	57·4	63·1	55·7	61·4	53·9	47·7	50·1
1914	58·2	64·6	56·1	61·4	54·3	49·0	51·2
1915	58·8	63·9	57·4	61·9	54·5	51·3	52·8
1916	63·2	71·7	62·9	62·6	56·6	57·2	55·5
1917	74·4	92·4	75·6	62·1	63·0	66·9	64·2
1918	87·2	106·2	102·5	63·2	73·3	85·9	76·7
1919	101·1	120·2	135·7	68·4	79·4	108·2	86·3
1920	116·2	133·1	161·6	80·4	93·1	132·8	99·1
1921	103·6	101·6	124·4	92·4	99·3	111·8	102·8
1922	97·2	95·0	101·0	95·1	98·6	94·8	99·7
1923	99·0	97·9	101·2	97·5	100·3	101·8	99·3
1924	99·2	96·9	100·4	101·0	99·1	100·1	99·9
1925	101·8	105·0	98·4	101·5	100·6	98·1	100·8
1926	102·6	108·5	97·0	100·5	102·2	95·9	101·1
1927	100·6	104·5	95·1	98·9	100·6	93·6	101·7
1928	99·5	103·3	93·7	96·5	98·9	91·3	102·3
1929	99·5	104·7	92·7	94·3	98·2	90·2	103·1
1930	97·0	99·6	90·7	91·7	97·2	87·9	103·5
1931	88·6	82·0	82·7	86·9	95·1	79·2	102·7
1932	79·8	68·3	73·2	78·0	90·4	68·9	100·2
1933	75·8	66·4	70·9	67·2	87·4	68·0	97·0
1934	78·6	74·1	77·5	62·9	88·6	74·9	96·7
1935	80·7	80·5	77·9	62·9	87·5	76·4	96·7
1936	81·6	82·1	78·7	64·2	87·5	77·8	96·5
1937	84·3	85·1	82·4	67·4	86·6	84·9	97·8
1938	83·0	78·9	82·3	69·5	87·0	84·5	98·6

**Monthly Labor Review*, June 1939, p. 1358.

†Covers 51 cities since June 1920.

In order to determine whether workers' incomes are sufficient to buy the right kinds, quantities, and qualities of food, housing, clothing, fuel, etc., it is necessary to establish a standard quantity budget which will be adequate to maintain the average family in health and efficiency.

Accordingly, in 1919 and 1920, the Bureau of Labor Statistics, in co-operation with experts from the Department of Agriculture, worked out standard minimum quantity budgets sufficient to maintain a single man, a single woman and the average worker's family in health and decency.

The standard minimum quantity family budget so compiled did not differ very much from the actual average budget purchased by families in the \$1,800–\$2,100 income group in the year 1918. These minimum quantity budgets were published in the *Monthly Labor Review* of the U.S. Bureau of Labor Statistics, Dec. 1919, Jan. 1920 and June 1920.

The value of a standard minimum quantity budget is apparent. The actual consumption of workingmen's families may be quite inadequate or ill-adapted to support them in health and efficiency. It may be that they expend more than they should for certain items of food, clothing or amusements. It is much more likely that they are unable to expend enough on the right kinds and qualities of food, clothing, medical care, education and insurance.

With such a minimum standard quantity budget as a guide, any unreasonable demand by workers for a wage increase or by employers for a wage cut would be made at once apparent. However, neither employers nor workers accepted the standard quantity budget as a base from which to measure changes in the cost of living. Instead, they agreed to the theoretically less precise method of measuring changes in the cost of the average family budget and obtaining the new wage rate by multiplying the old rate by the cost of living index number so calculated.

This method was used during the war and was employed in many establishments for several years thereafter. Imperfect as it is, industrial peace was furthered thereby and more reasonable wage rates were maintained.

Wage Adjustments.—As indicated above, the cost of living studies made by the U.S. Bureau of Labor Statistics have been extensively used in the adjustment of wage disputes. The study of 1917 was begun for the express purpose of furnishing the Labor

Adjustment Board of the Emergency Fleet Corporation with the facts necessary for settling the ship-building workers' demands for increased wages. Later, the scope of the study was greatly extended at the request of the War Labor Board. Nearly every award made by Federal wage boards from 1918 to the present was based upon the cost of living indexes compiled by the U.S. Bureau of Labor Statistics. State arbitration commissions and minimum wage commissions, as a matter of course, take account of changes in the cost of living in making their decisions. Miss Elma B. Carr ("The Use of Cost-of-Living Figures in Wage Adjustments," U.S. Bureau of Labor Statistics, *Bull. No. 369,* p. 432, Washington, D.C., 1925) estimates that cost-of-living figures had been used to adjust wages in industries employing directly $5\frac{1}{2}$ million workers, and that the number of workers indirectly affected was even greater. As a means of maintaining peace in industry, cost of living studies have amply justified themselves.

Changes in Consumption.—The study made by the Bureau of Labor in 1901–02 gave the quantities consumed for more than 80% of the food budget; consequently, the kinds and quantities of food consumed in 1901 can be compared quite accurately with 1918. In 1901 the food budget absorbed 43% of the total expenditures, while in 1918 only 38% was spent for food. It should not be too hastily assumed that the decrease in the proportion spent for food indicates a higher degree of well-being. If all of the groups of items making up the family budget increased in price uniformly, it would be fair to assume that a decrease in the percentage of expenditure for food would connote increased expenditures for things other than prime necessities and, therefore, a higher degree of well-being. But, during this period, clothing increased in price more than twice as much as food, so that the food expenditures had to be curtailed to eke out the clothing which otherwise would have become inadequate. Furniture and house furnishings also rose in price about twice as much as food, and competed hard for the family dollars. The quantities of meats, poultry, eggs and fish consumed in 1918 were less than in 1901, while the quantities of milk, fruit, and vegetables increased from 1901 to 1918. The amount of sugar eaten also decreased. The 1918 food budget appears to be better balanced and more healthful than the 1901 budget. The changes in food consumption were probably due to price changes and the economy program of the Food Administration during the war, rather than to any permanent improvement in eating habits. A study in 1939 would doubtless show much greater changes in food consumption than occurred between 1901 and 1918. Changes in clothing, housing and miscellaneous consumption are still more marked. The average family budgets of 1918, being war-time budgets, became obsolete after the industrial crisis of 1920 and the fall of prices, and incomes.

The most reasonable policy would be to discard the 1917–19 country-wide budget and construct a series of new cost of living budgets, making use of the consumption data obtained in the 1935–38 surveys, to represent different geographical sections.

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COST OF PRODUCTION. In economics, the cost of production is the sum-total of the labour expended and wealth consumed in producing a commodity. The amount of money which has to be paid to call out these efforts and sacrifices is termed the expenses of production. The sum so paid, expressed per unit of output, is termed the supply price of the commodity; that is, the price which has to be paid to induce production. The term "expenses of production" thus covers the whole of the producer's outlays and includes the producer's remuneration. Unless the producer's expenses, thus defined, amount to a supply price per unit of output not higher than the effective demand price, production must either cease or be carried on at a loss.

COSTON LIGHT, a pyrotechnic light designed for night signalling between vessels at sea and between sea and shore. The signal is made in the form of a cartridge containing slow-burning chemicals which produce an intense light, in various colour combinations. The cartridge is mounted on a cylindrical wooden base adapted to be inserted in a holder equipped with a brass ferrule to receive it, and a plunger for igniting the signal by means of a percussion cap, in much the same manner as a shell is exploded by the trigger of a gun. In clear weather these signals can be seen for a distance as great as 15mi. and have exceptional penetration in mist or fog. The signals are so constructed that they will show successively various colours—blue, green, red, yellow and white—and various combinations of these are extensively used by steamship lines as distinguishing night signals. This signal was adopted by the U.S. Life-Saving Service (now Coast Guard) in 1873, for use by the beach patrol at night and in thick weather to give notice upon discovery of a wreck or vessel in distress that they are seen and help is at hand, and to warn vessels running dangerously near the shore.

COSTS: *see* PRACTICE AND PROCEDURE.

COSTUME: *see* DRESS.

COSTUME DESIGN, THEATRICAL. The early history of theatrical costume can no more be separated from that of religious and ceremonial costume than the early history of drama as a whole can be separated from the history of religion, which merges by slow degrees into drama. The first steps away from religion proper are usually taken in the direction of comedy, many gods becoming the clowns of future generations. The Etruscan devil dancer may easily be the descendant of a powerful god to whom bloody offerings once were made; yet the lineal descendant of this god played a clown's part as recently as 50 years ago in a Hungarian mystery play.

Where religion and drama interweave, it is difficult to determine to what extent the costumes of the priests and members of secret societies may be considered theatrical. How far the Egyptian gods portrayed in bronze and stone represent priests dressed in the usual costume of the early dramatized gods remains largely a matter of conjecture. However, it seems logical that masked priests played a part in certain Egyptian mysteries. In the last few years numerous collections have been brought together of masks and costumes representing gods and demi-gods from different mystery plays of almost all nations, including European countries. The frequent occurrence of these masks over the civilized world suggests that they were also used by the Egyptians.

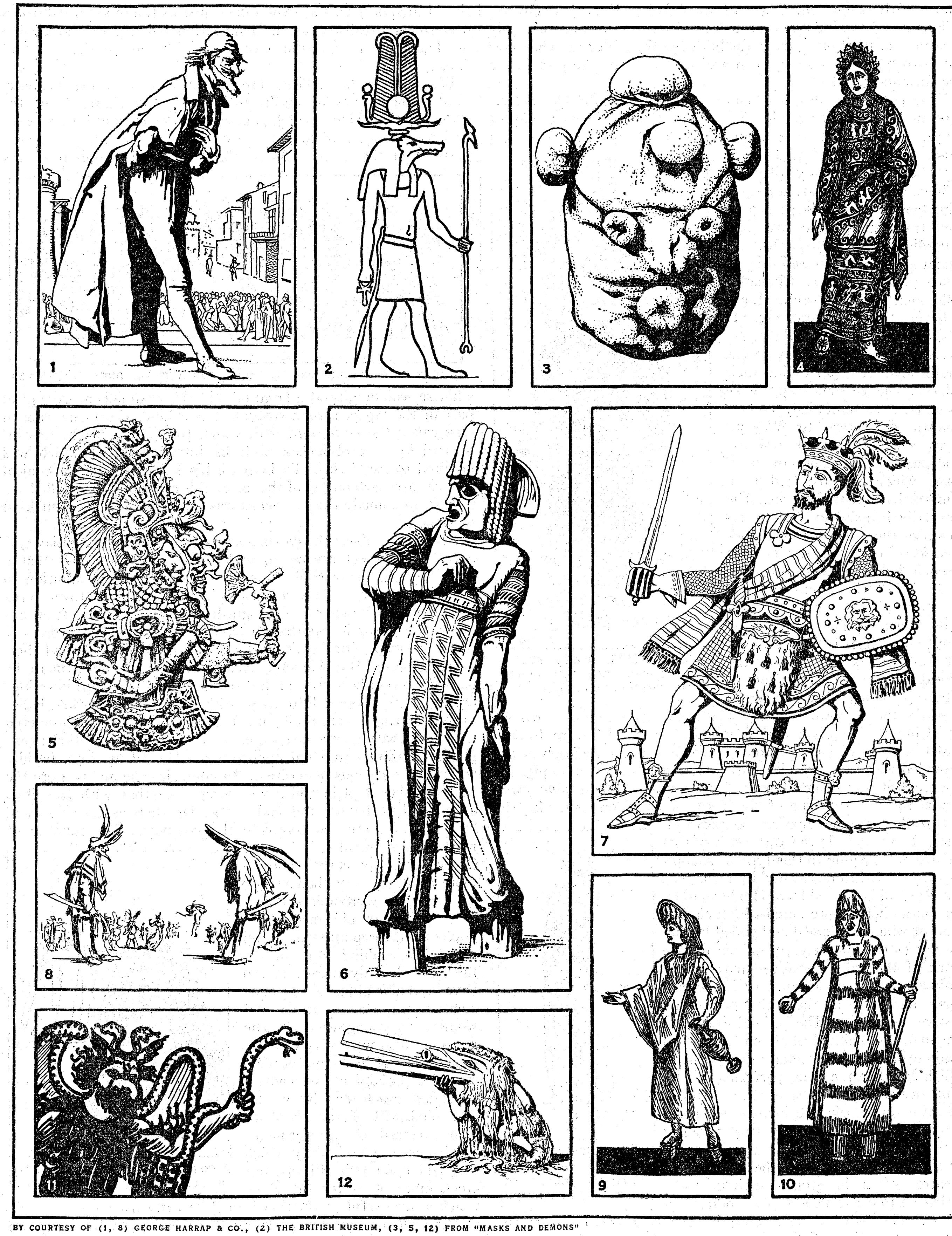
At the beginning of drama in each country one finds masked religious figures, gods or heroes. Long before the Javanese *wajang wong* there was the masked pantomime *topeng* dance. Long before the *Nō* performances in Japan existed, performances were given, within the temple, of the masked *kagura* dances. In China, in Mexico, in Greece and Central Europe, everywhere in fact, one comes across traces of the old religious costume in the drama of a more secular nature of much later date, so much so that it seems safe to regard the purely religious costume as the prototype of the more fantastic costumes in the secular and commercial theatre. Thus the temple dance in Japan through the *Nō* dramatic festival and the temple dance entertainment finally influenced the *kabuki* or popular theatre. Thus the religious images of the mediaeval church influenced the costuming of the municipal plays in the Low Countries during the 15th and early 16th centuries.

Oriental.—The Japanese *Nō* costumes and masks are largely preserved as temple treasures. They are among the most beautiful stage costumes ever made. As the *Nō* actor is held in popular esteem among the Japanese, whereas the actors in the popular theatre are regarded almost as outcasts, so the maker of the *Nō* masks is a highly esteemed artist who proudly signs his name to his work. Although the *Nō* dates from the 14th or early 15th century, the masks that one sees usually are of a much later date. Besides the carved wooden lacquered masks the costumes consist of gorgeous brocades which are specially woven with large mediaeval patterns, of beautifully wrought accessories, jewellery and fans. The combination of all these temple treasures, if worn by a fully apparelled *Nō* actor when he approaches with cadenced motions on the highly polished floor of the *Nō* stage, makes a spectacle

FROM JOSEPH GREGOR AND RENÉ FULOP—MILLER, "DAS RUSSISCHE THEATER" (AMALTHEA—VERLAG)

A RUSSIAN THEATRE COSTUME DESIGN FOR "JENGHIZ KHAN"

This design, distinctly Russian in style, was conceived by A. Stschekotikina, a modernist who carried on the work of stage symbolism established by Bakst. It achieves a fantastic effect expressive of Jenghiz Khan, the "perfect warrior," who terrorized the Eastern World in the 12th century by his conquest of China and bordering nations. The colours are used symbolically. Gold indicates wealth; red, passion; and yellow, Chinese imperialism, while the blue background below adds a note of mystery and terror.



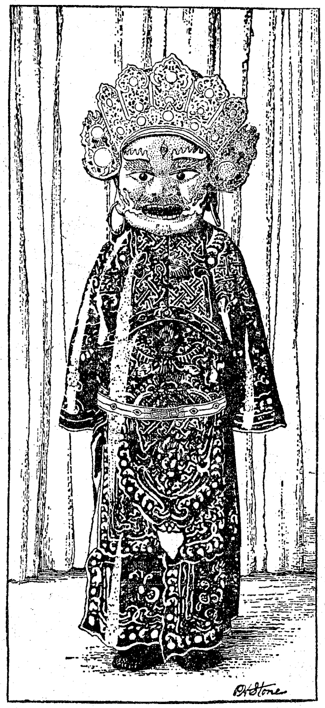
BY COURTESY OF (1, 8) GEORGE HARRAP & CO., (2) THE BRITISH MUSEUM, (3, 5, 12) FROM "MASKS AND DEMONS"

ANCIENT AND MODERN THEATRICAL COSTUME DESIGN

1. 17th century pantaloon; Italian comedy. 2. Sebek, the Egyptian crocodile god. 3. Mud head of the Zuni Indians. 4. A comic actor, 4th century B.C. 5. Mayan priest, from a Yucatan wall carving. 6. Ivory statuette of a Roman tragic actor. 7. Mr. Anderson as "Macbeth." 8. Guatsetto and Mestolino, after an engraving by Callot, 17th century. 9. A tragic actor with onkos and cothurnus. 10. A woman actor from a Russian mosaic. 11. The daemon Tuculcha on the Tombe dell 'Orco at Corneto; Etruscan. 12. North American Indian masked actor in a secret society initiation drama

never to be forgotten. The costume here, as in ancient Greece, China and Java, indicates through traditional accessories not only the rank or position of the actor but even the sex of the character he is to represent, as only men are permitted to take part in the performances.

The costumes worn in China are usually of embroidered silks and in a religious or semi-religious play they are even to-day of antique cut, with false jewellery and metal-work to make them look rich at a distance. In some of the congratulatory plays in China, where masks are worn, the number of masks is prescribed by tradition. There are four guardians, 28 patriarchs, 28 lunar gods, eight female fairies of such poetic names as Cinnamon Blossom, Pear Blossom, Lotus Flower, Spring Breeze, etc. In the commercial theatre the masks have been done away with, traditional make-up taking their place. The costumes also have been changed somewhat, the best known characters to Western eyes being the generals who are indicated by numbers of small flags which are arranged in a kind of halo on their backs. The prescribed make-up closely resembles the painted scroll work one sees on the masks, which are used to indicate ancestral heroes.



CHINESE ACTOR, T'ANG PERIOD, A.D. 618–900, WITH A HEADDRESS OF ANCIENT GREEK CHARACTER

In Tibet the lamas produce mystery plays at certain festivals which include among the most characteristic figures a kind of buffoon, looking for all the world like a half decayed corpse. The type of masks and costumes used in the Tibetan mystery plays closely resembles that of the Chinese. In Siam and Cambodia the masks worn by the ballet have a religious meaning. The costumes themselves are provided with the most elaborate jewellery. In Java a strange influence has been exerted on the costumes in the *wajang wong* drama by the prototype of this form of entertainment, viz., the cut leather shadow marionette performance. It was only in the 18th century that the plays belonging to this type of shadow theatre started to be enacted by men. The plays are all borrowed from Hindu sources, the heroes being represented with a curious kind of wings of pierced and gilded leather similar to the minutely cut golden filigree work of the leather shadow marionettes. Animals play an important part in the performances given by the native princes on festive occasions. The animal costumes are made of painted cloth on a bamboo frame-work. In the original *topeng* dances, which antedate the other performances by centuries, old court costumes are worn but all actors are masked to indicate the character and rank. It is only very recently that women have acted in the Javanese drama and then only in the commercial theatre, often in groups without men, which custom has also been introduced in China. The ballet dresses worn by the *corps de ballet* at the native courts do not differ from the regulation court dress, except for the addition of a very long brilliantly coloured scarf which is not usually worn by other women. The ballets given by these troupes are always private and the costumes are therefore designed to appear well at close range, just as the modern ball-room performers usually wear the conventional dress, or the geishas of Japan wear fantastic costumes with no particular stage value.

HERMIONE'S COSTUME IN GRANVILLE BARKER'S "WINTER'S TALE," DESIGNED BY ROTHENSTEIN

Classical.—The ancient Greeks instead of using make-up availed themselves of masks to indicate the character of the actor like the Chinese and Japanese. Besides the mask there were various attributes by which one could recognize the character's position in the drama. As in the traditional make-up of the Chinese, colour played a large part in this symbolism. A typical part of the Greek actor's costume was a kind of stilt or wooden clog called the *cothurnus,* with which the actor's height was increased by several inches, and the introduction of which was credited to Aeschylus. To increase his height further, a conical wig was arranged on top of the mask, this addition being called the *onkos.* In comedy the *cothurnus* was replaced by a different kind of shoe.

ACTORS OF A SATYRIC DRAMA, "DIONYSUS AND ARIADNE," IN NAPLES

Everything about the costumes was traditional. If the play was a tragedy the actor wore an underdress or *chiton,* over that a draped gown, also a gold embroidered overdress. In addition to the dress proper, there were various hand properties, crowns, etc., which made it possible to distinguish the characters one from another. Dionysus is reported to have worn a yellow overdress, a shoulder strap with flowers and a thyrsus. Other gods had their own attributes. If a character were supposed to be unfortunate he used dingy clothes, grey or faded blue, black or murky yellow. Queens were supposed to wear white and purple, other ladies saffron or frog green, these costumes being lavishly embroidered with gold. Satyrs wore goat skins, real or imitation panther skins, phallic attributes and red overdresses. The sileni wore, besides their tails, a curious underdress. In comedies the actors wore the *chlamys* over a plain white underdress, together with travelling hats and hair bands, and had properties such as bows, spears, knives, staffs, etc., to complete the costume. The number of masks were regulated by the Greeks also, apparently in a much more arbitrary way than among the Chinese. According to Pollux there were six old men, eight young men, three attendants and 11 women, making 28 in all. In the New Comedy there seem to have been nine old men, 11 young men, seven slaves, three old women, 14 young women. The costumes also were very conventional. The richness of the costumes, especially of the chorus, depended much on the wealth and good will of the *choragus,* who financed the performance sometimes as a civic duty which was laid upon rich citizens, but much more often for the glory which a successful production brought to the backer.

A COSTUME WORN BY MME. GEORGE IN "LA GUERRE DES SERVANTES"

Although most of the performances were given by groups of actors living near the large theatre, travelling was done even into the distant colonies. As an offshoot of the orthodox theatre in Greece a kind of theatre called the *phlyakes* seems to have been established in southern Italy in the 3rd century B.C. Judging from

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STAGES IN THE DEVELOPMENT OF THEATRICAL COSTUMES

1. "La Camargo," Lancret, 18th century. This type of dress was for a long time the model for the conventional ballet costume
2. A scene from the "Peasants' Opera" of Kloris and Roósje, portrayed by Cornelius Troost in the early 18th century. The opera is even now revived yearly in Holland. The costumes of these farcical operas seem to have followed closely the fashions of the period
3. "L'Étoile," by Degas. In 1868 Degas exhibited his first study of a dancer. He became widely known for his painting of ballet dancers, and his pictures form an accurate record of the ballet style of the late 19th century
4. A scene in P. Langendijk's "Mathematicians," by C. Troost, a designer for the Amsterdam theatre in the early 18th century. As in all popular comedy, the costuming closely resembles every-day dress
5. The Commedia dell 'Arte in France from a contemporary painting
6. The actor Talma in the type of costume which the painter David designed for him in the beginning of the 19th century
7. Lady Hamilton as "Sensibility," from the drawing by Romney (1789). Lady Hamilton was one of the leaders in the classical movement which changed theatrical costumes from the ample gowns of 18th century court dress to soft draperies

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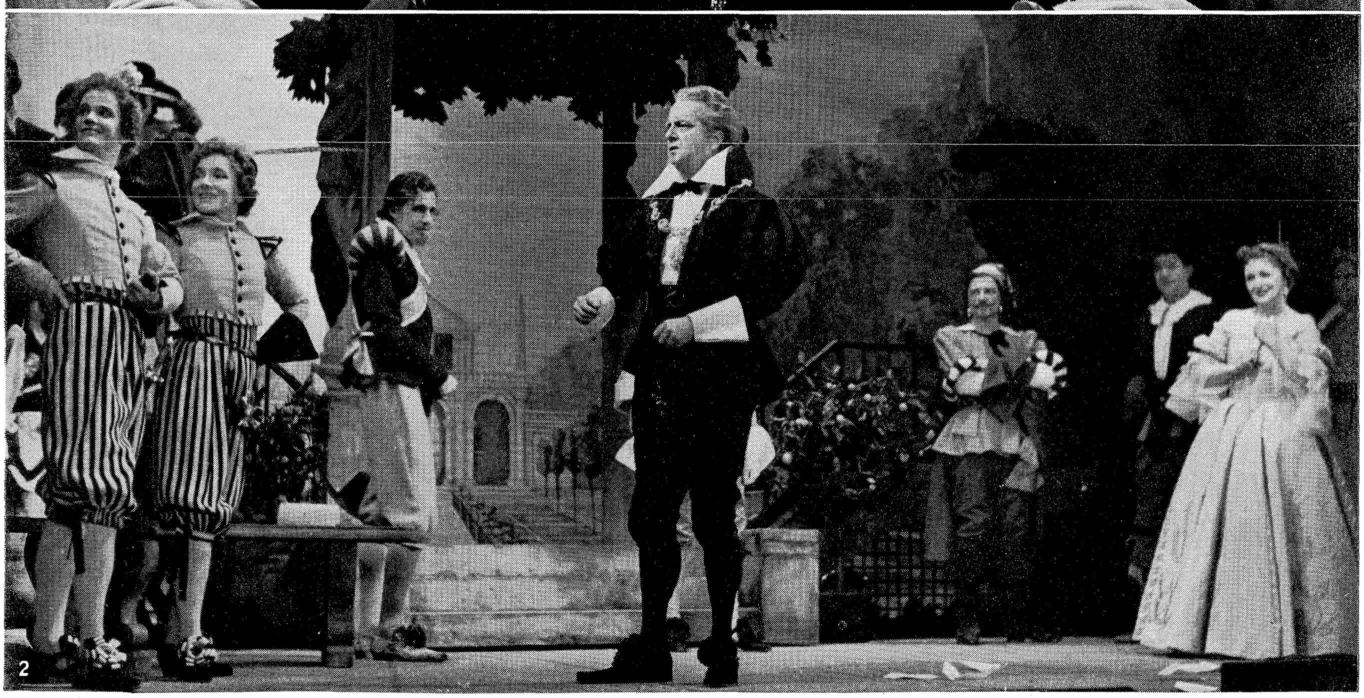

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PHOTOGRAPHS, (1) ERIC SCHAAL-PIX, (2) ARAL-PIX

COSTUMES FOR TWO SHAKESPEAREAN PLAYS

1. Costume by David Ffolkes for Maurice Evans in "Richard II"
2. Costumes designed by Stewart Chaney for "Twelfth Night," with Maurice Evans as Malvolio (centre) and Helen Hayes as Viola (second from left)

BY COURTESY OF (4) ATELIER WILLINGER

MODERN COSTUMES OF RUBBER CLOTH

Designs by Ernest de Weerth for costumes in Reinhardt's production of "King Lear" in Vienna. They were carried out in hand-painted rubber sheeting. 1. The actor Kloepfer as the King. 2. A servant. 3. A soldier. The armour was also made of rubber. 4. Kloepfer in "The Great World Theatre." 5. Edmund. 6. Cornwall. 7. A knight; six of these stood in a row on pedestals in the background of the first scene, thereby forming part of the scenery. 8. Regan

COSTUME DESIGN, THEATRICAL


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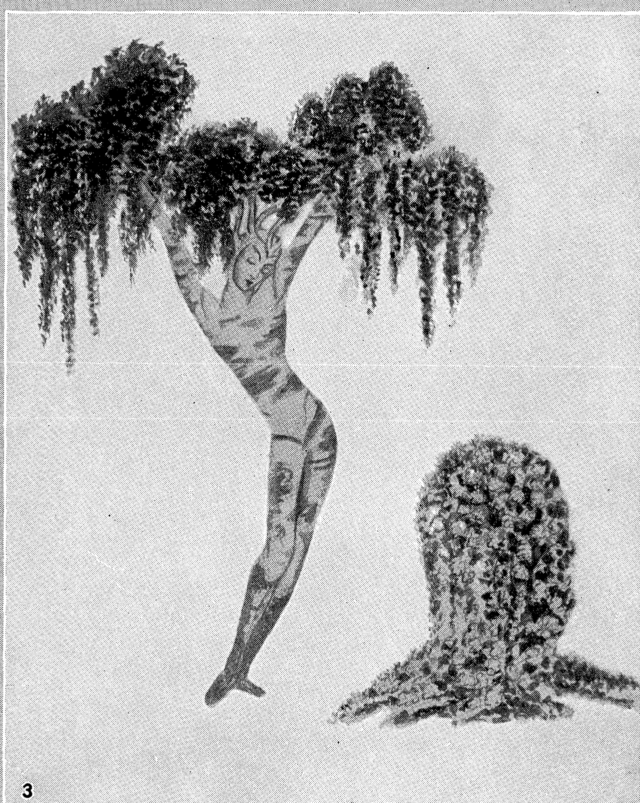
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PHOTOGRAPHS, (1) TRUDE FLEISCHMANN, (2) ELLINGER

MODERN COSTUME EFFECTS

1. Helene Thimig as Cordelia in Reinhardt's production of "King Lear" in Vienna. Note the sculpturesque folds of the rubber sheeting
2. Lady Diana Manners as the Madonna in "The Miracle." This costume was of crêpe de chine
3. Designs by Ernest de Weerth for the Reinhardt production of "Midsummer Night's Dream" in Vienna in 1925. Trees and bushes represented by dancers
4. Reiner as Oberon in the same production

COSTUMES FOR MIDSUMMER NIGHT'S DREAM

Designs by Ernest de Weerth for Reinhardt's production of "Midsummer Night's Dream" in New York, 1927. Note that the costumes were illustrative of the two different elements in the play: the fairies and the people. At the top, 1 and 2, represent Titania and Oberon; 3 and 4 represent Hippolyta and Theseus. The latter were executed in hand painted canvas.

COSTUME DESIGN, THEATRICAL

BY COURTESY OF (1) FLORENCE VANDAMM

DESIGNS BY DE WEERTH FOR THE CHINESE OPERA "KWAN YIN"

1. Photograph of the War God, showing gilded rubber used as ornament on the actual costume
2. The Goddess and attendants clothed in rubber sheeting painted silver, copper and gold. Note the musicians at the top of the photograph. These, being unimportant characters, were subordinated in black costumes against a black background
3. Original drawing for the War God's costume
4. The Captain

BY COURTESY OF (1, 2, 4, 11) GEORGE HARRAP & CO., (13) THE FIELD MUSEUM OF NATURAL HISTORY, (14) MARTIN BIRNBAUM, (16) MODERN THEATERBAU

ANCIENT AND MODERN THEATRICAL COSTUME DESIGN

1. A 16th century harlequin. 2. A 17th century harlequin. 3. "The Young Jewess," by Rembrandt. 4. A 17th century pierrot (Joseph Gereton). 5. A Greek comus costume of the 5th century B.C. 6. A comedy on the Roman stage; in a Naples museum. 7. Animal impersonation, from a dress of a statue of Demeter; Athens museum. 8. A masked actor of Greece as a follower of Odysseus. 9. Comic actors of the 3rd century B.C. 10. Formal costume of the 18th century. 11. Pierrot and Columbine in the 18th century. 12. The devil in a 19th century Hungarian mystery play. 13. Burial clay figures, from Kusha, of a Tibetan monk-actor in mask and costume representing a heavenly king in a mystery play. 14. Costume design by L. Bakst for a dancer in "Scheherazade," one of the Russian ballets showing strong Oriental influences. 15. Hans Burgkmair's fantastic entrance design for a 16th century play. 16. A fantastic entrance procession in the Bologna tournament theatre, 1628, for one of the elaborate theatrical entertainments so popular among Italian princes and burghers of Flanders during that period

the evidence on vases, we know that the costumes were caricatures of the gods of Greece and indicate that the plays were of a comic, popular nature. It is in this type of stage that some people see the ancestor of the *commedia dell'arte,* tracing the costumes of harlequin and other characters to the costumes worn by some of the actors in these comedies.

Roman tragedy costumes followed the Greek precedent. They were usually rich like the Greek costume but were slightly changed to conform to local Roman dress. The tendency of the Roman theatre was toward a greater and greater elaboration and realism. Horace mentions plays in which regiments of cavalry and even elephants took part. Probably these elaborate performances were emulated by the princes of Italy in the Renaissance period when the court masques became the vogue. Realism on the Roman stage certainly ran riot when the Emperor Domitian staged a real crucifixion at the end of one of the productions which he offered to the people of Rome, using a prisoner as a substitute for the actor who played the part of the victim. Great luxury was displayed also in the Roman pantomimes. The character of the costumes worn in the pantomimes was objected to by reformers, on the ground of their being made of very transparent materials. The objections, however, seem to have been just as much to the nature of the performance itself as to the costume. The mimic scenes in their costuming were probably very like the *phlyakes* scenes. The costumes used in the mimes were gradually made to resemble more and more the ordinary Roman dress. The actor also abandoned the mask as the object of the plays became realistic. In the Atellan farces masks seem to have been used, however.

Mediaeval.—There is a certain connection between the drama of ancient Rome and the drama of the middle ages in northern Europe, but to what degree the costumes which the clergy used for the performances of the early plays in the churches and within the church precincts were influenced by the costume of the ancient theatre it is difficult to determine. There may have been some type of aboriginal costume which was adapted into the devil costume of the mystery play. In the few documents which are known the devils wear masks and fantastic costumes. Some of the actors wear a costume almost identical with the costume of the period, while the sacred personages are attired in the type of costume one sees in contemporary ecclesiastical paintings and sculpture. The works of art of the 15th century, as Van Eyck's "Adoration of the Lamb," appear to be adaptations of scenes from the drama of that time. The elaborate costumes of God the Father, the angels and other persons would portray those of the actors of the day. Even if this should not be entirely true it is safe to say that the costumes used in the ecclesiastical drama must have been very like the ones shown in these paintings, as the people who painted them were engaged by the clergy to help in staging the plays.

AN 18TH CENTURY OPERA COSTUME, DESIGNED BY F. BOUCHER
16th century influences are visible

Certain pictures which have come from Italy show types of angel costumes with unmistakable stage tricks in their construction, the halo on some of them being fastened to a headdress, for instance. As the drama was gradually separated from the church and the larger part of the action was devoted to the shepherds and burghers rather than to the divine personages, the bulk of the costumes more and more resembled the local everyday dress. The later the period the better documented the drama becomes, and in the 16th century we find a number of engravings and other material which illustrate the theatrical costumes worn at that time.

Renaissance.—The Italian Renaissance naturally brought about a radical change in stage costume. To the mediaeval tournaments were usually added some dramatic interludes which gradually were given greater and greater importance. During the 15th and early 16th centuries this type of entertainment became more and more developed into a display of wealth in costumes and scenery which was only equalled by the Romans in their most spendthrift days. These court masques made much use of symbolic costumes and semi-classical draperies, suitable for the dressing of gods and goddesses of ancient times, dryads, nymphs and satyrs. The drama at that time began to be divided into the tragic, comic and satyric, and with the classical influence becoming so strong, the older Gothic costumes disappeared even from the stages in the northern countries, France, the Netherlands and England. But the classical costumes which became the vogue should not be confused with the antique Greek and Roman theatrical costumes; they should be thought of as resembling the classical figures seen in the paintings of Mantegna, Botticelli and other painters of the quattro-cento.

VITALE MASCARDI, PARTICIPANT IN THE QUADRILLE AT CARDINAL BARBERINI'S FEAST, ROME, 1634

Serlio, one of the most quoted sources of information on the drama of the Italian Renaissance, in his second book of architecture published in the middle of the 16th century, while speaking of the satyric scene, addresses the stage designers of the period as follows: "I would tell you of the superb costumes of certain shepherds made of rich cloth of gold and of silk, lined with the finest of wild animal furs. I would also tell of certain fishermen whose dresses were not less rich than the others, whose nets were of fine golden thread, and of all their other implements, all of them gilded. I would tell of some shepherdesses and nymphs, whose robes were made regardless of cost. But I leave it to the intelligence of the judicious architects to do such things when they shall find the patrons who are agreeable to their wishes and who give them full power with generous hands, to execute all which they desire."

AN 18TH CENTURY PIERROT COSTUME, DESIGNED BY ANTOINE WATTEAU

Court Performances.—As the financial control of the drama passed from ecclesiastical hands into those of the princes, it was used more and more as an aggrandizement of the courts. The costuming and mounting of the plays became more and more elaborate, one monarch trying to outdo the other in the splendour of the entertainments offered. Marriages, coronations, the birth of heirs to the throne, even funerals were made an excuse for great display of costumes and pageantry. The cities were required to give great feasts when the monarchs of the realm visited them. On the temporary stages erected for such occasions, *tableaux vivants* were posed in costumes rich in symbolic devices and emblems. Practically all the well-known painters, such as Albrecht Dürer, Velazquez, Rubens, Van Dyck, designed costumes and paraphernalia for entertainments of this kind during the 16th and early 17th centuries. In these tableaux the clothing of some of the characters was reduced to almost nothing, a fact which caused as much alarm among the reformers of those days as it had done during Roman times. Whether it is due to the number of engravings which have been preserved or not, Antwerp seems to have been one of the cities where the most elaborate of these entrance festivities were given, among them those of Philip II. in 1549, of the Archduke Ernest in 1594, and of Albert and Isabella in 1602.

The Flemish rhetoric drama was costumed in a Dutch version of the Italian classical period, and so were the court entertainments in England. Inigo Jones, who together with Ben Jonson produced several masques, studied in Italy, and followed the Italian fashion rather closely. A few drawings of his are preserved at Oxford, among them some of the very few drawings of costumes of characters in Shakespeare's plays. In some of the productions in the London theatres of the early 17th century the costumes were probably imitations on a more modest scale of those worn in the court productions. In others the costumes, judging by some woodcuts which have come down to us, were like the everyday dress. Ben Jonson thus describes the costumes in the masque of queens: "The habits had in them the excellency of all devices and riches and were worthily varied by his invention," *i.e.,* Inigo Jones's invention.

There was a regular stock of legendary characters which were costumed so that they would be easily recognized by the public: virtues and vices; curiosity covered with eyes; error with serpents and snakes; credulity with ears. There was the earth with oak leaves, plants and flowers. There was water with dolphins and fishes, and the air with eagles and other birds. There was fire with fiery salamanders between the flames, and there were signs of the zodiac, the winds, nymphs, dryads and witches, all in their proper symbolic costumes. These masques and other court entertainments later on developed into the court opera. Of the costumes of the intervening period we get probably a good idea from the floral costume in the painting by Rembrandt, which is similar to the costumes in several other paintings by men of the period.

Opera and Comedy.—From Italy also come the costumes of the *commedia dell'arte,* of harlequin, pantalone, pierrot and columbine and all the other characters so dear to everyone who loves the theatre. This type of theatre is supposed to be the

ITALIAN AND FRENCH MASQUE COSTUMES (PRAGUE, 1817)

lineal descendant of the Roman classical drama. Its costuming seems to be almost entirely of the Italian 16th century except that of harlequin which might be traced quite easily to Roman prototypes. The exaggerations of certain parts of the body are also a classical trick. Later these costumes became definitely established and changes in them were made only rarely. Perhaps this was due to the method of production used in the *commedia dell'arte,* which only makes use of a certain number of characters, who reappear in all the different scenarios. In the course of the years new characters appeared, but on the whole the Italian comedy changed no more than harlequin's costume.

Poorly as the Shakespearian period is represented by documentary material, the opera is elaborately recorded. As a court entertainment, it received all the attention usually given to the exploits of the princes of the 16th and 17th centuries, to their ballets, their carousals, their tournaments and other dramatic enterprises. With the growing preponderance of France in European politics one may trace the growing aesthetic influence of France. As at first Italy influenced France in the drama as well as the other arts, so France now began to influence Italy. When designers such as Berain and Le Pautre originated a new set of costumes for a court entertainment, echoes could be heard all over Europe. As the masque was supplanted by the opera the costume gradually changed, the lines becoming more and more like the exaggerated court dress of the period.

Entirely different was the costuming of the comedy stage which usually was of a realistic nature with a sprinkling of *commedia dell'arte* motives. The comedy often employed music, and sometimes comedies were made as skits on the operatic stage, called by such names as *Peasant's Opera,* the famous Dutch *Kloris and Roosje,* or *Beggar's Opera,* Gay's famous English entertainment, both of the early 18th century. The costuming of these farcical operas, in fact of all comedy of that time, seems to follow rather closely the fashions of the period. Of course, fantastic plays called for a different kind of costumes and presumably followed the court performers in the same way as the popular Japanese theatre in certain plays follows the *Nō* theatre precedents, using more showy material and designs but adhering closely to the original type.

Modern Design.—Towards the end of the 18th century the classical movement began in the theatre and within a few years the stage costume changed from the ample gowns of the 18th century court dresses to draperies of soft woollens and clinging gauzes. The Viganos, in their ballets, adapted subjects like Diana and Endymion, and used for the portrayal of these characters dresses of the lightest and most transparent materials. Some years earlier Lady Hamilton had given performances in classical draperies only. With the advent of the romantic movement, the costumes which became the fashion were stage adaptations of period costumes. After the romantic Gothic revival one period after another seems to have come to the fore. The Gothic costumes of 1840, however, are entirely different from the Gothic costumes of the '80s. In each period only those parts of the original dresses were adapted which were not too incompatible with contemporary taste in form and colour. The modern dress designer for the stage has gone so far as to imitate the technique of pottery, sculpture, engraving and painting. Several modern designers also use old fashions as a source of motives, using them perhaps with a little more freedom than the original designers.

THE COSTUME OF MLLE. MARS AS DOÑA SOL IN "HERNANI," BY VICTOR HUGO, 1830

From the time when Henry Irving employed artists of fame to design the costumes and scenery for some of his productions there has been a strong competition among managers, one trying to outdo the other in the artistic excellence of the costuming of the plays which he produces. Of course, the results vary enormously. The famous Meiniger troupe prided themselves on the historical accuracy of their costumes. Men of the type of Alma-Tadema combine historical accuracy with a definite attempt to secure artistic harmony. Others, like the Russian Bakst, sacrifice historical accuracy to the artistic conception, being chiefly concerned with the composition in colour, form and line. Attempts have been made to reduce the actor to a two dimensional figure by means of lighting, and even to annihilate him, as far as his value in the composition is concerned, and use him as an intelligent machine, animating the abstract composition of colour and form which he carries by way of dress. It is curious to notice how one of the best known of the modern painters, Pablo Picasso, resorts to the same methods which were used by the 16th and 17th century designers in their emblematic costumes. The only difference lies in the artistic approach to the emblems combined to form the costume.

Technically, there are a few points in the construction of theatrical costumes which make them entirely different from ordinary everyday dress. First, the artistic meaning of the costume is usually exploited at the expense of any adherence to fashion. In the ordinary drama, where motions of the actors are not different from those of everyday life, the differences in construction usually limit themselves to simplicity in fastening and the choice of the materials, which are selected to appear well under the stage lights and from a distance. In costumes designed for dancers, acrobats, etc., the method of construction becomes of supreme importance to the artistic conception of the costumes. A ballet dancer can use skirts only of a certain length, an acrobat will have to protect certain parts of his body, others he must leave uncovered for the sake of free motion. It is probably on account of this difficulty of making the costumes of special artists of this kind artistically important that the managers have developed the expedient of the show girl, these girls being selected entirely for their good looks and their ability to wear and display elaborate stage costumes.

THE COSTUME OF WAGNER AS ORTRUD IN "LOHENGRIN," IN 1859

Materials.—The materials employed in the construction of stage costumes are often the same as those used for conventional dress, but usually the extremes in brilliancy are popular with the designer as this brilliancy is the only means by which he can avail himself of tonal and also of colour value. Often substitutes for expensive materials can be used which give an equally elaborate effect and are equally serviceable. The distance at which the costumes are usually seen not only makes these changes possible but sometimes even makes them necessary. This is especially true of all materials which are decorated with patterns or have been embroidered, for it is much easier to get an effect with the painted or appliquéd metal surfaces in an imitation brocade than it would be to get a similar effect out of a woven fabric. Some painters treat their costumes as if they were a part of the stage scenery, and by using mat surfaces only, produce a certain paint-like quality even in the dresses. The materials most commonly used for indicating more costly fabric are muslin, satin, cambric, cotton, flannel, terry cloth, oilcloth and the like. In Goethe's day glazed chintzes seem to have been a common substitute for silks, he himself advertising the use of them. In the middle ages a great deal of use was made of printed linens brightened with gold. Among the Javanese extensive use is made of the batik technique which has also found favour with a great many contemporary Western designers. To-day, as at all times, appliqué work is very popular with costume designers as well as the more showy kinds of embroidery. In stage embroidery liberal use is made of small mirrors, spangles, braided straw, chenille and similar materials; curled ostrich feathers have always been a favourite material.

AN EMBLEMATIC COSTUME, BY CHRISTOPHER WHALL, 1899

The materials used for the making of masks have been leather, papier mâché and wood, and for larger masks cloth stretched over a skeleton of bamboo, ratan or wire; even leaves have been used. Most of the modern masks are made of papier mâché over a base of modelling wax or plaster of Paris in much the same way as the *commedia dell'arte* masks were made from leather over a wooden mould. When a great number of the same masks are desired the usual method is to reverse the process, the mask being made of papier mâché inside a form, the resultant cast then being painted or lacquered in the same manner as the other masks are finished. The Japanese *Nō* masks and the Javanese *topeng* masks are made of lacquered wood; the Chinese and Tibetan masks are made of papier mâché, which material the Chinese use for the construction of entire costumes, making the actors resemble lacquered statuary, as for instance in the case of the Kwan Yin costume now in the Field museum in Chicago.

Legal Regulation.—From time to time ordinances have been passed to regulate theatrical costuming, but they have usually failed. During the 18th century a certain conformance with local custom was considered necessary by the management of the theatre, and the actors and actresses were instructed to dress according to the rules of etiquette. Actresses who portrayed ladies could not wear simple short-waisted dresses but had to wear at least *demi-parure,* or if several ladies took part in the scene they were to wear *grande parure* and no hats. Soubrettes were to wear no hats except when travelling, and no rings; only simple dresses possibly of appliquéd atlas. Young girls of the bourgeoisie were to wear skirts and jackets but never made of white material, at least never when the first lady was wearing white. The Javanese, Chinese and Japanese costumes are also stringently regulated, but even if regulations were not made, common sense would reach the same results. Who for instance would attract attention to one of the minor characters by dressing him in a vivid colour at the expense of more important players in the same scene? The dimensions of the human body and the motions which are natural to it have, of course, determined the form of costumes more than any other factor. Costumes peculiar to certain types of actors seem to persist through the centuries, and if these traditional forms are changed by intense artistic endeavour or even by political ordinances from time to time, they will presently reappear. The English Christmas pantomime costumes of clowns and harlequins are not different from the costumes used by the artists in the *commedia dell'arte* or even by the comedian who acted in the Greek and Roman farces. What determines the form of a costume most is the actor and his work. If certain motions which the actor is to make look best when made in certain costumes, these costumes will naturally persist.

ENGLISH PANTOMIME CLOWNS, SECOND HALF OF THE 19TH CENTURY

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MODERN

There are various ways of regarding costumes in the theatre. Costumes may be a realistic period clothing for the actors, in which case they are of little interest beyond being an example of historical data. They may be an elaborate and ornate fantasy, designed purely for the purpose of pleasing the eye and forming a picture, sometimes actually derived and adapted from paintings and sculptures of certain schools. Costumes may however play a far more important part in the theatrical production: namely as a psychological study of the characters individually and of the spectacle as a whole. It is this third, or what might be termed the more modern, development of this art that is of greater importance in the theatre to-day and therefore requires more consideration than is usually given it. A progress of this kind may possibly, at some future date, result in a uniform for actors, differing one from the other only in colour pattern to show the status or relative value of the figures clad.

Artists are always searching for the new, striving step by step for what they think is right, toward an ultimate goal of self-expression and interpretation. In the theatre, the furthest point so far reached is a stylization of individuality ranging from design to the actual material used in the execution of the clothes. There is one great hindrance to an actual and far-reaching progress in designing for the theatre of to-day. It is the paucity of theatrical productions which give the artist sufficient scope for creation.

The stage reached the climax of a glamorous and overdecorated period in 1914. That was the height of a certain baroque style in the theatre. It was unnecessary to go any further along those lines, anything of the same type that came later could only be compared with or be an exaggeration of the original. It was an easy form of spectacle to understand and tremendously effective.

"The play's the thing." Next should come the *régisseur;* the actor third and the decoration last. The decoration should be completely under the direction of the *régisseur,* who should guide the entire production, not merely direct a play and, which is worse, direct it badly, as is so often the case, but actually lead the performance like the conductor of an orchestra. He should always be a man of authority, culture and taste, combining all the arts: as such he would create a fine production. Nothing should be done without his word. A director of actors should be under his guidance, since it is not necessary for the *régisseur* himself to direct their every move; except for giving the final touches.

This manner of directing, which is not by any means new, is the only possible road toward a truly fine result. The *régisseur* should always bear in mind the relative values as given above: if one of the branches oversteps its own importance, there is the danger of the entire production being overbalanced. If the scenery, for example, is too ornate, it will of necessity interfere with the visual background of the actor. If the costumer loads down his poor patients beneath head-dresses and bejewelled clothes of impossible sizes and weight, the acting will suffer accordingly.

Importance of Simplicity.—An actor should be clothed as simply yet as appropriately in colour, texture and design as necessary. The costumes of the principal actors should be an asset to them, a help, an interpreter of their character, an aid in their movements; they should free them in order that the artists may give all that is in their power without being hampered in any way. Moreover a player acting an important part should be in complete contrast to the background, so that his motions always appear clear and well defined. Supposing, as a rather crude example, that the scenery is black, the leading actor or actress should be in white. The people of intermediary classification of parts would be clothed in the corresponding scale of colour according to their importance, the quite unimportant characters finally going so far as to melt into the background and actually become part of the decoration.

This theory was realized with great success in Reinhardt's performance of *King Lear* in Vienna, when at regular intervals across the backdrop of a huge but perfectly simple grey wall stood knights in dull silver armour, on pedestals, leaning on their tremendous shields and thus forming decorative pilasters. Even in that instance there was colour only in the pattern (coat-of-arms) on their shields. Their silver armour blended into the silvery walls, resulting in a suggestion rather than in a reality, which never interfered with the action. In fact, costumes should never over-attract attention; they should pass utterly unnoticed, if they are to be right. The same should be the case with scenery. No matter what the decorative scheme may be, the setting should always come second to the costumes, be of relative value and of the necessary simplicity to form an adequate background for them and therefore naturally for the artists wearing them. What is worse than to go to see a favourite artist play a famous part and not be able to see the face or body, for the lack of lighting, or on account of the brilliance of the costuming, or, worse than everything, because of a background which is so crowded with pattern and design that one cannot concentrate on anything else? At the Théâtre Français the superb acting of a well-known star was actually invisible owing to an over brilliantly lighted crystal chandelier which hung in the middle of the stage and drew all the attention, though of absolutely no interest or import to the plot.

One should revert to the "Primitive" idea of staging, as in the other arts, to attain the greatest beauty. Just as those six stationary knights in *King Lear* denoted the castle, a garden for instance would be represented by a tree of a decorative design if a general impression only is wanted, or a tree of a particular kind, to suggest the garden's geographical situation; *e.g.*, a palm tree would suggest Africa, a stone pine southern Italy, a cypress Tuscany, an elm New England, and so forth. Moreover unless the tree literally plays a part in the production (in other words, unless it becomes an "actor") it should be merely suggested, in outline or in tone; it should never be realistic. If a tree is called for in the plot and is vital to the action, it might be represented by a human being, in order to give the necessary movement and play of nature, the wafting to and fro, the trembling and bending by the wind.

The stage should be alive. Only the things which really matter and are of importance to the plot and action should be shown; the rest left to the imagination. Everything actual should play its part. *Macbeth, Hamlet, Lear, Medea, Oedipus,* or *Electra* are all plays of a cosmic nature, possible to interpret in a hundred different ways. Thus Reinhardt alone has staged *A Midsummer Night's Dream* in something like 15 various styles. His original production was staged realistically. Another was done by Granville Barker with gilded fairies; yet another by Reinhardt in the manner of Botticelli. In New York it has been given an 18th century setting like a fresco by the Venetian Tiepolo. In order to render the full effect of his style, the costumes were actually made out of painted canvas, but there were no actual designs or patterns on them. The folds were accentuated with high lights and shadows; otherwise there was no detail whatsoever which would attract unnecessary attention.

Use of Rubber.—One of the most extraordinary instances of successful designing was in Reinhardt's production of *King Lear* in Vienna. The costumes were made of rubber sheeting. On the opening night the unusual use of this material passed unnoticed save that the critics praised the beauty of the performance as a whole. A few days later the rubber was a sensation. The reason for using that material was that Reinhardt wished the characters in *Lear* to look as though they had been sculptured out of stone. This was not in itself a new idea. It had been done with the figure of the Madonna in *The Miracle* in New York. In this particular instance however when the statue came to life the actress was obliged to step forth out of her cement robe, rather like a chicken breaking through an egg shell. The mantle was made out of some rigid and stiff preparation which would of course have been quite unsatisfactory for an entire cast of actors. Oilcloth was rejected as an impossible medium, being paperlike and clumsy. Rubber sheeting was chosen. It was found that when stationary it falls in magnificent and completely sculpturesque folds, and when in motion it is altogether supple and moves with an easy grace that clings to and follows every movement of the actor. It was painted in tones of greys, terracotta, pastel blues and mauves, mixed with silver and gold which gave it the glimmer and vitality of stone. The result was amazing.

This material was also used in Salzburg in von Hofmannsthal's *The Great World Theatre,* when by slightly different weight and treatment it successfully represented painted wooden figures. The scene was a vast and towering church altar in three stages, one above the other, connected by invisible steps and inclines. On the lower level were niches wherein stood the allegorical figures of Beauty, Wisdom, Wealth, etc. These were dressed in brilliant colours. Above them stood Holy People in variously toned shades of copper, brass and steel. At the top, rising to a summit in the centre, were the angels, all in armour, one mass of glittering gold and silver. The rubber when painted with metal pigments takes on a shiny and resplendent quality which is unequalled in any other material. Furthermore, in order to keep a consistency throughout the scene, even the Beggar, in his torn and drab rags, was clothed in rubber; it may appear like old moth-eaten cloth carved out of wood when so desired. The stained-glass window effect which was produced when the various coloured lights were turned on the upper figures covered with the shiny metal rubber was an unforgettable impression; so successful indeed that Reinhardt used this idea again in New York for the angels in the final tableau of *Jedermann* (Every man). In this instance they were not clad in armour but in the flowing golden folds of early Gothic statues. They wore no tinsel haloes, but wigs of little gilded curls, also made of rubber.

A very important factor in costumes of unusual material hand-painted to resemble carved wooden images, statues of marble and metal, etc., is the "make-up" of the people wearing them. This can be no ordinary stage grease paint with rouge and mascara. The "mask" must suit the costume, look just as wooden as a figure carved from oak, as stony as a statue sculptured out of marble; and still be the movable face and skin itself, capable of every expression and pantomime. In shadows and high lights it should follow the lines of the clothes, in colour equal their intensity, tones and shades. This naturally applies to wigs and head-dresses as well. In *King Lear,* for example, certain of the actors volunteered to make up their own hair without being obliged to wear wigs. This meant actually painting lights and shadows in colours and metal. This would of course be impossible anywhere but in a theatre where plays are given on the repertory system. One could hardly expect the actors to make up in this manner twice in one day as is the custom where plays are put on for "runs." The result, however, starting as it did from the normal and actual nature of hair, was even finer and more successful than the completely stylized quality of a wig. The women in *Lear* and *The Great World Theatre* wore head-dresses which concealed the hair, with the exception of tresses long or looped up, which were made of lightly padded, woven and plaited rubber. Cordelia in *King Lear* was completely shrouded in a pleated nun-like veil of the same material so that no hair was visible. For her costume white rubber sheeting was used, painted in grey with shadows of jade green and pastel blue, which gave her the pallor and transparency of ice, like the Madonna in a certain famous Crucifixion where she seems frozen to stone in the agony of her suffering. The evil sisters, on the other hand, were clothed in colours of moss-covered rocks and topaz, green and brown, yellow and orange. In spite of the many different tones, the general scheme of the entire production was grey, as though carved out of stone, with the lights giving the variety. Each individual had his or her own scale of colour: the King himself wore gold and purple combined with a replica of ermine, but the manner was always subtle, merely a suggestion. That is what is meant by a psychological study of the characters individually and of the spectacle as a whole.

Rubber must not be judged as an invention, nor as a criterion for new costuming In these productions it merely served a purpose and may be used in various other ways, not only for entire costumes. Jewellery has been made of it; the reason being that any sparkling stones attract too much attention to themselves and therefore interfere with the consistency of the stage picture. One of the many interesting advantages of using rubber is that its brilliancy may be regulated according to the necessity. Helmets, spears, armour in general, may be made shiny or dull at will by merely adding gold or silver paint and polishing or painting over. Even soldiers' plate-armour has been made of little circular scales of rubber superimposed and painted steel colour and blue, the edge of each flecked with silver. The helmets, built on a buckram form, were covered entirely with the rubber sheeting, the high lights painted in polished silver, thereby giving an effect of shiny steel without the dazzling and disturbing reflection of real armour. This method enables an actor's face to be at all times clear and visible.

In *Kwan Yin,* a Chinese opera performed in New York, rubber was used as a decoration on the costumes. The excessively ornate clothes of the Chinese actors have as a rule a tinsel quality, which to Westerners is a trifle vulgar and certainly foreign to the new tendency toward simplicity in our theatres. Therefore the designs, instead of being embroidered with metal threads and sequins were painted on a comparatively inexpensive material. The heavily embossed parts and the thick, rolled edges were executed in rubber stuffed with cotton batting and painted with metal pigments, polished or left dull according to the result desired. Even the little mirrors so often used on Chinese costumes could be faithfully reproduced without giving the disturbing sparkle. The result was more like a Chinese painting of a drama than an actual Chinese theatre.

It must be remembered that the stage is always extremely deceiving, tricky and utterly unrealistic. The most exquisite and magnificent brocade may lose every vestige of its value once it is seen "across the footlights"; and it is also very costly to acquire. On the other hand, a piece of cheesecloth, treated and painted in the right manner, may look like the finest tissue from Tyre. Cloth of gold may look dark and drab, gilded rubber worth a king's ransom. The point is to find what material, combined with treatment and paint, will give the best result.

Often strong contrasts are desired. This is only attainable by means of a great variety in the stuffs used. In order to give the feeling of the storm in *King Lear,* Reinhardt wished to have a continual movement on the stage throughout the heath-scenes, though the simple grey-blue cyclorama and the lack of any realism on the stage in the way of trees or rocks, proved a difficult problem for the designer. True, there were moving clouds and other light effects, sounds of wind and rain, the roaring of thunder and vivid flashes of lightning; but yet not enough movement. Veils were used, of every conceivable thickness, size and weight; not, however, as scenery. They were worn as costumes, carried, wafted to and fro, dragged across the stage by girls, who themselves were shrouded in these mists of blues and greys, with streaks of silver painted on them to catch the light as they passed, tearing across the back like ragged bits of fog driven hither and thither by the storm. The contrast of these light and airy muslin veils with the heavy rubber folds of the stonelike figures of the actors can well be imagined. Lear stood like a monument hewn out of rock, braving the elements.

Reinhardt's "Midsummer Night's Dream."—In Reinhardt's production of *A Midsummer Night's Dream* in the Tiepolo manner, the costumes were made out of canvas, in order to resemble as closely as possible the actual paintings of an old master. There was, however, another and possibly more important reason for employing the material. In this comedy of Shakespeare's there are two strongly opposed factors: on the one side, the human being of Theseus' court and on the other, Nature, as represented by the forest and the Fairies. Puck is the meeting point of the two. The whole has a dreamlike quality and therefore even the human beings may be costumed as fantastically and imaginatively as becomes entertaining. Moreover, to many people the play has a rather childish mood and certainly the classic Greek attire is wearisome at best. Accordingly, the 18th century interpretation of mythological characters was selected, which gave Theseus and

Hippolyta waving plumes and tremendous robes of heavy silks and satins, and the other members of the palace rich and ornate brocades. In order to produce this effect and further accentuate the stiffness of the Court, with all its pomp and forced rigidity, nothing could have been as satisfactorily hard and unbending as thick painters' canvas. Not even the plumes could be made of feathers, because they would have been too realistic. They were therefore made of thick muslin, gathered and drawn close on wires, and then painted and sprayed to look like feathers sketched by a master technician.

The result of those Court scenes was truly magnificent. There was no actual scenery. The backdrop was designed as two gigantic tapestries surrounding the stage in a semicircle. The main opening was in the centre. For the fairy forest scenes, these curtains could be lighted from the back and became translucent. An elevation in the centre of the stage consisted of inclines running in circles to different points and altitudes and leading to exits above and below the stage level. At the same time, this entire structure was joined together in the middle by one long flight of steps, down which the wedding procession came in the last scene. The figures looked as though they might be stepping forth out of the very tapestries, so unreal and exotic did they seem. Around the back of the stage to the top of the staircase on either side stood living candelabra: people clothed in armour wrought in wondrous shapes of "gold and precious stones" and holding a thousand lights.

How airy and slight, exquisitely dainty and youthful seemed, by such a complete contrast, the springtime smilax, the fern-like veils and transparent muslins of the fairies. It was Nature unloosened in a moonlight night of fantasy, far removed from the rigour and severity of a bombastic court. The forest became the human element. Bushes moved and mists floated by. Through a fog, in a cloud of mystery, Oberon and Titania appeared like two white and radiant blossoms in the dusk. Their costumes, consisting though they did of veils and gauzes, were in no way realistic copies of flowers. Rather were they, in design, of the very same 18th century period, both in shape and form. The important difference and complete contrast lay in the fact that they were executed in transparent silky veilings in contrast to the heavy canvas of the court costumes. When Titania lay asleep on the mound, a graceful silver birch watched over her from above, gently waving her tender and fragile arms with muslin leaves in the dream-like breeze of imagination. Later on, she beckoned to other silver birches to join her to gaze upon the strange spectacle of their queen making love to an ass's head; until at last the stage seemed full of youthful trees, a grove of birches shining silver in the night. Dawn appeared and dispersed the moonbeams; ferns, trees and bushes slowly vanished. The heavy rustling of the canvas robes, stiff and rigid, together with the metallic sound of trumpets and horns, ushered in the court once more.

Of such combinations and contrasts have Reinhardt's performances consisted; whether always successful in the carrying out of the ideas is of little or no importance. The chief reason for this elaboration of a production, which in fact simplifies it, is that it brings a play to life. Furthermore, it does not interfere with the acting. If Theseus and Hippolyta had been obliged to move about freely they would not have been clothed in stiff materials. As it is, the poet intended them merely to stand, look handsome and declaim. When the lovers fled to the woods, away from the pomp and dignity of the court, they, quite naturally, shed their stiff and cumbersome outer garments and head-dresses and were free to move, run, lie down, etc., in no way hampered by their clothes. Puck was in tights. Absolutely nothing interfered with his pranks, leaps, jumps, bounds and somersaults. He was painted from head to toe; in front, in brilliant colours and gold to resemble the courtiers; on the back, in greens and silver to suggest the fairies. Thus when he turned about, he could become almost invisible by the colours of his back melting into the woodland scene. Puck is the actor in *A Midsummer Night's Dream* who requires the greatest freedom of movement; therefore he could not have been impeded by any unnecessary materials and had to resort to his ingenuity of make-up to bring about the desired meeting point between mortals and the realm of the unreal.

Shadow Costuming.—An interesting project for a music drama has long been under consideration, in which the characters on a lower stage would be the singers clad in rich and elaborate costumes. They would sing without acting, merely forming a picture representing the period desired and set the mood. Upon an upper platform would be cast shadows, either from below against a solid background, or in silhouette through a translucent "drop." (Both of these might be used simultaneously.) These shadows, freed from decoration and merely clothed in tights, would play the scene which in song would be told about below. Their every movement would be visible and clear, undisturbed by hanging sleeves or trains; moreover, by arrangements of the lights and background, the figures on the upper level could be enlarged or reduced according to importance or desire, resembling the "close-ups" in a cinematograph.

Another possibility of this sort of shadow costuming would be to have the actors playing on a level above the mob and unimportant characters. Above and behind the principal actors would be cast the shadows of the people in their thoughts and imagination. As an example of this, Medea standing high above the Greek Chorus is plotting the death of her children. In shadow, above her, stripped of all earthly and unnecessary clothing, she sees herself in the act of killing them. Or, in other scenes, the chorus might be shown in shadows only, so as not to interfere with the concentration on the principal actors. At a climax, like Mark Antony's speech in *Julius Caesar,* the Roman mob could be just as realistic and seem far vaster in number, if only dimly seen in silhouette below the speaker. Antony would stand alone and impressive in the brilliancy of a central spotlight.

There are so very many ways and means of gaining truly wonderful effects, even on our stages of to-day, and yet how often do we see the same old-fashioned scenes and costumes, lighted in the same conventional manner. The fact remains that design in costuming is not the most important part. It is invention, creation, flights of imagination and ideas, which denote progress in the art of staging. It is not necessary to go so far as to put people in wheels and ladders, pieces of machinery, motor horns and sheets of music. These may look like effective attempts at post-impressionism and cubism when sketched on paper, but they are not and never can be an adequate clothing for actors, if we are to consider the theatre as an art centre for dramas in which the play and acting are the most important items.

For the most part, theatrical producers and even the public seem to imagine that designing costumes for a production means an artist drawing pretty sketches, usually in water colours, and having dressmakers carry out the designs by matching the colours and trying to decipher what material was meant, whether velvet or Chinese silk or organdy; pictures these, sometimes actual masterpieces, records of old time periods which, framed and hung in museums, will go down to posterity. That is not progress in costuming. Just as there has been a slow but astounding change, during this century, in the mechanism of the stage, scene shifting, theatre architecture and, above all, lighting, so there is also in costuming. What a startling difference there is between an old operatic production of *La Gioconda* dressed in the realistic costumes of velvets, paste jewellery and gilded lace, and Reinhardt's *King Lear,* clothed entirely in rubber. One was realism, the other art. Realism, the imitative portrayal of the real, without the intermediary of poetry and genius, can at best only breed confusion, which excludes it from the realm of art. *Lear* is a product of genius with a dominant idea throughout; so also in *décor* and costumes there should be a simplification of means, thereby directing the attention to the great purpose of the play. The highest mission of the theatre is to present creative ideas. The field is so new that unfortunately there have been few pioneers who have been equipped with the necessary financial backing, combined with the creative instinct, to develop these new ideas in costuming.

(E. DE W.)

COSWAY, RICHARD (*c.* 1742–1821), English miniature painter, was baptized in 1742; his father was master of Blundell's school, Tiverton, where Cosway was educated. His success in miniature painting is said to have been started by his clever portrait of Mrs. Fitzherbert, which brought Cosway his earliest great patron, the prince of Wales. He speedily became one of the most popular artists of the day, and his residence at Schomberg house, Pall Mall, was a well-known aristocratic rendezvous. In 1791 he removed to Stratford place, where he lived in a state of great magnificence till 1821, when he went to reside in Edgware road. He died on July 4, 1821, and was buried in Marylebone New church.

Cosway, who married Maria Hadfield in 1781, had one child who died young. She is the subject of one of his most celebrated engravings. He painted miniatures of very many members of the royal family, and of the leading persons who formed the court of the Prince Regent. Perhaps his most beautiful work is his miniature of Mme. du Barry, painted in 1791.

Cosway's work is of great charm and of remarkable purity, and he is certainly the most brilliant miniature painter of the 18th century.

For a full account of the artist and his wife, see *Richard Cosway, R.A.*, by G. C. Williamson (1905).

COTA DE MAGUAQUE, RODRIGO (d. before 1495), Spanish poet, was born at Toledo. Little is known of him save that he was of Jewish origin and abjured his religion. He is the author of the *Diálogo entre el amor y un viejo,* a striking dramatic poem first printed in the *Cancionero general* of 1511, and of a burlesque epithalamium written in 1472 or later.

His *Obras* have been edited by R. Foulché-Delbosc, in the *Cancionero Castellano del siglo xv.* (1915).

CÔTE-D'OR, a department of eastern France, formed of the northern region of the old province of Burgundy, bounded north by the department of Aube, north-east by Haute-Marne, east by Haute-Saône and Jura, south by Saône-et-Loire, and west by Nièvre and Yonne. Area, 3,393 square mi. Pop. (1936) 334,386. The plateau de Langres, consisting chiefly of Jurassic rocks, runs from north-east to south-west through the centre of the department and separates the basin of the Seine from that of the Saône. In the north-west is the wooded district of Châtillonais drained by the Seine and the Ource, both fed by the abundant springs characteristic of Burgundy. Spurs from the granitic mountains of Morvan occupy the south-west where the Arroux, a tributary of the Loire, the Armançon and other affluents of the Yonne are the chief rivers. The western slopes of the department are well watered and provide good pasture for sheep and cattle. The eastern side is drier and warmer and is famous for its vineyards, especially those of the Côte-d'Or which comprise the three main groups of Beaune, Nuits and Dijon. The Tertiary rocks of the Saône valley provide good agricultural land. The chief cereals are wheat, oats and barley; potatoes, hops, beetroot, rape-seed, colza and some tobacco are also produced. The department has anthracite mines and produces freestone, lime and cement. Manufactures include iron, steel, nails, tools, machinery and other iron goods, paper, earthenware, tiles and bricks, leather goods, biscuits and mustard, and there are flour-mills, distilleries, oil and vinegar works and breweries. Coal is the principal import; there is an active export trade in wine, brandy, cereals and live stock and in manufactured goods. The P.L.M. railway main line passes through Dijon. The canal of Burgundy, connecting the Saône with the Yonne, has a length of 94 mi. in the department, while that from the Marne to the Saône has a length of 24 mi.

Côte-d'Or is divided into the arrondissements of Dijon, Beaune and Montbard, with 37 cantons and 717 communes. It forms the diocese of the bishop of Dijon, and part of the archiepiscopal province of Lyons and of the 8th military region. Dijon is the seat of the educational circumscription (*académie*) and court of appeal to which the department is assigned. Châteauneuf has a château of the 15th century, St. Seine-l'Abbaye, a fine Gothic abbey church, and Saulieu, a Romanesque abbey church of the 11th century. The château of Bussy Rabutin (at Bussy-le-Grand), founded in the 12th century, has an interesting collection of pictures. Montbard, the birthplace of the naturalist Buffon, has a keep of the 14th century and other remains of a castle of the dukes of Burgundy. The remarkable Renaissance chapel (1536) of Pagny-le-Château, belonged to the château destroyed in 1768. At Fontenay, near Marmagne, a paper-works occupies the buildings of a well-preserved Cistercian abbey of the 12th century. At Vertault there are remains of a theatre and other buildings marking the site of the Gallo-Roman town of Vertilium.

See also DIJON; BEAUNE; CHÂTILLON-SUR-SEINE; SEMUR-EN-AUXOIS; AUXONNE; FLAVIGNY-SUR-OZERAIN; CITEAUX.

CÔTES-DU-NORD, a maritime department of the north-west of France, formed in 1790 from the northern part of the province of Brittany, and bounded north by the English Channel, east by the department of Ille-et-Vilaine, south by Morbihan, and west by Finistère. Pop. (1936) 531,840. Area, 2,787 sq.mi. It consists of much denuded Devonian, Silurian and Cambrian rocks with granitic intrusions. The higher parts in the interior form the watershed between the rivers running respectively to the Channel and to the Atlantic ocean. The rivers of the Channel slope are the Rance, Arguenon, Gouessan, Gouet, Frieux, Tréguier and Léguer, while the Blavet, Meu, Oust and Aulne belong to the southern slope. In the southeast are the Landes du Menez which run in a northwesterly direction, while further west the watershed bifurcates to form the Montagnes Noires in the southwest and the Monts d'Arrée in the west of the department. Both these lines are continued into Finistère. Exposure to strong rain-bearing winds from the Atlantic and a thin soil limit agriculture on the interior plateaus which pasture cattle and horses. Seaweed manure promotes coastal agriculture with wheat, oats and buckwheat as the chief crops, also potatoes, flax, mangels, apples, plums, cherries and honey. Paimpol equips a large fleet which sets out annually for the Icelandic fishing grounds. Sardines are caught locally and large quantities are preserved. The department produces slate, building-stone, lime and china-clay. Flour-mills, saw-mills, sardine factories, tanneries, iron-works, manufactories of polish, boat-building yards and rope-works employ many people and cloth, agricultural implements and nails are manufactured. The chief imports are coal, wood and salt. Exports include agricultural products (eggs, butter, vegetables, etc.), horses, flax and fish. The chief commercial ports are Le Légué and Paimpol. The department is served by the Ouest-État railway; its chief waterway is the canal from Nantes to Brest which traverses it for 73 mi.

Côtes-du-Nord is divided into the four arrondissements of St. Brieuc, Dinan, Guingamp and Lannion which contain 48 cantons and 390 communes. Bas Breton is spoken in the arrondissements of Guingamp and Lannion, and in part of that of St. Brieuc. The department belongs to the ecclesiastical province, the *académie* (educational division), and the appeal court of Rennes, and is in the region of the X army corps. Extensive remains of an abbey of the Premonstratensian order, dating chiefly from the 13th century, exist at Kerity; and Lehon has remains of a priory of the same period. The churches of Ploubezre (12th, 14th and 16th centuries), Perros-Guirec (12th century), Plestin-les-Grèves (16th century) and Lanleff (12th century) are of interest. The church of St. Mathurin at Moncontour, a place of pilgrimage, contains stained glass of the 16th century, and the mural paintings of the chapel of Kermaria-an-Isquit near Plouha, which belongs to the 13th and 14th centuries, are well known. Near Lannion is the ruined castle of Tonquédec, built in the 14th century. At Corseul there is a temple and other Roman remains. (*See* also DINAN; GUINGAMP; LAMBALLE; TRÉGUIER.)

COTGRAVE, RANDLE (d. 1634?), English lexicographer, of a Cheshire family, was educated at Cambridge, entering St. John's college in 1587. He became secretary to Lord Burghley, and in 1611 published the first French-English dictionary (1611) a work which has great historical value for the study of both languages. He was still alive in 1632, when he issued the 2nd ed. of his dictionary.

CÖTHEN, a town of Germany, in the *Land* of Anhalt, on the Ziethe, 42 mi. N.W. of Leipzig by rail. Pop. (1939) 34,000.

Cöthen was a Slav settlement destroyed by the German king Henry I. in 927. In 1300 it was burned by the margrave of Meissen. In 1547 the town was taken from its prince, and given by the emperor Charles V. to the Spanish general and painter, Felipe Ladron y Guevara (1510–1563), but was soon repurchased.

Hahnemann, the founder of homoeopathy, lived and worked in Cöthen. From 1603 to 1847 Cöthen was the capital of the principality, later duchy, of Anhalt-Cöthen. It consists of an old and a new town with four suburbs. The former palace of the dukes of Anhalt-Cöthen, in the old town, contains the ornithological collection of Johann Friedrich Naumann (1780–1857). The Lutheran Jakobskirche (called the cathedral), a Gothic building, has some fine old stained glass. The industries include iron-founding and the manufacture of agricultural and other machinery, malt and beet-root sugar; there is trade in grain and cattle.

COTMAN, JOHN SELL (1782–1842), English landscape-painter and etcher, son of a well-to-do silk mercer, was born at Norwich, on May 16, 1782. He was sent to London to study art, where he became the friend of Turner, T. Girtin and other artists. He died in London on July 24, 1842. Cotman's work was not considered of much importance in his own day, and his pictures only procured small prices; but he now ranks as one of the great figures of the Norwich school. His sons, Miles Edmund (1810–58) and Joseph John (1814–78), were landscape-painters of merit; and his younger brother Henry's son, Frederic George Cotman (1850–1920), was a water-colour artist.

See G. A. Stephen, *Norfolk Artists* (1915); H. M. Cundall, *The Norwich School* (1920).

COTONEASTER, a genus of the rose family (Rosaceae), containing about 50 species of shrubs and small trees, natives of Europe, north Africa and temperate Asia. *C. vulgaris* was a native on the limestone cliffs of the Great Orme in north Wales but is now extinct. Several species are grown in shrubberies and borders, or as wall plants, mainly for their clusters of bright red or yellow berry-like fruits. Plants are easily raised by seeds, cuttings or layers, and grow well in ordinary soil.

COTOPAXI, a highland province of Ecuador situated a short distance S. of the equator; area 1,780 sq.mi., pop. (1944 est.) 202,385, capital, Latacunga (est. pop. 20,357). The people of Cotopaxi, for the most part pure Indian, are concentrated in a moderately fertile and well watered plateau basin (Basin of Latacunga), which lies at an average elevation of 8,000 ft. between the two towering and closely spaced ranges of the Ecuadoran Andes. Economic activity is confined largely to the intensive cultivation of cool temperate crops (potatoes, barley, wheat, corn and beans) and the grazing of cattle and sheep. Most of the products of the region are consumed locally. The Macuchi mines (gold-copper-silver), operated by the Cotopaxi Exploration Co., are located 50 mi. W. of Latacunga at an elevation of 6,000 ft. on the west slope of the Cordillera Occidental. (R. W. RD.)

COTOPAXI, a mountain of the Andes, in Ecuador, South America, 35m. south-south-east of Quito, remarkable as the loftiest active volcano in the world. The earliest outbursts on record took place in 1532 and 1533; and since then the eruptions have been both numerous and destructive. Among the most important are those of 1744, 1746, 1766, 1768 and 1803. In 1744 the thunderings of the volcano were heard at Honda on the Rio Magdalena, about 500m. distant; in 1768 the quantity of ashes ejected was so great that it covered all the lesser vegetation as far as Riobamba; and in 1803 Humboldt reports that at the port of Guayaquil, 160m. from the crater, he heard the noise day and night like continued discharges of a battery. There were considerable outbursts in 1851, 1855, 1856, 1864 and 1877.

In 1802 Humboldt made a vain attempt to scale the cone, and pronounced the enterprise impossible; and the failure of Jean Baptiste Boussingault in 1831, and the double failure of M. Wagner in 1858, seemed to confirm his opinion. In 1872, however, Dr. Wilhelm Reiss succeeded in reaching the top on Nov. 28; in the May of the following year the same feat was accomplished by Dr. A. Stübel, and he was followed by T. Wolf in 1877, M. von Thielmann in 1878 and Edward Whymper in 1880.

Cotopaxi is one of the most beautiful mountain masses of the world, rivalling the celebrated Fujiyama of Japan in its symmetry of outline, but overtopping it by more than 7,000ft. It is more than 15,000ft. higher than Vesuvius, more than 7,000ft. higher than Teneriffe, and nearly 2,000ft. higher than Popocatepetl. Its slope, according to Orton, is 30°, according to Wagner 29°, the north-western side being slightly steeper than the south-eastern. The apical angle is 122° 30′. The snowfall is heavier on the eastern side of the cone, which is permanently covered, while the western side is usually left bare, a phenomenon occasioned by the action of the moist trade winds from the Atlantic. Its height, according to Whymper, is 19,613ft., and its crater is 2,300ft. in diameter from north to south, 1,650ft. from east to west, and has an approximate depth of 1,200ft.

It is bordered by a rim of trachytic rock, forming a black coronet above the greyish volcanic dust and sand which covers its sides to a great depth. Whymper found snow and ice under this sand.

On the southern slope, at a height of 15,059ft., is a bare cone of porphyritic andesite called *El Picacho,* "the beak," or *Cabeza del Inca,* "the Inca's head," with dark cliffs rising fully 1,000ft., which according to tradition is the original summit of the volcano blown off at the first-known eruption in 1532. The summit of Cotopaxi is usually enveloped in clouds; and even in the clearest month of the year it is rarely visible for more than eight or ten days. Its eruptions produce enormous quantities of pumice; and deep layers of mud, volcanic sand and pumice surround it on the plateau. Of the air currents about and above Cotopaxi, Wagner says (*Naturw. Reisen im trop. Amerika,* p. 514): "On the Tacunga plateau, at a height of 2,600 metres, the prevailing direction of the wind is meridional, usually from the south in the morning, and frequently from the north in the evening; but over the summit of Cotopaxi, at a height of 18,000 ft., the north-west wind always prevails throughout the day.

"The gradually widening volcanic cloud continually takes a south-eastern direction over the rim of the crater; at a height, however, of about 21,000 ft. it suddenly turns to the north-west, and maintains that direction till it reaches a height of at least 28,000ft.

"There are thus from the foot of the volcano to the highest level attained by its smoke-cloud three quite distinct regular currents of wind."

COTSWOLDS or **COTTESWOLDS,** a range of hills in the western midlands of England. The greater part lies in Gloucestershire, but the system also extends into Worcestershire, Warwickshire, Oxfordshire, Wiltshire and Somersetshire. It lies on a line from north-east to south-west, forming a part of the great Oolitic belt. On the west the hills are steeply scarped by the vales of Evesham, Gloucester and Berkeley (valleys of the Worcestershire Avon and the Severn). On the east they slope more gently towards the basins of the upper Thames and the Bristol Avon. The watershed lies close to the western line, except where the Stroud valley, with the Frome, draining to the Severn, strikes deep into the heart of the hills. The principal valleys are those of the Windrush, Lech, Coln and Churn, feeders of the Thames, the Thames itself, and the Bristol Avon which forms the southern boundary of the hills. The crest-line from Bath, in the south, to Meon Hill, in the north, measures 57m. The breadth varies from 6m. in the south to 28 towards the north, and the area is some 300 sq.m. The features are rolling plateaux or wolds and bare limestone uplands, rich in remains of prehistoric times, alternating with deep narrow valleys, well wooded and traversed by shallow, rapid streams. The average elevation is about 600ft., but Cleve Cloud, above Cheltenham, and Broadway Hill, in the north, are well over 1,000ft. The hills are famous for the breed of sheep which takes its name from them. The wealth accruing from wool from the 14th to the 17th centuries is preserved in the wonderful Perpendicular churches of the area, *e.g.,* at Chipping Campden. Near this town the once famous Cotswold games were founded by Robert Dover in the 17th century.

COTTA, the name of a family of German publishers of noble Italian descent, and at the time of the Reformation settled in Eisenach in Thuringia.

JOHANN GEORG COTTA (1) (1631–1692), the founder of the publishing house of J. G. Cotta, married in 1659 the widow of the university bookseller, Philipp Braun, in Tübingen, and took over the management of his business, thus establishing the firm which was subsequently associated with Cotta's name. On his death, in 1692, the undertaking passed to his only son, Johann Georg

(2); and on his death in 1712, to the latter's eldest son, also named Johann Georg (3), while the second son, Johann Friedrich (*see* below), became the distinguished theologian.

Although the eldest son of Johann Georg (3), Christoph Friedrich Cotta (1730–1807), established a printing-house to the court at Stuttgart, the business languished, and it was reserved to his youngest son, Johann Friedrich, Freiherr Cotta von Cottendorf (1764–1832), who was born at Stuttgart on April 27, 1764, to restore the fortunes of the firm. He entered the university of Tübingen and after graduating spent a considerable time in Paris. In December 1787 he took over the publishing business and in 1794 the *Allgemeine Zeitung,* of which Schiller was to be editor, was planned. Schiller was compelled to withdraw on account of his health, but his friendship with Cotta deepened every year. In 1795 Schiller and Cotta founded the *Horen,* a periodical very important to the student of German literature. The *Horen* brought Goethe and Schiller into intimate relations with each other and with Cotta; and Goethe, while regretting that he had already promised *Wilhelm Meister* to another publisher, contributed the *Unterhaltung deutscher Ausgewanderten,* the *Roman Elegies* and a paper on "Literary Sansculottism." Fichte sent essays from the first, and the other brilliant German authors of the time were also represented. In 1798 the *Allgemeine Zeitung* appeared at Tübingen, being edited first by Posselt and then by Huber. Soon the editorial office of the newspaper was transferred to Stuttgart, in 1803 to Ulm and in 1810 to Augsburg; it is now in Munich. In 1799 Cotta was sent to Paris by the Württemberg estates as their representative. Here he made friendships which proved very advantageous for the *Allgemeine Zeitung.* In 1801 he paid another visit to Paris, also in a political capacity, when he carefully studied Napoleon's policy.

In 1810 he removed to Stuttgart; and from that time till his death he was loaded with honours. State affairs and an honourable commission from the German booksellers took him to the Vienna Congress; and in 1815 he was deputy-elect at the Württemberg diet. In 1819 he became representative of the nobility; then he succeeded to the offices of member of committee and (1824) vice-president of the second chamber. In 1828–29 appeared the famous correspondence between Schiller and Goethe. In addition to his standing as a publisher, Cotta was a scientific agriculturist and promoted many reforms in farming. He was the first Württemberg landholder to abolish serfdom on his estates. In politics he was throughout his life a moderate Liberal. In 1824 he set up a steam printing press in Augsburg, and, about the same time, founded a literary institute at Munich. In 1825 he started steamboats on Lake Constance, and introduced them in the following year on the Rhine. In 1828 he was sent to Berlin by Bavaria and Württemberg. He died on Dec. 29, 1832.

His son, Johann Georg (4), Freiherr Cotta von Cottendorf (1796–1863) greatly extended the connections of the firm by purchase, in 1839, of the publishing business of G. J. Göschen in Leipzig, and in 1845 of that of Vogel in Landshut; while, in 1845, "Bible" branches were established at Stuttgart and Munich. He was succeeded by his younger son, Karl, and by his nephew, Hermann Albert von Reischach. Under their joint partnership, the before-mentioned firms in Leipzig and Landshut and an artistic establishment in Munich passed into other hands, leaving, on the death of Herman Albert von Reischach in 1876, Karl von Cotta the sole representative of the firm until his death in 1888. In 1889 the firm of J. G. Cotta passed by purchase into the hands of Adolf and Paul Kröner, and in 1899 the business was converted into a limited liability company.

See Albert Schäffle, *Cotta* (1895); *Verlags-Katalog der J. G. Cotta'schen Buchhandlung, Nachfolger* (1900); Lord Goschen's *Life and Times of G. J. Göschen* (1903); *Briefe an Cotta: Das Zeitalter Goethes und Napoleons, 1794–1815* edited by Maria Fehling (1925).

Johann Friedrich Cotta (1701–1779), the theologian, was born on March 12, 1701, the son of Johann Georg Cotta (2). After studying theology at Tübingen he began his public career as lecturer in Jena university. He became professor at Tübingen in 1733. In 1736 he removed to the chair of theology in the University of Göttingen. In 1739 he returned as extraordinary professor of theology to his Alma Mater, and died, as chancellor of Tübingen university, on Dec. 31, 1779. His chief works are his edition of Johann Gerhard's *Loci Theologici* (1762–77) and the *Kirchenhistorie des Neuen Testaments* (1768–73).

COTTA, BERNHARD VON (1808–1879), German geologist, was born near Eisenach, on Oct. 24, 1808. He was educated at Freiburg and Heidelberg, and from 1842 to 1874 he held the professorship of geology in the Bergakademie of Freiburg. He was one of the earliest to use the microscope in determining the structure of fossil plants. Later on he studied ore-deposits, rocks and metamorphism. Cotta died at Freiburg on Sept. 14, 1879. Among his many works may be mentioned *Geologie der Gegenwart* (1866).

COTTA, GAIUS AURELIUS (*c.* 124–73 B.C.), Roman statesman and orator. In 92 B.C. he defended his uncle P. Rutilius Rufus, unjustly accused of extortion in Asia. He was intimate with M. Livius Drusus, who was murdered in 91. Shortly afterwards he was prosecuted under the *lex Varia,* directed against all who had supported the Italians against Rome, and went into exile. He did not return until 82, during the dictatorship of Sulla (*q.v.*). In 75 he was consul and carried a law that abolished the Sullan disqualification of the tribunes from holding higher magistracies. In 74 Cotta obtained the province of Gaul, but died suddenly on his return. According to Cicero, P. Sulpicius Rufus and Cotta were the best speakers of the young men of their time. Cotta's successes were chiefly due to his searching investigation of facts. He is introduced by Cicero as an interlocutor in the *De oratore* and *De natura deorum* (iii).

See Cicero, *De oratore,* iii. 3, *Brutus,* 49, 55, 90, 92; Sallust, *Hist. Frag.;* Appian, *Bell. Civ.* i. 37.

His brother, Lucius Aurelius Cotta, when praetor in 70 B.C., brought in a law by which the jurors were to be chosen, not from the senators only as limited by Sulla, but from senators, equites and *tribuni aerarii* (*see* Aerarii). In 66 Cotta and L. Manlius Torquatus successfully accused the consuls-elect for the following year of bribery at the elections, and were chosen in their places. Cotta proposed a public thanksgiving for Cicero's services in suppressing the Catilinarian conspiracy, and after Cicero had gone into exile, maintained that the law of banishment (introduced by Clodius, *q.v.*) was legally worthless. He afterwards attached himself to Caesar, and it was reported that he intended to propose that Caesar should receive the title of king. After Caesar's murder he retired from public life.

See Cicero, Orelli's *Onomasticon;* Sallust, *Catiline,* 18; Suetonius, *Caesar,* 79; Livy, *Epit.* 97; Vell. Pat. ii. 32; Dio Cassius xxxvi. 44, xxxvii. 1.

COTTABUS, a game of skill for a long time in great vogue at Ancient Greek drinking parties, especially in the 4th and 5th centuries B.C. (Gr. κότταβος). It is frequently alluded to by the classical writers of the period, and not seldom depicted on ancient vases. The object of the player was to cast a portion of wine left in his drinking cup in such a way that, without breaking bulk in its passage through the air, it should reach a certain object set up as a mark, and there produce a distinct noise by its impact. Both the wine thrown and the noise made were called λάταξ. The thrower, in the ordinary form of the game, was expected to retain the recumbent position that was usual at table, and, in flinging the cottabus, to make use of his right hand only. To succeed in the aim no small amount of dexterity was required.

Various modifications of the original principle of the game were gradually introduced, but for practical purposes we may reckon two varieties. (1) In the Κότταβος δι' ὀξυβάφων shallow saucers (ὀξύβαφα) were floated in a basin or mixing-bowl filled with water; the object was to sink the saucers by throwing the wine into them, and the competitor who sank the greatest number was considered victorious, and received the prize, which consisted of cakes or sweetmeats. (2) Κότταβος κατακτός, is not so easy to understand. (The epithet κατακτὸς [let down] may refer to the rod, which might be raised or lowered as required; to the lower disk, which might be moved up and down the stem; to the moving up and down of the scales, in the supposed variety of the game mentioned below). There is little doubt as to the apparatus, which consisted of a ῥάβδος or bronze rod; a πλάστιγξ, a small disk or basin, resembling a scale-pan; a larger disk (λεκανίς); and (in most cases) a small bronze figure called μάνης. The discovery (by Professor Helbig in 1886) of two sets of actual apparatus near Perugia, and various representations on vases help to elucidate the somewhat obscure accounts of the method of playing the game contained in the scholia and certain ancient authors who, it must not be forgotten, wrote at a time when the game itself had become obsolete, but much still remained uncertain.

The game, so far as we know, seems to have been of Sicilian origin, but it spread through Greece from Thessaly to Rhodes, and was especially fashionable at Athens. Dionysius, Alcaeus, Anacreon, Pindar, Bacchylides, Aeschylus, Sophocles, Euripides, Aristophanes, Antiphanes, make frequent and familiar allusion to the κότταβος; but in the writers of the Roman and Alexandrian period such references as occur show that the fashion had died out. In Latin literature it is almost entirely unknown.

See "Kottabos" in Daremberg and Saglio's *Dictionnaire des antiquités,* and L. Becq de Fouquières, *Les Jeux des anciens* (1873); English readers may be referred to an article by A. Higgins on "Recent Discoveries of the Apparatus used in playing the Game of Kottabos" *Archaeologia,* li. (1888). *See* also C. Sartori, *Das Kottabos-Spiel der alten Griechen* (1893), in which a full bibliography of ancient and modern authorities is given.

COTTENHAM, CHARLES CHRISTOPHER PEPYS, 1st Earl of (1781–1851), lord chancellor of England, was born in London on April 29, 1781. He was the second son of Sir William W. Pepys, a master in chancery, who was descended from John Pepys, of Cottenham, Cambridgeshire, a great-uncle of Samuel Pepys, the diarist. Educated at Harrow and Trinity college, Cambridge, Pepys was called to the bar at Lincoln's Inn in 1804. He practised at the chancery bar and was made a K.C. in 1826. He sat in parliament, successively, for Higham Ferrars and Malton, was appointed solicitor-general in 1834, and in the same year became master of the rolls. On the formation of Lord Melbourne's second administration in April 1835, the great seal was for a time in commission, but eventually Pepys, who had been one of the commissioners, was appointed lord chancellor (Jan. 1836) with the title of Baron Cottenham. He held office till the defeat of the ministry in 1841. In 1846 he again became lord chancellor in Lord John Russell's administration. Shortly before his retirement in 1850 he had been created Viscount Crowhurst and earl of Cottenham. He died at Pietra Santa, Italy, on April 29, 1851.

Both as a lawyer and as a judge, Lord Cottenham, though an indifferent speaker, was remarkable for his mastery of the principles of equity. His only important contribution to the statute-book was the Judgments Act, 1838, which amended the law for the relief of insolvent debtors.

Bibliography.—E. Foss, *The Judges of England* (1848–64); J. Campbell, *Lives of the Lord Chancellors* (1869); E. Manson, *Builders of our Law* (1904); J. B. Atlay, *The Victorian Chancellors* (1906).

COTTET, CHARLES (1863–1925), French painter, was born on July 12, 1863, at Puy. He studied at the École des Beaux-Arts, and under Puvis de Chavannes and Roll. He travelled and painted in Egypt, Italy, and on the Lake of Geneva, but he made his name with his sombre and gloomy, firmly designed, severe and impressive scenes of life on the Brittany coast. His signal success was achieved by his triptych, "Au pays de la mer," at the Luxembourg. The Lille gallery has his "Burial in Brittany." He died on Sept. 25, 1925.

COTTII REGNUM, a district in Liguria, Italy, including much of the important road over the pass (6,119ft.) of the Alpis Cottia (Mont Genèvre) into Gaul. This route was certainly in use about 100 B.C. In 58 B.C. Caesar met with some resistance on crossing it, but afterwards entered into friendly relations with Donnus, the king of the district; he refers to it as the shortest route. Donnus's son Cottius erected a triumphal arch at his capital Segusio, the modern Susa, in honour of Augustus. Under Nero, after the death of the last Cottius, it became the province of "Alpes Cottiae," governed by a *procurator Augusti.*

COTTIN, MARIE (called Sophie) (1770–1807), French novelist, *née* Risteau, was born in Paris in 1770. *Élisabeth, ou les exilés de Sibérie,* her last and most famous tale, was published in 1806. Its subject was treated later with an admirable simplicity by Xavier de Maistre. She died at Champlan (Seine et Oise) on April 25, 1807.

A complete edition of her works, with a notice by A. Petitot, was published, in five volumes, in 1817.

COTTINGTON, FRANCIS COTTINGTON, Baron (1578–1652), English lord treasurer and ambassador, was appointed English agent in Spain during the recall of the ambassador, Sir Charles Cornwallis, from 1609 to 1611. In 1612, he became consul at Seville, and in 1616 ambassador to Spain, making in 1618 James's proposal of mediation in the dispute with the elector palatine. After Charles's accession Buckingham brought him into disfavour; but on the duke's assassination he regained his position, being made a privy councillor in 1628, chancellor of the exchequer in 1629, and two years later Baron Cottington of Hanworth, Middlesex. The unpopularity caused by his exactions as master of the court of wards and by his declaration that for the Scottish war the king might levy money without Parliament led him to give up the court of wards in 1641 and the chancellorship of the exchequer in 1642. He rejoined the king in 1643, took part in the proceedings of the Oxford parliament, and was made lord treasurer, in Oct. 1643. He signed the surrender of Oxford in 1646 and, being excepted from the indemnity, retired abroad, joining Prince Charles at The Hague in 1648. He went to Spain to obtain help for the royal cause but, receiving no response, settled there and died on June 19, 1652.

Bibliography.—See *Dict. of Nat. Biography;* Clarendon's *Hist. of the Rebellion, passim,* esp. xii. and xiii. 30; Clarendon's *State Papers and Life;* Strafford's *Letters;* Gardiner's *Hist. of England and of the Commonwealth;* Hoare's *Wiltshire;* Laud's *Works,* vols. iii.–vii.

COTTON, SIR ARTHUR THOMAS (1803–1899), English engineer, tenth son of Henry Calveley Cotton, entered the Madras engineers in 1819, served in the first Burmese war (1824–26), and in 1828 began his life-work on the irrigation works of southern India. He constructed works on the Cauvery, Coleroon, Godavari and Kistna rivers, making anicuts (dams) on the Coleroon (1836–38) for the irrigation of the Tanjore, Trichinopoly and South Arcot districts; and on the Godivari (1847–52) for the irrigation of the Godivari district. He also projected the anicut on the Kistna (Krishna), which was carried out by other officers. Before the beginning of his work Tanjore and the adjoining districts were threatened with ruin from lack of water; on its completion they became the richest part of Madras, and Tanjore returned the largest revenue of any district in India. He was the founder of the school of Indian hydraulic engineering, and carried out much of his work in the face of opposition and discouragement from the Madras government; though, in the minute of May 15, 1858, that government paid an ample tribute to the genius of Cotton's "master mind." He was knighted in 1861.

See Lady Hope, *General Sir Arthur Cotton* (1900).

COTTON, CHARLES (1630–1687), English poet, the translator of Montaigne, was born at Beresford in Staffordshire on April 28, 1630. His father, Charles Cotton, was a man of marked ability, and counted among his friends Ben Jonson, John Selden, Sir Henry Wotton and Izaak Walton. Cotton travelled in France and perhaps in Italy, and at the age of 28 he succeeded to an estate greatly encumbered by lawsuits during his father's lifetime. The rest of his life was spent chiefly in country pursuits, but from his *Voyage to Ireland in Burlesque* (1670) we know that he held a captain's commission and was ordered to that country. His friendship with Izaak Walton began about 1655. Walton's initials made into a cipher with his own were placed over the door of his fishing cottage on the Dove; and to the *Compleat Angler* he added "Instructions how to angle for a trout or grayling in a clear stream." He married in 1656 his cousin Isabella, who was a sister of Colonel Hutchinson. His wife died in 1670 and in 1675 he married the dowager countess of Ardglass. He was buried in St. James's church, Piccadilly, on Feb. 16, 1687. Cotton's reputation as a burlesque writer may account for the neglect with which the rest of his poems have been treated. Their excellence was not, however, overlooked by good critics. Coleridge praises the purity and unaffectedness of his style in *Biographia Literaria,* and Wordsworth (*Preface,* 1815) gave a copious quotation from the "Ode to Winter." The "Retirement" is printed by Walton in the second part of the *Compleat Angler.* His masterpiece in translation, the *Essays of M. de Montaigne* (1685–86, 1693, 1700, etc.), has often been reprinted.

His other works include *The Scarronides,* or *Virgil Travestie* (1664–70), a gross burlesque of the first and fourth books of the *Aeneid,* which ran through 15 editions; *Burlesque upon Burlesque . . . being some of Lucian's Dialogues newly put into English fustian* (1675); *The Moral Philosophy of the Stoicks* (1667), from the French of Guillaume du Vair; *The History of the Life of the Duke d'Espernon* (1670), from the French of G. Girard; the *Commentaries* (1674) of Blaise de Montluc; the *Planter's Manual* (1675), a practical book on arboriculture, in which he was an expert; *The Wonders of the Peake* (1681); the *Compleat Gamester* and *The Fair one of Tunis,* both dated 1674, are also assigned to Cotton.

William Oldys contributed a life of Cotton to Hawkins's edition (1760) of the *Compleat Angler.* His *Lyrical Poems* were edited by J. R. Tutin in 1903, from an unsatisfactory edition of 1689. His translation of Montaigne was edited in 1892, and in a more elaborate form in 1902, by W. C. Hazlitt. *See* also J. Beresford, *Poems of Charles Cotton, 1630–87,* with introduction, notes and portrait, (1923); and *Poems from the Works of Charles Cotton,* Newly decorated by Claud Lovat Fraser. (1922).

COTTON, GEORGE EDWARD LYNCH (1813–1866), English educationist and divine, was born at Chester on Oct. 29, 1813. He was educated at Westminster school, and at Trinity college, Cambridge. He graduated B.A. in 1836, and became an assistant-master at Rugby. Here he worked devotedly for 15 years, inspired with Arnold's spirit, and heartily entering into his plans and methods. He became head master at Marlborough college in 1852, and in his six years of rule raised it to a high position. In 1858 Cotton was offered the see of Calcutta, which, after much hesitation about quitting Marlborough, he accepted. Cotton established schools for British and Eurasian children, did much to improve the position of the chaplains, and was unwearied in missionary visitation. On Oct. 6, 1866, he was drowned at Kushtea on the Ganges.

A memoir of his life with selections from his journals and correspondence, edited by his widow, was published in 1871.

COTTON, SIR HENRY JOHN STEDMAN (1845–1915), Anglo-Indian administrator, son of J. J. Cotton of the Madras civil service, was educated at Magdalen college school and King's college, London. He entered the Bengal civil service in 1867, and became chief secretary to the Bengal Government (1891–96), acting home secretary to the Government of India (1896), and chief commissioner of Assam (1896–1902). He retired in 1902, and became known as the leading English champion of the Indian nationalists. In 1906 he entered parliament as Liberal member for East Nottingham. He was the author of *New India* (1885; rev. 1904–7).

His brother, JAMES SUTHERLAND COTTON (1847–1918), was born in India and educated at Magdalen college school and Trinity college, Oxford. For many years he was editor of the *Academy;* he published various works on Indian subjects, and was the English editor of the revised edition of the *Imperial Gazetteer of India* (1908).

COTTON, JOHN (1585–1652), English and American Puritan divine, sometimes called "The Patriarch of New England," born in Derby, England, on Dec. 4, 1585. He was educated at Trinity college, Cambridge, and became a fellow of Emmanuel college, Cambridge, then a stronghold of Puritanism. In June 1612 he became vicar of the parish church of St. Botolph in Boston, Lincolnshire, where he remained for 21 years. Becoming more and more a Puritan in spirit, he ceased, about 1615, to observe certain ceremonies prescribed by the legally authorized ritual, and in 1632 action was begun against him in the high commission court. He thereupon escaped, disguised, to London, lay in concealment for several months, and eluding the watch set for him at the various English ports, in July 1633 emigrated to the colony of Massachusetts Bay, arriving at Boston early in September. On Oct. 10 he was chosen "teacher" of the First Church of Boston, of which John Wilson (1588–1667) was pastor, and here he remained until his death on Dec. 23, 1652. In the newer, as in the older Boston, his popularity was almost unbounded, and his influence, both in ecclesiastical and in civil affairs, was probably greater than that of any other minister in theocratic New England. He was a man of great learning and was a prolific writer. His writings include: *The Keyes to the Kingdom of Heaven and the Power thereof* (1644), *The Way of the Churches of Christ in New England* (1645), and *The Way of Congregational Churches Cleared* (1648), these works constituting an invaluable exposition of New England Congregationalism; and *Milk for Babes, Drawn out of the Breasts of Both Testaments, Chiefly for the Spirituall Nourishment of Boston Babes in either England, but may be of like Use for any Children* (1646), widely used for many years, in New England, for the religious instruction of children.

See the quaint sketch by Cotton Mather, John Cotton's grandson, in *Magnalia* (London, 1702), and a sketch by Cotton's contemporary and friend, Rev. Samuel Whiting, printed in Alexander Young's *Chronicles of the First Planters of the Colony of Massachusetts Bay from 1623 to 1636* (Boston, 1846); also A. W. McClure's *The Life of John Cotton* (Boston, 1846), a chapter in Arthur B. Ellis's *History of the First Church in Boston* (Boston, 1881), and a chapter in Williston Walker's *Ten New England Leaders* (1901). (W. W.)

COTTON, SIR ROBERT BRUCE, BART. (1571–1631), English antiquary, the founder of the Cottonian library, born at Denton, Huntingdonshire, on Jan. 22 1571, was a descendant, as he delighted to boast, of Robert Bruce. He was educated at Westminster school under William Camden the antiquary, and at Jesus college, Cambridge, where he graduated in 1585. His antiquarian tastes were early displayed in the collection of ancient records, charters and other manuscripts, which had been dispersed from the monastic libraries in the reign of Henry VIII.; and throughout the whole of his life he was an energetic collector of books, manuscripts and coins from all parts of England and the continent. In 1600 he visited the north of England with Camden in search of Pictish and Roman monuments and inscriptions. On the accession of James I. he was knighted, and in 1608 he wrote a *Memorial on Abuses in the Navy,* that resulted in a navy commission, of which he was made a member. He also presented to the king an historical *Inquiry into the Crown Revenues,* in which he speaks freely about the expenses of the royal household, and asserts that tonnage and poundage are only to be levied in war time, and to "proceed out of good will, not of duty." In this paper he supported the creation of the order of baronets, each of whom was to pay the crown £1000; and in 1611 he himself received the title.

Cotton helped John Speed in the compilation of his *History of England* (1611), and was regarded by contemporaries as the compiler of Camden's *History of Elizabeth.* It seems more likely that it was executed by Camden, but that Cotton exercised a general supervision, especially with regard to the story of Mary, Queen of Scots. The presentation of his mother's history was naturally important to James I., and Cotton himself took a keen interest in the matter. He had had the room in Fotheringay, where Mary was executed, transferred to his family seat at Connington. Meanwhile he was enlarging his collection of documents. In 1614 Arthur Agarde left his papers to him, and Camden's manuscripts came to him in 1723. In 1615 Cotton, as the intimate of the earl of Somerset, whose innocence he always maintained, was placed in confinement on the charge of being implicated in the murder of Sir Thomas Overbury; he confessed that he had acted as intermediary between Sarmiento, the Spanish ambassador, and Somerset, and had altered the dates of Somerset's correspondence. He was released after about eight months' imprisonment without formal trial, and obtained a pardon on payment of £500. From Charles I. and Buckingham Cotton received no favour; his attitude towards the court had begun to change, and he became the intimate friend of Sir John Eliot, Sir Simonds d'Ewes and John Selden. He had entered parliament in 1604 as member for Huntingdon; in 1624 he sat for Old Sarum; in 1625 for Thetford; and in 1628 for Castle Rising, Norfolk. The publication of his political tract entitled *The Danger in which the Kingdom now standeth,* and the circulation of another, known as the *Proposition to bridle Parliament,* the original of which was found in Cotton's library, led to his imprisonment in 1629 and the sealing up of his library by the king. Cotton was himself released the next month; but the library was not restored to him. He died on May 6, 1631, and was buried in Connington church, Huntingdonshire, where there is a monument to his memory. Many of Cotton's pamphlets were widely read in manuscript during his lifetime, but only two of his works were printed, *The Reign of Henry III.* (1627) and *The Danger in which the Kingdom now standeth* (1628). His son, Sir Thomas (1594–1662), added considerably to the Cottonian library; and Sir John, the fourth baronet, presented it to the nation in 1700. In 1753 it was transferred to the British Museum.

See the article LIBRARIES, and Edwards's *Lives of the Founders of the British Museum,* vol. i. Several of Cotton's papers have been printed under the title *Cottoni Posthuma;* others were published by Thomas Hearne.

COTTON AND THE COTTON INDUSTRY. Cotton in 1940 continued king, even though its rule was being threatened as never before. It was without question the leading textile raw material, but new fibres were competing for its position. Cotton still played a greater part in the economy and politics of the world than did any other commodity, but its participation was by 1940 an increasingly stormy one.

Cotton agriculture and the cotton industry throughout the world were buffeted by an amazing interplay of impulses during the two decades following the World War of 1914–18. The most serious was the post-war adjustment itself. This had by no means been completed when the development of a new European crisis and the outbreak of a new war destroyed what little stabilization had been achieved. Ranking probably second to war as a factor contributing to the cotton chaos was the dislocation of cotton production throughout the world, and of the cotton industry not only throughout the world but within many individual countries. Third in importance based on results up to 1940—but probably first in its potentialities—was the competition from other fibres.

Statistically, the latter impulse made only a limited impression. In 1930, the world production of the four major fibres was approximately: cotton 82%, wool 14%, silk 1%, rayon 3%. In 1939, the break-down had changed to approximately: cotton 75%, wool 12%, silk 1%, rayon 12%. Thus, cotton still led by what appeared to be an overwhelming margin. However, new trends were under way which threatened to speed up this statistical shift. The necessities of the so-called nationalistic countries—even in peace-time, and more acutely so in time of war—forced substitution of synthetic for natural raw materials. The result was a tremendous increase in the production and consumption of rayon staple fibre in Germany, Italy, and Japan—and the outlook at the start of the new decade in 1940 was for an intensification of this change. Then, too, entirely new types of synthetic fibres were being announced in rapid succession during the last years of the preceding decade: fibres made from spun glass, from skimmed milk, from soybeans, from synthetic resins, and from a synthesis of coal, air and water—not to mention a whole collection of other sources, many of which would undoubtedly develop into commercial realities. Coupled with this competition from new fibres was a challenge from old materials. Paper, for example, had been encroaching upon many of the household uses in which cotton formerly held undisputed sway. Against this barrage the cotton industries in many countries used as a defence the offensive measure of seeking new uses, or expansion of existing uses, for cotton. This served to lessen the blow, but did not alter the fact that cotton was on the defensive—and probably would continue to be.

The factor of dislocation of cotton agriculture and industry was a continuing one, and therefore threatened to be more far-reaching in its effects than war. In essence, this dislocation amounted to decentralization. New countries, and new sections of individual countries, have reached for their share of the production of this vital raw material, and of the processing of cotton into yarns and fabrics. Cotton has the distinction, and at the same time the weakness, of being the forerunner in industrial change. Its manufacture, by power, was the opening gun in the industrial revolution of some two centuries ago in England, which started the transition from hand-craft to mechanization. Similarly, cotton is the fibre which first engages the attention of hitherto backward countries which decide to enter the industrial lists. Almost without exception, the first industry which these newly aroused nations undertake is cotton manufacture. The effect is obvious. Older industrial nations, geared up to supply far-flung markets, find those markets taken away from them by local industries or by other nations seeking their share in the world trade in cotton products.

Great Britain felt this world impulse first and most acutely. Its cotton industry was essentially an exporting industry. The growth of a home industry in countries such as India reduced that export outlet. But that was not all. Countries like Japan, particularly, intruded upon hitherto invulnerable markets, by way of low wage-scales and low production costs. The results in both these directions can be illustrated and dramatized by these two comparisons: In 1913, Great Britain exported 3,057,000,000 yards of cotton goods to British India; in 1935 she exported 498,000,000 yards to that same country. In 1924, Great Britain's total export of cotton goods to all countries was 4,444,000,000 yards, while Japan's export was 997,000,000 yards; by 1936 Great Britain's export had shrunk to 1,917,000,000 yards while Japan's had expanded to 2,708,000,000 yards.

The results of these shifts can also be measured in terms of cotton spindles in place in the principal producing countries. In the two decades from 1920 to 1940, the United Kingdom lost well over one-third of its spindles, by liquidation; the United States lost nearly one-third of its spindles by the same route; Japan tripled its spindleage, and India increased its spindleage by 50%.

But within a given country, as previously indicated, this same process of decentralization took its toll. The United States is the best example of this trend. New England, like Old England, was geared up to supply far-flung needs for cotton products. It was the cotton manufacturing centre of the United States. And yet, in less than two decades (1923–38) a shift developed whereby, from a position where New England housed more than 50% of the spindles of the country, the South drew up to an ownership of practically 75% of the spindleage, against 25% in New England. And the productive capacity of the southern equipment, new and modern, made its advance more dramatic than these cold figures indicate.

That leads to a discussion of another vital factor in the shifting ways of the world's cotton industry. Technological development has been progressing at a dizzy rate. Introduction of single-process picking, of long-draft roving and spinning, of automatic preparatory machinery, of higher-speed looms, and of rapid innovation of new finishes, has favoured the new industrial countries, and the new industrial sections of a given country, against the old. Here again a statistical comparison dramatizes this change. Despite the fact that Great Britain led the world in 1940 in number of spindles, a study showed the United States well ahead in productive capacity of its lesser number of spindles, due of course to greater potential output per spindle. The study cited the total number of cotton spindles in the United Kingdom as 41,400,000 (in 1936) against 28,200,000 in the United States, but after reducing both figures to similar types of spindles, and multiplying by a "machine working-time factor" based on relative productivity in the two countries, it showed that the "mechanical-equivalent-commercially available" spindles in the United Kingdom corresponded to only 29,200,000 as against 47,700,000 in the United States.

The same holds true further along the line, in weaving capacity. Greater use of automatic looms in the United States and in Japan, for example, have placed those countries well ahead of older manufacturing nations, like Great Britain, in output per loom.

Cotton Agriculture.—To turn from cotton manufacture to cotton agriculture, even more revolutionary shifts were under way by 1940: more revolutionary, because they involved the destinies of great masses of people dependent upon the growing of cotton for a livelihood. For the dwindling demand for the products of Manchester's cotton industry in England—serious as that has been in its effect upon the employed personnel of that area—was of relative unimportance compared with the threatened shift in cotton production, so far as it affected the Southern States of the United States. The latter country at various times produced from one-half to practically all of the world's raw cotton. Since 1933, the percentage of United States' production in relation to world output, steadily decreased through 1939 with the exception of one year. This has been due partly to the crop control of that country, and partly—although to some extent this is a result rather than a cause—to the increased production of other countries such as Brazil and Russia, for example. This whole question is tied up with that of governmental policies, not only in the United States but in other countries. In the United States, these policies included crop control, as noted above, and also other devices such as Government loans on cotton and an export subsidy on cotton.

Cotton growing was in 1940 an important part of the economy of approximately 60 different countries—and in many of them one of the most vital phases. The number of people in the world dependent upon cotton agriculture, either directly or indirectly in 1940, was incalculable but certainly ran into many, many millions. In fact the major cotton textile industry alone, in the principal producing countries, employed over 5,000,000 workers—and those engaged in agriculture constitute a far greater group than the employees of the industry. Consequently, the world-wide currents mentioned have affected the lives of a considerable percentage of the world's population.

Despite the new forms of competition, mentioned previously, both production and consumption reached record heights in the latter part of the decade of the '30s. This in itself, however, affords no ground for security. To hold its own, cotton must advance, in a world whose needs per capita are increasing constantly.

In view of all the circumstances—the historical significance of cotton; the dependence of millions of people on it for their livelihood; the interplay of competition between cotton and other fibres; the decentralization of both the growth and manufacture of cotton in new countries and new sections; the political implications of cotton control, and a myriad of other cross-currents—it is particularly important to set down in the pages that follow, a moving rather than a static picture of this industry, and in the following phases:

I. Botany and Cultivation:—
- A. The Cotton Plant.
- B. Cotton Cultivation.
- C. Pests and Diseases of the Cotton Plant.

II. Raw Cotton:—
- A. Ginning, Baling, Transportation.
- B. The World's Cotton Supplies.
- C. Marketing, Exchanges, Futures, etc.

III. Cotton Spinning and Manufacture:—
- A. Invention and Development.
- B. The World's Cotton Spindles.
- C. The World's Cotton Power Looms.
- D. Varieties of Cotton Cloth.

IV. Cotton Trade and Organization:—
- A. Cotton Yarn Output.
- B. Commerce in Cotton Yarns.
- C. World Trends in the Cotton Industry.

V. The Distribution of Cotton Textiles:—
- A. World Commerce in Cotton Manufactures.
- B. Post-War Reconstruction of the Textile Markets.
- C. Organization of Cotton Textile Distribution.

VI. Cotton Machinery:—
- A. Cotton-Ginning Machinery.
- B. Cotton-Spinning Machinery.
- C. Cotton-Weaving Machinery.
- D. Cotton-Finishing Machinery.

VII. Cotton Industry in the United States. (D. G. Wo.)

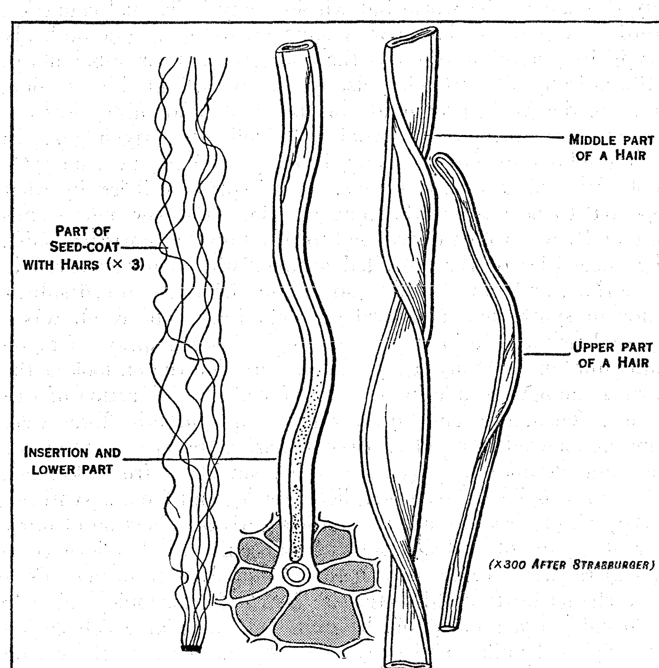
I. BOTANY AND CULTIVATION

A. THE COTTON PLANT

"What a royal plant it is! The world waits in attendance on its growth; the shower that falls whispering on its leaves is heard around the world; the sun that shines on it is tempered by the prayers of all the people; the frost that chills it and the dew that descends from the stars are noted; and the trespasses of a little worm upon its green leaf is more to England than the advance of a hostile army on her Asian outposts. It is gold from the instant it puts forth its tiny shoot. Its fibre is current in every bank, and when, loosing its fleeces to the sun, it floats a sunny banner that glorifies the fields of the humblest farmer that man is marshalled under a flag that will compel the allegiance of the world and bring a subsidy from every nation," once wrote Henry W. Grady. He voiced, in an exaggerated form, the sentiments of cotton growing and consuming peoples from earliest times; for cotton, the white fluff consisting of a mass of unicellular hairs which grow attached to the seed on all types of cotton plants, has been from time immemorial a valued article of trade.

The derivation of the word cotton, from the Arabic *qutun*, or *kutun*, locates it early in that section of the Old World. We know too that it was in India before Alexander; samples found in tombs there date it back to 3,000 B.C. It was certainly grown and spun by the ancient Egyptians; Chinese wise men wrote of it; it has been found in pre-historic pueblo ruins of Arizona; and the most ancient cotton fabrics now existent are the grave cloths of pre-Inca Peru. It was mentioned in a Hindu Rig-Veda hymn 15 centuries before Christ, and it was the subject of legend and myth during the Middle Ages. It was in the search for additional sources of supply of this fibre that many of the great exploration expeditions of the 15th and 16th centuries were undertaken.

The commercial fibre we know today as cotton is the result of many hundreds of years of the melting pot. For this fibre,—of the genus *Gossypium*—a branch of the Mallow or Malvaceae family—



FROM STRASBURGER "LEHRBUCH DER BOTANIK" BY COURTESY OF GUSTAV FISCHER

FIG. 1.—SEED HAIRS OF COTTON, GOSSYPIUM HERBACEUM, WHICH CONSIST OF FLAT TWISTED FIBRES ATTACHED TO THE SEEDS

in its present physical structure is the result of civilization and seed selection. All of this has aimed to make the plant more adaptable to climatic and soil conditions and to make the lint better for spinning purposes. And yet, despite the various stages of evolution, the fibre of cotton remains fundamentally the same.

A single hair of mature cotton, viewed under a microscope, is seen to be a flattened tube with spiral convolutions, the length of the fibre being from 1,000 to 3,000 times its diameter. The various species of cotton govern the diameter and number of twists the respective fibres have: the more twists—the better spinning qualities. The spirality of a cotton fibre distinguishes it from all other fibres, and gives it superior value for spinning. No other natural fibre has this feature and none of the man-made fibres can imitate it. It is the spirality of cotton fibre which gives it elasticity and makes it an excellent medium for craftsmanship.

The cotton plant has adapted itself to its various homes. For instance, in the tropics the plant is a perennial, some species attaining a height of 15 to 20ft. and being known as tree cottons. However, it is generally treated as an annual to insure the production of cotton of the best quality, and to keep insect and fungoid pests in check. In the United States and other commercial growing countries the plant is an annual, a soft-stemmed shrub, multi-branched and varying in height from 2 to 6 feet.

Botanical Classifications.—The genus *gossypium* is considered to be a difficult one taxonomically. The primary reason for this is due to faulty foundation by Linnaeus who based descriptions of some of the most important species on cultivated plants and those descriptions were not full enough to clearly define the various species. Secondary reasons are that a large section of the tropics in which cotton plants are found most abundantly has not been adequately explored by botanists; and for many centuries cultivated plants have been transferred from one country to another for commercial purposes and these species have undergone considerable crossing and hybridizing. This hybridizing has been accidental as well as intentional, but evidences of it are noted in the lack of stability in practically every variety with frequent reversions to ancestral type. Therefore, it is impossible to establish definitely the origin of many of the cultivated species and still more difficult to give the land of their origin. However, for practical purposes it is possible to define the most important cultivated varieties into particular species.

1. *G. barbadense,* Linnaeus.—Sea Island cotton owes its trade name to the fact that it has flourished on the islands along the coast of South Carolina and Georgia (U.S.A.) and the West Indies. Its cultivation along the coastal region of the United States declined from 1914 through the next 20 years, the crop dropping from an annual 100,000 bale production to a minimum production of 7 bales in 1933. However, a successful revival of Sea Island cultivation has been under way since 1934 in south Georgia and north Florida (U.S.A.) with an annual increase in production and a crop in 1938 of about 3,000 bales. The staple of Sea Island is long, fine, and silky with a lustre unequalled by any other variety. Its staple length ranges from 1½in. to 2¼in. and it is especially valuable for all spinning purposes requiring high breaking yarns.

The Egyptian crop, while usually regarded as being of the *Barbadense* strain, may be, according to Watt, in some cases hybrids of *G. Braziliense.* About two-thirds of the crop is Uppers, or Ashmouni, planted in the Upper Egypt valley, and Zagora, the same seed but planted in the Delta. Both types run in staple from 1³⁄₃₂in. to 1³⁄₁₆ inches. Almost all varieties of Egyptian cotton, other than Uppers, are grown in the Nile delta. They are listed according to spinning qualities as follows: Giza 26, Sakellaridis, Sakha 4, Maarad, Giza 7, Giza 12.

Strains of Egyptian cotton are also being cultivated in the Sudan, near Khartoum and the Kassala district and Tokar. In the two latter districts a type of cotton is produced similar to Sakellaridis, before it began deteriorating.

Egyptian cotton is also grown under irrigation in the United States, particularly in Arizona, Oklahoma and California. The first strain developed from planting Sakellaridis seed is *Pima.* About 1928 another strain was derived from cross-breeding of Pima and Sakellaridis seed. This is known as SXP. It is slightly whiter in colour and shorter in staple than Pima, which runs from $1\frac{7}{16}$ in. to $1\frac{5}{8}$ inches.

2. *G. braziliense,* Macf.—This species is generally thought to be a native of Brazil although it has been found growing wild in certain sections of South Africa, and it grows both wild and cultivated in China, Japan, India, Central America and the West Indies. The fibre is generally white, fine and silky but lacks spirality found in most cottons. It, however, seems adapted for mixing with wool. The staple varies from 1 to 1½ inches.

3. *G. purpurascens,* Poiret.—This species resembles very closely *G. Taitense* Parl. and is known only in a state of cultivation. It has been grown in Egypt, East Africa, Madagascar, Siam, India, South America and on islands in the Atlantic, Indian and Pacific oceans. Its lint is white, soft and silky.

4. *G. hirsutum,* Linn.—This species is widely used in cultivation and is the source of American Upland cotton. It is to be found throughout the American cotton belt, entirely rain-fed, and it is also known in Africa, India, Java, China, Persia and Europe. Its origin and ancestry are uncertain but it is not found in a wild state. Watt states that this is a cultivated form of *G. Punctatum* Sch. and Thon. It is considered that practically all of the American Upland cottons, some Mexican varieties, Dharwar cotton in India, Hindi cotton in Egypt, and American varieties in China and Africa are derived from this species. Its lint is medium fine to medium coarse and varies from ¾in. to 1¼in. in length.

G. hirsutum, Linn., var. *religiosa,* Watt. This variety is a sacred cotton. A type very similar to *G. hirsutum* and according to Watt is classified as hirsutum. However, it is not the true hirsutum since it has slender trailing branches instead of ascending and spreading branches and because of its rust coloured lint from which it derives its name of Khaki.

5. *G. peruvianum,* Cavanilles.—Watt considers this cotton indigenous to the equatorial regions in the Andes. It grows in Peru and other parts of South America, Central America, Africa and other cotton growing countries. Some authorities feel that present day Egyptian cottons may trace their ancestry to this line.

6. *G. herbaceum,* Linn.—Widely grown in Asia and also formerly grown in South Europe. Its origin was probably Arabia and Asia Minor. It is said that this was one of the first cottons grown in America, but was later displaced by other varieties. At any rate, it is the parent of many Asiatic varieties which are grown extensively although they are not the most desirable types. Levant cotton, one of the most important cottons derived from *G. herbaceum,* is grown in Arabia, Asia Minor and southern Europe. Some Indian varieties are also traced to this species. Its lint is coarse and grayish white.

7. *G. nanking,* Meyen.—This species is unknown except in the cultivated state. According to Watt it is cultivated in China, Japan, Malaya, Siam, Burma, India, Central Asia, Arabia, Madagascar and Africa. Certainly a considerable portion of the native cultivated cottons of China and Japan are of this variety and it is thought that it is prominent in India and other portions of Asia. Its lint is white with a tendency to become rufous.

8. *G. arboreum,* Linn.—It is not known in its original wild state but was probably the first species cultivated and was known centuries ago in a cultivated state in India, Arabia and Africa. It is now a garden plant of the Orient. However, some branches of this cotton are important for field planting. Bengal, Jari, Deshi, Dacca and Garo Hill cottons are among these varieties. The lint is white in its cultivated state.

B. COTTON CULTIVATION

Cotton, one of the most important of the world money-crops is cultivated in more than 60 countries within a zone between 35° and 40° north and south latitudes. The trend in cotton acreage and production in all countries was upward steadily from 1895 until 1933. After 1933 and to date (1940) United States production has decreased under Government control but production has continued to increase in all other countries.

Although cotton is almost a universal crop, there are certain fundamental requirements: an approximate six month growing season; sufficient moisture during the growing season (either from rainfall or irrigation) but also plenty of sunshine; and a dry period when the cotton reaches maturity.

Since methods of cultivation are at variance in each cotton growing country a summary of cultural methods in each of the most important is given below:

Cultivation in the United States.—That the United States leads every country in the production of cotton is due to both soil and climatic conditions. It is grown on about 2,000,000 farms in its southern cotton belt, where a growing season of 200 to 260 days is enjoyed. However, because of the prevalence of the boll weevil early maturing varieties of cotton have necessarily been developed which will mature the boll beyond the weevil damage in 110 days.

Considering the cultivation of cotton throughout the entire United States cotton belt cultural practices followed are poorer than those used in growing other top ranking agricultural crops. And yet they are more advanced in the United States than in other countries. Improved methods have made it possible to produce in an ordinary year, in the United States, an average yield of about 210lb. of cotton per acre as compared to 165lb. in 1925. Increased yield per acre is particularly true in certain sections such as the Mississippi delta, parts of Texas and South Carolina where excellent farming practices are followed.

Most of the land to be planted in cotton is flat broken or broken by listing and bedding prior to the middle of April. Bedding is extensively practiced throughout the cotton belt. The work is done with one-, two-, three-, or four-horse turning ploughs or with heavy disc, sulky or gang ploughs, the type and size of the plough depending upon the section of the country, topography of the land, and financial status of the farmer. For instance, on the flat level prairies of Texas and Oklahoma and low flat Mississippi delta, where cotton farmers plant several hundred or thousand acres, large ploughs and two to four-row equipment drawn by heavy teams or tractors are widely used, but in the rolling or hilly sections of the Carolinas, Georgia, Alabama and Mississippi and on small farms smaller one-horse turning ploughs are generally used.

In making a cotton crop in the United States the usual custom is to obtain a firm but well pulverized seed bed by thoroughly pulverizing the soil some weeks before planting, letting it rest until a good rain has settled it and then rebreaking the surface with a light harrow. Planting dates in the United States range from March 1 for southern Texas to June 1 in North Carolina. The general method of planting is in drills with a one-horse mechanical planter which opens the small furrow, drops the seeds and covers them. A few farmers drop seed by hand; other wide-scale operators use two- or four-row planters. Depth of one inch is generally sufficient for seed germination. To be sure of a good stand a large quantity of seed is planted, about one bushel per acre. Then, when the plants are up, those not wanted are thinned out or "chopped."

There is a close relation between the yield of cotton and the number of cultivations received. Experiments show that cotton worked four or five times yielded 763lb. of seed compared to a yield of 1,012lb. when the cotton was worked eight or nine times. On the whole the United States cotton crop is well cultivated. A one-horse plough is the system generally used in southern States. The second step in cultivation is chopping or hoeing. Although attempts have been made to perfect a mechanical chopper so far such devices have proved unsatisfactory and the best results are obtained by hand labour. In chopping the worker scrapes all the land in the row left unploughed and chops out unnecessary plants leaving two or more in hills the desired distance apart. Cultivation is continued until plants are matured or have put on a good crop of bolls. Cultivation usually ceases about the first of August in the central part of the cotton belt and earlier in the southern part and likewise later in the northern part.

The rate of growth of cotton plants and of development of flowers varies considerably with seasonal weather conditions as well as geographical differences. In the central part of the United States cotton belt cotton planted in mid-April usually shows young flower buds, or squares, in 35 to 45 days. Bolls require a maturation period of 45 to 65 days and picking of the lint gets under way as early as August in some sections and continues until the crop is harvested, usually around November 1.

The crop is harvested almost entirely by hand, although stripping is sometimes practiced in some parts of Texas when both cotton and labour are at a premium. Stripping, however, produces cotton of very low grade. Although mechanical cotton pickers are generally improved they are still in the experimental stage and have not yet become an economic factor in cotton cultivation. The Rust cotton picker, the International Harvester machine, and the Berry cotton picker all operate ably in the field, picking cotton on the rotating spindle theory with great rapidity. However, it has been found that the grade of mechanically picked cotton is lowered to some extent through inclusion of bolls and leaves plus discolouration by leaf stain.

Careful seed selection is employed by the majority of cotton farmers, and in some sections of the belt we find "one-variety communities," a program established to keep seed pure, which includes planting one variety, ginning the crop and assembling it in even-running bales which are sold through a central agency.

Cotton growers of America are becoming more and more familiar with the use of stable manure, motes, and cover crops as fertilizers; methods to prevent soil erosions have been generally practiced since 1933 under the Government's agricultural program. Commercial fertilizers are used to some extent, but mostly in States east of the Mississippi river.

Although most of the cotton belt is rain-watered, the lower Rio Grande valley in Texas and the cotton sections of Oklahoma, California and Arizona are irrigated.

Cotton Cultivation in India.—Four-fifths of India's cotton is grown in black soil, or regur, although there are three distinct classes of soil. In rank of importance they are: regur, Indo-Gangetic and red. Regur does not respond well to irrigation; the other two give good yields under irrigation. Since 1934–35 irrigated acreage has increased to 19% of the total cotton acreage, compared to 15% in 1925–26, with the provinces of Sind and Punjab alone accounting for a net increase in irrigated acreage of 1,136,000. The area planted in cotton increased from 654,000 and 2,884,000 acres in 1934–35 to 982,000 and 3,692,000 respectively in 1936–37.

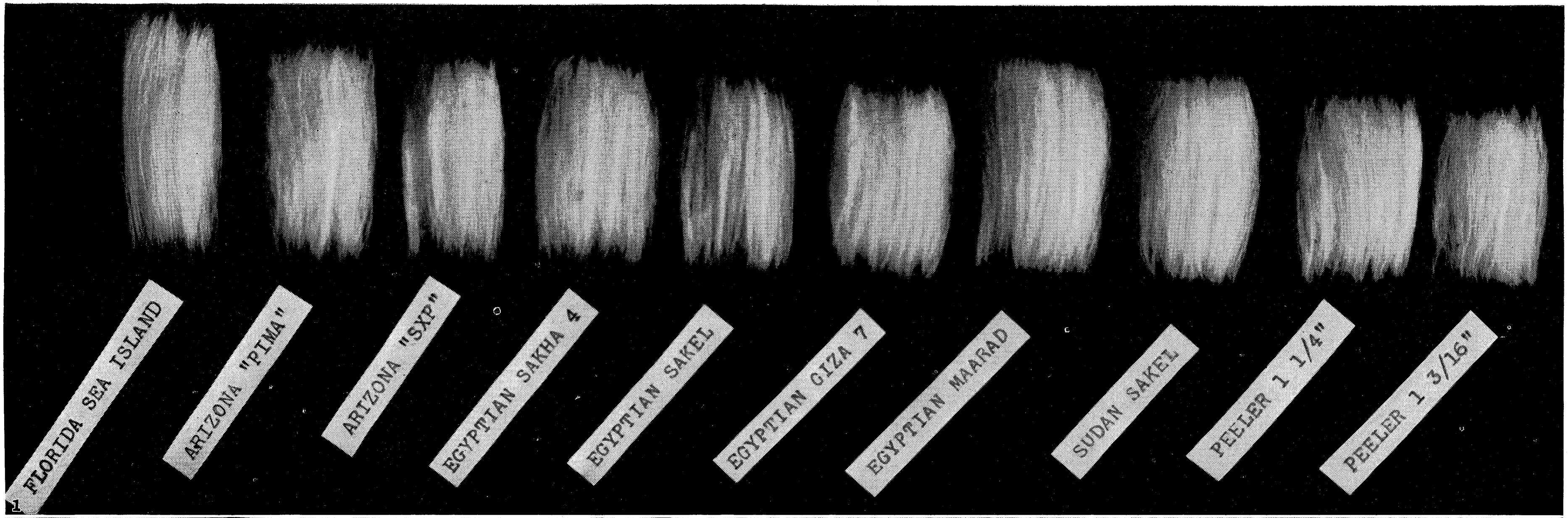
Considerable progress has been made in India in cultivation systems, although the use of machines other than the ordinary indigenous agricultural implements and a few improved and remodelled types of such implements is rare. The economic condition of the peasantry as a whole does not permit the development of mechanical cultivation. Holdings are small for individual ownership of the expensive machines and co-operative ownership has not yet come into practice there. However, trials with tractor ploughing on a large scale have been successfully carried out and found to be economical. There is great demand for tractor ploughing on the contract system by big landholders in connection with opening up of new lands, and the Department of Agriculture has been helpful in this direction.

The general cultivation method, however, remains that of the plough, drawn by bullock, with drill sowing in most instances, and the practice of crop rotation, spacing cotton with wheat, sugar cane, gram and berseem. Fertilizers consist mainly of somewhat sparse manuring. Nowhere in India is the use of artificial fertilizers common.

Great irrigation systems are part of the cotton growing programs in India. The Indo-Gangetic plain, made up of alluvial soil has large irrigation projects which very greatly increase cotton acreage cultivation. The Punjab possesses the greatest irrigation system in the world with 92% total cotton crop irrigated, and in Sind irrigation has increased since opening of the Lloyd Barrage canal system from 250,000ac. in 1923–33 to 804,171ac. in 1935–36. An additional increase of 25% over the present area is anticipated. In the United Provinces one-third of the cotton acreage is irrigated.

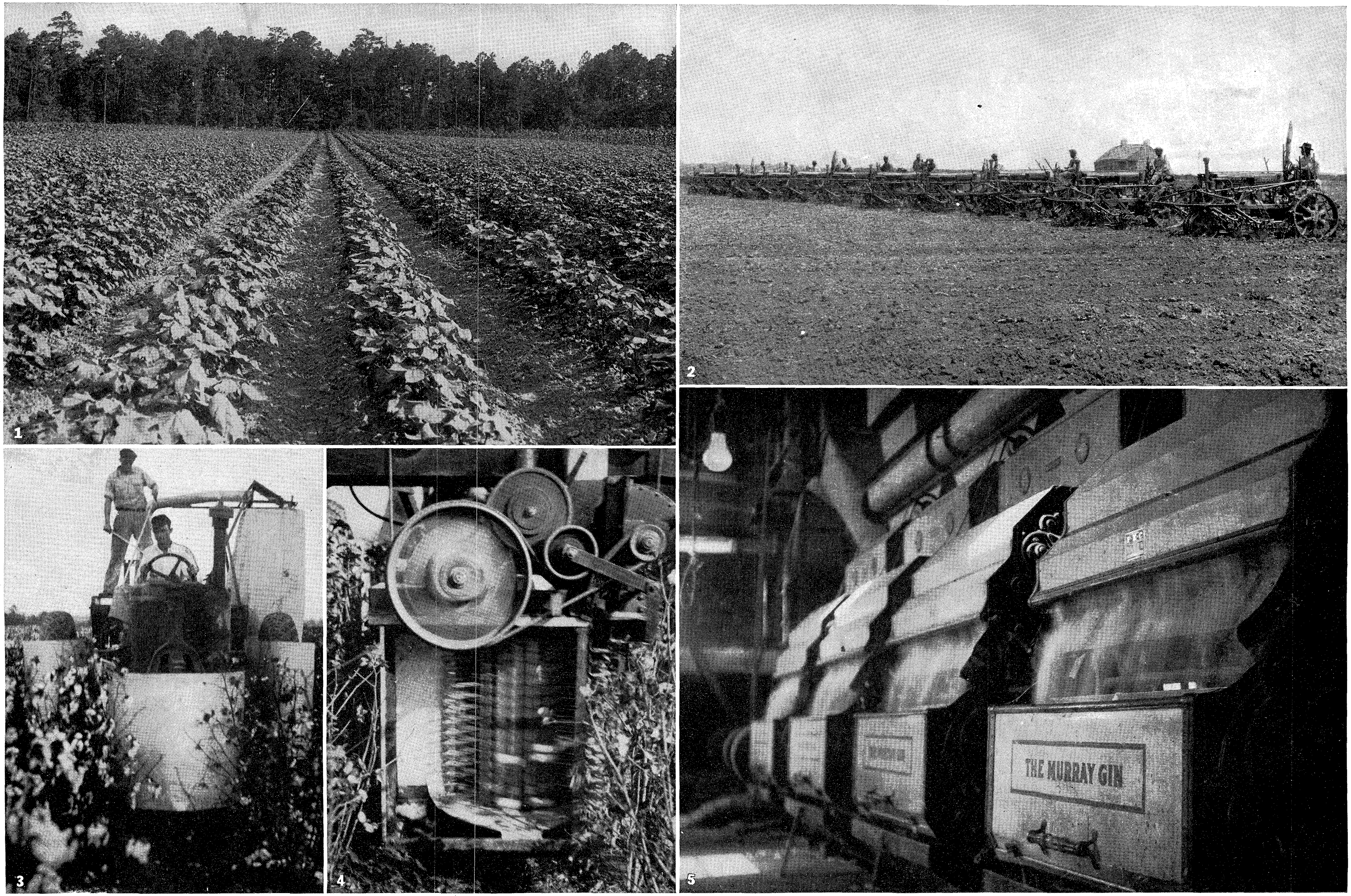
In the vast cotton areas of the Malwa plateau, the Herbaceum and Oomras tracts are rain-fed and there are few irrigation systems of any importance in these tracts. In South India on red soils, about 40% to 60% Cambodia cotton is irrigated.

In India there has been no effort on the part of cultivators to keep cotton seed from deteriorating in quality, but the Depart-



BY COURTESY OF (1) PAUL CERESOLE, (2) WILLA JOHNSTON, (3) DELTA EXPERIMENT STATION, STONEVILLE, MISSISSIPPI

1. Pulls, showing the relative lengths of various types of staple cotton
2. Cotton flower and green boll
3. Field of long staple cotton in the Mississippi delta



BY COURTESY OF (2, 3, 4) MILDRED G. BARNWELL, (5) WILLA JOHNSTON; PHOTOGRAPH, (1) EWING GALLOWAY

CULTIVATION AND GINNING OF COTTON

1. Field of young cotton under cultivation near Wilson, North Carolina
2. Battery of four-row cultivators on plantation in Mississippi delta

3, 4. The Rust mechanical cotton picker at work

5. Group of gin stands in modern ginnery

ment of Agriculture has adopted the "Wave" system which provides for voluntary agreement to gin cotton under department supervision, returning all seed to the department. Under this system a continuous supply of pure seed is available to a large number of cultivators.

Cultivation in Egypt.—The agricultural area of Egypt is confined to the lands of the valley and delta of the Nile. Climate conditions are favourable to the cotton which is planted in the alluvial soil of those regions in February, March and April, and harvested during the fall months without ever being in danger of frost. The Egyptian crop is entirely an irrigated one. Until about 1925 most of the cotton crop was watered by land being river flooded twice a year. Now more dependable and regular irrigation is properly rotated to each grower in each district through a system of canals developed by the British Government.

About two-thirds of the cotton acreage is farmed by small 10 to 15ac. farmers, who find cotton their only cash crop and on these small farms primitive methods of cultivation, with the water buffalo as beast of burden, prevail. The other one-third of the agricultural section is held by extensive landholders—wealthy families or large agricultural companies; but on these places also (with the exception of tractor ploughing) hand labour, which is cheap and plentiful, is used.

Government control of seed is very strict, all seed sold for planting being required to have an approval test and certification by the Government. Through such systematic methods Egyptian seed supply is kept remarkably pure.

Cultivation in Brazil.—Brazilian cotton acreage is divided into two distinct districts: northeastern States and southern States. Soil and climatic factors in the two districts are very different and cotton in each is distinctly different both in type and quality. Southern Brazil produces cotton of American Upland type, while northeastern Brazil produces its famous tree cotton.

Southern Brazil with an area about equal to the United States cotton belt west of the Mississippi river cultivates less than 35% of it. The climate of southern Brazil is well adapted to cotton growing considering both rainfall and temperature, despite the fact that occasionally rainy weather extends into picking season. In the plateau districts of northeastern Brazil favourable temperatures are found and their periodic droughts will be overcome by the several irrigation systems now under construction.

Due mainly to the fact that the coffee and cotton harvests occur at the same time Brazil has a labour shortage, although in recent years large numbers of Portuguese, Spaniards, Italians and Japanese have immigrated to the southern part of Brazil to become tenant farmers or independent producers. It is estimated that at least 42% of the cotton grown in Sao Paulo during 1933–34 was produced by Japanese labour. A great number of large cotton plantations in that State are owned by Japanese operating companies.

In an effort to improve the quality of their cotton the Brazilian Federal Government and State Governments have encouraged experiment-station activities, upheld Federal and State gin inspections with State control of seed distribution. Better ginning equipment operated by competent engineers has greatly assisted in making Brazilian cotton of the southern Brazilian States a factor in the world market.

The few problems that handicap Brazil's cotton growing industry are shortage of labour supply, inadequate transportation facilities, shortage of modern machinery, and lack of an organized system of credit for producers.

Cultivation in Soviet Union.—In the Soviet, the Government manages a highly systematized type of agricultural control. Since 1936 cotton growing districts have been grouped into fairly well defined regions, based on soil and climate, and the system of central breeding stations and sub-stations for seed selection has been inaugurated.

The Government closely supervises growing of cotton by peasants who are for the most part organized into collective farms. In addition, the Government owns and operates farms of its own. Out of 4,827,000ac. planted to cotton in 1935, 4,300,000 or 89% were in collective farms.

Each collective farm grows cotton under Government contract according to terms of which the agronomic division of the county civic administration has power of command over all farm methods although the actual routine work of directing the farming activities of collective farms is done by agronomic sections of the local machine-tractor station. Each collective farm is small, about 632ac. for 70 to 80 households, or about 8 to 9ac. of crops per family, but each agronomist supervises work done on 4,000 to 7,000 acres. The stations, collaborating with the Commissariat of Light Industry, determine which collectives should grow cotton, fields to be planted, acreage and all other details.

These Government-owned and Government-operated stations are powerful factors in agricultural policies. Each station is divided into three units: agronomic, political and mechanical. The latter contracts with collective farms to do their ploughing, harrowing, seeding and cultivation, etc., the farm paying wages of the tractor driver plus a share of the crop per acre for each operation. The work done by the stations is supplemented by each farm's own draught animals and implements. In some instances, because of the topography of the land, machine-tractor stations are unable to serve the farms. In 1935 there were 452 stations specializing in cotton, compared to 17 stations in 1930. A light universal-type tractor has been found best suited for work done by these stations.

Considerable progress has been made in tillage methods in the Soviet since 1930. All cotton land is shallow ploughed after harvesting the crop. Late in the fall it is again ploughed 8 to 10 inches deep by power-drawn ploughs. Application of fertilizer and intertillage cultivation is practiced on collective farms.

Cotton opens in September and is almost entirely hand-picked. Although extensive experiments have been made in mechanical picking in the Soviet, it has not been adopted to any great extent, as a result of the custom of planting narrow rows.

The cotton crop as it is picked by hand is classed by the picker according to seed cotton grades established by the Government, the picker's apron having pockets for each grade. In actual practice, however, cotton harvesting in the Soviet is not efficient and great losses have been sustained due to delayed picking, poor storing and drying facilities.

All cotton is delivered to the warehouse at a specified procurement point. None is kept by the producer or the tractor station. Final payment is made in cash on the basis of percentage of seed cotton grades in total amount delivered.

Cultivation in China.—China has greatly increased its production since 1920. Most of this expansion has taken place in North China, one of two distinct cotton producing regions, the other being the Yangtze valley. In these two regions climate, soils and cropping systems are very different. In the Yangtze valley the farmer can depend to a great degree upon adequate rainfall, while in North China approximately 50% of the farmers have irrigation wells.

Chinese cotton is raised in low altitudes and is largely produced on alluvial soil of good texture but low in fertility and organic matter. Planting and harvesting in both the Yangtze valley and North China occur at approximately the same dates—planting being done around May 1. In the Yangtze valley the general practice is to broadcast seed in the wheat or barley crop, which when harvested leaves young cotton plants about 2 to 3 inches high. In North China cotton fields are spring-ploughed and harrowed and the seed is planted by hand in rows. The principal cultivation is hoeing by hand. Various fertilizers are used: barnyard manure, canal and pond mud, ashes and some oilseed cakes.

The North China irrigation system requires considerable labour as the water from the wells is generally brought up by an endless chain of small buckets which is operated by a power wheel pulled by a donkey, horse or cow.

Earliest maturing cotton opens August 1 and though several pickings are made each season about 70% of the crop is harvested during September, and the crop is completely harvested by early October.

C. PESTS AND DISEASES OF THE COTTON PLANT

Insect Pests.—The cotton plant probably has more destructive insect enemies than any other cultivated crop, for it has several points of attraction. On the midrib on the under side of each leaf, at the base of each bract on the outside of the square, and inside the flower near the base of the petals are small nectaries, cup shaped structures which hold a drop of sweet fluid. The flowers are heavy in pollen, and the plant itself is succulent and rich in nutrient materials. These attributes urge insects to feed on the plant, or even to take up residence in its tissues. Of these the boll weevil, the pink boll worm, the cotton leaf caterpillar, and the boll worm do most damage, although others listed are of grave importance.

The Mexican boll weevil (*Anthonomus grandis*, Boh.) is a native of Central America or Mexico. It is known as a cotton pest from Mexico southward to Costa Rica and in Cuba, and in the cotton belt of the United States where it first appeared in Texas in 1892, spreading year by year until by 1921 it had covered the entire belt. In some years in the United States it has caused a loss in the cotton crop of more than $200,000,000, but due to planting of faster maturing types of cotton, adoption of cleaner farming practices, and more intelligent use of insecticides losses from boll weevil have shown a downward trend since 1929. The adult insect, a small grayish or brownish weevil, winters in sheltered places. The survivals of the winter emerge from hibernation from March 1 to about July 1, and attack both squares and young bolls, puncturing them with their snouts for feeding and for egg-laying. The favourite food of the boll weevil is the pollen of the unopened flower-bud, or square; for that reason the female weevil prefers to deposit her eggs in the square in the small puncture, made with her snout, which is sealed with a plug. If squares are scarce bolls are used. The egg hatches in about three days into a stout white larva which becomes full grown in seven to twelve days, remains three to five days in the pupa stage, and emerges a full grown beetle which in five to seven days begins a new generation. The life cycle of the boll weevil is from 18 days to four weeks or longer, depending upon the weather. Warm weather hastens development, hot dry weather increases mortality. The boll weevil multiplies so rapidly that the offspring of a single pair, if all survive, would total several millions in one season. The migration season begins about August 1 and a weevil may travel 100mi. or so before hibernating.

The fight against boll weevil infestation is a great one on the part of the farmer. As soon as 10% of the squares in a field are found infested the war is on.

The most approved method of direct control is to dust cotton plants with calcium arsenate at the rate of 4 to 6lb. per acre, applied when the air is reasonably calm and plants moist. Generally this is at night or just at dawn. After the first application others must be made, three or more, at five-day intervals. Small farmers growing a few acres of cotton may use hand dusters to good advantage. Cotton planters growing a few hundred acres of cotton may use five and six-row power dusters with good results, whereas planters growing thousands of acres of cotton will find aeroplane dusting more satisfactory. Regular companies are organized for the purpose and have planes especially built for dusting. A farmer contracts at so much per acre per season for the work. It has many advantages and costs no more than dusting with ground machinery.

Another method of poisoning the boll weevil, which is used most successfully on Sea Island cotton, is application with a hand mop direct to the plant of a mixture of molasses, calcium arsenate and water at the rate of one gallon per acre. It is a laborious and expensive method, however, and only the premium paid for this long staple justifies expenses involved.

The pink boll worm (*Pectinophora gossypiella,* Saunders) probably originated in India, and today is found throughout practically all cotton producing regions of the world.

The pink boll worm is the larval stage of a small brown moth, somewhat resembling the common clothes moth. The female moth lays her eggs on the green bolls or in the flowers of cotton. The eggs hatch in four to twelve days and the larva immediately bores into the boll and eats the seed. Often a larva hollows out two adjacent seeds and webs them together, forming the characteristic double seeds which furnish a quick method of determining whether or not a lot of seed is infected. The pink boll worm has been known to remain alive in a quiescent condition as long as 31 months. It has been found alive in cotton bales 18 months after the bales have been stored. It has been introduced from country to country in shipments of cotton-seed.

The most important methods of control are fumigation of cotton-seed, strict quarantine laws, and cleaning up cotton fields.

The cotton leaf worm or army worm (*Alabama argillacea,* Hubn.) a native of tropical America, migrates northward each spring and generally enters the United States through Texas, multiplies on cotton and spreads throughout the main cotton belt, sometimes by late summer reaching the northern States and even into Canada. The moth deposits eggs on the under side of the cotton leaf, where they hatch in three to 20 days, the larva feeding voraciously on the younger leaves. In ten days to three weeks the larva is mature and webs itself in a rolled up leaf and pupates. The pupal stage is one to four weeks. From the pupa is hatched a tawny-coloured moth with wing spread of about 1in. and the cycle of life goes on. The army worm is controlled by poisoning with calcium arsenate or Paris green.

The boll worm (*Heliothis obsoleta,* Fab.) feeds on some 70 plants but is most destructive to corn, cotton, tomatoes and tobacco. The caterpillars attack flowers of cotton plants or bore into squares or bolls, eating the inside. It can be poisoned by dusting, as for the boll weevil.

The cotton flea hopper (*Psallus seriatus,* Reut.) punctures the very tiny squares which turn black and fall from the plant. The affected part of the stalk shows an abnormal growth and branching which is very erratic, having many suckers. The hopper is a very small green flea about $\frac{1}{8}$in. in length. Dusting with sulphur (about 10lb. per acre) is advised for destroying this pest as well as the tarnished plant bug and rapid plant bug which attack cotton plants in the same manner.

The red spider (*Tetranychus telarius,* L.) is a mite barely visible to the naked eye. It works on the under side of cotton leaves laying its eggs there, spinning delicate webs and sucking sap from the leaves, eventually covering the leaves with minute punctures. This pest has been from time to time one of the most destructive of cotton's insect enemies particularly in the south-east section of the United States cotton belt. The spider does not limit his operations to the cotton plant but has been found on 200 species of garden and field crops and ornamental plants and seeds. About 17 generations a year is the life cycle of this insect. Preventive measures consist of a spray of potassium sulphide, kerosene emulsion, or flour paste solution. Dusting with sulphur is also recommended and it is particularly important to cut and burn all weeds and underbrush near the cotton fields.

Many other insects attack the cotton plant. Among the less important are the cotton square borer, the cotton stainer, the cotton dauber, the garden web worm, the salt marsh caterpillar, the cotton leaf perforator, the cotton aphid, the thurberia weevil, cotton wire worms and southern grass worms.

A new pest, the white-fringed beetle, has recently been found in several localities in the south-eastern portion of the cotton belt of the United States. This insect is considered dangerous because in the larval stage it eats the roots and in the adult stage it eats the foliage from many species of plants. Cotton is among its favoured food plants.

Diseases of the Cotton Plant.—The damage to cotton plants caused by bacteria and fungus diseases comes to an annual loss of many millions of dollars. In the United States alone it is estimated that an annual loss of $30,000,000 to $40,000,000 is entailed from cotton plant diseases, the damage varying, of course, with the season, since a warm rainy season is more conducive to diseases of this sort than a hot dry season.

The most troublesome of cotton plant diseases are wilt, anthracnose, root knot and angular leaf spot.

Fusarium wilt (*F. Vasinfectum,* Atk.), also known as "frenching," attacks cotton plants which may be stunted and the yield may be reduced considerably, or they may show little external evidences of the disease and still produce a very reduced yield. The first sign of the wilt disease is a yellowing of the lower leaves which later shrivel and fall leaving the stem and branches bare. If one should examine the interior of the stem or root or leaf blades one should find the woody parts brown and darkened. Although cotton plants only a few days old have been observed to be victims of the wilt disease, it generally attacks plants when they are about one foot high.

The cause of this disease is a fungus which lives in the soil and enters the plants through the roots. Once in the plant the fungus forms a poisonous chemical which causes the plant to wilt.

The fungus may live saprophytically in infected soil for years. Also soil may easily become infected by the fungus being transferred from one field to another through dirt on ploughs and other implements or even the feet of men and animals, by infected manure and other means.

Cotton wilt seems to be little affected by climate conditions, and rotated planting is not helpful in its control.

The most effective means of fighting the wilt disease is to plant wilt resistant varieties of cotton, many of which have been developed.

Anthracnose (*Colletotrichum gossypii*, South) or pink boll rot has been known since 1890 when it was first described by a member of the U.S. Department of Agriculture. This disease is widespread in most cotton growing regions of the world and entails an annual loss to cotton farmers of millions of dollars. It may kill young plants either just before or just after they break the ground or it may cause the bolls to rot or infect others to the point where the lint, if not destroyed, is badly damaged. This disease is particularly virulent during rainy seasons in humid regions.

The disease attacks all parts of the cotton plant except roots of the very large plants. The chief source of infection is diseased cotton-seeds and the best control measure is to plant the seed from non-infected fields using seed preferably two years old, the adoption of crop rotation, and the practice of fall ploughing. Also, some disease-resisting varieties may be planted.

Root knot [*Heterodera radicicola* (Greef) Muell] is caused by a small eel-like worm or nematode which is found in most areas where cotton wilt is in evidence. It abounds most frequently in light sandy soil. The nematode enters the roots of cotton plants, multiplies rapidly, and causes swelling of the root which later develops into a thick-walled cyst.

Plants infected with root knot are generally dwarfed in appearance, with a sickly colour. They also tend to wilt even with abundant moisture.

Soil is easily infected and effective eradication measures have been found of no practical value. A control measure recommended is the use of chemical fertilizers in order to stimulate plants to increased growth and strength.

Angular leaf spot (*Pseudomonas malvacearum*, E.F.S.) is a disease of considerable economic importance and is widely distributed throughout the cotton growing sections.

Although the leaves are generally attacked, the greatest damage is to the bolls.

When the disease attacks the leaves it causes dark green spots on the under surface. These later show up on the upper surface and turn dark brown. Badly infected leaves curl up and drop off. When it attacks the branches or the stalk the infected portions turn black. When the disease attacks the bolls soft, dark green water-soaked spots appear, gradually enlarge, and turn black in the centre. The locks of the boll may be so injured that they fail to open.

This is an infection which results from year to year from bacteria which have survived the winter on cotton-seeds and attached lint.

The only satisfactory control measure known is the use of non-infected seed, although treating the seed has given some fair results.

Among other diseases attacking the cotton plant are Texas root rot, boll rot, rust, smut, red leaf, sore shin, etc.

II. RAW COTTON

A. GINNING, BALING, TRANSPORTATION

Before cotton can become commercially valuable it must go through the process of ginning—the separation of seed from the lint. Baling and shipping are the other two steps which link the individual farmer's crop with the world market. Each is of utmost importance, for the failure to meet certain standards in any of these steps penalizes the farmer, the ginner, the shipper and the consumer.

In the United States, roller gins are used only for ginning Pima cotton and Sea Island cotton while the bulk, American Upland, crop is ginned by saw-gins. In the United States cotton belt ginning has become "big business" with a total investment in cotton gins in 1938 of over $200,000,000.

Easily reached by excellent highways and farm-to-market roads, large public gins located in central points and equipped with the most up-to-date machinery have supplanted the small individual plantation ginneries. In 1933 the number of active gins in the United States was 13,543 compared to 18,262 in 1925. Although the trend is to fewer gins, the larger gins are better equipped, and the crop can be ginned better and faster than formerly.

In the United States when a truck or wagon load of seed cotton pulls up before the gin the load is automatically weighed, the seed cotton is drawn by a suction pipe out of the conveyance and carried mechanically through cleaner, distributor and feeders to the saws. From the saws the lint is blown to condensers which drop it into the press box, while the seed is carried by a mechanical conveyor to a storage bin or, if requested, back to the grower's wagon or truck. Most growers, however, sell their seed to the commercial ginner at prevailing prices, for "seed money" is an important part of the tenant's financial life.

When the lint is dropped into the press box it is packed by mechanical trampers and pressed into a bale of oblong shape, weighing approximately 500lb., measuring about 54x27x46in., with a density of 12½lb., approximately, per cubic foot. The jute bagging and ties in which the bale is wrapped weigh about 21lb., and if the bale should be wrapped in cotton bagging, as many are under a subsidy program inaugurated by the Government in 1938, the tare weighs about 7lb. less.

The farmer pays the ginner 30 cents to 40 cents per 100lb. for seed cotton, plus a charge of $1.25 to $1.50 per bale for bagging and ties, or a total cost of $5.00 to $7.00. Modern American saw-gins can gin a bale of cotton in from 5 to 30 minutes. The average time is 15min. from the lowering of the suction pipe to the wagon-load of seed cotton to ejection of the finished bale from the press.

Cotton bales may be compressed for shipping purposes to a density somewhat above 22½lb. per cu.ft., at a charge of 55 cents to 75 cents per bale. Compressed bales have an irregular and ragged appearance but twice as many compressed bales can be placed in a railway car, and freight differentials make compression necessary on rail shipments.

The use of round bales is becoming more and more popular in the United States, particularly in Arkansas, Oklahoma and Texas. Fully 75% to 85% of round bales put up in the United States are exported. Anderson, Clayton & Company own all of the round bale presses in the United States, furnishing them to independent ginners who operate them under a lease arrangement. The round bale is about 25in. in diameter, weighs about 250lb., and has a density of 33lb. per cubic foot. One or two round bale presses are in operation in Mexico, two have been installed in China, and one in Indo-China. The American flat bale does not compare favourably in appearance with bales of other countries, but the round bale is very neat.

Cotton cultivated and harvested with care, ginned under best conditions, representing a full year's income to the grower, cannot be actually evaluated in dollar-return unless it finds a way to the world market. Therefore, the last step between months of labour and out-of-pocket expense and a possible profitable income is of greatest importance. Much of the cotton crop must travel considerable distances from the gins or compresses to the consumer mills. The most economical route must be chosen. In the United States excellent transportation facilities are to be had in trucking systems which are in great competition with railroads. In the western section cotton hauls of several hundred miles are made via modern highways to concentration points, and combination truck and rail hauls are also used. East of the Mississippi river rail is most generally used for long hauls, and trucks for short hauls. Most cotton for export is shipped by rail, truck, or river barge, or combination of two or all three to Houston and Galveston in Texas, and New Orleans in Louisiana where compresses capable of caring for $1\frac{1}{2}$ to 2 million bales are located. Some 60-odd steamship lines operate from these ports with approximately 150 foreign destinations. Other ports along the Gulf coast and Atlantic seaboard get their share, too, of export business.

In Egypt roller-gins are used exclusively. This process is a more gentle one than saw-ginning, and is more satisfactory for the long staple crop of Egypt, the lint pulling easily from the seed.

The gins are substantial concerns, run either independently or controlled by cotton exporters. The ginneries are well equipped and efficiently managed. Strict laws prevail as to cotton-seed which is not allowed to be mixed at the gin; each lot of seed sold for planting must bear a tag stating it has been approved and tested, and other facts.

The larger portion of the Egyptian crop is sold by the grower as seed cotton at the gin, the ginner—in turn—selling the various lots to the exporters. The gin-bales averaging around 800lb. are shipped to Alexandria, the bottle-neck through which the entire Egyptian crop passes. There they are stored until sold. When exported each bale is torn apart in the farara, or warehouse, and a blend is made from as many as a dozen lots of country bales in order to prepare and press one lot of export bales. This gives the exporter, and the purchaser, an even running blend equal to a specified type prepared for individual spinners. When a sufficient quantity of a blend is prepared and done up loosely in bags, it is pressed in steam presses into the neat, highly compressed, 750-lb. burlap wrapped bale, peculiar to Egyptian cotton.

In addition to America, France, and Lancashire, England, Egyptian cotton is exported to Japan, India, Rumania, Yugoslavia and other countries.

In Brazil the cotton ginner has always been the primary buyer, buying the seed cotton from growers and then ginning all his cotton together, regardless of type or quality. After it was ginned it was sold to larger merchants who in turn sent it to the coast, where at seaports the bales were broken open and classed, the method of classing being by sight, the classer determining types by colour differences. Crude and approximate, it resulted in great losses in waste because of lack of uniformity in the cotton.

In 1934, a Brazilian Federal decree requiring annual registration and licensing of all cotton gins and presses was passed. This also provided for annual inspection of gins and after Sept. 1, 1935 all gin machinery had to conform to prescribed standards. Enforcement of this latter provision increased imports of American gin machinery from $68,000 in 1933 to $847,000 in 1935. It tapered off to $555,000 in 1938. As a result of Government requirement since 1931 of official classification of all cotton destined for export, plus the excellent new gins, Brazilian cotton is able to compete in world markets on a quality basis.

The Brazilian Government, through its ministry of agriculture, has established nine grades for each of the various types of cotton grown in the country. Of these, physical standards for five grades and descriptive standards for four have been promulgated.

Transportation facilities of the north-eastern Brazilian States are poor. Railroads extend only short distances from the seacoast and the equipment is not modern or kept up. The service is slow and expensive. Highways are not hard-surfaced and are almost impassable at times. The farmer is dependent in most instances on the ox-cart or on mule pack trains to transport his crop to the nearest railway. A road building program is underway, however, under the Government's drought-relief program. In the southern Brazilian States' cotton districts transportation facilities are good although there are still large areas in which transportation is still a major problem.

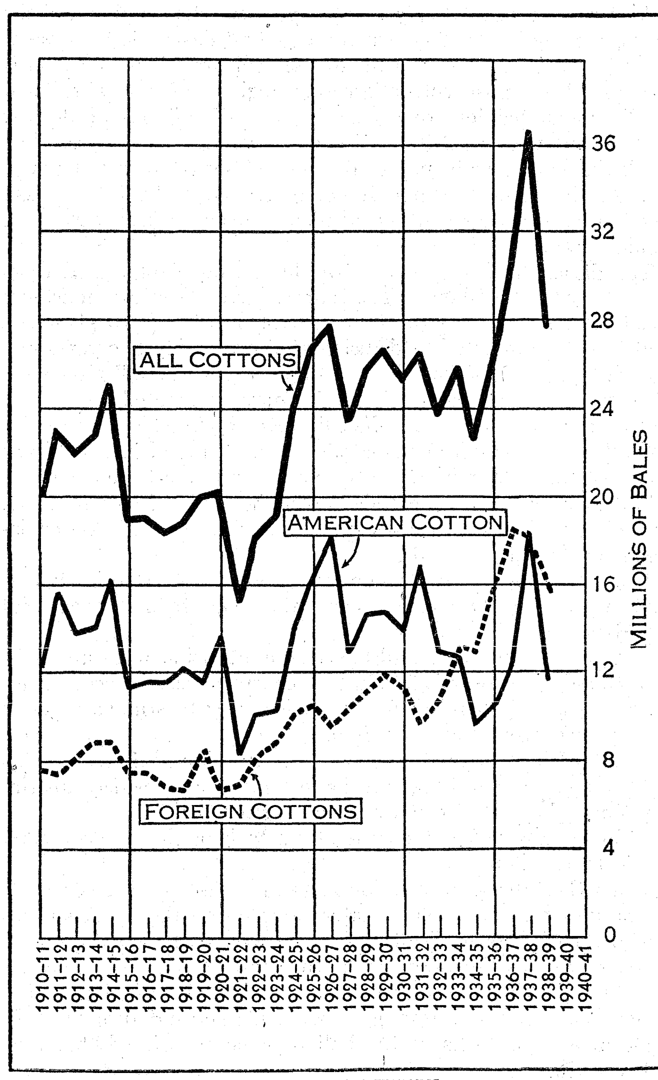
In China marketing of cotton requires considerable hand labour, for methods are relatively inefficient. In remote places seed is still separated from the lint by hand, but most of the cotton is ginned in the home during fall and winter—when the farmer has more leisure time—by means of a spike-gin operated by the foot.

Near some of the cotton centres farmers sell their seed cotton to a central gin. The majority sell their ginned cotton to a local buyer, who, in turn, sells to a visiting middleman who ships it to some concentration point. It is conveyed from the interior in baskets, bags, hand-pressed bales, straw-bales, jute-bales and press-packed bales.

The only Chinese cotton which is known in the world markets is put up in the Tientsin bale which weighs about 530lb. and has a density of 52lb. per cu.ft.; is wrapped in close-meshed jute and carries three ties. (M. G. B.)

B. THE WORLD'S COTTON SUPPLIES

World Production.—During the five years from 1935 to 1939 inclusive the annual production of commercial cotton in the world averaged approximately 30,000,000 bales. This figure is for actual bales of American cotton—these bales averaging about 490lb. net weight—and for equivalent 478lb. net weight bales of



FROM COTTON YEARBOOK OF THE NEW YORK COTTON EXCHANGE

FIG. 2.—PRODUCTION OF COMMERCIAL COTTON IN THE WORLD

(Actual bales for American cotton. Equivalent 478-lb. bales for non-American growths.)

non-American cottons. Figures for non-American cottons are not usually given in terms of actual bales because those cottons are put up in bales of widely varying weights, some foreign cotton bales weighing less than 100lb. and others around 750 pounds. The equivalent 478lb. net weight bale has been adopted as the unit for statistics for non-American cottons because a bale of that weight has been looked upon as the standard bale of American cotton—although, as stated, American bales currently average a little heavier. The term "commercial cotton" refers to cotton which enters commercial channels by being processed mechanically in mills, as distinguished from cotton which is processed by hand-spinning, used for stuffing mattresses or padding clothing, or otherwise utilized outside of mills.

The approximate average world crop of 30,000,000 bales is the combined output of about 60 countries. Of these 60 countries, approximately two-thirds are in the northern hemisphere. Most of the larger cotton growing countries are north of the equator. Consequently, 85% to 90% of all the cotton grown in the world is produced in the northern hemisphere. This is important from the standpoint of the timing of the annual output of the staple, for it means that the bulk of each of the world's cotton crops comes onto the world market in the second half of the calendar year. The output of southern hemisphere countries has increased substantially in the decade, 1930–39, and consequently the volume of newly produced cotton which enters commercial channels in the first half of the year has expanded appreciably, but it is still relatively small.

The United States produces far more cotton than any other country. Up to a few years ago it produced well over one-half of all of the commercial cotton grown in the world, but this is no longer true, since the United States has reduced its average output substantially in recent years while numerous other countries have increased theirs. At the close of the decade of the '30s about 90% of the world's commercial cotton production was furnished by six countries, these being the United States with an average output of about 12,500,000 bales, India 5,000,000, Russia 3,600,000, China 2,000,000, Brazil 2,000,000, and Egypt 1,900,000. Most of the balance of the world crop was turned out by nine countries, these being, in order, Peru with an average output of close to 400,000 bales, Mexico with about 300,000, Argentina, Uganda and the Anglo-Egyptian Sudan with about 275,000 each, Turkey, Chosen and the Belgian Congo with 175,000 to 200,000 each, and Iran with 150,000. Approximately 45 other countries produced a total of about 750,000 bales, but none of them produced as much as 100,000 on an average, and most of them produced less than 50,000. All of the foregoing figures for non-American cottons are in terms of equivalent 478-lb. bales.

While the increase of cotton growing in numerous widely separated countries and the decrease of it in the United States has tended to make the world output more stable, world cotton crops still fluctuate greatly. Taking the 12 months from August 1 of one year to July 31 of the next as constituting the world cotton season—this being the 12-month period which is best adapted to that purpose—world production of commercial cotton increased from approximately 26,100,000 bales in the 1935–36 season to about 30,800,000 in the 1936–37 season; it increased further to about 36,800,000 in the 1937–38 season, but it then dropped to about 27,400,000 in the 1938–39 season. The increase from 1935–36 to 1936–37 was about 18%, and from 1936–37 to 1937–38 was about 19%. The decrease from 1937–38 to 1938–39 was about 26%. Such wide variations in outturn are due chiefly to changes in yield per acre, and only to a relatively small degree to changes in acreage. In some parts of the world yields are greatly reduced at times by severe droughts, in others they are often lowered by excessive rains. Insect damage tends strongly to vary with weather conditions. It is chiefly because of the impossibility of controlling weather conditions and resultant yields per acre that the United States Government has encountered great difficulties in its efforts to control production by controlling acreage.

Many of the cotton growing countries of the world consume the larger portion or practically all of their output of the staple. Many others, on the other hand, export the larger portion or practically all of their output. Among the countries which consume the larger portion or most of their output are the United States, Russia, China, Chosen, Turkey and Mexico. Among those which export the larger portion or most of their output are India, Egypt, Brazil, Peru, Argentina, Anglo-Egyptian Sudan, Uganda, Belgian Congo and Iran. The great majority of the small cotton growing countries export most or all of their output. The greater portion of the cotton which is exported by cotton growing countries goes to Great Britain, countries of the continent of Europe, Canada, Japan and China. Great Britain, most countries of the continent of Europe, and Canada do not grow cotton, and Japan produces only a negligible quantity, since those parts of the world have too cool temperatures for producing the staple. In consequence of the facts just stated, roughly 40% of the world output of cotton moves in international trade. Cotton is one of the most important commodities in international commerce.

Notwithstanding the world-wide disruption of trade and industry and the curtailment of world buying power in the decade of the '30s, in consequence of the economic debacle early in that decade and the subsequent political confusion, and, notwithstanding, also, the phenomenal expansion in the use of rayon products during that decade, world production and world consumption of cotton reached record high levels in that period. Scores of millions of agricultural and industrial workers of the world were unable to make normal purchases of cotton goods. In certain countries, notably Germany and Japan, consumption of cotton was substantially reduced as a result of Government regulations requiring the use of rayon staple fibre in direct substitution for cotton. In other countries expansion of the use of cotton was restrained by the fact that rayon staple fibre was used in place of cotton for certain purposes for purely commercial reasons. In the face of these adverse factors, cotton growers of the world as a whole increased their output of the staple, and the world responded by finding new uses for the staple in the older areas and larger outlets in newer areas. One of the outstanding trends in world consumption of cotton in the decade indicated was the increase in the use of the staple in the more recently industrialized countries, such as India, Brazil and Argentina, and, until the outbreak of the Sino-Japanese war, in Japan and China. Peak world production of cotton was reached in the 1937–38 season, at approximately 36,800,000 bales. Peak world consumption was reached in the 1936–37 season, at approximately 30,600,000 bales.

In considering world supplies of cotton, it should not be assumed that all cotton has the same physical characteristics, and that, hence, any given kind of cotton is adapted to the manufacture of all kinds of cotton manufactured products. There are hundreds of commercially recognized varieties of cotton, and of each variety there are many commercially recognized qualities. The physical characteristics in cotton which are of chief importance from a commercial standpoint are length of staple, *i.e.*, length of fibre; amount and character of intermingled leaf, twigs and other foreign matter; colour, strength, smoothness, silkiness, adherence of fibres to each other and resiliency. Different cottons which are more or less similar with respect to these characteristics may be used interchangeably for the manufacture of a given product, but cottons which are not similar may not be so used. Consequently, while the various cottons produced in the world are to a large degree interchangeable and hence they compete with one another, such interchangeability and competition are subject to limitations. To be specific, certain kinds of cotton produced in volume in the United States compete directly with certain kinds produced in volume in India, but most cotton produced in Egypt has only a remote competitive relationship with most cotton produced in India.

The commercial cottons of the world vary in length of staple from about $\frac{3}{8}$in. to about $1\frac{3}{4}$in. or more. The longest cottons include the longer varieties of Egyptians, Peruvians, and Sudans; Sea Island cotton, long staple American Upland cotton, and a variety grown in the United States known as Pima. The shortest cottons include the shorter varieties of Indian and Chinese cottons, and numerous unimproved varieties grown in the smaller producing countries. Roughly 60% to 65% of all the cotton grown in the world is in the range of length from $\frac{7}{8}$in. to $1\frac{3}{32}$ inches. About 25% to 30% is in the range from about $\frac{3}{8}$in. to $\frac{27}{32}$ inches. About 10% is in the range from $1\frac{1}{8}$in. to about $1\frac{3}{4}$ inches. Of the cotton produced in the United States, exclusive of the very small amounts of Pima and Sea Island, 85% or more is in the range from $\frac{7}{8}$in. to $1\frac{3}{32}$ in., 7% to 9% is $1\frac{1}{8}$in. or longer, and 5% to 8% is under $\frac{7}{8}$ inch.

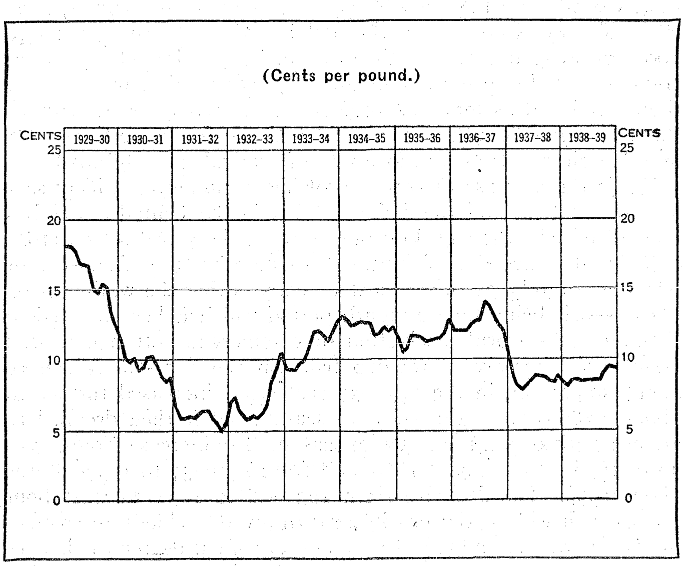
The American Crop.—For the most part, the production of cotton in the United States is spread over a tremendous area in the southern portion of the country, commonly called the cotton belt. In its greatest dimensions this area stretches 1,500mi. east to west, from the South Atlantic seaboard to the eastern section of the State of New Mexico, and 700mi. north to south, from the northern boundaries of Texas and Oklahoma to southernmost Texas. It is larger than France, Germany, Italy and Spain combined. In addition, cotton is grown in volume in the Far West, in the States of California and Arizona. Practically all of the cotton produced in the cotton belt is rain-grown, the chief exception being a small amount that is produced by irrigation in New Mexico. The cotton grown in the Far West is produced by irrigation. Over the vast territory comprising the cotton belt there are many widely varying types of soils, many types of topography, and great variations in weather. Seasonal changes come at different times in the southern and northern portions of the belt, necessitating differences of timing in the various operations of cotton growing. Mid-summer heat comes to southern Texas while Oklahoma, Arkansas and other northern cotton growing areas are unable to start farm operations because of actual or threatened frosts.

Planting usually begins early in March in the southernmost part of Texas, around the first of April in the middle of the belt, and toward the end of April in the northern portion of the belt. In any given district it is usually completed in two to four weeks. Picking usually starts around the first of July in southern Texas, about the middle of August in the middle portion of the belt, and about the first of September in the northern areas. Picking is spread over three to four months in each section. Consequently, picking is not completed in the northernmost areas until about the end of the calendar year, or even later if it is delayed by cold or wet weather. Notwithstanding the great expanse of the cotton belt, the belt-wide average yield per acre is subject to large variation from year to year, because of differences in weather and insect infestation. In the western part of the belt the yield is often reduced by prolonged drought. In the eastern part it is often cut down by excessive rains. The principal insect pest is the boll weevil. That pest, however, has done much less damage to the crops than formerly. The crop is heavily fertilized in the eastern portion of the belt, less fertilized in the central portion, and mostly not fertilized in the western portion. Average yields per acre have shown a pronounced upward trend. It is not possible to give any significant figure for the average cost of growing cotton in the United States, since most of the growers raise their crops by their own labour and that of members of their families, the recompense for which labour consists simply of that portion of the returns from the sale of the cotton and cotton-seed which is left after other costs have been met.

Almost all of the cotton grown in the United States is of the botanical type known as "Upland." The very small balance consists of Pima cotton, grown in Arizona, and Sea Island cotton, grown in Florida and the southern part of Georgia. Upland cotton varies in length from about $\frac{3}{4}$in. to about $1\frac{3}{8}$in., the bulk of it being in the range from $\frac{7}{8}$in. to $1\frac{1}{16}$ inches. The longer Upland cotton is grown in the areas adjacent to the Mississippi river and in a limited area in South Carolina. Pima and Sea Island cottons are very long, mostly $1\frac{1}{2}$in. or longer. Pima cotton was originally developed from Egyptian seed, and hence is often referred to as American-Egyptian. Sea Island cotton was formerly produced in fairly large volume in the south-eastern portion of the belt, but for some years practically none was raised because of its vulnerability to the boll weevil. Recently the production of it has been revived, on a very small scale. The U.S. Department of Agriculture issues periodical reports during each harvesting season on the grade and staple of the cotton produced, based on samples taken at the gins. Governmental and private agencies have devoted a great deal of effort during the '30s to raising the quality of U.S. cotton, particularly as to its staple length, and they have accomplished much in that direction.

The United States produces far more cotton than it consumes, although it consumes much more than any other country. Consequently, a large portion of each crop has to be merchandised abroad. The bulk of the cotton produced in the eastern portion of the cotton belt, and part of that produced in the central portion, are taken by domestic mills located in the south-eastern part of the country. The bulk of the cotton produced in the western portion of the belt, and part of that produced in the central portion, are exported. A substantial amount of cotton, particularly from the central and western portions of the belt, goes to mills in the north-eastern States. Cotton of a given quality in the eastern portion of the belt may be worth one cent a pound more than cotton of the same quality in the north-western portion of the belt, because of differences in the cost of transportation to domestic mills and to ports. Cotton exported by the United States goes, in peace-times, principally to Great Britain, countries on the continent of Europe, Japan, China and Canada. American cotton competes only very indirectly with foreign growths in the domestic market, because of transportation costs incurred in moving foreign cottons to the United States, but it competes very directly and very keenly with foreign growths in foreign markets, particularly in Great Britain, on the continent of Europe, and in Japan and China.

Since 1929 the United States Government has pursued many programs, or lines of action, designed to maintain or raise the price of American cotton. These may be broadly classified in three categories, namely, programs designed to restrain the flow of cotton to market, programs designed to limit production, and a program designed to stimulate exports. The programs designed to restrain the flow of cotton to market have taken the form of price-supporting loans to the growers, such loans being made directly by, or guaranteed by, the Government. The loan programs have resulted in the growers putting tremendous quantities of cotton into the loan stocks, instead of selling such cotton. The programs designed to limit production have taken the form of induce-



FROM COTTON YEARBOOK OF THE NEW YORK COTTON EXCHANGE

FIG. 3.—MONTHLY AVERAGE PRICES OF MIDDLING UPLAND SPOT COTTON AT TEN SOUTHERN SPOT MARKETS IN THE UNITED STATES IN TEN SEASONS

Note: Seasons run from August 1 in one year to July 31 in the next. The ten markets from which prices have been taken and averaged for this chart are Norfolk, Augusta, Savannah, Montgomery, Memphis, Little Rock, Dallas, Houston, Galveston and New Orleans

ments to growers to reduce the amount of land devoted to cotton growing, such inducements being partly in the form of payments in compensation for compliance with the programs and partly in the form of penalties for non-compliance with them. The production control programs have included requirements that the growers plant land diverted from cotton to soil-building crops or engage in other soil-building practices. The production control programs have led the growers to reduce their cotton acreages drastically, this, however, being partially offset by increases in average yields per acre. The program designed to stimulate exports has consisted of the granting of a Government subsidy on exports of cotton, together with quotas on imports. This program was put into effect just before the outbreak of the European war in 1939, and the results of it were obscured, at the outset at least, by the repercussions of that conflict.

The Government loan programs were initiated with loans made by the Federal Farm Board, a Government agency, in 1929. When the Farm Board made its first loans, the basic quality of cotton, middling $\frac{7}{8}$in., was selling for about 18 cents a pound, and the Board loaned 16 cents. The price subsequently declined to a point far below the loan level. In 1930 the Farm Board made further loans at rates averaging about 9 cents. Again the price dropped to a point far below the loan level. By 1932 cotton was selling for about 5 cents a pound. Roughly 3,600,000 bales of cotton were pledged against Farm Board loans, part of which was sold at great losses and part given to the Red Cross. The Farm Board's total loss on its cotton loan programs was estimated at $150,000,000. In 1933 a new series of Government cotton loan programs was begun, with loans by the Commodity Credit Corporation, a new Government agency. That agency made loans at the rate of 10 cents a pound in 1933, 12 cents a pound in 1934, 10 cents a pound in 1935, 9 cents a pound in 1937, and 8.3 cents a pound in 1938. For the most part, the Commodity Credit Corporation had the same experience as the Farm Board had had. The price of cotton fell below the Government loan rate in periods in which economic conditions called for such decline, and the Commodity Credit Corporation was left with huge stocks of loan cotton which it was unable to sell except at a loss. In 1936 and 1937 the Corporation released some of its cotton to the borrowing growers at a loss, in 1939 it disposed of a further quantity at a loss under a cotton-rubber barter deal with the United Kingdom, and late in 1939 it still held about 10,250,000 bales in which it had invested far more than it could recover from the sale of the cotton at current prices. The actual losses taken by the Commodity Credit Corporation plus its potential losses on cotton held were comparable with the losses of the Federal Farm Board.

TABLE II.—*Acreage, Yield per Acre, Production and Price of Cotton in the United States*

Year	Planted Acreage (Acres)	Harvested Acreage (Acres)	Yield per Acre (Pounds)	Production (500-lb. Gross Weight Bales)	Season-Average Price of Middling ⅞″ Spot Cotton* (Cents per Pound)
1910	32,480,000	31,508,000	176·2	11,609,000	14·65
1911	35,634,000	34,916,000	215·0	15,693,000	10·85
1912	33,199,000	32,557,000	201·4	13,703,000	12·20
1913	35,721,000	35,206,000	192·3	14,156,000	13·12
1914	36,197,000	35,615,000	216·4	16,135,000	8·23†
1915	30,544,000	29,951,000	178·5	11,192,000	11·72
1916	33,977,000	33,071,000	165·6	11,450,000	18·96
1917	33,064,000	32,245,000	167·4	11,302,000	29·02
1918	36,123,000	35,038,000	164·1	12,041,000	29·76
1919	34,573,000	32,906,000	165·9	11,421,000	38·34
1920	35,872,000	34,408,000	186·7	13,440,000	16·66
1921	29,716,000	28,678,000	132·5	7,954,000	18·09
1922	32,176,000	31,361,000	148·8	9,762,000	25·83
1923	37,000,000	35,550,000	136·4	10,140,000	30·14
1924	40,690,000	39,501,000	165·0	13,628,000	24·22
1925	45,968,000	44,386,000	173·5	16,104,000	19·68
1926	45,839,000	44,608,000	192·9	17,977,000	14·40
1927	39,471,000	38,342,000	161·7	12,956,000	19·72
1928	43,737,000	42,434,000	163·3	14,478,000	18·67
1929	44,448,000	43,232,000	164·2	14,825,000	15·79
1930	43,329,000	42,444,000	157·1	13,932,000	9·61
1931	39,110,000	38,704,000	211·5	17,096,000	5·89
1932	36,494,000	35,891,000	173·5	13,002,000	7·15
1933	40,248,000	29,383,000	212·7	13,047,000	10·81
1934	27,860,000	26,866,000	171·6	9,637,000	12·36
1935	28,063,000	27,509,000	185·1	10,638,000	11·55
1936	30,627,000	29,755,000	199·4	12,399,000	12·70
1937	34,090,000	33,623,000	269·9	18,945,000	8·66
1938	25,018,000	24,248,000	235·8	11,944,000	8·70

*Prices given are averages for 12-month periods from August 1 in year indicated to July 31 in following year. For seasons from 1902–03 to 1914–15, inclusive, they are for spot cotton at New Orleans; for subsequent seasons they are averages for spot cotton at 10 southern markets.

†Average for about 10 months from Sept. 23, 1914 to July 31, 1915.

The Government production control programs were initiated in 1933 with the ploughing-up of about one-fourth of the acreage planted to cotton in that year. The 1933 program took that form because the law which provided for it was not enacted until the growers had seeded the current crop. In subsequent years the programs consisted of the non-planting of cotton on certain percentages of the land usually devoted to the staple. There were such programs in all years beginning with 1934. The land withheld from cotton ranged roughly from 25% to 40% of the theoretical full acreage. Most of the growers co-operated in these programs. However, since the growers left their poorer land out of production and planted their best, since they cultivated their smaller acreages more intensively, and since they built up the fertility of their soils by soil-building practices provided for in the Government programs, yields per acre rose to unprecedented levels and crops were not reduced in ratio with the decreases in acreage. In 1937 the Government control program was completely nullified by a phenomenal yield per acre in consequence of exceptionally favourable growing conditions, the crop of that year being the largest ever raised. Still, on an average, production was sharply reduced by the control programs.

To understand why the Government adopted the export subsidy program, to stimulate exports, one must observe the broad effects of the loan and production control programs on the American cotton trade.

TABLE I.—*American Cent Equivalents of Pence Prices for Spot Cotton at Liverpool*[a] (*Liverpool Cotton Association figures*) (Per pound)

Season (Aug. 1 to July 31)	American		Brazilian			Peruvian		Egyptian		West Indian	East Indian		
	Low Middling	Middling	Fair			Good		Fully Good Fair		Good	Fully Good	Fine	Fully Good
			Pernambuco	Ceara	Sao Paulo	Tanguis	Mitafifi	Saks	Uppers	Sea Island	Broach	Oomra No. 1	Sind
1910–11 . .	15·78	16·32	17·15	17·15	..	17·77	22·36	28·12	21·04	34·90	14·92	14·41	12·65
1911–12 . .	11·90	12·63	13·48	13·48	..	14·44	19·32	23·33	18·69	34·22	11·58	11·38	10·22
1912–13 . .	13·37	14·00	14·54	14·51	..	15·89	19·56	21·87	19·07	33·42	12·72	12·54	11·31
1913–14 . .	14·11	15·08	15·11	15·01	..	16·32	20·54	21·35	18·27	31·31	12·75	12·06	10·35
1914–15 . .	10·06	11·00	11·62	11·57	..	12·39	16·47	18·33	13·59	25·69	9·66	9·07	7·48
1915–16 . .	14·44	15·04	16·17	16·07	..	16·61	20·55	26·32	19·51	29·76	13·86	11·98	10·69
1916–17 . .	24·37	24·72	25·96	25·86	..	26·80	43·58	50·99	41·14	60·44	23·20	20·55	18·77
1917–18 . .	42·44	43·56	47·84	47·78	..	50·12	62·46	61·27	52·67	b	40·82	37·20	33·50
1918–19 . .	37·38	39·46	46·93	46·93	..	49·70	53·77	54·56	47·06	c	36·74	35·52	30·86
1919–20 . .	38·36	42·40	48·35	48·35	..	62·13	86·97	96·35	76·97	d	34·61	31·18	24·24
1920–21 . .	16·68	19·73	19·61	19·61	18·28	28·84	40·36	45·72	28·20	73·86	15·91	14·14	9·63
1921–22 . .	19·01	20·19	19·77	19·77	19·36	25·32	27·71	33·97	26·63	52·81	17·43	16·71	13·45
1922–23 . .	28·28	28·70	27·93	27·93	27·58	32·18	30·12	32·99	29·96	51·16	23·43	21·26	16·72
1923–24 . .	31·53	32·99	33·17	33·17	32·31	36·79	39·10	39·35	38·19	47·43	26·36	24·37	21·54
1924–25 . .	25·62	27·09	28·85	28·85	27·22	35·63	44·10	58·76	38·30	63·63	23·24	23·49	21·48
1925–26 . .	19·48	21·82	22·64	22·01	20·48	30·63	35·02	40·47	29·14	67·89	18·71	18·15	15·78
1926–27 . .	14·45	16·57	17·31	16·15	15·13	20·20	24·10	31·20	23·55	57·96	14·20	14·58	12·70
1927–28 . .	21·92	22·65	23·04	22·31	21·72	25·39	33·14	39·38	29·71	50·14	19·48	18·66	16·88
1928–29 . .	20·34	21·36	21·76	20·83	20·64	24·88	29·32	36·83	24·57	51·29	17·60	16·30	14·23
1929–30 . .	17·04	18·44	17·56	17·34	17·27	21·15	22·33	29·44	21·25	50·47	13·79	12·95	10·47
1930–31 . .	10·53	11·61	11·54	11·36	11·36	13·78	14·54	18·42	13·95	40·16	8·63	8·19	7·28
1931–32 . .	7·18	7·54	7·61	7·45	7·50	9·67	9·97	10·69	8·93	e	6·80	6·76	6·11
1932–33 . .	8·07	8·52	8·68	8·53	8·61	10·56	11·17	11·77	10·61	f	7·58	7·29	6·55
1933–34 . .	11·66	12·47	12·32	12·17	12·28	15·06	15·28	16·73	13·77	c	9·57	9·35	7·70
1934–35 . .	13·49	14·24	13·67	13·56	13·86	16·16	c	17·49	15·49	c	11·52	10·78	7·75
1935–36 . .	12·58	13·50	13·06	12·91	13·45	15·74	c	18·99	15·49	c	11·23	10·78	9·05
1936–37 . .	13·16	14·62	13·72	13·43	14·12	18·23	c	22·19	17·40	c	11·75	10·87	10·60
1937–38 . .	8·78	10·31	9·45	9·30	10·18	14·21	c	17·06	13·10	c	8·38	7·96	7·73
1938–39 . .	8·71	10·15	g	g	9·63	12·34	c	h	11·80	c	7·69	7·14	i

[a]Average of monthly averages which were based on Friday's prices. Monthly averages in pence had been converted to cents at current average monthly rates of exchange as reported by the Federal Reserve Board. [b]No quotations after May 3, 1918. [c]No quotations. [d]Quotations only from March 19, 1920 through July 30, 1920. [e]No quotations after Aug. 21, 1931. [f]Quotations only from Feb. 3, 1933 through July 28, 1933. [g]No quotations after Jan. 27, 1939. [h]No quotations after June 30, 1938. [i]No quotations after Dec. 16, 1938.

These effects were a large increase in production of cotton by other cotton growing countries, a large displacement of American cotton by foreign cottons in foreign consuming countries, and, hence, a great shrinkage in exports of cotton by the United States. Foreign cotton growing countries increased their output because, largely as a result of the United States Government programs, foreign prices of cotton were held at such levels that cotton growing was more profitable than other agricultural activities. Foreign cotton consuming countries switched from American to foreign cottons because, largely as a result of the United States Government programs, American cotton was priced out of line with foreign growths. It was to meet this situation that the United States Government began in 1939 to pay a subsidy at the rate of $1\frac{1}{2}$ cents a pound on exports of cotton.

The Indian Crop.—Since India extends approximately 2,000 mi. from north to south and the same distance from east to west, and cotton is grown in roughly three-fourths of it, the planting and harvesting seasons for Indian cotton are naturally spread over many months of the year. Cotton is planted in northern India in May and June, in central India in June and July, and in southern India in September and October. It is harvested in northern India in October to January, in central India in November to February, and in southern India in February to April. In India as a whole, as will be noted, planting is spread over the months from May to October, and harvesting is distributed over the months from October to April. Thus the planting and harvesting periods for Indian cotton are several months later than those for American cotton, and Indian cotton largely comes onto the world market at a different time of the year than American cotton. A large portion of the cotton produced in India is much shorter than most American cotton, and consequently a large portion of the Indian crop is not directly competitive with the bulk of the American crop. However, a very substantial portion of Indian cotton is of such length that it competes very directly and keenly with certain qualities of the American staple. Many mills in Europe and the Orient use mixtures of Indian and American cotton, and such mills change the percentage of each growth in their mixtures when relative prices make it advantageous to do so. Other mills, which use American or Indian cotton straight, switch from one growth to the other when market conditions justify their doing so.

Cotton grown in India is commonly classified in the Indian cotton trade into long staples, medium staples, and short staples. In considering these classifications, it should be noted that cotton which is called "long staple" in India would be called only "medium staple" in the United States, while cotton which is called "medium staple" in India would be called "short staple" in the United States. Indian cotton which measures 1 in. to $1\frac{1}{16}$ in. is classified in India as long staple, that which measures from $\frac{7}{8}$ in. to $\frac{31}{32}$ in. is classified as medium staple, and that which measures less than $\frac{7}{8}$in. is classified as short staple. By these classifications roughly 5% of Indian cotton is long staple, 30% to 35% is medium staple, and 60% to 65% is short staple. The most important commercial varieties of Indian cotton are those which are grouped in the classifications known as American Seed, Oomra and Bengal-Sind. Each of these classifications embraces a number of more or less distinct varieties. Other important varieties include Broach, Western-Northern, Dhollerah, Compta-Dharwar, Surti, Southerns and Mathia. American Seed cottons are mostly medium and long staple, Oomras are fairly short or very short, and Bengal-Sinds are distinctly short, according to Indian length classifications.

While Indian cotton crops show irregular changes from season to season because of variations in yield per acre due to differences in growing conditions, the trend of production in India was definitely upward in the decades of the '20s and the '30s. In the five seasons from 1934–35 to 1938–39 the average commercial crop was about 6,200,000 actual bales of about 400lb. each, compared with about 5,500,000 in each of the two quinquenniums immediately previous and 5,000,000 in the third quinquennium previous. These figures cover only cotton produced for domestic mill consumption and exportation. In addition, India produces a quantity of cotton, variously estimated from 350,000 to 750,000 400-lb. bales per year, for household use within the country. Most of the increase in production has been absorbed by the mills of India, which greatly increased their output of cloth in the years indicated. Exports of cotton by India have fluctuated with the crops and with the changes in price relationships between Indian and non-Indian cottons, but they have not shown any pronounced trend either upward or downward. The greater portion of the cotton exported by India normally goes to Japan and China, but a very large portion goes to countries of Europe, chiefly Great Britain, Germany, France, Belgium and Italy.

Although India ranks second among the countries of the world both in the production and in the exportation of cotton, it imports substantial quantities of the staple. In the last half of the decade of the '30s, its imports in individual seasons ranged from about 250,000 to about 650,000 equivalent bales of 478lb. each. The imports by India are chiefly from Kenya, Egypt, the Anglo-Egyptian Sudan and, in occasional years, from the United States. India imports principally long staple cotton, of which it does not produce enough to supply the requirements of its mills, although it produces a large exportable surplus of short cotton.

TABLE III.—*Production of Commercial Cotton in World* (*New York Cotton Exchange figures*)

(American cotton in actual bales. Other cottons in equivalent 478-lb. bales, 000's omitted)

The table below includes only cotton entering commercial channels, *i.e.*, it does not include large amounts grown in India, China, and other countries for consumption in the homes of the people of those countries. For the United States, figures are given both for the actual ginnings from each crop, as reported by the Bureau of Census, and for the total production in the statistical season. The adjustment applied in arriving at the total production in the statistical season is computed by: (a) deducting from the actual ginnings from each crop the ginnings before the opening of the statistical season; (b) adding those ginnings from the next crop which are made before the beginning of the next statistical season; (c) adding an allowance for city crop, *i.e.*, rebaled samples, pickings from cotton damaged by weather and fire, etc.; and (d) adding imports of Mexican cotton into the United States. Imports of Mexican cotton into the United States are included in the figures on production by the United States because such cotton loses its identity on entering the United States and is counted with American cotton in returns on consumption and exports of the United States. Mexican cotton imported into the United States is excluded from figures on production outside of the United States, to avoid duplication. Figures for Indian cotton are computed from consumption in India, exports by India, and changes in stocks in India.

Season (Aug. 1 to July 31)	United States			Other Countries							Total World
	Actual Ginnings	Adjustment (See note above)	Total Production in Season	Brazil	China*	Egypt	India†	Russia	Other Countries‡	Total Other Countries	
1911–12	15,553	173	15,726	290	780	1,485	2,876	982	852	7,265	22,991
1912–13	13,489	206	13,695	348	732	1,507	3,698	959	917	8,161	21,856
1913–14	13,983	35	14,018	407	649	1,537	4,276	1,077	930	8,876	22,894
1914–15	15,906	325	16,231	395	785	1,298	4,153	1,304	883	8,818	25,049
1915–16	11,068	239	11,307	269	884	961	2,961	1,532	936	7,543	18,850
1916–17	11,364	195	11,559	267	847	1,022	3,349	1,114	845	7,444	19,003
1917–18	11,248	310	11,558	344	865	1,262	3,068	605	759	6,903	18,461
1918–19	11,906	290	12,196	336	940	964	2,937	575	781	6,533	18,729
1919–20	11,326	185	11,511	391	1,150	1,114	4,476	440	1,010	8,581	20,092
1920–21	13,271	393	13,664	406	1,235	1,198	3,250	58	817	6,964	20,628
1921–22	7,978	307	8,285	434	989	1,052	3,668	43	702	6,888	15,173
1922–23	9,729	395	10,124	483	1,529	1,143	4,240	55	877	8,327	18,451
1923–24	10,171	159	10,330	506	1,392	1,306	4,282	197	1,077	8,760	19,090
1924–25	13,639	367	14,006	723	1,493	1,464	4,736	453	1,219	10,088	24,094
1925–26	16,123	58	16,181	532	1,504	1,733	4,578	782	1,433	10,562	26,743
1926–27	17,755	407	18,162	442	1,378	1,649	4,002	830	1,467	9,768	27,930
1927–28	12,783	174	12,957	439	1,831	1,237	4,489	1,096	1,294	10,386	23,343
1928–29	14,297	258	14,555	376	1,733	1,655	4,719	1,174	1,590	11,247	25,802
1929–30	14,548	168	14,716	513	1,494	1,740	4,978	1,279	1,531	11,535	26,251
1930–31	13,756	117	13,873	401	1,715	1,698	4,590	1,589	1,510	11,503	25,376
1931–32	16,629	248	16,877	505	1,113	1,309	3,342	1,843	1,490	9,602	26,479
1932–33	12,710	251	12,961	378	1,718	1,038	4,110	1,816	1,440	10,500	23,461
1933–34	12,664	48	12,712	946	2,000	1,739	4,834	1,887	1,948	13,354	26,066
1934–35	9,472	104	9,576	1,328	2,344	1,523	4,198	1,738	2,335	13,466	23,042
1935–36	10,420	75	10,495	1,757	1,840	1,758	5,323	2,250	2,718	15,646	26,141
1936–37	12,141	234	12,375	1,824	3,020	1,863	5,661	3,400	2,653	18,421	30,796
1937–38	18,252	160	18,412	2,075	2,323	2,259	4,942	3,700	3,073	18,372	36,784
1938–39	11,623	42	11,665	1,913	912	1,703	4,574	3,800	2,840	15,742	27,407

*Includes Manchuria. †Includes Burma through 1936–37. ‡Includes Burma beginning 1937–38.

BY COURTESY OF BESSIE W. CALLAWAY

STEPS IN COTTON'S PROGRESS FROM FIELD TO MARKET

1. A cotton-picking scene
2. Cotton on its way to the gin
3. Weighing a bale of cotton at the compress
4. Transferring cotton to the warehouse

BY COURTESY OF (1, 2, 4, 5) SOUTHERN COMBED YARN SPINNERS ASSOCIATION, (3, 6) "TEXTILE WORLD"; PHOTOGRAPHER (3), COXE, GREENVILLE, SOUTH CAROLINA

PRELIMINARY PROCESSES IN COTTON MANUFACTURE

1. Cotton starting on its way through the mill
2. Placing cotton in a conveyor which carries it to a vertical opener
3. Single-process picking, one of the new developments in cotton preparation
4. After picking, a worker removes the "lap" from the machine
5. The next operation is carding; photograph shows a cotton card
6. Several rows of cotton cards

The Egyptian Crop.—Cotton is produced in Egypt chiefly in a narrow strip of country bordering on the Nile and in the broad delta of that river. The narrow cultivated area along the Nile varies in width from only one or two miles to a maximum of only 20 to 25mi., and it fringes the river for a distance of approximately 500 miles. The delta is roughly in the form of a triangle, approximately 100mi. to each side. Cotton growing is confined to these areas because, due to lack of rainfall, the staple can be grown only in districts which may be irrigated by the waters of the Nile. The crops are planted in the months from February to May, and are harvested in the months from August to December. Thus Egyptian cotton enters world markets at about the same time of the year as American cotton. Since the soil in which cotton is grown in Egypt is a rich alluvial deposit, the average yield per acre is exceptionally high.

Practically all Egyptian cotton is what the world classifies as long staple, *i.e.*, $1\frac{1}{8}$in. or over, and the Egyptian crop constitutes the principal supply of such cotton. It is also finer, stronger and silkier than most other growths. Egyptian cotton is much longer than most American cotton and, hence, it competes only very indirectly with most of the cotton grown in the United States. The competition with American cotton is further restricted by the fact that the United States maintains a high tariff duty on imports of such cotton as Egypt grows, with the result that only a small amount of Egyptian cotton is taken by the United States and the United States exports little cotton of a sort which is directly competitive with Egyptian. Because of its superior quality, Egyptian cotton commands substantial premiums over most cotton grown in the United States and over the bulk of the cotton produced elsewhere in the world. It is used chiefly in the manufacture of those yarns, threads and fabrics in which fineness or strength, or both, are requisite qualities.

There are some 10 to 12 principal varieties of Egyptian cotton. These varieties are commonly grouped in the Egyptian cotton trade in the classifications of long staple, long medium staple, and medium staple. The long staple varieties include Giza 7, Sakellaridis, Maarad, and Sakha 4; the long medium include Giza 12, Fouadi, Giza 26, and Giza 3; and the medium include Ashmouni and Zagora, these latter being known as Uppers. The long staple varieties generally measure $1\frac{3}{8}$in. or over, the long medium from $1\frac{1}{4}$in. to $1\frac{11}{32}$ in., and the medium from $1\frac{1}{8}$in. to $1\frac{7}{32}$ inches. The long staples and the long medium staples are produced almost exclusively in the delta of the Nile, this area being known as Lower Egypt. The larger portion of the medium staples is produced on the borders of the Nile above the delta, this area being known as Upper Egypt. However, a large portion of the medium staples is produced in the delta. The history of cotton growing in Egypt discloses that numerous varieties of the staple have come and gone, as new and better varieties have been developed and have degenerated or have been superseded by still better varieties.

Egypt exports most of the cotton that it produces. Practically all of the exports of the staple go out of the country through Alexandria, the very small balance being exported through Port Said. Great Britain takes much more Egyptian cotton than any other country. Other countries which took (before 1939) large quantities include Germany, France, Italy, Switzerland and Japan. Countries of the Continent other than those named, and the United States, India and China take varying quantities which total to a large quantity in the aggregate. Consumption of cotton in Egypt has increased, but it still aggregates only 6% to 7% of the crop. Because of the fact that most of the Egyptian crop passes through Alexandria, that city is the great market for it, and the prices established there are recognized as the measures of world values of the Egyptian staple. At the end of most seasons there is very little cotton left in the interior of Egypt, and consequently the receipts at Alexandria closely approximate the total production of the country from season to season.

Production of cotton in Egypt showed a pronounced upward trend in the decades of the '20s and the '30s. In the five seasons from 1934–35 to 1938–39 the average crop was approximately 1,200,000 actual bales of about 750lb. each, compared with 990,000 in the first previous quinquennium, 1,020,000 in the second previous, and 760,000 in the third previous. This expansion of output was due primarily to increases in average yield per acre for the acreage devoted to cotton in Egypt showed little net change in these 20 years.

The Brazilian Crop.—Cotton is grown in two fairly well defined sections of Brazil, commonly referred to as north Brazil and south Brazil. North Brazil plants chiefly in April to June and harvests chiefly in August to January. South Brazil plants chiefly in September to November and harvests chiefly in March to June. At the beginning of the decade of the '30s, south Brazil grew only a very small portion of the total output of the country, but it subsequently increased its production very rapidly. The chief stimulus to this expansion was the fact that world prices of cotton were prevented by United States Government cotton programs from declining to a parity with prices of other agricultural products, while prices of coffee, the chief crop of south Brazil, fell to very low levels notwithstanding the efforts of the Brazilian Government to sustain market values of that commodity. At the end of the decade, south Brazil was producing roughly two-thirds of the greatly enlarged cotton crop of the entire country. North Brazil also increased its output of the staple during this decade, but by very much less than south Brazil. Brazil as a whole ap-

TABLE IV.—*World Consumption of All Growths of Cotton*
(*New York Cotton Exchange figures*)
(In bales, 000's omitted)

Growth and Season	United States	Great Britain	Continent	Orient	Elsewhere	Total
American Cotton (actual bales, averaging about 490lb. net)						
1928–29	6,778	1,936	4,707	1,535	270	15,226
1929–30	5,803	1,390	4,227	1,397	204	13,021
1930–31	5,084	944	3,440	1,384	204	11,056
1931–32	4,744	1,323	3,556	2,696	209	12,528
1932–33	6,004	1,365	4,079	2,701	236	14,385
1933–34	5,553	1,403	4,230	2,321	273	13,780
1934–35	5,241	941	2,739	2,032	253	11,206
1935–36	6,221	1,295	2,963	1,757	267	12,503
1936–37	7,768	1,150	2,446	1,420	309	13,093
1937–38	5,616	1,144	2,494	1,322	294	10,870
1938–39	6,736	986	2,164	1,097	298	11,281
Indian Cotton (actual bales, averaging about 400lb. net)						
1928–29	35	205	1,294	3,984	Negligible; included in Orient	5,518
1929–30	61	225	1,556	4,722		6,564
1930–31	42	248	1,305	4,488		6,083
1931–32	22	201	734	3,902		4,859
1932–33	16	168	624	3,516		4,324
1933–34	15	283	848	3,879		5,025
1934–35	23	398	1,086	4,809		6,316
1935–36	55	466	1,037	4,695		6,253
1936–37	77	570	1,009	4,927		6,583
1937–38	61	386	771	4,938		6,156
1938–39	50	481	818	4,789		6,138
Egyptian Cotton (actual bales, averaging about 730lb. net)						
1928–29	155	364	416	43	18	996
1929–30	137	307	430	58	18	950
1930–31	70	246	435	96	17	864
1931–32	53	315	498	120	22	1,008
1932–33	59	302	422	97	38	918
1933–34	69	388	540	109	44	1,150
1934–35	55	368	522	177	46	1,168
1935–36	45	371	556	159	40	1,171
1936–37	52	400	565	207	69	1,293
1937–38	31	347	600	169	74	1,221
1938–39	35	347	606	166	88	1,242
Other Cottons (equiv. bales of 478lb. net)						
1928–29	49	421	1,506	1,856	792	4,624
1929–30	46	550	1,758	2,145	659	5,158
1930–31	39	503	1,915	1,966	774	5,197
1931–32	24	613	2,067	1,473	765	4,942
1932–33	30	433	2,122	2,210	616	5,411
1933–34	30	440	2,289	2,509	786	6,054
1934–35	18	772	2,743	2,834	1,079	7,446
1935–36	18	604	3,493	2,983	1,146	8,244
1936–37	41	823	4,534	3,688	1,222	10,308
1937–38	35	642	5,202	2,862	1,345	10,086
1938–39	29	769	5,700	2,854	1,078	10,430
All Cottons (American in actual bales. Others in equiv. 478lb. bales)						
1928–29	7,091	3,074	7,881	6,643	1,089	25,778
1929–30	6,106	2,587	7,884	7,408	890	24,875
1930–31	5,263	2,019	7,060	7,086	1,004	22,432
1931–32	4,866	2,576	6,968	7,472	1,007	22,889
1932–33	6,137	2,392	7,342	7,870	910	24,651
1933–34	5,700	2,659	8,017	8,100	1,126	25,602
1934–35	5,361	2,591	7,144	8,982	1,402	25,480
1935–36	6,351	2,836	8,130	8,738	1,474	27,529
1936–37	7,950	3,037	8,648	9,363	1,636	30,634
1937–38	5,748	2,625	9,229	8,392	1,752	27,746
1938–39	6,858	2,670	9,444	8,036	1,510	28,518

Note: Totals for all cottons do not equal sums of detail figures for American, Indian, Egyptian, and other cottons, because of differences in bale weights.

proximately quadrupled its output during the decade, raising its annual crop from about 500,000 to about 2,000,000 equivalent 478lb. bales. The State of Sao Paulo took the leadership in the growing of the staple, and at the end of the decade it produced more than all other States combined.

Cotton grown in north Brazil is of three varieties, called Mattas, Sertao and Serido. Mattas cotton averages about $\frac{29}{32}$in., Sertao about 1in., and Serido about $1\frac{3}{16}$ inches. Cotton grown in south Brazil averages about one full inch. Since Serido cotton constitutes only about 5%, or less, of the total production of Brazil, fully 95% of the total output of that country consists of cotton averaging around $\frac{29}{32}$ in. to one full inch, and such cotton is directly competitive with the bulk of the cotton grown in the United States. Brazil consumes only about 35% to 40% of the cotton that it produces, and so exports 60% to 65%. In recent seasons (late '30s) its exports have gone chiefly to Great Britain, Germany, Japan and China, but numerous other countries have taken smaller quantities. Since south Brazil, from which section the greater portion of the exports move, harvests its crop chiefly in the second quarter of the calendar year, Brazilian cotton enters the world market largely at the time of the year when American cotton is not being offered in volume.

Chinese and Russian Crops.—The cotton crops of China and the U.S.S.R. are normally much larger than those of Egypt and Brazil, but they are here treated more briefly because they enter (1940) world commerce to a far less degree. China has never exported more than a few hundred thousand equivalent 478-lb. bales in any one season, and the U.S.S.R. has in most seasons exported only negligible quantities. Furthermore, Chinese growers use a large portion of the cotton that they raise for hand-spinning, padding clothing, and other household uses. Consequently most Russian cotton and a large portion of Chinese cotton do not compete directly with other growths. However, there is a large degree of actual or potential indirect competition between these cottons and other cottons. This is shown by the facts that the quantity of cotton that China imports is largely determined by the quantity of cotton that it produces, and the U.S.S.R. imported substantial quantities of cotton in years before it increased its output to a level equal to its domestic requirements.

Since both China and the U.S.S.R. are northern hemisphere countries, they both plant cotton in the early months of the calendar year and harvest it in the late months. Chinese growers plant in April and May and harvest in August to October. Russian growers plant in April to June and harvest in August to December. There are two principal cotton growing areas in China, a northern area which lies chiefly in the basin of the Yellow river and a southern which lies in the basin of the Yangtze river. The bulk of the cotton grown in China is shorter than $\frac{7}{8}$in., some being only $\frac{1}{2}$in. or less. Some of it is of a harsh, rough character, this being used largely in mixture with wool in the manufacture of blankets. The cotton growing regions of the U.S.S.R. are Kazakstan in Central Asia, Transcaucasia, and the southern portion of European Russia. It is understood that most Russian cotton is in the length range from about $\frac{7}{8}$in. to $1\frac{1}{32}$ inches.

During the latter half of the decade of the '30s the total growth of cotton in China reached an estimated peak of about 3,900,000 equivalent 478-lb. bales, but the commercial crop of the country reached only about 3,000,000 bales. Subsequently, during the Sino-Japanese war, production declined to less than half of the peak output. In the same period Russian crops ranged from about 3,400,000 to about 3,800,000 equivalent 478-lb. bales.

Other Crops.—There remain to be considered the nine crops which are usually in the range from 150,000 to 400,000 equivalent 478-lb. bales and the approximately 45 crops which are usually less than 100,000 equivalent 478-lb. bales. These crops are of different types, and they come to market at different times of the year.

The Peruvian crop is of special interest for several reasons. Peru grows practically all of its cotton in mountain river valleys, by irrigation. The cotton plants make satisfactory yields for two or three years. Yields per acre are exceptionally high, running in line with those obtained in Egypt. Because of differences in the incidence of the seasons from region to region, planting and harvesting are spread out over most of the year. Cotton is raised chiefly on large plantations, many of them being 2,000 to 4,000ac., and a few as large as 7,500 to 10,000 acres. About 85% of the cotton grown in Peru is of the variety known as Tanguis, which averages about $1\frac{3}{16}$ inches. About 7% is Pima, which averages about $1\frac{1}{2}$ inch. The small remaining portion consists partly of American type long staple cotton and partly of moderately rough native varieties, these cottons being mostly in the range from $1\frac{1}{8}$in. to $1\frac{3}{16}$ inches. Peruvian cotton is noted for its whiteness, and is usually of high grade. Because of its length and other desirable qualities it is one of the best cottons grown. Peru exports approximately 90% of its crop.

Argentina, being a southern hemisphere country, plants cotton in September to November and harvests in March to July. Due to variations in weather conditions, yields per acre and, hence, total production in Argentina are subject to wide fluctuations. Most Argentine cotton is of about one full inch staple. Argentina consumes roughly half of what it produces in good years, and exports the balance. Mexico, being situated immediately south of the United States, plants and harvests its crop at about the same times as the southernmost portion of the United States. Its planting period is from February to April and its harvesting period from August to November. Most Mexican cotton is in the length range from $\frac{7}{8}$in. to $1\frac{1}{32}$ inches. Mexican mills consume the bulk of the crop, but in some seasons about one-third of it is exported. The Anglo-Egyptian Sudan plants in the months from May to September and harvests from November to May. The bulk of the cotton grown in the Sudan is of around $1\frac{5}{8}$in. staple, and hence it ranks among the long staple cottons of the world. The Sudan exports all cotton that it produces. Uganda plants from April to September and harvests from December to May. The greater portion of the crop of Uganda is of medium length, and the balance is long staple. Uganda exports all of its cotton.

Since Turkey, Iran and Chosen are in the northern hemisphere they plant in the months from February to May and harvest in the months from July to November. In the Belgian Congo, the northern crop is planted in May and June and harvested in December to March, but the southern crop is planted in November and December and harvested from June to September. These countries grow medium or short staple cottons. Turkey, Iran and Chosen consume a large portion of their output, but the Belgian Congo exports all that it produces.

The approximately 45 countries of the world which produce less than 100,000 equivalent 478-lb. bales each are scattered over the five continents and adjoining islands. Small cotton growing areas in North America and adjacent islands include Salvador, Nicaragua, Haiti and the British West Indies. In South America there are Colombia, Venezuela, Ecuador and Paraguay. In Europe there are Spain, Italy, Greece, Bulgaria, Yugoslavia and Rumania. In Asia cotton is grown in relatively small volume in Syria, Iraq, Cyprus, Burma, Siam, French Indo-China, Dutch East Indies and Manchoukuo. In Africa it is grown in French West Africa, Togoland, Nigeria, French Equatorial Africa, Kenya, Tanganyika, Angola, Nyasaland, Portuguese East Africa and the Union of South Africa. Australia also contributes a small crop. Some of these smaller producing countries consume all that they raise, but most of them export most or all of their output.

Supply and Distribution.—The most fundamental facts as to the statistical situation in any growth of cotton in any given season are: (*a*) The total stock of that cotton in all hands and in all positions in the world at the beginning of the season, this being termed the "carry-over"; (*b*) The new crop produced in the season; (*c*) The total supply for the season, this consisting of the carry-over at the beginning of the season plus the new crop; (*d*) The world consumption of the cotton in question during the season; and (*e*) The total quantity of that cotton left in all hands and in all positions in the world at the end of the season, this obviously equalling the total supply for the season less the consumption during the season and constituting the carry-over into the next season.

Such calculations are commonly made for American cotton, Indian cotton, Egyptian cotton, other cottons in the aggregate, and all cottons combined. The 12 months from August 1 in one year to July 31 in the next constitute the period which is commonly accepted as the cotton season for statistics for American cotton, and it is used also for statistics for all cottons in the aggregate. For statistics for various non-American cottons, other 12-month periods are commonly taken as constituting the cotton season, but when the statistics for such other cottons are combined with those for American cotton to arrive at statistics for all cottons in the aggregate the statistics for the other cottons are adjusted to the August 1–July 31 season basis.

All who are interested in cotton watch closely the changes in the statistical situation of American and non-American cottons, with respect to the basic facts just stated, because they have found by experience that there is a relationship between the changes in these facts and the changes in the price level of the staple. The changes in prices of cotton cannot be correlated with the changes in the statistical situation of the staple with mathematical precision, for various reasons, but, broadly speaking, and subject to the absence of other factors of an offsetting character, the price of cotton rises when the supply for a season is found to be small relative to the consumption, and it declines when the reverse is the case. One offsetting factor which may prevent a correlation between the price and the supply-consumption ratio is a change in the buying power of money as reflected in a change in the commodity price level. Another factor—one which was operative during much of the decade of the '30s—may be the diversion of American cotton from commercial channels to United States Government loan stocks, or the releasing of such cotton from those stocks. The diversion and the release of such cotton have temporary effects on price levels of the staple, but they do not change the average, long-term price level.

The cotton trade follows not only the basic statistics for carryover, new production, total supply and consumption, but also numerous other series of statistics which point the way to changes in the fundamental facts of supply and distribution. To some degree—although less than in former times—traders watch weekly statistics on what is termed the "movement into sight" of American cotton. The figures for movement into sight constitute a rough measure of the marketing of cotton by the growers and other first hands. Weekly figures on forwardings of American cotton to domestic and foreign mills and on exports by the United States command widespread interest, as rough measures of the takings of the American staple by domestic and foreign spinners and foreign importers. Statistical records available at weekly intervals for non-American cottons are not so comprehensive as those for the American staple, but they throw light on the trends of production, consumption and stocks.

At monthly intervals during the summer and fall the U.S. Department of Agriculture issues certain cotton statistical reports which command widespread interest not only throughout the cotton trade of the world but also throughout general commercial channels in the United States and abroad. These reports contain estimates of the acreage and forecasts of the production of cotton in the United States. Reports containing estimates of acreage are issued on or about the eighth of July, September and December. Reports containing forecasts of production are issued on or about the eighth of each month from August to December inclusive. These reports often cause changes in world prices of cotton, because of the predominating importance of the American crop in world production of cotton, the substantial changes often occurring in the United States cotton acreage from year to year and in the American cotton crop prospect from month to month during the growing season, and the high degree of confidence of the world cotton trade in the soundness and integrity of the crop reporting work of the U.S. Department of Agriculture. Periodical estimates for cotton crops of other countries are issued by the various governments, but they are not the subject of such general interest as those issued by the United States Government for the American crop, largely because of the smaller size of the crops of other countries but in some cases because of the unreliability of their estimates.

The world cotton trade is undoubtedly better supplied with dependable statistics than many other important commodity trades. The New York Cotton Exchange, on which there is conducted the leading futures market for American cotton, compiles and publishes comprehensive statistical reports on all the basic phases of supply and distribution of American and foreign cottons. It is the only organization which does such a comprehensive statistical

TABLE V.—*Supply and Distribution of Cotton in the World*
(*New York Cotton Exchange figures*)

American Cotton
(Actual bales, 000's omitted)

Season	Carry-over at beginning of season	Production			Total supply	Consumption	Destroyed	Carry-over at end of season
		Ginnings	City crop	Total				
1928–29	5,206	14,295	260	14,555	19,761	15,226	18	4,517
1929–30	4,517	14,540	176	14,716	19,233	13,021	25	6,187
1930–31	6,187	13,685	188	13,873	20,060	11,056	28	8,976
1931–32	8,976	16,693	184	16,877	25,853	12,528	62	13,263
1932–33	13,263	12,810	151	12,961	26,224	14,385	30	11,809
1933–34	11,809	12,593	119	12,712	24,521	13,780	40	10,701
1934–35	10,701	9,466	110	9,576	20,277	11,206	30	9,041
1935–36	9,041	10,367	128	10,495	19,536	12,503	35	6,998
1936–37	6,998	12,243	132	12,375	19,373	13,093	45	6,235
1937–38	6,235	18,267	145	18,412	24,647	10,870	65	13,712
1938–39	13,712	11,602	63	11,665	25,377	11,281	66	14,030

Other Cottons
(Equivalent 478-lb. bales, 000's omitted)

Season	Carryover August 1	Production	Total supply	Consumption	Carryover July 31
1928–29	5,329	11,247	16,576	10,552	6,024
1929–30	6,024	11,535	17,559	11,854	5,705
1930–31	5,705	11,503	17,208	11,376	5,832
1931–32	5,832	9,602	15,434	10,361	5,073
1932–33	5,073	10,500	15,573	10,266	5,307
1933–34	5,307	13,354	18,661	11,822	6,839
1934–35	6,839	13,466	20,305	14,274	6,031
1935–36	6,031	15,646	21,677	15,026	6,651
1936–37	6,651	18,421	25,072	17,541	7,531
1937–38	7,531	18,372	25,903	*16,976	8,927
1938–39	8,927	15,742	24,669	17,237	7,432

*Includes 100,000 bales of cotton destroyed in China.

All Cottons
(American in actual bales. Others in Equivalent 478-lb. bales, 000's omitted)

Season	Carryover August 1	Production	Total supply	Consumption	Destroyed	Carryover July 31
1928–29	10,535	25,802	36,337	25,778	18	10,541
1929–30	10,541	26,251	36,792	24,875	25	11,892
1930–31	11,892	25,376	37,268	22,432	28	14,808
1931–32	14,808	26,479	41,287	22,889	62	18,336
1932–33	18,336	23,461	41,797	24,651	30	17,116
1933–34	17,116	26,066	43,182	25,602	40	17,540
1934–35	17,540	23,042	40,582	25,480	30	15,072
1935–36	15,072	26,141	41,213	27,529	35	13,649
1936–37	13,649	30,796	44,445	30,634	45	13,766
1937–38	13,766	36,784	50,550	27,746	165	22,639
1938–39	22,639	27,407	50,046	28,518	66	21,462

work for all growths of cotton in the world, and its statistics are accepted and republished by the United States Government. Statistics on these subjects in the accompanying tables are from that source. The International Federation of Master Cotton Spinners' and Manufacturers' Associations, with headquarters at Manchester, England, has for many years done a highly important work in the collection of statistics on world consumption and world mill stocks of American and foreign cottons, but the Federation's reports do not cover production nor stocks outside of mills. The New Orleans Cotton Exchange has for years issued statistical reports for American cotton. The Department of Agriculture of the United States, as already indicated, issues vitally important reports during the domestic crop growing season on the acreage and production of cotton in that country, and the Department of Commerce of the United States issues monthly reports on domestic consumption and domestic mill and warehouse stocks. Various cotton trade organizations abroad, notably the cotton exchanges at Liverpool, England; Alexandria, Egypt and Bombay, India, and many foreign governments issue important reports relating to the cotton trade in the countries in which they are located.

TABLE VI.—*Production of Commercial Cotton in the Smaller Producing Countries* (*New York Cotton Exchange figures*)
(In Equivalent Bales of 478lb. Net Weight)

	1925–26	1926–27	1927–28	1928–29	1929–30	1930–31	1931–32	1932–33	1933–34	1934–35	1935–36	1936–37	1937–38	1938–39
NORTH AMERICA:														
Mexico*	176,476	266,882	156,238	226,460	207,029	162,506	189,226	101,537	257,000	255,000	302,000	343,000	298,000	240,000
Salvador	200	200	189	217	216	200	314	314	2,000	2,140	3,138	4,184	4,811	6,237
Nicaragua	2,000	100	...	100	...	...	...	...	500	988	2,163	6,540	5,343	5,549
Haiti	23,035	22,604	20,419	21,929	23,635	19,244	29,095	26,965	24,453	27,238	25,371	23,773	20,643	17,550
Puerto Rico	2,972	1,622	1,296	1,413	2,846	3,713	637	724	...	...	272	546	581	523
Br. West Indies	3,503	4,972	5,085	3,421	4,500	4,746	4,273	2,112	2,187	4,061	4,951	4,270	4,488	3,700
Other N. America	2,200	600	285	104	116	770	200	200	...	350	474	998	1,382	1,338
SOUTH AMERICA:														
Colombia	15,912	24,906	11,207	9,501	10,000	10,000	12,783	9,916	5,535	13,836	11,530	19,173	23,268	16,736
Venezuela	32,000	32,000	32,000	36,380	10,000	10,000	10,000	12,000	10,000	12,105	14,113	12,105	13,375	11,992
Ecuador	6,100	6,340	4,556	5,097	6,788	9,414	4,740	3,887	8,160	8,156	12,983	13,192	14,339	18,523
Peru	204,000	268,000	246,000	216,000	239,000	292,000	215,000	232,000	301,000	364,194	396,086	400,698	393,691	396,712
Paraguay	11,481	8,485	15,000	12,604	16,744	18,449	15,787	14,000	41,000	42,969	49,734	57,364	44,623	27,672
Argentina	135,352	57,767	114,934	118,486	150,420	138,599	169,201	149,945	199,969	295,352	373,385	143,760	237,272	304,402
Other S. America	100	100	100	100	100	100	100	100	50	75	51	37	67	69
EUROPE:														
Spain	1,108	3,344	2,553	3,189	4,677	7,431	3,668	5,330	4,200	9,000	11,213	9,072	11,306	9,340
Italy	4,500	4,500	4,500	4,500	3,300	4,433	1,401	1,121	1,183	4,378	3,717	9,858	19,508	43,770
Greece	14,609	17,759	12,571	14,875	15,264	16,149	14,097	22,716	44,200	51,901	67,797	72,706	93,645	71,488
Yugoslavia	580	385	190	218	585	622	342	542	500	710	966	2,008	3,174	4,910
Bulgaria	2,068	2,309	3,457	3,214	4,180	3,751	4,144	6,005	11,046	19,219	38,843	30,786	41,154	32,036
Rumania	28	28	28	28	28	18	31	285	470	282	519	1,176	1,978	2,811
Other Europe	654	424	286	453	317	245	168	34	34	26	27	23	22	25
ASIA:														
Turkey	105,172	97,000	53,831	113,255	100,433	73,970	90,762	83,746	127,710	162,130	202,934	221,382	230,607	221,382
Cyprus	2,778	3,861	1,766	1,796	2,946	3,948	2,397	936	1,200	1,734	4,364	2,505	3,908	1,821
Syria and Lebanon	13,421	8,117	9,582	4,312	14,000	12,397	17,008	5,277	4,262	10,147	25,136	19,602	36,298	35,975
Iraq	2,126	2,929	1,506	4,351	3,933	2,762	803	342	2,800	1,697	3,686	7,923	17,060	12,889
Persia (Iran)	98,200	90,600	85,000	120,000	82,000	98,700	105,503	71,576	148,000	169,000	127,000	147,000	160,000	128,000
Ceylon	218	156	169	318	208	79	39	28	86	110	241	323	312	197
Burma	†	†	†	†	†	†	†	†	†	†	†	†	108,000	80,000
Siam	4,624	2,747	2,885	2,756	3,206	3,823	2,737	2,500	2,500	3,944	5,996	7,379	10,014	4,693
Fr. Indo-China	5,667	3,285	5,067	6,181	8,109	6,452	5,092	6,685	5,797	4,243	6,457	6,500	9,395	11,530
Du. East Indies	5,469	4,388	5,315	4,262	4,105	3,874	5,537	2,907	5,649	7,103	6,471	11,410	8,500	6,000
Chosen	123,214	142,694	133,238	149,878	138,942	149,372	100,707	135,026	139,339	136,839	189,137	117,485	212,814	187,083
Japan	1,561	1,123	1,100	943	724	678	588	583	814	760	812	994	994	1,000
Other Asia	200	200	200	200	200	200	200	200	...	...	...	...	...	...
AFRICA:														
Morocco	415	738	369	323	369	300	300	300	100	23	189	40	86	257
Fr. West Africa	38,220	27,323	28,884	53,417	63,294	24,505	18,241	19,121	13,836	13,795	16,244	18,369	22,537	17,106
Gold Coast	1,019	238	221	248	167	249	220	57	121	122	47	47	50	50
Togoland	5,677	7,661	7,084	9,432	8,805	6,547	5,916	4,782	5,000	7,203	7,106	7,656	8,482	7,384
Nigeria	40,091	22,982	17,515	26,884	36,757	15,774	5,245	20,390	23,608	49,248	50,371	39,752	26,436	17,862
Ang.-Egypt. Sudan	101,365	123,948	105,536	135,177	132,024	100,678	196,623	114,966	131,904	227,781	207,862	278,526	277,648	277,000
Eritrea	1,845	2,767	1,384	1,061	1,245	1,706	1,061	784	872	1,207	1,000	1,384	1,300	1,200
It. Somaliland	2,537	2,767	3,828	5,809	5,083	3,459	5,435	5,000	2,174	3,100	2,767	1,384	1,500	1,500
Fr. Equat. Africa	1,000	750	692	830	3,573	5,535	5,904	13,000	20,708	28,692	30,929	39,452	45,522	48,427
Belgian Congo	16,142	22,539	27,557	30,867	33,906	66,986	40,000	67,398	88,760	102,472	121,198	158,481	180,999	175,013
Uganda	151,346	110,233	115,888	170,759	108,761	160,088	170,096	246,718	239,319	211,918	275,344	283,173	336,569	252,823
Kenya	1,712	1,031	1,038	1,660	1,270	617	1,452	3,579	5,649	7,341	13,085	19,184	15,479	8,400
Tanganyika	18,179	20,318	13,361	27,577	23,251	19,360	9,499	15,095	25,803	32,644	48,994	52,831	53,983	41,570
Angola	3,842	2,011	1,992	3,670	3,597	3,623	2,643	2,578	4,044	4,148	5,326	10,272	12,729	17,950
Rhodesia, So.	6,116	562	89	234	1,253	1,652	485	297	297	577	474	276	444	283
Nyasaland	6,459	4,164	2,336	3,741	5,100	7,808	3,519	4,240	4,972	8,674	17,142	11,130	9,684	11,700
Port. East Africa	2,230	11,952	11,956	10,221	9,110	6,844	8,265	8,000	8,600	8,567	12,637	21,296	37,088	43,000
Union So. Africa	17,055	8,571	9,216	8,179	13,567	6,797	2,344	1,556	2,042	2,483	1,659	2,843	983	492
Other Africa	5,583	8,039	3,401	6,288	7,950	5,453	1,449	280	21	50	111	262	434	259
AUSTRALIA, ETC.:														
Australia	6,008	4,921	8,591	5,269	11,714	10,232	4,163	11,635	18,346	14,774	13,921	8,607	9,987	12,025
Other Australia	4,511	2,646	2,677	1,769	1,913	2,708	961	297	33	185	136	80	144	146
Total	1,432,880	1,466,588	1,294,168	1,589,956	1,531,260	1,509,566	1,490,401	1,439,612	1,947,853	2,334,691	2,718,109	2,652,817	3,072,656	2,840,400

*Exclusive of minor exports to United States, which counted in United States production. †Included in India.

C. MARKETING, EXCHANGES, FUTURES, ETC.

There are literally millions of growers of cotton in the various cotton producing countries of the world—over 2,000,000 in the United States alone. There are several thousand mills which consume the staple. Many mills—notably those in the south-eastern section of the United States and many in India and China—are located in cotton growing areas and manufacture such types of goods that they can utilize locally produced cotton. Others are either located thousands of miles from cotton fields or they manufacture such types of goods that they must look to cotton growing areas thousands of miles away for their raw material. For economical transportation, the bulky, loosely packed bales in which the cotton is put up initially in many producing areas have to be recompressed into smaller, tightly packed bales before they are shipped great distances. Most cotton growers sell in lots ranging from one, two, or three bales up to 10 to 15 bales. Spinners usually buy in quantities ranging from 100 bales up to several thousand bales. Growers generally sell their cotton in lots consisting of bales of various qualities. Spinners generally buy cotton only in lots in which the bales are of uniform quality.

Since cotton is an annually produced agricultural product, the crop from any producing area is harvested within a few months each year, but the consumption of it is spread over the full year. The result is that millions of bales of cotton have to be stored, insured and financed for long periods of time, ranging from a few months up to a year or more. Growers receive payment for their cotton in the currencies of the countries in which they produce the cotton, but, in the case of that great quantity of cotton which annually moves in international trade, the spinners pay for the cotton which they buy in the currencies of the countries in which they operate their mills. The exchange values of the various currencies are subject to great fluctuations. Prices of cotton are subject to large variations, sometimes rising or falling 10% to 15% within one or two days. In consequence, holders of cotton have to assume large risks of loss on their holdings, unless they operate in such a manner that they avoid or minimize those risks.

It will be readily seen from the foregoing that the handling of the world cotton crops is a great undertaking, calling for participation by many different kinds of operators and many different interests, performing many types of services, and providing many different forms of facilities. Thousands of compresses are required to pack the bales, and thousands of warehouses are utilized for the storage of them. Railroads, trucks, river boats and ocean steamships are called upon to move this great product. Countless banks participate in financing it, and countless insurance companies join in the insurance of it against loss by fire and other hazards. There is of necessity an army of dealers in cotton, including local operators in small country markets, domestic shippers who buy from growers or other first hands and sell to spinners in the producing countries, exporters in producing countries, importers in consuming countries, great international firms which do a world-wide business, brokers, and buying and selling agents who operate on a commission basis. There are a number of highly organized exchanges on which cotton is sold and bought for future delivery, primarily for the transference of the price risks which are inherent in merchandising cotton, rather than for disposing of or acquiring the staple.

The cotton markets of the world are of two classes, "spot markets" and "futures markets." These two kinds of markets are very different in character and purpose.

Spot markets are centres in which cotton is sold and bought primarily for the purpose of moving it along the road from producers to consumers. The spot markets consist of country markets and central markets in producing countries and importing and mill markets in consuming countries. In those markets growers sell to dispose of the cotton that they produce, dealers buy and sell as intermediate distributors of cotton, and spinners buy to acquire cotton for consumption. Purchase and sale contracts made in spot markets are normally fulfilled by deliveries of cotton against them. The contracts made include commitments for immediate delivery and commitments for forward delivery, and they contain whatever specifications the buyers and sellers may agree upon.

Futures markets are centres in which cotton is sold and bought primarily for the purpose of transferring price risks, rather than for merchandising the staple. Handlers of cotton—including growers' co-operative associations and the larger individual growers, domestic shippers, exporters, importers and spinners—trade in the futures markets to free themselves of price risks on cotton bought or sold in spot markets, and speculative traders, within or outside of the industry, buy and sell in the futures markets to assume price risks. Producers do not as a rule look to the futures markets for outlets for their crops, and spinners do not as a rule look to those markets for cotton for consumption. All of the contracts made on the futures markets call for future deliveries, and hence those contracts are called "futures." All futures contracts for any given growth or variety of any growth carry identical terms except as to the price and month of delivery. Hence contracts of sale may be offset by contracts of purchase, and vice versa, and most futures contracts are liquidated in that manner, rather than by actual deliveries.

Among the leading spot markets of the world are Dallas, Tex., Houston, Tex., Memphis, Tenn. and New Orleans, La., for American cotton in the United States; Alexandria, for Egyptian cotton in Egypt; Bombay and Karachi, for Indian cotton in India; Shanghai, for Chinese and other cottons in China; Osaka, for various growths of cotton in Japan; Sao Paulo, for Brazilian cotton in Brazil; Liverpool, England, Le Havre, France, Bremen, Germany, and Milan, Italy, for various growths of cotton in Europe. There are thousands of other spot markets, including the large number of small country markets in the producing countries and the many importing and mill markets in consuming countries.

The principal futures markets of the world are on the New York Cotton Exchange, the New Orleans Cotton Exchange, the Liverpool Cotton Exchange, the Bombay Cotton Exchange and the Alexandria Cotton Exchange. On the exchanges at New York and New Orleans the futures trading is in American cotton only. On the Liverpool exchange there is futures trading in American, Egyptian, and Empire and miscellaneous cottons. On the Alexandria exchange the trading is in Egyptian cotton only, and on the Bombay exchange the trading is in Indian cotton only. There are a number of smaller cotton futures markets, including one at Chicago for American cotton, at Sao Paulo for Brazilian cotton, at Buenos Aires for Argentine cotton, at Le Havre for American cotton, and at Bremen for American cotton. The New York Cotton Exchange is recognized as the leading cotton futures market of the world, since it is the chief futures market for American cotton, which is the principal growth of the staple.

The classification of cotton is a highly important phase of cotton merchandising, for differences in staple length, amount of foreign matter, colour, and other physical properties greatly affect its spinning utility. The poorest quality of cotton of any given variety may be worth less than half as much as the best quality of that variety. Consequently, every bale of cotton has to be put into its own quality category.

In the cotton trade the term "grade" means a given classification of cotton from the standpoint of foreign matter and colour; it does not cover length of staple, strength, or other characteristics. For American cotton there are nine grade classifications for white cotton, these being, in order from highest to lowest, middling fair, strict good middling, good middling, strict middling, middling, strict low middling, low middling, strict good ordinary, and good ordinary. American cotton of a colour other than white, such as extra white, blue stained, gray, spotted, yellow tinged, light yellow stained or yellow stained, is graded into classifications carrying the same names, but the range of grade classifications for cotton of colours off white is not so broad as that for white cotton. Non-American growths of cotton are similarly classified for grade, but the grade classifications of other growths and the names of such classifications are different from those for American cotton.

The subject of the merchandising of cotton in general covers such a large and varied field that the remainder of this discussion must be limited to American cotton. However, the merchandising system, methods, and practices for American cotton are largely representative of those for other growths, and, hence, the following outline indicates in a general way how the cotton trade of the world as a whole is conducted.

THE MARKETING OF THE AMERICAN COTTON CROP

Trading in Country Markets.—In its movement from farms to mills, the bulk of the American cotton crop passes first through country markets. To those markets the great majority of the growers take their cotton, and there they sell it to various classes of buyers.

Most growers over the larger part of the belt have their cotton ginned before they sell it, and hence they offer the lint cotton and the cotton-seed separately in the country markets. Many in north-western Texas and in Oklahoma, however, sell their cotton unginned, and, hence, they sell the lint and the seed together. Growers who pursue the common practice of having their cotton ginned before they sell it generally put their bales in warehouses or in cotton yards in the country markets, have the bales sampled there, and then offer the cotton in those markets by submitting samples to the prospective buyers. A substantial percentage of the growers, however, still follow the old-time practice of taking their bales into the market places in the country towns on their wagons, and offer them to street buyers who draw samples from the bales as the bales lie on the wagons. There are various classes of buyers in the country markets. Generally over the belt, the country market buyers include local men who either buy and sell cotton as a side-line to other business or who make a specialty of it, country storekeepers who buy cotton from farmer customers in order to collect from them money which the latter owe for goods bought by them on credit, resident or travelling buyers of large merchants in central markets, and receiving agents of co-operative associations. In the eastern belt markets, there are also resident or travelling buyers for mills, and in western belt markets there are also ginner buyers.

Growers generally desire to sell their cotton, or at least a good part of it, when they harvest it or very soon afterward. In years when it appears that prices will advance, some growers hold part or all of their crops for expected higher prices, but such growers always constitute a minority. A large percentage of the growers have no choice with reference to when they will sell, for they are obliged to sell at harvest time to pay off loans which mature at that time. They are forced to negotiate during the growing season to meet living expenses and production costs. The growers obtain most of such credit from Government sources, the country banks, and the country merchants. For the most part, the growers sell their cotton in nearby country markets, usually not over a few miles away. They demand and obtain immediate payment for their cotton on selling it.

While there are numerous classes of buyers in the country markets, operating in different ways, it may be broadly said that perhaps three-fourths of that portion of the crop which passes through the country markets is taken by local dealers. The term "local dealers" is here used to mean operators who buy cotton from the growers in the country markets and sell the cotton locally. These operators sell on the spot to the local buyers of the larger merchants who are in the central markets or to local mills, or they sell by long-distance communication to a limited number of distant merchants, or, possibly even to a few distant spinners with whom they have special contacts. The local dealers in the country markets do not generally hold cotton very long. Generally they sell toward the end of each day all cotton bought earlier in the day. However, when the prevailing market sentiment is bullish, the dealers may hold considerable cotton, for varying lengths of time.

Buyers in country markets buy cotton in three ways, known respectively as individual bale buying, hog-round buying, and basis middling buying. In individual bale buying, the buyer and the seller agree on a price per pound for each individual bale, the buyer usually ascertaining the quality of each bale by examining a sample from it and setting his price accordingly. In hog-round buying, the buyer agrees with the seller on only one price per pound, this being the average price applying to the entire lot; the buyer ordinarily arrives at this average price by inspecting samples from the bales offered, to determine the quality of each bale, and by computing for his own guidance the price that he will pay for each bale. In basis middling buying, the buyer agrees with the seller on a basic price for middling ⅞in. cotton, premiums for grades better than middling and for staples longer than ⅞in., and discounts for poorer grades and shorter staples. When a buyer purchases cotton on basis middling terms, he does not class the cotton before he buys it, but arranges with the seller for the classing of it later, and he agrees with the seller that the ultimate settlement is to be determined on the basis of such later classing.

Shippers and Their Operations.—The bulk of the American crop—perhaps 80% of it—normally passes from the growers and the first hands in the country markets to a class of operators known as shippers. That portion of the crop which is not handled by the shippers is bought from the growers or other first hands by mills in the cotton growing areas or is handled by the cotton growers' co-operative associations. Most of the shippers have their head offices in the larger interior markets or in the port markets. They are generally organized as unincorporated, partnership firms, and there are roughly 300 such firms.

The shippers are the domestic and international merchants of the United States cotton trade, and they render the broad merchandising services required for the distribution of American cotton to domestic and foreign mills. They buy cotton in lots of mixed qualities from growers and country dealers, classify the cotton in those mixed lots and put it up in lots of uniform qualities, and sell the cotton in even-running lots to domestic spinners, foreign importers, and foreign spinners. They compress the relatively large, loosely packed country bales into smaller, tightly packed bales for economical transportation, and have the cotton moved over land and over seas to points specified by those to whom they sell. They solicit sales of American cotton in foreign markets in competition with those who offer foreign growths. They carry millions of bales of American cotton—storing, financing, and insuring it—from the time when growers and other first hands sell it to the time when domestic and foreign spinners and foreign importers will buy it. They make forward sales to spinners and foreign importers, often for periodical deliveries running a year or more ahead and from crops not grown when the sales are made. As will be seen later, the shippers utilize the futures markets extensively to protect themselves from losses arising from adverse price changes on unsold cotton which they carry in stock and on uncovered forward commitments.

Shipping firms differ greatly in scope of operations, form of organization, and volume of business. The very large firms buy all over the belt and sell in all parts of the world where American cotton is used. Moderate-sized firms generally buy in only certain sections of the belt—perhaps three or four States—and while they may endeavour to sell in all or most of the principal cotton consuming countries they do the bulk of their business in certain sections of the world spinning industry, such as the United States, Great Britain, certain countries of the Continent, or the Orient. Small firms usually buy in only very limited territories, some of them only within a radius of 100 to 200mi., and they sell only to domestic mills or to buyers in only one or two foreign markets. The annual volume of business per shipping firm ranges all the way from perhaps 5,000 bales or less to 1,000,000 to 2,000,000 bales or more. One cotton shipping firm has been known to turn over approximately 3,000,000 bales in one season, but that was in the days before the United States reduced its output.

Selling in Domestic Mill Markets and Foreign Markets.—The shippers sell cotton to domestic mills chiefly through independent brokers or through their own selling agencies in the mill markets. The brokers sell cotton for the shippers on a commission basis. Some of them also buy some cotton from growers and local dealers in nearby towns and sell such cotton to the mills on their own account. The selling agencies for some of the large shippers operate more or less as independent shipping organizations, buying cotton in country markets in the territories in which they operate and selling such cotton to the mills. In New England mill markets much cotton is handled by local firms which operate as quick-turnover dealers. Such dealers buy cotton from the shippers and sell it to the mills on their own account, but do not carry stocks. In the important domestic mill markets there are selling agencies of the cotton growers' co-operative associations. The manufacturers generally buy cotton at their mill offices.

American cotton is merchandised in foreign markets in several different ways, but these may be summarized briefly. In Liverpool there are three main classes of cotton dealers, namely, c.i.f. agents, importing merchants, or importers, and mill buying brokers. The c.i.f. agents are intermediaries between the exporting shippers in the United States and the buyers in Liverpool, and as such they operate on a commission basis. The importing merchants, except those who have branch offices in the United States, buy American cotton chiefly through the c.i.f. agents, and they sell chiefly to the spinners, operating as principals. The mill buying brokers buy cotton for the spinners, on a commission basis. Some large American shippers have their own affiliated importing organizations in Liverpool. At Le Havre there are c.i.f. agents, importing merchants, local commission merchants, and local brokers. The local commission merchants buy from the importers, chiefly on orders from spinners, for commissions. The local brokers act as intermediaries between the merchants. At Bremen there are c.i.f. agents, local importing merchants, and German importing firms which are affiliated with exporting shippers in the United States. In Milan most American cotton is handled by selling agencies of exporters in the United States. In Osaka a very large portion of the American cotton imported is handled by Japanese firms which have buying agencies in the United States. Most of the rest of it is handled by the selling agencies of large exporting shippers in the United States.

Trading in Futures.—The trading in American cotton in the futures markets—chiefly on the New York Cotton Exchange, the New Orleans Cotton Exchange, and the Liverpool Cotton Exchange—runs parallel with and supplements the trading in the spot markets, as the latter has just been described. The essential function of these futures markets is to provide media through which handlers of American cotton, including shippers in the United States, growers' co-operative associations, foreign importers, and domestic and foreign spinners, may carry stocks of cotton or make commitments for the forward sale of cotton without incurring risks of large losses through adverse price changes. The cotton futures markets are used, also, by handlers of cotton yarns and cotton cloths to obtain similar protection against losses from adverse price changes on stocks and forward sales of such cotton manufactures. By reducing the risks of large losses from price changes, the futures markets make it possible for those who handle cotton and cotton manufactures to operate more economically, as well as more safely, and thus they reduce the margins between the prices received by the growers for their raw cotton and the prices paid by ultimate consumers for cotton goods.

The trading method by which handlers of cotton and cotton manufactures obtain protection from losses arising from adverse price changes through operations in the futures market—a method used in many of the great commodity trades of the world—is called "hedging." The fundamental principle of hedging, in dealings in any commodity, is the establishment of an even or balanced market position by a sale for future delivery on a futures exchange against an unsold holding of the commodity or by a purchase for future delivery on a futures exchange against an uncovered forward sale of the commodity in merchandising channels. Hedging operations in any commodity trade are based on the fact that there is a substantial degree of parallelism between price movements in the futures markets and price movements in the spot markets. There is necessarily this high degree of parallelism between the price movements in the two classes of markets since any great divergence between them would lead traders to buy in the markets of one class and sell in the markets of the other class, and make or call for deliveries against such transactions, and such trading would bring the prices in the two classes of markets back to normal relationship with each other.

If a cotton shipper carries a stock of cotton without having on his books a forward sale of a quantity equal to that stock, he is obviously not in a balanced market position. He runs the risk of incurring a loss on the stock by having to sell it later at a lower price in the event of a decline of market values for cotton. In the absence of an opportunity to sell the cotton advantageously to a spinner or other buyer in a spot market, the shipper achieves a balanced market position by making a sale of an equivalent quantity of cotton for future delivery in a futures market. When he does so, he, in the parlance of the cotton trade, hedges his holding. On the other hand, if a shipper makes a forward sale of cotton to a spinner without having in hand a quantity of cotton equal to the quantity that he sells, he is obviously not in a balanced market position. He runs the risk of incurring loss by having to pay a higher price for the cotton, when he buys it, in consequence of an advance in cotton values, than the spinner agreed to pay him. If, in the absence of an opportunity to buy the cotton advantageously in a spot market, the shipper buys an equivalent quantity in a futures market, for future delivery to himself, it is said that he "hedges" his sale to the spinner.

A shipper who hedges a holding of cotton by making an equivalent sale for future delivery in a futures market does not as a rule deliver his holding on the sale contract in that market. He subsequently sells his holding to a spinner or other buyer in a spot market, and on doing so he buys in the futures market the same quantity as he previously sold there. Since his futures market commitments balance, he neither makes nor receives delivery in the futures market. A shipper who hedges an uncovered forward sale of cotton to a spinner by buying an equivalent quantity of cotton for future delivery to himself in a futures market does not as a rule take delivery on his purchase contract in the futures market. He subsequently buys in a spot market the cotton that he has to deliver to the spinner, and on doing so he sells in the futures market the same quantity as he previously bought there. Since his futures market commitments balance, he neither receives nor makes delivery in the futures market.

In both cases, the transactions in the futures market protect the shipper from large losses arising from broad price movements which are adverse to him with respect to his transactions in the spot markets, for broad price movements which are adverse to the shipper with respect to his transactions in the spot markets are favourable to him with respect to his transactions in the futures market, and hence he derives from his transactions in the futures market profits which approximately offset his losses from his transactions in the spot markets. If the broad price movements are favourable to the shipper with respect to his transactions in the spot market, they are adverse to him with respect to his transactions in the futures market, and under those circumstances the shipper incurs a loss in the futures market which largely offsets his profit in the spot markets, but the shipper who hedges gives up opportunities for large profits in order to avoid the risks of large losses. Broadly speaking, and on an average, the losses incurred by the shipper in one type of market do not fully offset the profits that the shipper realizes in the other type of market. In each transaction the shipper endeavours so to operate that his profits from one market will be greater than his losses from the other market, and if he succeeds in doing this he realizes a net profit. He does this, so far as he can, by buying cotton in the country markets a little lower relative to the price at which he sells in the futures market than he sells cotton to the spinners relative to the price at which he buys in the futures market.

An illustration of a hedging operation by a shipper will make the matter clearer. It may be assumed that in October of a given year a shipper buys a certain lot of cotton in a country market for 10.00 cents a pound. Since, it is assumed, he cannot find a spinner buyer for that cotton immediately, he sells an equal quantity of cotton in a futures market—such as the New York Cotton Exchange—for delivery in the following March, the price in his futures sale contract being 10.50 cents. Thus the shipper buys the cotton for 0.50 cent a pound less than the price that he realizes for the March delivery which he sells in the futures market. The following January, it may be assumed, the shipper finds a spinner who will buy the cotton that he is carrying, but at that time the market price for the cotton is only 8.25 cents. The market price for March deliveries in the futures market, it may be assumed, is 8.00 cents. The shipper sells the cotton to the spinner for 8.25 cents a pound, and on doing so he buys the same quantity of cotton in the futures market for 8.00 cents a pound. Thus the shipper sells the cotton for 0.25 cent a pound more than the price that he pays for the March delivery in the futures market.

The shipper lost 1.75 cents a pound, before costs, on the cotton transactions in the spot markets, since he bought the cotton in the country market for 10.00 cents and he sold it to the spinner for 8.25 cents. If it be assumed that his costs for compressing, transporting, storing, insuring, financing, and handling the cotton totaled 0.60 cent a pound, the shipper lost a total of 2.35 cents a pound on the cotton. However, the shipper realized a profit of 2.50 cents a pound on the transactions in the futures market, since he sold the March delivery for 10.50 cents and bought it for 8.00 cents. Hence, he realized a net profit of 0.15 cent a pound. It is to be understood that, in this case, as usually, the shipper neither made nor received delivery of cotton in the futures market, since his initial sale of cotton for March delivery was subsequently offset by his purchase of cotton for March delivery.

Spinners use the cotton futures markets extensively for hedging their holdings of cotton, yarn and cloth, and their forward sales of yarn and cloth, buying and selling in those markets to protect themselves from losses on such holdings and such commitments. However, the spinners utilize the futures markets to a much greater extent in an indirect manner, namely, by buying their cotton "on call," rather than "at fixed price." When a spinner buys cotton from a shipper on call, the absolute price is not agreed upon at the time of such purchase. Agreement is reached only on the point that the price is to be a certain premium on or a certain discount off the price of a given future delivery in a given futures market, and the shipper gives the spinner the right to establish the absolute price by applying that premium or that discount to the price of that future delivery prevailing at any time within a specified period. For example, a spinner may buy a certain quality of cotton from a shipper for a premium of 0.50 cent a pound on the March delivery on the New York Cotton Exchange, and if the spinner applies that premium when the March delivery is selling for 9.50 cents the absolute price of the cotton is fixed at 10.00 cents. The bulk of the American crop is merchandised to spinners by such pricing method. Shippers can sell cotton in this way because they hedge their operations in the futures markets, and so they protect themselves from large losses arising from price declines.

In the merchandising of cotton—non-American as well as American—the futures markets are fully as important as the spot markets. The pricing of cotton is, in fact, largely centred in or based on the futures markets, and buyers and sellers of cotton and cotton goods throughout the world accept the prices established on those markets as measures of world values of the staple. This is so because the futures markets are free, open markets on which converge all of the forces of supply and demand for cotton from all quarters of the globe. Trading by hedgers on these markets is necessarily supplemented by trading by speculative operators, for speculators are needed to assume the price risks from which the hedgers free themselves by their hedging. The speculative traders endeavour to forejudge future changes in supply and demand conditions and operate accordingly, and to the extent that they correctly anticipate future conditions their operations tend to smooth out the cotton price movement. By inter-market straddling, the speculators also help to keep the various cotton markets of the world in sound relationship to one another. In brief, the cotton futures markets utilize speculation—inherent in the cotton trade under any merchandising system—in such a manner that it serves the interests of the trade, thereby making it possible for cotton to be merchandised more economically and more safely and making cotton prices more continuously and more fully responsive to world supply and demand conditions.

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III. COTTON SPINNING AND MANUFACTURE

A. INVENTION AND DEVELOPMENT

During thousands of years the spinning of yarn and the weaving of cloth persisted as a manual operation. At the outset primitive appliances were used which through the centuries were developed and refined until highly productive and efficient devices were evolved. Their proper employment was still dependent on the skill and manipulation of the operator and, therefore, production remained comparatively small. From India and Asia the knowledge of the manipulation of cotton to produce yarn or thread spread throughout Europe. Legend has it that the Indian spinners could produce a yarn of such extreme fineness that when woven into a piece of muslin the fabric could easily be passed through a ring. Although perhaps not so fine as the legendary fabric a piece of muslin brought from India about the year 1786 proved conclusively that the hand workers of that country could produce a yarn and fabric of exquisite fineness. Comparing the yarn with the standards of to-day the counts were 250s. Cotton counts are estimated in the following way: if one hank or skein of cotton yarn weighs 1lb. avoirdupois then the counts of the yarn are 1s. So that where the counts of yarn are 250s it follows that 250 hanks of 840yd. each hank, weigh one pound. Approximately the length of 1lb. of this yarn would be 119mi., which will give an idea of its extreme fineness.

It is certainly true that even if this excellence of manipulation was not passed on from India to Europe the spinners and weavers

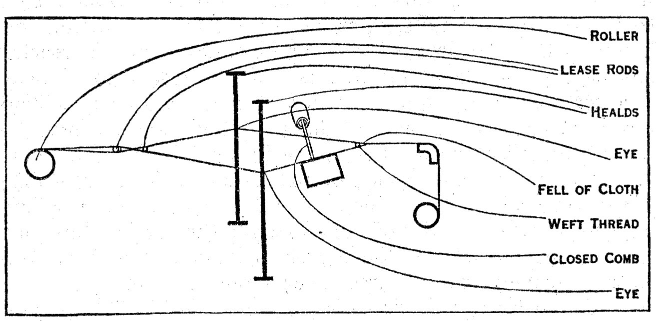


FIG. 4.—DIAGRAM ILLUSTRATING, FROM LEFT TO RIGHT, THE THREE MAIN OPERATIONS: THE DIVISION OF THE WARP YARNS, THE INSERTION OF THE WEFT OR FILLING YARNS, AND THE BEATING-UP OF THE LAST WEFT YARN TO THE "FELL OF CLOTH"

of the mediaeval ages possessed considerable ability as is evidenced by the fabrics that have been preserved from that period. Time occupied in the production of fabric must have been an important factor. Certainly the operatives worked much longer hours and were satisfied with much less return for their labour. It is well to remember that at the outset cotton clothing did not altogether find favour and the extension of its use was slow. Linen and woollen fabrics were more in demand.

Hand Appliances.—Crude forms of spinning wheels were used by the Indian spinners and most certainly the principle of construction was maintained until such wheels were deposed by power-driven mechanism. Similarly there are early examples of hand looms which in character and appearance resemble closely

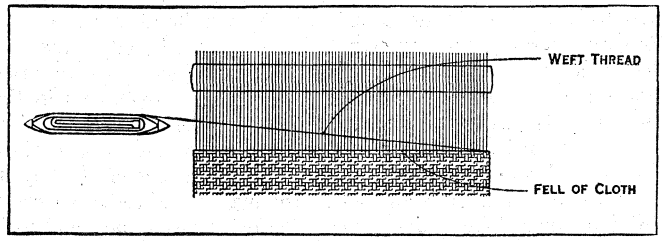


FIG. 5.—DIAGRAM SHOWING THE LENGTHWISE OR WARP YARNS, THE FELL OF CLOTH OR FABRIC PROPER, AND THE SHUTTLE CONTAINING THE WEFT OR FILLING IS SEEN TO THE LEFT

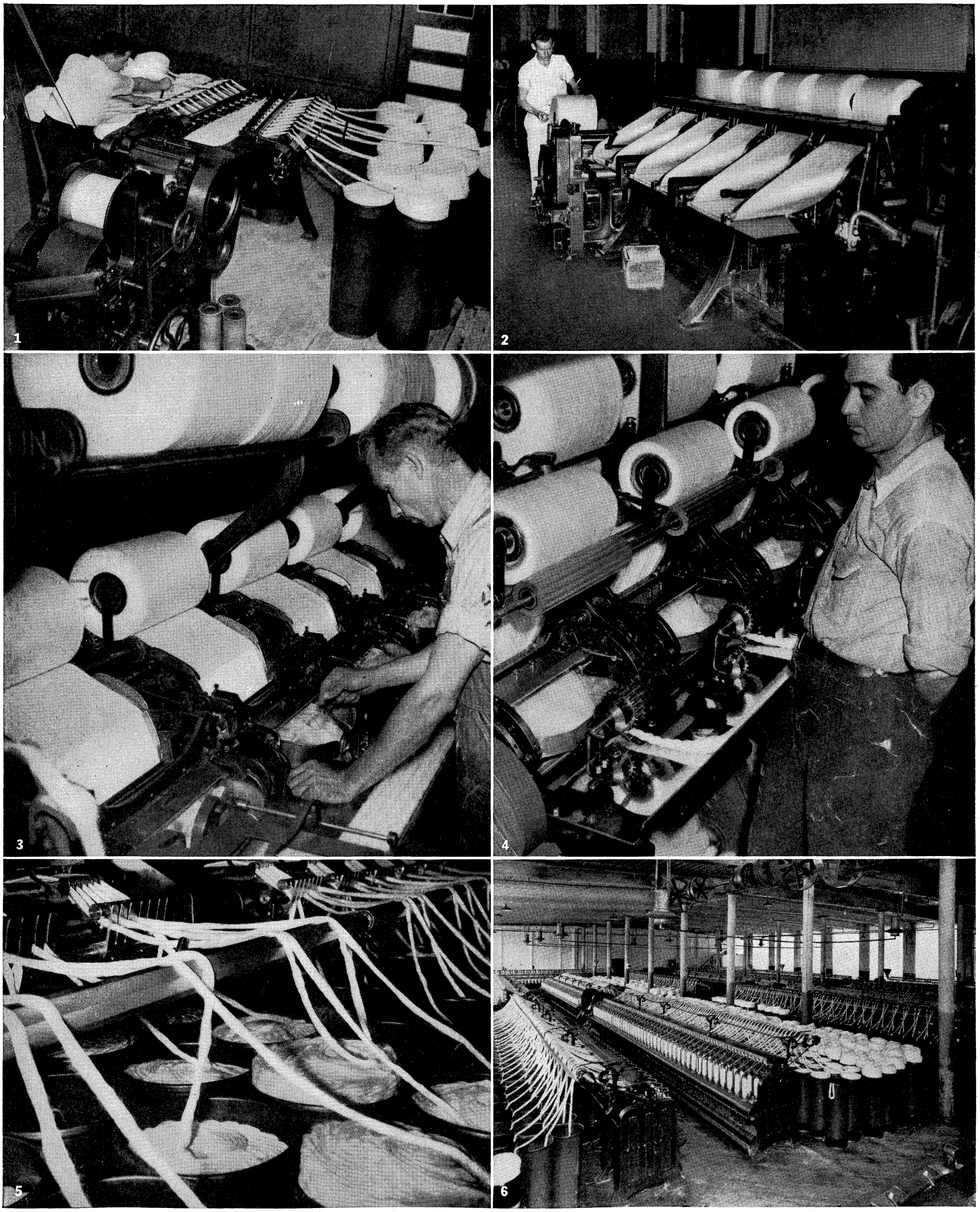
those that were in general use during the early part of the 18th century.

By 1800, however, new types of spinning machines developed in England had superseded the spinning wheel and power looms had begun to replace hand looms. Spinning and weaving mills had been built and put into operation. The textile industry had been born.

To appreciate fully the changes effected by the inventions of textile machinery in the 18th century it is necessary to understand the machinery then existent. The spinning wheel had been improved but still remained a manually operated device. It is recorded that in 1519 Leonardo da Vinci invented a flyer which, consisting of a ∩ shaped device the legs of which extended on either side of the spinning spindle, facilitated the operations of twisting and winding the thread on the said spindle. Also, in 1530 there is a record of Johann Jurgen making a wooden flyer. Later the Brunswick spinning wheel was invented in 1533. From that date onwards it is conceivable that improvement followed advancement in craftsmanship and knowledge until we come to the quite excellent spinning wheels of the early days of the 18th century.

Weaving Operations.—The hand loom had also been refined although in principle it remained the same as that used in the 4th and 5th centuries. Essentially there are three main operations in weaving. They are the division of the warp or lengthwise yarns of the fabric so the weft or filling yarns may be interwoven crosswise between them; the insertion of the weft or filling; and the beating up of the last inserted weft yarn to the "fell of the cloth" or the fabric proper. Simple diagrams illustrate this point (fig. 4). The warp or lengthwise yarns are wound on a beam or roller and are drawn forward, being divided by lease rods before they pass through the eyes of guides known as healds or heddles. Each heald frame supports a number of cords or wires intermediate in the length of which is an eye through which an individual yarn is drawn. By raising one heald frame and lowering the other, division of the warp yarns is secured. What is termed a shed is formed, and through this opening the shuttle containing the weft or filling is passed from side to side. When this has been accomplished, the weft yarn is forced or beaten up to the fell of the cloth by means of a closed comb, or reed suitably supported, and between the teeth of which the individual warp yarns pass. There are other secondary motions in weaving, such as winding up the woven cloth, but of primary motions there are but three.

It will be readily conceived that a simple method of operating the heald is that shown in the line illustration herewith (fig. 6). The upper heald frames are connected together by a strap or cord passing over or attached to a revolvable roller. The lower heald frames are connected to treadles. By depressing one treadle, one heald frame is lowered and the other raised in order to divide the warp yarns. Modifications and additions were made to hand looms in order to secure greater variety of weave than the



BY COURTESY OF (1-5) SOUTHERN COMBED YARN SPINNERS ASSOCIATION, (6) "TEXTILE WORLD"

OPERATIONS PRELIMINARY TO SPINNING

1. Product of the card—known as sliver—in a combed yarn mill, as passed out of the sliver lap machine
2. The ribbon lap machine condenses six of the bands from the previous machine into one, preparatory to being combed
3. The comber, which makes combed yarn distinct from the ordinary carded yarn
4. Another type of comber
5. The back of a drawing frame, showing six slivers of cotton being condensed into one
6. Long-draft roving, the process which precedes spinning

BY COURTESY OF (1-3, 5) "TEXTILE WORLD," (4) BARBER-COLMAN CO., (6) SOUTHERN COMBED YARN SPINNERS ASSOCIATION; PHOTOGRAPHER (1), COXE, GREENVILLE, SOUTH CAROLINA

EARLIER PROCESSES IN COTTON MANUFACTURE

1. Long-draft cotton spinning, a late development in the spinning process
2. High-speed winders
3. A high-speed spooler and warper
4. Warpers running at 900yd. per minute from automatic-spooler creels
5. Slashers, on which the warps are run through a sizing compound to give them added strength on the looms
6. Drawing-in. Here the warp threads are drawn into the heddles preparatory to the weaving process

simple plain cloth which was the original product. But up to 1733 the method of passing the shuttle carrying the weft from one side of the warp to the other by hand still obtained. It was in that year that John Kay invented his "flying" shuttle and inaugurated that great inventive epoch which before the end of the century was to revolutionize the whole of the cotton industry of England and eventually of the world.

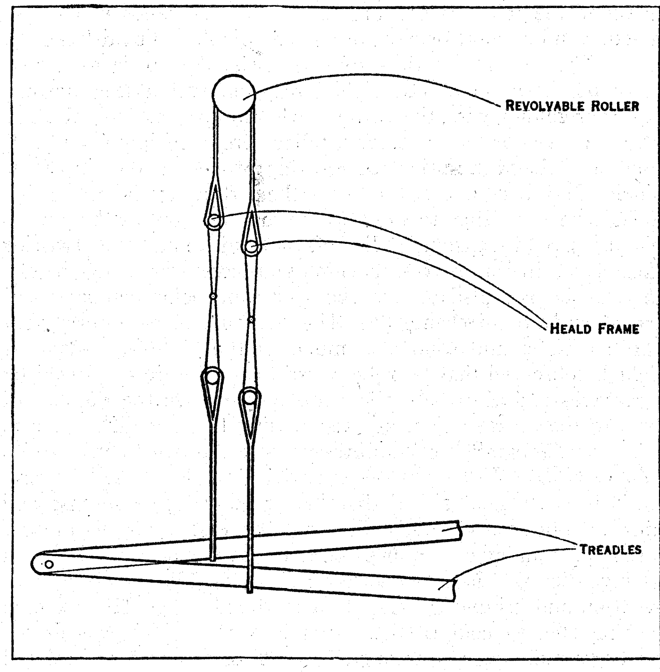


FIG. 6.—DIAGRAM SHOWING METHOD OF OPERATING HEALD OR HEDDLE
The upper heald frames are connected by a cord passing over a roller, and the lower frames connected to treadles. By depressing one treadle, one heald frame is raised and the other lowered, separating the warp yarns for the passage of the shuttle, carrying the weft from one side to the other

Kay's "Fly" Shuttle.—It will be appreciated that the method of operation of "picking" described above was slow. Kay's invention was of great value and will be more readily appreciated from examination of the illustration (fig. 7). To the lathe, now called slay or lay, Kay added two small boxes, one on either side, the lower face of the boxes being in correct alignment with the race board or upper face of the lathe. These boxes were for the reception of the shuttle, and, in each, spindles were fixed. On each spindle a piece of wood or leather was threaded, this being known as a picker. The two pickers were connected together with fly cords which the weaver when at work held in his hand by a small handle, called in the old days a fly pin. It will be readily understood that a shuttle having been placed in one box, by a sharp jerk or flick of the fly pin in a direction across the loom the weaver could project the shuttle through the shed from box to box. The right hand being wholly used for the purpose, the left hand was free to operate the lathe to beat up the weft, thus materially increasing the speed of weaving and naturally increasing production.

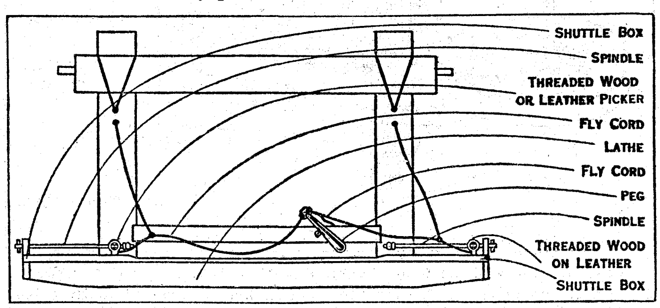


FIG. 7.—KAY'S FLY SHUTTLE SHOWING PARTS, INVENTED IN 1733 BY JOHN KAY

State of the Industry.—It is essential at this point to consider the state of the industry fully to appreciate the effect of Kay's invention and the later developments which were so considerable. There was quite an organized industry in existence in the early part of the 18th century. In Manchester, England, there were factors or merchants who bought largely the fabrics made in certain villages and small townships of Lancashire. In fact, very much as it is to-day, the Manchester of those days was a trading rather than a manufacturing centre. In the villages surrounding Bolton and Rochdale the weavers had their habitation and their looms. They secured yarn from the factors or merchants, who took in return the cloth they wove and paid to them the difference. It is no doubt true that some of the weavers were independent workers and after having bought their own yarn and woven it into cloth could afford to wait for their returns until they sold the product. Merchants had their own weavers working for them, although such weavers were probably not all in one village or town. Figures are available which show what wages were paid to men, women and children about 1750. The return varied, but a man on the average earned about 6*s.* a week. A woman averaged slightly less, about 5*s.* 6*d.* per week, while children earned an average of 2*s.* 6*d.* These were weavers. Among spinners—who were mostly women—the wages earned varied from 2*s.* to 5*s.* per week and girls from six to 12 years of age could earn from 1*s.* to 1*s.* 6*d.* per week. The following figures give the imports of cotton "wool" (as it was then termed) into England during the early years of the 18th century:

Year.	lb.	Year.	lb.
1701.	1,985,868	1720.	1,972,805
1710.	715,008	1730.	1,545,472

An interesting comparison can be made here between the imports of 1730 and 1937 which will demonstrate clearly the enormous development of the industry. In the former year as shown 1,545,472lb. of all sorts of cotton were imported into Great Britain; in 1937 the amount was approximately 16,000,000,000 pounds.

Effect of Kay's Invention.—Kay was a luckless inventor. As has been stated the weaver by using the fly shuttle could increase the production of the loom. Fearing that through this increase they would be thrown out of employment the weavers rose and attacked Kay's house, all his machines and effects being destroyed. He emigrated to France, where he eventually died. Kay's invention did not put the weavers out of work, but it did bring about a shortage in yarn supply. The hand spinning wheels were not able to cope with the demand made upon them, and although in 1761, 1765 and 1767 a number of inventions were introduced which were intended to improve their productive capacity, there was still a shortage of yarn for the weavers. The time was undoubtedly ripe for the production of a mechanical spinning device which would be at least semi-automatic in its action and operation.

Principles of Spinning.—To appreciate fully what was required from the inventor it is essential to understand the principles of cotton spinning and what is involved. From a matted mass of material—individual fibres which are lying in all directions—it is necessary, in order to produce yarn, first to arrange the fibres in parallel order, and secondly to reduce the number of fibres to the cross-section to such a degree that a comparatively fine yarn may be spun. The manual operative spinner drew the fibres out by hand as the revolving spindle twisted them and then allowed the twisted yarn to wind round the spindle.

It is curious that the inventors who attacked the problem of finding improved methods of spinning did not at the outset concern themselves with the earlier or preparation machines; that is, those which open out the matted mass of fibre, clean it and to a certain extent parallelize the fibres. Their efforts were directed to finding a machine that would give them an increased production over the best hand spinning wheels then in existence. There is evidence of considerable inventive activity throughout England from 1740–50 and undoubtedly in many directions men were busily engaged in experimental work. Considerable controversy has since arisen as to who really invented many of the mechanisms which have been embodied in cotton spinning machinery from that time. News would travel slowly owing to the inadequate transport facilities and there can be no doubt that a number of men were working along precisely similar lines.

The Early Inventors.—At this date it matters little whether Wyatt or Lewis Paul invented the method of drafting or attenuating by the use of rollers. The invention is credited to the latter and it was in 1738 that he took out his patent. His invention was of extreme importance because it made the subsequent machines of Hargreaves, Arkwright and Crompton possible. Lewis Paul's own words extracted from his patent specification explain his invention quite clearly:

"The wooll or cotton being thus prepared, one end of the mass, rope, thread or sliver, is put betwixt a pair of rowlers cillinders or cones or some such movements, which being turned round by their motion, draws in the raw mass of wooll or cotton to be spun, in proportion to the velocity given to such rowlers, cillinders or cones; as the prepared mass passes regularly through or betwixt those rowlers, cillinders or cones a succession of other rowlers, cillinders or cones moving proportionably faster than the first, draw the rope, thread or sliver into any degree of fineness which may be required."

Here we have in a few words the whole principle of drafting or attenuating the sliver or untwisted rope of fibres in order to reduce the number of such fibres in the cross-section and thus enable the spinning of a yarn of comparative fineness. The invention was the first real step towards emancipation from the production of yarn by hand.

Hargreaves' Invention.—There is some doubt about the exact date of Hargreaves' invention of the spinning jenny. Baines, in his *History of the Cotton Manufacture,* gives it as his opinion that the machine was invented in 1764. As he points out, Hargreaves, who was only a weaver at Stand Hill near Blackburn, had to work hard for his living and no doubt spent years in perfecting his machine.

It was both perfected and proved when Hargreaves went to Nottingham in 1768, which somewhat discredits Arkwright's statement that the machine was first invented in 1767. It is interesting to note that Hargreaves is said to have received the original idea of his machine from seeing a one-strand hand-spinning machine overturned on the floor, when both the wheel and the spindle continued to revolve. The spindle was thus thrown from a horizontal to a vertical position and the thought seems to have struck him that if a number of spindles were placed upright several strands might be spun at once. The illustration herewith (fig. 8) will assist the following description. A frame was made in one part of

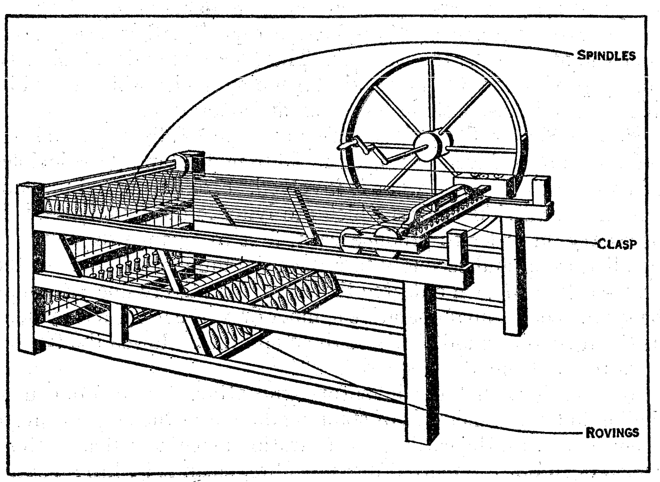


FIG. 8.—HARGREAVES' SPINNING JENNY, INVENTED IN 1764, WHICH WAS THE FIRST ATTEMPT TO SPIN SEVERAL STRANDS OF YARN AT ONCE, AND CONTAINING ALL THE ELEMENTS, EXCEPT ROLLERS, OF THE MODERN SPINNING MULE, BUT OPERATED BY HAND

which were placed rovings in a row, and in another part a row of spindles. The rovings, when extended to the spindles, passed between two horizontal bars of wood forming a clasp which opened and shut in a like manner to a parallel ruler. When pressed together the clasp or clamp held the strands fast. A certain portion of roving being extended from the spindles to the wooden clasp, the latter was closed and was then drawn along the horizontal frame to a considerable distance from the spindles, by which the strands were lengthened out and reduced, as Baines says, "to the proper tensity."

The spinner's left hand was occupied in this work, while his right hand turned a wheel which, by a band, rotated a roller. Passing round the roller were a number of endless bands which also passed round a whorl or wharve on the spindles, thus driving the latter. The roving was thus spun or twisted into yarn and by return of the clasp to its original position and letting down a presser or guiding wire, the yarn was wound upon the spindle. The presser, or, as it is termed to-day, faller wire, is of importance. It maintained the yarn during the twisting process at the tip of the spindle. It will be appreciated that the latter, revolving rapidly, would have a tendency to wind up the material, but as the yarn is held at the tip, it constantly slips off the said tip and thus twisting takes place. In Hargreaves' machine you have practically the elements of the present-day mule, the operations being manually performed and not mechanically. The machine is an intermittent drafter, twister and winder-on much as the mule is to-day. It might be observed that no rollers for drafting were employed by Hargreaves and also that rollers not only reduce the number of fibres to the cross-section, but also, owing to their differences in rate of speed, parallelize the fibres passing through them.

Arkwright's Invention.—Arkwright, in the "case" he presented to parliament stated that "after many years intense and painful application he invented, about the year 1768, his present method of spinning cotton, but upon very different principles from any invention that had gone before it." Arkwright knew of Paul's invention and utilized the idea in a modified form. His spinning machine (fig. 9) comprised a drum or wheel which was driven by a horse, subsequently through the medium of a water wheel and bevel gearing—hence the name water frame. A belt conveyed the motion of the wheel to the whole machine. A vertical shaft connected to the small drum drove the wheel and through it the four pairs of rollers. The part of the roller through which the cotton

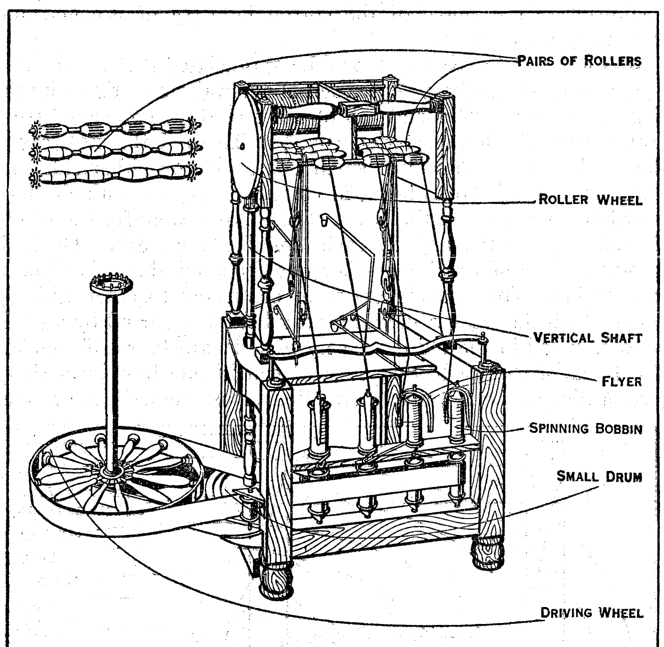


FIG. 9.—ARKWRIGHT'S SPINNING FRAME, INVENTED ABOUT 1768
The wheel was driven by a horse, the motion being conveyed to the whole machine. The rovings passed through the rollers and the strands were twisted between the last two rollers and the flyers

passed, was covered with wood, the top roller with leather and the bottom one fluted. The pairs of rollers moved at different rates of speed. The rovings were arranged horizontally in the illustration and the strands passed through the rollers to flyers having small wires on the side. The flyers were mounted on the spindles and wire yarn guides were fastened to their sides. The twisting of the strand took place between the nip of the last pair of rollers and the yarn guide on the flyer. In essence that is the principle of ring spinning to-day, the twist being inserted immediately the roving issues from the last pair of rollers, and whatever thick or thin places happen to be in the rovings such are twisted into the yarn, while in mule spinning the length of the draw or stretch is such and the operation of twisting is so distinct from winding-on that the thick places disperse through the yarn. That is the fibres in a thick place run along the other fibres and fill up the thin places.

Crompton's "Mule."—Crompton practically combined Hargreaves' and Arkwright's invention and the cross was termed a "mule." It is interesting to note how they name the frames. Owing to the fact that the flyer of Arkwright's frame gave out a whistling sound like a thrush singing it was called a "throstle frame." It was also called a "jack frame," and later, when operated by water power, it was called a "water frame." Some writers have said that the word "mule" was applied to Crompton's invention because it was a cross between the "jack" and the "jenny"; others stated that it was because it spun yarn fine enough to be used in weaving muslin and that the original name was the "muslin" wheel, afterwards corrupted into "mule."

It is inferred that he commenced to make his machine in 1774 and completed it in 1779, combining principles of the two earlier inventions. For example, Crompton took Arkwright's system of spindles without bobbins, which in combination with the faller or presser wire gave the twist to the yarn. The said yarn in this type of machine is stretched and spun at the same time as it was in Hargreaves', but the action is automatic and involves the stoppage of the rollers when a sufficient length of roving has been paid out. The most noteworthy feature of the machine invented by Crompton is the movable carriage which carries the spindles. The carriage was in Crompton's machine, drawn out for a distance of from 54in. to 56in. from the roller beam—this is known as the draw—in order to stretch and twist the yarn. It will be remembered Hargreaves moved his clasp out by hand, his spindles being stationary. When twisting is complete the carriage moves back towards the roller beam, the yarn winding on to the spindles in the process.

It will be recognized that within a comparatively short time from 1738 to 1779, many considerable and far-reaching improvements had been made. The productive capacity of the spinner was multiplied many times, and, moreover, the quality of the yarn was immensely improved. It might be stated here that the alteration in movement of direction of the mule carriage had to be governed by hand. It was Roberts, in 1830, who invented the self-acting mule which removed the onus of government from the spinner and put it on the machine.

Preparatory Machines.—The cotton received in bale form is in a matted tangled condition, charged with dust, twig, broken leaf, broken seed and other foreign matter which must be removed before actual spinning can take place. The fibres must be cleaned, disentangled and arranged in parallel order to facilitate the production of yarn or thread. Crude hand-operated devices were originally used, but with the advent of the spinning machinery it was recognized that the enormously increased production capacity of such machines necessitated revolutionary changes in the preparation processes. The invention of Lewis Paul rendered the production of one important preparatory machine a comparatively easy matter and led also to the production of three others. The machines referred to are the "drawing" or "drafting" frame which essentially comprises successive pairs of rollers running at increased speeds, and the three subsequent machines known to-day as the "slubber," "intermediate" and "speeder," all of which embody the same idea. The object of such frames is to reduce the number of fibres to the cross-section and to parallelize them. A machine was devised to open the matted dirty cotton taken from the bale, such machine comprising a hopper or bin into which lumps of cotton were fed, and within which a roller having a number of projecting spikes was caused to revolve. The spikes came in contact with the cotton and tore it apart, while a strong air current induced by a powerful fan freed it from most of the dust and seed it contained. In 1797, Snodgrass, then resident in Glasgow, invented a further cleaning machine which remains practically the same to-day. It was termed a "scutcher" or "picker" and comprised three or four metallic blades revolving at a speed of from 4,000 to 7,000 revolutions per minute. The material to be opened was presented to the rapidly revolving blades over the edge of a metallic feed plate, and as the cotton was broken up the dust, leaf, seed and other foreign matter was beaten out and dropped through grids into a dust chamber. A further machine of similar type was employed and with it was combined a lapping machine whereby the cotton in the form of an endless sheet was rolled round a central spindle or core. From the final scutcher the "lap," as it is termed, proceeds to the carding engine or card. The early hand card consisted of brushes with short pieces of wire arranged at a certain angle. The cotton was laid upon the back of one hand card while it was combed or brushed with the teeth of another. It was a simple evolution to increase the size of the cards to make one fixed and to suspend the other by a movable cord and pulley from the ceiling thus materially increasing production. It was Lewis Paul in 1748 who conceived the idea of a rotary cylinder covered with card clothing or wire teeth and a set of stationary "flats" or strips of wood fitted with card clothing placed below the cylinder. This was the genesis of our present-day card, the chief difference being that the flats are now placed above the cylinder, are formed in an endless chain and travel at a slow rate of speed over the cylinder, which is running at a high rate of speed.

Ring Spinning.—In 1828 Charles Danforth, of Paterson, N.J., and John Thorp, of Providence, R.I., took out separate patents on cap spinning devices. At present cap spinning is used only for worsted, but, when originally introduced, was used for cotton also. In the same year Thorp was granted the first ring-spinning patent. The most important improvement made in ring-spinning was the invention of the traveller. There is some doubt as to who was the inventor of the traveller, but the first patent now available which shows the traveller in its present form was granted to Thorp in 1844. The invention of the ring and traveller resulted in a great saving in initial cost of construction of spinning machines, as well as in power as compared to the flier, and permitted much higher spinning speeds. In the latter half of the 19th century many improvements were made in spinning machines, particularly in the types of spindles. In the United States practically all cotton yarn is now spun on ring frames. In Great Britain mules are still used to a greater extent than are spinning frames.

Most important recent development in cotton spinning has been the introduction of high-draft or long-draft spinning. Several types of long-draft systems are now in use, the first successful method having been developed about 1904 by Fernando Casablancas, of Sabadell, Spain. In 1938, less than 15 years after long-draft spinning had been introduced in the United States, approximately 30% of the cotton spindles installed were operating on some system of long draft.

In conventional methods of cotton spinning the draft is in the range of 8 to 15; that is, in spinning roving into yarn, the strand is drawn out or drafted to 8 to 15 times its original length. In high-draft spinning, the usual draft is in the range of 15 to 30. The major advantage of high draft is that it permits a reduction in the number of preparatory operations previous to spinning and thus results in a saving in labour and equipment.

Loom Development.—We come now to the invention of the power loom by Dr. Edmund Cartwright in 1786. Cartwright mechanized the operations of weaving as previously performed by hand. His early looms were not successful, but improvements were speedily made and eventually the power loom became a commercial and practical success. Continued use and the development of the machine industry brought about rapid and effective refinement of the loom and its development as a more accurate and precise weaving machine. It was not, however, until 1800 that the power loom was a definite commercial success, and it will be interesting at this stage to examine the industry and indicate its position in regard to spindles and looms.

Early Mill Census.—It may be fairly assumed that by the year 1811 the spinning mill of that time could be fitted with a full equipment of preparatory and spinning machinery, while the weaving shed was provided with power looms, practical and, in comparison with hand looms, highly productive. It was estimated that in 1811 over 5,000,000 spindles were at work of which 310,500 were of the Arkwright—or "throstle" frame—principle, while no fewer than 4,600,000 were mule spindles of Crompton's invention and there still remained at work 156,000 spindles of Hargreaves' "jenny" type. In 1820 the number of power looms at work in England and Scotland was 14,500, but in 1829 the number had risen to 55,500 and in 1833 to 100,000. Hand loom weaving had by no means died out, for in 1834 before the Commons committee on the hand loom weaver it was stated that in Scotland alone there were 45,000 to 50,000 of them at work, and it has been estimated that at least 200,000 hand weavers were still at work in England.

The first successful cotton mill in the United States was put into operation in the year 1790 in Pawtucket, R.I., under the management of Samuel Slater, a young Englishman. Up to 1814 weaving in the United States was largely a household industry, most of the mills confining their activities to spinning. In 1813 the Waltham Company was formed, and on the Charles river at Waltham, Mass., was erected the first power-driven cotton mill in the world where all processes of manufacture of raw cotton into cotton cloth were carried out in the same structure.

In the first half of the 19th century erection of cotton mills continued both in Great Britain and in the United States. The early plants were built at locations where water power was available for driving the machines.

Development by Watt of the steam engine permitted the building of textile mills where water power was not available or inadequate, giving an impetus to cotton manufacturing in coastal locations; for example, in Fall River and New Bedford, Massachusetts. Again, textile manufacturers who originally ran their mills by water power installed auxiliary steam plants as the mills grew in size.

Cotton mills were pioneers in the use of electricity for power, mills in Columbia and Pelzer, S.C., being driven exclusively by electric motors as early as 1895. Some textile mills generate all their electric power; others purchase it from public utility companies; still others generate part of their power and purchase the rest.

Effect of Machines on Operatives.—An endeavour will now be made to trace the effect of machine production upon the operatives, particularly in regard to their remuneration. In 1769, Arthur Young examined the question of wages paid in England for spinning and weaving cotton cloth. Men weavers received an average of 7*s.* 6*d.* per week, women 6*s.* per week, and children 2*s.* 6*d.* per week. Quite a variety of goods were woven, the prices naturally varying in accordance with the character and quality of the fabric. Spinners who were women and girls averaged about 3*s.* 6*d.* per week for the former and from 1*s.* to 1*s.* 6*d.* for the latter. Daniels states that in 1800 the amount paid for weaving a piece of cambric which required a week for its performance was 25*s.* Later there was quite a decline, and by 1829 the price had fallen away to 5*s.* 6*d.* In 1835 a certain quality of cambric 24yd. long cost 6*s.* when woven on a hand loom and 2*s.* when woven on a power loom. The difference between hand loom production and that of the power loom was, even in these early days, most marked, for the hand loom weaver could only produce one piece a week, while the power loom operator turned out four.

Operatives Employed.—It was from 1835 onwards that we have details of the operatives employed in cotton mills in the United Kingdom, and the early figures are interesting. A comparison has been made between the years 1835, 1856, 1872, 1895, 1924, and 1936.

	1835	1856	1872	1895
Male and female under 13, half-timers (per cent)	13·2	6·5	14·0	5·8
Male 13 to 18 "	12·5	10·3	8·0	7·9
Male over 18 "	26·4	27·4	24·1	27·6
Female over 13 "	47·9	59·8	53·9	58·7
Totals	218,000	379,300	479,600	538,900

	1924	1936
Male	180,990	160,968
Female	320,831	273,800
Totals	501,821	434,768

With regard to hours, an enquiry in 1819 in reference to 325 cotton spinning mills showed that 98 worked from $72\frac{1}{2}$ or $73\frac{1}{2}$ to 82 or 93 hours a week, while the remaining 227 ran from 66 to 72 hours a week. The pernicious system of farming out children in batches from the poorhouse was in existence, and in many cases where double shifts were in vogue, the children going off got into the same beds as those just awaking to work their turn. It was by an Act of 1844 that night work was killed because it made it illegal for any operatives who were not adult males to practise it. The large proportion of children and women essential to maintain the balance of effective operation were thus excluded and night work became commercially unremunerative. During the 19th century many acts were passed which were beneficial to the operatives. The age at which children could commence work in the factory was constantly advanced. Finally we come to the more recent act which reduced the hours in cotton mills to 48.

In the United States, when the cotton spinning industry was first established, the employees—mostly children from 8 to 14 years old—received from 80 cents to $1.40 a week. In 1817 weavers in Fall River were paid $2.50 a week; work began at 5 A.M. in summer and as soon as it was light at other times and stopped at 7:30 P.M. In 1937 the average number of workers in the cotton manufacturing industry was 435,428; wages paid totalled $324,083,030. On Oct. 24, 1939, a minimum wage of $32\frac{1}{2}$ cents per hour and a maximum work-week of 42hr. for the workers in the cotton industry were established under the so-called wage-hour law (Fair Labor Standards Act of 1938).

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B. THE WORLD'S COTTON SPINDLES

The continuous growth of the population of the world and the improvement of the standard of living in most countries naturally produce an increase in the demand for cotton for clothing, home furnishings and for use in the products of industry. It is true that the competitive position of cotton is constantly subjected to greater and greater pressure by the products of chemistry, namely, rayon and paper, but nevertheless cotton still holds its place as the world's principal textile fibre and except for years of general business depression the use of it steadily expands.

But this increase in the use of cotton has not resulted in any increase in the world's cotton spindles. In fact spindleage equipment has shrunk. Every year between 1928 and 1938 witnessed a diminished number of spindles in place. Prior to 1928, however, there was a steady year to year growth in the world's cotton spindles.

The contrast between expanding cotton consumption and decreasing cotton spindles is exhibited in Table VII.

As can be seen from this table, the consumption of cotton was higher during the three years ended July 1939 than in any year during the preceding two decades, but the number of spindles in the world, after increasing between 1920 and 1928 from 153,056,000 to 165,103,000, declined steadily thereafter to 147,153,000 in 1938. The decrease continued in 1939 for the reason that in

TABLE VII.—*Comparison of World Cotton Mill Consumption and Spindles in Place, 1913 and 1921 to 1939 Inclusive*

Cotton, Year Ended July 31	World consumption of cotton (equivalent 478-lb. Bales)*	World's cotton spindles†	Bales consumed per spindle in place
1913	23,000,000	143,449,000	·160
1921	17,151,000	153,056,000	·112
1922	19,778,000	155,153,000	·127
1923	21,337,000	157,075,000	·136
1924	20,027,000	158,819,000	·126
1925	22,734,000	161,363,000	·141
1926	24,168,000	163,723,000	·148
1927	25,679,000	164,597,000	·156
1928	25,442,000	165,103,000	·154
1929	25,778,000	164,211,000	·157
1930	24,875,000	164,108,000	·152
1931	22,432,000	162,278,000	·138
1932	22,889,000	161,002,000	·142
1933	24,651,000	157,755,000	·156
1934	25,602,000	156,878,000	·163
1935	25,488,000	153,778,000	·166
1936	27,708,000	151,745,000	·183
1937	30,689,000	149,618,000	·205
1938	27,876,000	147,153,000	·189
1939	28,602,000	not available	..

Sources: *New York Cotton Exchange. †International Federation of Master Cotton Spinners, Manchester, England.

the United States there was a shrinkage in spindles between July 1938 and Aug. 1939 of over 1,100,000. One has to go back to 1914 in order to find a year when the spindleage equipment of the world approximated the 1938 total.

It is evident from the foregoing record that the 1938 cotton spindle produced much more than the spindle of 10 or 20 years earlier. There are several reasons for this development, among them (1) longer hours of spindle operation, (2) substitution for the slow producing mule spindles of the faster producing ring spindles, and (3) increasing speeds of the ring spindle.

Conditions in the United States illustrate these changes. The adoption of the 40-hour work-week in 1933, as part of the Cotton Textile Code, caused a great many mills to run two shifts of 40 hours in place of a single shift ranging from 48 to 60 hours a week. The natural result was longer hours of operation per spindle.

Concrete figures that pertain to the two most active years that

TABLE VIII.

	Total cotton consumption in the United States		Total spindle hours (millions)	Total active spindles in the United States (monthly average)	Average hours run per active spindle in year	Raw cotton processed per spindle hour (in pounds)
	Bales	Millions of pounds				
1927	7,405,021	3,587.7	104,450	32,547,119	3,209	.0343
1937	7,417,991	3,657.1	95,591	24,079,936	3,970	.0382

Source: United States Bureau of the Census.

the cotton industry in the United States had in the 20 years prior to 1938, namely 1937 and 1927, are illuminating. In those two years, the output of cotton mills was almost identical, their processing of raw cotton amounting to 7,400,000 bales in both years. But in 1937, the average running time per active spindle amounted to 3,970 hours and in 1927 to 3,209 hours. In other words, the 1937 spindle ran nearly 25% more hours than the 1927 spindle. Also, the 1937 spindle with its more rapid rate of production processed an average of .038lb. of cotton per spindle per hour against .034lb. in 1927. This is a production increase of 12% due to greater efficiency alone, distinct from longer hours of operation. These fundamental changes can be more easily visualized in the comparison in Table VIII.

The United Kingdom continued up to 1939, as it has since the industrial revolution, to lead the world in cotton spindleage equipment. The United States was second and Japan third. Japan's position, however, was only slightly in advance of Germany, Russia, France and India.

Table IX gives the distribution among the principal cotton manufacturing countries.

The record below of nearly two decades brings out the shifts that have taken place in the distribution of world cotton spindles. In the United Kingdom, the number dropped from 58,692,000 in 1920 to 36,879,000 in 1938, a loss of over 20,000,000 spindles. Similarly, in the United States the number dropped from a peak of 37,804,000 in 1924 to 26,376,000 in 1938, a loss of over 10,000,000 spindles. On the other hand, cotton spindles in Japan increased over threefold between 1920 and 1938 while in France and Germany the number has been almost stationary; India's increase was 50% during this period. Within the United States a decided change occurred between 1923 and 1938 in the concentration of spindles as between different sections of the country. The number in the New England States decreased sharply; the number in the cotton growing States increased. The reasons generally ascribed

TABLE IX.—*Spindles in Place in the World's Cotton Mills, for Selected Countries, 1913 and 1920–1938 Inclusive.*
(Thousands of Spindles)

July 31	United Kingdom	United States	Japan	France	Germany	U.S.S.R. (Russia)	India	Italy	China	Czechoslovakia	Brazil	Belgium	Spain	Poland	Switzerland	Canada	World Total†
1913	55,653	32,150	2,300	7,400	11,186	7,668	6,084	4,600	1,000*	..	1,200	1,492	2,000	1,322	1,398	855	143,449
1920	58,692	35,834	3,690	9,400	9,400	7,200	6,690	4,515	1,600	3,584	1,600	1,572	1,800	1,400	1,536	1,200	154,477
1921	56,141	36,618	4,127	9,600	9,400	7,200	6,763	4,507	1,800	3,583	1,521	1,548	1,806	1,161	1,531	1,100	153,056
1922	56,605	36,946	4,646	9,600	9,500	7,200*	6,871	4,560	2,248	3,549	1,600	1,630	1,806	1,200	1,519	1,051	155,153
1923	56,583	37,409	4,877	9,600	9,605	7,246*	7,331	4,570	2,680	3,508	1,700	1,683	1,813	1,200	1,513	1,076	157,075
1924	56,750	37,804	4,825	9,359	9,464	7,246*	7,928	4,570	3,300	3,460	1,700	1,741	1,813	1,101	1,515	1,167	158,819
1925	57,116	37,929	5,292	9,428	9,500	7,246*	8,500	4,771	3,350	3,471	1,950	1,788	1,813	1,172	1,517	1,319	161,363
1926	57,286	37,586	5,573	9,511	10,480	7,246*	8,510	4,833	3,436	3,568	2,493	1,854	1,817	1,375	1,529	1,167	163,723
1927	57,235	36,696	5,952	9,567	10,800	6,945	8,714	5,086	3,568	3,629	2,593	1,936	1,873	1,372	1,518	1,153	164,597
1928	57,136	35,540	6,272	9,770	11,153	7,311	8,703	5,189	3,504	3,663	2,610	2,070	1,897	1,544	1,525	1,154	165,103
1929	55,917	34,820	6,530	9,880	11,250	7,465	8,704	5,210	3,602	3,673	2,750	2,156	1,875	1,557	1,504	1,240	164,211
1930	55,207	34,025	7,072	10,250	11,070	7,612	8,907	5,342	3,829	3,636	2,775	2,172	1,875	1,554	1,446	1,277	164,108
1931	54,246	32,673	7,312	10,350	10,591	7,612*	9,125	5,397	4,054	3,638	2,690	2,164	2,070	1,555	1,381	1,276	162,278
1932	51,891	31,709	7,798	10,144	10,233	9,200*	9,312	5,384	4,285	3,622	2,690	2,156	2,070	1,706	1,346	1,245	161,002
1933	49,001	30,893	8,209	10,144	9,850	9,200*	9,506	5,336	4,585	3,627	2,620	2,087	2,070	1,818	1,303	1,240	157,755
1934	45,893	30,942	9,115	10,170	10,109	9,800*	9,572	5,493	4,680	3,627	2,702	2,106	2,070	1,696	1,295	1,187	156,878
1935	42,688	30,093	9,944	10,157	10,109*	9,800*	9,613	5,483	4,810	3,618	2,709	2,090	2,070	1,688	1,265	1,155	153,778
1936	41,391	28,147	10,867	9,932	10,109*	9,800*	9,705	5,483*	5,010	3,562	2,712	2,009	2,070	1,707	1,241	1,110	151,745
1937	38,753	26,982	11,880	9,783	10,236	10,050	9,876	5,483*	5,071	3,445	2,714	2,004	2,070	1,693	1,269	1,108	149,618
1938	38,897	26,376	12,550	9,794	11,074‡	10,050*	9,731	5,350	4,300	3,330	2,725	1,986	2,000	1,748	1,241	1,137	147,153

†Including all other countries. ‡Includes Austria. *Estimated.
Source: International Federation of Master Cotton Spinners; U. S. Bureau of the Census.

for these changes have been lower cost of manufacture in the cotton growing States, easier access to raw cotton and lower taxes. The decline in New England and the expansion in the South are exhibited in Table X.

TABLE X.—*Spindles in Place in New England and Cotton Growing States*
(Thousands)

July 31	New England States	Cotton Growing States	July 31	New England States	Cotton Growing States
1923	18,930	16,458	1931	12,168	19,109
1924	18,576	17,226	1932	11,374	19,138
1925	18,333	17,635	1933	10,810	19,052
1926	17,946	17,875	1934	10,582	19,331
1927	16,871	18,169	1935	9,741	19,340
1928	15,463	18,508	1936	8,135	19,025
1929	14,549	18,848	1937	7,172	18,891
1930	13,479	19,122	1938	6,773	18,798

Source: United States Bureau of the Census.

The general term "spindles" covers two basically different types of machinery—the ring spindle and the mule spindle. Generally speaking, it may be assumed that ring spindles produce the comparatively coarser sizes of yarns and the mule the finer sizes. There are, of course, important exceptions to this generalization, for it is an established fact that ring spindles are producing some of the finest commercial sizes of cotton yarn. Nevertheless, the division of the spindles of any country between ring and mule will give a broad measure of the degree to which the cotton industry

TABLE XI.—*Cotton Spinning Spindles, by Types, July 31, 1936*
(By percentage of all types)

Country or group	Per cent of total: Ring	Per cent of total: Mule	Per cent of total spinning Egyptian cotton (ring or mule)
Over 95% ring:			
Brazil	100	..	..
China	100	..	..
Denmark	100	..	..
Japan	100	..	9
Mexico	99	1	1
United States	99	1	4
From 95% to 85% ring:			
Canada	94	6	7
India	93	7	5
Sweden	93	7	16
Italy	89	11	13
Hungary	88	12	22
Finland	87	13	9
Other countries*	86	14	13
Belgium	85	15	5
From 85% to 75% ring:			
Norway	83	17	..
Spain	79	21	10
Netherlands	78	22	2
U. S. S. R.	77	23	..
France	76	24	21
From 75% to 70% ring:			
Yugoslavia	74	26	21
Poland	73	27	20
Austria	70	30	17
Portugal	70	30	15
Below 70% ring:			
Germany	67	33	14
Switzerland	67	33	60
Czechoslovakia	58	42	20
United Kingdom	27	73	41
All countries	71	29	17

*Almost entirely "new industrial" countries (*e.g.*, Argentina, Bulgaria, Colombia, Greece, Rumania, Turkey).
Source: *International Cotton Bulletin*, vol. xv., No. 57, Oct. 1936, pp. 150–151.

in that country is engaged upon fine or coarse work. Table XI shows this division.

Spindles on Egyptian cotton are included in Table XI for the reason that any spindle, either ring or mule, running on long staple cotton from that country is in the main, turning out fine yarns.

The ring spindle is the more modern invention, and is more easily operated than the mule; as against the high degree of skill required by the mule spindle, the ring spindle may be operated by comparatively unskilled labour provided that supervision of superiors is constant and close.

There is, therefore, a fundamental difference between the cotton spindle equipment of the United Kingdom on the one hand and the United States and Japan on the other. Countries in which the cotton industry was established relatively early, such as the principal European countries, had in 1936 a substantial number of mule spindles, while in those areas where the industry's development occurred largely in the 20th century, the ring spindle is used almost exclusively. The United Kingdom's possession of more mule spindles than any other country in the world and its access to an abundant supply of long staple Egyptian cotton, which is especially suited to mule spinning, enables the United Kingdom to control the export market of the world for fine cotton yarns and fabrics made therefrom.

At one time, the New England States had a substantial number of mule spindles. In 1914, they constituted 12% of the United States' total spindle equipment and 24% of New England's equipment. The number has dwindled every year since that date until in 1938, the New England States had only about 200,000 mule spindles or less than 1% of the total spindles in the United States. Japan had 37,000 mule spindles in 1928 or less than 1% of the total. Ten years later the number was reduced to 9,000.

It should be said in this connection that the great bulk of the world's business in cotton goods is in the class of medium and coarse goods. Statistics indicative of the relative proportion of

TABLE XII.—*Production of Cotton Yarns by Counts in the Principal Manufacturing Countries*
(In millions of lb.)

	Coarse (up to 20s)	Medium (21s–40s)	Fine (41s–80s)	Superfine (over 80s)	Total (all counts)
United States*					
1929	1,418	1,203	212	13	2,906§
1931	1,107	911	168	10	2,217§
1935	1,235	904	139	10	2,327§
1937	1,722	1,198	181	24	3,125
	(up to 20s)	(21s–42s)	(above 43s)		
Japan†					
1930	631	331	40		1,002
1933	722	454	54		1,230
	(up to 22s)	(23s–44s)	(above 45s)		
1934	819	518	41		1,378
1935	803	561	49		1,413
1936	811	566	55		1,432
	(up to 20s)	(21s–40s)	(41s–80s)	(over 80s)	
Great Britain‡					
1930	808		183	40	1,031
1933	465	484	191	40	1,180
1934	483	499	178	41	1,201
1935	512	496	177	40	1,225
	(up to 20s)	(21s–40s)	(above 40s)		
India¶					
1930	521	322	24		867
1933	564	333	37		934
1934	568	365	42		975
1935	592	397	57		1,046
1936	609	389	57		1,055

*Bureau of Census, U. S. Department of Commerce. †The Japan Cotton Spinners' Association. ‡Census of Production, 1930 and 1935; Import Duties Act Inquiry, 1933 and 1934. ¶Bombay Mill Owners' Association. Figures for coarse counts include yarns made from cotton wastes. §Includes unclassified cotton yarns produced for sale.

TABLE XIII.—*Changes in United States Spindle Equipment, 1925–38*

Calendar year	Total spindles scrapped	Additions* and replacements	Total spindles† in place at end of year
1925	411,128	343,292	37,871,936
1926	724,470	217,264	37,364,730
1927	1,394,946	496,192	36,465,976
1928	1,454,802	255,912	35,267,086
1929	1,046,384	320,784	34,541,486
1930	1,184,928	251,936	33,608,494
1931	1,487,036	205,068	32,326,526
1932	1,028,260	143,908	31,442,174
1933	852,402	348,568	30,938,340
1934	578,696	529,840	30,889,484
1935	1,850,914	214,874	29,253,444
1936	2,022,566	469,316	27,700,194
1937	1,768,442	772,724	26,704,476
1938	896,136	178,280	25,986,620
Total (14 years)	16,701,110	4,747,958	..

Sources: *Association of Cotton Textile Merchants of New York; †U. S. Bureau of the Census.

coarse, medium and fine yarn produced—available for four important countries—are shown in the Table XII.

Great Britain and the United States produce about an equal quantity of fine yarn but the former exports a very important part of its fine yarn whereas practically all of the latter's fine yarn is used for knitting and weaving. Japan and India likewise are evenly matched in the fine yarn field.

Although there has been, as observed in a foregoing tabulation, a steady decline in the number of spindles in the United States, it should be said that a certain amount of new installation goes on continually. The year-to-year decline in the number of spindles is a net figure representing the difference in the number of old spindles that have been discarded and the additions and replacements. The cotton ring spinning spindle, which is not a single machine but always installed on heavy frames containing 200 or 300 separate spindles, is a long lived machine. The additions and replacements each year represent only a small proportion of the total number in place as will be noted in Table XIII.

Thus of the 26,000,000 spindles in place at the end of 1938 about 5,000,000 or 18% were less than 15 years old and the balance ranged in age upwards from that figure to perhaps 40 to 50 years.

In addition to installations of new spindles to take the place of those that are worn out, a fundamental change has been going on since about 1926 in the spinning operation itself. This change embraces what is known as long draft spinning. Most new frames are so equipped but the system also can be introduced into spinning frames that have already been installed by means of an attachment. Among the advantages that long draft spinning contributes are ability to use shorter staple cotton than in the case of ordinary spinning, improved yarn strength and a very substantial reduction in the number of steps required in the preparation of the fibre in the average cotton mill prior to spinning the yarn. One-third to one-half of the spindles in the United States in 1939 were said to be long draft or equipped with the long draft attachment.

In mills where fine yarns are manufactured to an important extent long draft spinning does not offer the same advantage as in the case of medium and coarse yarns, and for that reason the introduction of long draft spinning in European countries has not proceeded to the same extent as in the United States and Japan.

The International Labour Office in its study entitled "The World Textile Industry," prepared for the Tripartite Technical Conference on the Textile Industry held in Washington, D.C., in April 1937, presents an ingenious analysis of actual spindle capacity which allows for different types of spindles, and their normal operating time in various countries. This comparison shows the capacities of the various cotton manufacturing countries to produce cotton yarn, irrespective of coarseness or fineness. Naturally, from this standpoint the United Kingdom has a much lower capacity than the aggregate of its spindles shown in Table IX would suggest.

A statement from *The World Textile Industry* introduces this illuminating analysis and is followed by the analysis itself:

"In reducing actual to equivalent ring spindles, it may be assumed that ring spindles operate at an appreciably higher level of mechanized technique than do mule spindles, at least to the extent that both types are employed for similar manufacturing purposes. In reducing equivalent ring spindles to their actual (commercially feasible) capacities, it has been assumed that various economic and social factors hold down spinning activities in all countries below the theoretical maximum of 168 hours weekly. Custom, collective agreement, law, or all three combined, assign limits which vary among countries to the maximum labour week and to the number of daily operating shifts. It should be stressed that the conversions in question have had to neglect the extremely important factors of relative obsolescence and relative machine speed. Moreover, no adjustment has been made for variations in average yarn counts produced by different countries. Despite these important limitations, the results obtained would appear to approximate much more closely to the actual relative capacities than do mere numbers of spindles in place. The results obtained are presented (in millions of spindles) in Table XIV."

TABLE XIV

Country	Actual number of spindles*	Equivalent ring spindles†	Machine working-time factor‡	Mechanical equivalent—commercially available spindles
Germany	10·1	8·8	1·0	8·8
China	5·0	5·0	3·0	15·0
France	9·9	8·9	0·9	8·0
India	9·7	9·5	2·6	24·7
Japan	10·9	10·9	2·3	25·1
United Kingdom	41·4	29·2	1·0	29·2
United States	28·2	28·0	1·7	47·7

*As of July 31, 1936.

†Computed by weights as follows: mule spindles, 0.6; ring spindles, 1.0. The weights used are more or less conventional. In actual practice, the spread in productivity between ring and mule spindles varies considerably with yarn count. The spread is at its maximum for the coarse counts (one ring spindle equals about two mule spindles), and falls as count rises (for counts over 60's one ring spindle equals somewhat less than one-and-a-half mule spindles).

‡Computed by assuming *maximum* man-hour weeks as follows: Germany, 48; China, 71; France, 40; India, 54; Japan, 55; United Kingdom, 48, and United States, 40; and by assuming average daily shifts numbering: Germany, 1; China, 2; France, 1.1; India, 2.3; Japan, 2; United Kingdom, 1, and United States, 2.

The spindles in the United States are assigned a capacity 60% in excess of the capacity of the United Kingdom notwithstanding its smaller equipment of actual spindles. Also, on a capacity basis, Japan and India are both rated close to the United Kingdom although these countries have barely one-quarter as many spindles as has the United Kingdom. This comparison serves to emphasize the danger of regarding a spindle as a yardstick of production.

BIBLIOGRAPHY.—Bulletins of the International Federation of Master Cotton Spinners' and Manufacturers' Associations, Manchester, England, contain data as to each country's spindles on a semi-annual basis beginning with 1913.

Publications of the Bureau of the Census show activity of spindles in the United States by months and for the important manufacturing States since 1921.

The Bombay (India) and Japan (Osaka) Cotton Associations also publish monthly statistics relating to spinning mill activity in their respective countries.

C. THE WORLD'S COTTON POWER LOOMS

Data as to the aggregate number of looms in the different countries that manufacture cotton goods were not regularly compiled until this work was undertaken by the International Federation of Master Cotton Spinners' and Manufacturers' Associations in 1930. Since then, at three-year intervals, the Federation has taken a census of the cotton power looms in all the cotton manufacturing countries of the world. The results of the 1936 survey showing a grand total of almost 3,000,000 looms in place are given in Table XV.

Great Britain and the United States of America together had in 1936 about one-third of the world's total looms. Ten years earlier these two countries had about half of the total in the world. As is also the case with cotton spinning spindles there is wide variation both with respect to normal operating time and relative output of looms in various countries. Looms differ as to the speed at which they may be operated, the width of cloth they can produce and in the amount of attention required from the operative or weaver. The automatic loom makes it possible, in the manufacture of standard cotton fabrics such as narrow sheetings, for a weaver, with some assistance, to tend as many as 60 looms or more whereas only four looms is the customary assignment of the non-automatic type. Most of the European countries whose cotton textile industries were established during the latter part of the 19th century continue to have a very large proportion of non-automatic looms. The automatic loom, although invented by an Englishman, has not been widely accepted in Lancashire because of labour problems and for other reasons, but it is extensively used in North America and Japan. In the latter country, a particular type of automatic loom called the "Toyoda" loom, is said to rival all others including non-automatic looms in its speed of operation. This loom has become the model loom of the Orient. On the other hand, the Toyoda type of loom would be uneconomical for use in American mills as it requires more battery hands than American looms which adds to the labour cost at the considerably higher American wage scales.

TABLE XV.—*World Distribution of Looms, Dec. 31, 1936*
International Cotton Loom Statistics, Manchester, July 1937

	Ordinary	Automatic	Automatic attachments	Total
EUROPE				
Great Britain	483,984	15,224	5,565	504,773
U.S.S.R.*	216,000	25,000	9,000	250,000
Germany	169,800	18,200	12,500	200,500
France	152,800	37,700	3,400	193,900
Italy†	91,500	33,500	21,500	146,500
Czechoslovakia	100,890	1,930	1,360	104,180
Spain†	61,337	5,249	..	66,586
Holland	45,829	3,671	1,667	51,167
Belgium‡	52,000	..	..	52,000
Poland	25,535	10,714	64	36,313
Switzerland	15,153	4,600	1,461	21,214
Sweden	6,621	8,828	388	15,837
Portugal	14,991	1,098	..	16,089
Austria	8,508	1,707	870	11,085
Hungary	11,500	1,500	1,000	14,000
Yugoslavia	6,461	3,526	1,617	11,604
Finland	6,113	1,745	48	7,906
Estonia	4,757	120	502	5,379
Rumania	14,500	..	..	14,500
Denmark	3,190	690	84	3,964
Greece	5,037	204	99	5,340
Norway	2,291	646	43	2,980
Turkey	1,858	..	..	1,858
Bulgaria	3,459	..	..	3,459
Latvia	932	..	..	932
Lithuania	136	..	..	136
European total	1,505,182	175,852	61,168	1,742,202
ASIA				
Japan	¶292,564	40,000	..	¶332,564
India and Ceylon	197,363	4,185	..	201,548
China	38,515	17,645	..	56,160
Chosen	4,496	..	..	4,496
Manchoukuo	3,626	..	..	3,626
Indo-China	490	..	..	490
Iran	800	..	..	800
Palestine	116	..	..	116
Asiatic total	537,970	61,830	..	599,800
AMERICA				
U.S.A.§	39,777	428,995	..	468,772
Brazil	74,246	4,160	2,497	80,903
Mexico	29,140	705	80	29,925
Canada	1,833	22,976	..	24,809
Peru	3,223	1,223	..	4,446
Colombia	1,767	518	..	2,285
Argentina	1,670	1,976	..	3,646
Venezuela	1,429	..	300	1,729
Chile	820	480	..	1,300
Ecuador	1,224	..	..	1,224
Bolivia	246	..	..	246
Salvador	235	..	..	235
Uruguay	168	76	..	244
Guatemala	186	..	..	186
Costa Rica	87	10	..	97
American total	156,051	461,119	2,877	620,047
Egypt	3,279	..	..	3,279
Australia	355	32	..	387
World total	2,202,837	698,833	64,045	2,965,715

*No returns. Figures estimated from trade sources. †No returns. 1933 totals given. ‡No separate figures given for Automatic and Automatic Attachments. ¶Includes 109,000 looms only 15 in. wide. §Figures for U.S.A. adjusted to conform with 1937 Census report.

The advantages to be gained by the use of highly mechanized equipment seem to be largely confined to the medium and coarse range of cotton textile products on a mass production basis. When an abundance of highly skilled labour is available and wherever such skilled labour is required as in the manufacture of fine goods, for example, the saving in cost on short runs obtained by the use of automatic looms is much smaller proportionately than is the saving when coarse goods are woven because of slower rate of production of fine goods and other manufacturing delays. This has often been given as the explanation for the ability of Great Britain to continue more or less to monopolize the fine goods export markets of the world in spite of her non-automatic weaving equipment.

From a mechanical standpoint there are two broad and distinct types of looms—plain and fancy—leaving out of consideration as relatively unimportant the narrow fabric looms weaving tapes, labels, webbing, etc. The great bulk of the world's cotton power looms come under the first classification and are used in the manufacture of plain, twill and satin weaves with variations and combinations of these weaves. In the second category are included the dobby, box and Jacquard looms that weave respectively geometric designs, two or more colours or kinds of weft or filling and floral or other intricate patterns. Unfortunately detailed statistics giving the numbers of these different kinds of looms are available only for the United States which makes it impossible to give international comparisons. It is a known fact, however, that some countries, *i.e.* Belgium, Italy and the region formerly known as Czechoslovakia, specialize in Jacquard weaving and must, therefore, have a substantial number of Jacquard looms. In 1935, according to the U.S. Census of Manufactures, there were 385,894 plain looms, 75,210 dobby looms, 21,571 box looms and 10,784 Jacquard looms in place out of a total of 493,459 cotton looms.

The relationships that exist between spindles and looms in the cotton textile industries of the various countries offer a means for analyzing each country's position in the international picture. In some countries such as Great Britain, China and Japan spinning and weaving are carried on to a large extent as separate sections of cotton manufacturing. Fundamentally the development of the industry followed similar courses in each of these three countries, but it has progressed to a more highly organized form in Great Britain than in the Orient. The machine spinning of cotton yarn was originally designed to supply the requirements of local hand weavers. Later when power looms were invented separate establishments were built for weaving. So also were finishing plants developed and a non-integrated industry was thus established.

Using the data for looms in place on Dec. 31, 1936 given in Table XV and the number of spindles in place on the nearest date from the same source, the ratio of spindles to looms is indicated in the tabulation in Table XVI.

A cotton mill is said to be in balance if its spindles can produce just enough yarn to supply its looms when both types of

TABLE XVI.—*Comparison of Spindles per Loom in the Principal Cotton Manufacturing Countries of the World*

Country	Number of spindles per loom	Country	Number of spindles per loom
EUROPE		EUROPE—cont.	
Great Britain	79	Sweden	37
U.S.S.R.	40	Portugal	29
Germany	51	ASIA	
France	51	Japan	36
Italy	37	India and Ceylon	49
Czechoslovakia	34	China	90
Spain	31	AMERICA	
Holland	24	U.S.A.	54
Belgium	38	Brazil	34
Poland	47	Mexico	29
Switzerland	60	Canada	46

machinery are operated an equal length of time: in other words when there is no surplus equipment. This balance depends upon the size of the yarn that is spun and the relative closeness (*i.e.* threads per inch or yard) of the weave. In the average mill making coarse bagging fabrics, 30 ring spindles to the loom would be a balanced arrangement. In the case of medium weight carded dress fabrics and shirtings, a ratio of 40 spindles to the loom would be considered satisfactory and 50 spindles would be needed to supply yarn for each loom in the average mill making fine combed dress fabrics. These ratios, when compared with the ratios in the above table, give a rough indication of the kind of woven goods produced in the various countries. There are, however, certain other qualifying factors which must be considered in appraising these relationships. If a country such as the United Kingdom specializes in manufacturing yarn for export or for a large knitting industry, there will be many more spindles in place than are normally required to supply yarn for weaving. In the case of India and China where hand weaving continues on a very large scale the number of power looms in place is only part of the weaving equipment supplied by the spindles. There are literally millions of hand looms in India and China. Included in Japan's weaving equipment are approximately 109,000 power looms 15 inches wide. These looms manufacture exclusively for the home market. They are in small family shops and their efficiency is, therefore, relatively low. Moreover, Japan's spindles customarily operate two shifts as against a single shift in most of the small weaving establishments. Consequently the ratio indicated for Japan showing 36 spindles per loom is somewhat deceptive in view of the fact that there is also a substantial number of hand looms in Japan.

Owing to the meagreness of the data available, it is not possible to trace with accuracy the development in the use of cotton power looms in the world as a whole. Some statistics are available for the eight most important cotton manufacturing countries and they are arranged for convenient comparison in Table XVII.

TABLE XVII.—*Number of Cotton Looms in Place in the Eight Most Important Cotton Manufacturing Countries of the World for Selected Years* 1899–1937*

Year	Europe				Orient			United States of America
	Great Britain	U.S.S.R. (Russia)	Germany	France	China	Japan	India	
1899	648,820	..	..	..	8,900	..	40,000	450,682
1904	652,166	..	230,000	106,000	..	..	50,000	540,970
1909	741,197	..	..	..	..	..	83,000	632,963
1914	805,452	..	230,000	108,000	9,400	..	94,000	672,754
1925	788,197	202,011	240,700	182,500	25,934	238,999	154,000	762,808
1928	767,524	159,100	..	..	29,788	..	154,262	715,046
1931	692,899	159,100	206,077	200,100	29,582	..	179,682	588,005
1934	587,964	197,400	205,000	198,200	44,000	277,343	190,216	504,343
1937	504,773	216,000	200,500	193,900	56,160	332,564	201,548	468,772

*Where .. is shown no comparable figure is available. In some cases the figure given applies to one year later than that indicated.

Based on figures from: International Federation of Master Cotton Spinners; Tattersall's *Cotton Trade Review;* Worrall's *Cotton Spinners' and Manufacturers' Directory;* Comtelburo, Ltd.; United States Bureau of the Census.

In Great Britain and the United States, it will be noted, there was a more or less steady growth in the number of looms up until 1914. Following the World War (1914–18) the number began to decline in Great Britain but the peak in the United States was not reached until 1925. This year also coincides with the time when the greatest number of spindles was recorded. The decline from 1925 to 1937 followed the same trend in both countries so much so that it would seem that they were affected by similar economic forces. This would be true if it could be said that old inefficient nonautomatic looms were unable to meet competition from modern high speed automatic looms. England's competition, however, was in her export trade with the Orient whereas in the United States there was an inter-regional shift of production caused by a rapid decline and liquidation of equipment in the older manufacturing region of New England as the manufacture of cotton goods was transferred to the lower cost mills of the southern States with their newer automatic looms and lower-paid workers not handicapped by restrictive labour legislation.

The other three European countries, for which data are given in the table, display mixed trends. Russia and Germany both lost some of their textile mills after the war of 1914–18. Since 1928 Russia has been trying to rebuild its cotton industry by means of various 5-year plans in conjunction with expanding production of raw cotton. Germany has turned more and more to the substitution of rayon for cotton under its program of national self-sufficiency which probably accounts for some of the decline in looms accompanied by the natural obsolescence of looms that have been in use for 40 years or more. In the case of France the transfer from Germany of 50,300 looms in the Alsace-Lorraine district in 1919 accounted for most of the increase between 1914 and 1925. From 1931 to 1937 a downward trend has prevailed not only in France and Germany, but also in many other European countries not shown in Table XVII with the notable exception of Russia.

On the other hand a steady growth is evident in the number of looms installed in the mills of the Orient. The largest absolute increase was in Japanese mills but not all of this expansion represents new equipment. An indeterminate number of second-hand looms were brought from the United States, Great Britain and elsewhere during the ten years ended in 1937. It is a corollary in the development of the Oriental textile industry that wherever relatively low-paid labour is employed the need and importance of labour-saving and otherwise efficient machinery is greatly minimized. The expansion in India's looms between 1928 and 1937 naturally does not reflect the movement similar to the United States migration away from Bombay to lower cost areas of a substantial volume of production. It is extremely significant that in a similar way Japan's cotton textile industry was also beginning to feel the pressure of higher costs and starting in 1939 there began an exodus of surplus Japanese spindles and looms to the areas of North China which at the time were being industrialized by Japanese capital. The development of power weaving in China was slow in getting started but rapid progress was made between 1931 and 1937. Although the conflict between Japan and China that started in the latter year was responsible for the destroying of many Japanese-owned cotton mills many of these mills have been rebuilt and the world may well look to China for the next great expansion in the cotton textile industry.

BIBLIOGRAPHY.—The sources mentioned in the bibliography under section "The World's Cotton Spindles" also contain data as to looms. For additional information the following reports should be consulted: Cabinet Committee Report (U.S.), *Cotton Textile Industry* (Senate Document No. 126, 74th Congress, 1st session) 1935; Committee on Industry and Trade (Great Britain), *Survey of Textile Industries* (1928); International Labour Office, *World Textile Industry* (1937); Charles K. Moser, *Cotton Textile Industry of Far Eastern Countries* (1930). (P. B. H.)

D. VARIETIES OF COTTON CLOTH

Cotton Fabrics.—In the American, Canadian and British cotton cloth markets there are three broad divisions: (*a*) *gray cloths* —those woven of unbleached yarns—in some cases used in this state; (*b*) *finished or converted cloths*—which are gray cloths converted by bleaching, dyeing, printing and finishing; (*c*) *woven coloured yarn cloths*—woven and finished ready for use by the mills making them, known as mill finished cloths.

There are many fabric names used. These include (*a*) basic cloth names which are usually the same in both the gray or finished state; (*b*) cloths named after the finishes used on them.

A large number of fabrics are made in the British cotton cloth trade especially for export markets and suitable only for their particular purpose.

The following cloths are generally standard in British (home and colonial) and/or American markets:

Aeroplane Fabric.—Strong, plain woven, usually 2-ply combed yarns (mercerized or plain). Single combed yarns also used. Made of Sea Island type cotton, Egyptian, Pima or other long staple American cottons. Square thread construction. One of the strongest cloths for its weight made. Uses, covering of wing, tail and fuselage of aircraft, tow targets. Also bleached and dyed and used for shirtings, boys' wash suits, etc.

Albert Twill.—See Beatrice Twill.

Awning Fabric.—Strong, closely woven, bright coloured striped fabrics. Either yarn dyed or oil painted stripes (one side only). Plain woven, ply yarn, army duck fabric used for better qualities. Single yarn flat ducks, drills used for cheaper painted awnings. Uses, awnings, canopies, beach chairs, hammocks, umbrellas, window blinds, garden, beach tents.

Balloon Fabric.—Plain woven, high thread count, combed, usually single yarn cloths of selected extra strength, long stapled cotton. About the strongest cloth for its weight made. Uses, gas cells in airships, balloons. Bleached, dyed, mercerized, used for men's shirtings, shorts, underwear, rubberized raincoat fabric. Similar but higher thread count fabrics called typewriter ribbon cloths.

Batiste.—(*a*) Highly mercerized, soft finished, light weight, combed yarn, converted, lawn type fabric, bleached, dyed, printed. Uses, women's and children's lingerie, nightgowns, summer dresses, infants' wear, linings. (*b*) In the corset trade (American) strong, heavy, plain woven poplin type fabric. Also has Jacquard designs, all carded, all combed yarns, cotton warp and rayon filling, dyed flesh colour. Uses, corsets, brassieres.

Beach Cloth.—Strong cotton fabric chiefly used for flag bunting. Two ply, carded yarn, loose texture. Used in white, red, navy, etc. for signal flags by railroads, army, navy. Also base for embroidery, men's suitings, draperies.

Beatrice Twill (British) or *Albert Twill* (American).—Five harness weft (filling) face twill usually of combed yarns. Dyed fast black, given highly lustrous mercerized and Schreinered finishes. Used for vests, coat linings, umbrellas. Albert is similar twill (American), made with 4 (or 5) harnesses.

Bedford Cord.—Fabric with lengthwise prominent raised cord effects similar to warp pique but coarser. Heavier qualities usually have additional coarse warp (wadding) yarns, along back of cloth only, to help to raise cords. Sometimes napped on back for softness, bulk, warmth. Uses, riding breeches, hunting clothes, summer slacks, uniforms. Wide widths used for car upholstery. Piece dyed, printed stripes, checks given plain, mercerized, preshrunk finishes.

Broadcloth.—(American name for British fine poplin.) Has a very fine rib across the width. Is plain woven with about twice as many ends as picks. Has higher thread count than regular poplin, always has more picks. Usually combed, ply or single yarns used. Cheapest qualities made with carded print cloth yarns. Uses, shirtings, pajamas, shorts, summer dresses, beachwear, etc.

Brocade.—Elaborate, compound, Jacquard woven, upholstery fabric, made of dyed yarns (mercerized, ply cotton warp yarns, silk or rayon filling). Filling yarns float to form the designs which stand out in relief and include multicolour, small floral effects, similar to upholstery damask except that finer yarns, higher thread count and more than one colour filling used. Lighter British brocade is made of fine single, combed yarns, piece mercerized and dyed. Used for dress goods, linings, etc. Other brocaded fabrics of different weights and colourings are made expressly for corset trade, men's necktie trade.

Calico.—An old term given to plain woven, white, dyed or printed medium weight fabrics in general household use for aprons, house dresses, playsuits, pillow cases, etc. Same fabrics in different finishes also referred to as domestic, printed percale, chintz, cambric, muslin, cretonne, etc.

Cambric.—Smooth, lustrous, finished, plain woven cloth. Usually white, also dyed, soft or slight starched finish. Finer cambrics are converted from heavier lawn type cloths. Cheap cambric qualities converted from carded yarn print cloths are backfilled with China-clay and starched for weight and appearance. English cambrics are usually converted from finer yarn lawns only. Uses, cheaper carded cambrics—trimmings, bindings, linings, quilted pads, toys. Softer and finer yarn cambrics—infants', children's wear, underwear.

Casement Cloth.—Flat, lustrous, British curtain fabric, plain woven, combed or super-carded yarns with larger number of picks of heavy yarns than ends which are finer. Mercerized, bleached, dyed ecru and other colours. With higher thread count also known as Limbric (British).

Chambray, Work Chambray, Dress Chambray.—Shirting fabric, plain woven, all dyed warp yarns—woven with unbleached (white after bleaching) filling. Work chambrays have carded yarns, more ends than picks, dyed warp yarns and unbleached filling yarns. Blue warp yarn generally used (also gray) is a starched mill finished fabric. Dress chambrays have combed yarns with almost square thread count, are always bleached and often pre-shrunk. When made with alternating white and coloured warp ends known as end-and-end madras or end-and-end chambray. Fancy chambrays also made with small designs over chambray ground. Used for dress shirts, women's, children's wear. Bleached, given plain, mercerized, pre-shrunk finishes.

Cheese Cloth or Tobacco Cloth.—Loosely woven, soft, light weight low thread count plain woven fabric, also called hospital gauze. In bleached soft finish used for surgical dressings, bandages, tea bags, cleaning and wiping cloths. In stiff starched finish used for interlinings, hat shapes (also called crinoline). Also used for base or backing for paper. When unbleached used for wrapping meats, cheeses. In 36in. called tobacco cloth.

Chintz.—A highly lustrous, firm, plain woven, brightly coloured, printed summer drapery fabric with a glazed (friction calendered) finish. Small colourful patterns are generally used, also solid drapery colours. Chintz fabrics are generally converted from gray print cloths (or printers).

Covert.—American covert cloth is a widely used mill finished work clothing fabric. Has a characteristic mottled or flecked appearance made of mock twist single warp yarns spun from white and coloured rovings. Heavier black filling yarns are used. Usually are closely woven 3-harness warp face twills. Light weights used for work shirts, smocks, work caps; heavy weights, trousers, uniforms. Cheapest qualities are plain woven.

British made coverts generally are closely woven topcoat or raincoat fabrics made with "grandrelle" warp yarns. These are mottled 2-ply yarns, one white and one coloured.

Cottonade.—Strong, 3-harness warp faced twill mill finished work clothing fabric with coloured yarns made in oxford gray and black over stripes, and in all dark oxford gray. Grayish white blended warp and heavy black filling yarns used. Given a firm starched finish, sometimes napped on back. Used for work trousers. Usually heavier than covert.

Coutil.—Three-harness warp faced herringbone twill, closely woven, of strong carded yarns. Piece dyed flesh, or pink. Made especially for the corset trade.

Crash.—Finished, plain woven, heavy coarse yarn cloth. Bleached, dyed, also printed. Often given lustrous, mercerized and chased finishes to imitate linen crash, plain and backfilled finishes. Sheeting and osnaburgs are used in converting.

Crepe.—A rough, pebbly surfaced fabric obtained by using high twisted crepe yarns. These when wet out immediately contract pulling in or creping the cloth with it. Different warp tensions used in weaving also produce crepe effects found in seersucker or crimp (British) fabrics. Crepe effects are also formed in finishing by caustic soda printing and by embossing with crepe design rollers. A crepe or oatmeal effect is obtained by weaving fine warp and coarse filling (weft) yarns in granite or mock Leno weaves. These are called momie crepes (in American market).

Croydon.—Name of a British firm-finished, smooth-faced, bleached plain woven fabric. Printers and sheeting type fabrics used for converting. Cheaper qualities often have a back filled finish.

Damask.—Jacquard woven elaborate decorative fabrics. (*a*) Table damask, flat reversible patterns, changeable light and shadow effects formed by contrasting light reflections of (horizontal) weft yarn satin floats over (vertical) warp yarn satin floats. Bleached white, also dyed, also made with white and coloured yarns, given plain, mercerized or special "no lint" finishes. (*b*) Drapery-Upholstery damask, heavier, coloured yarn, lustrous decorative fabrics usually of rayon (warp-twist) and cotton filling (weft). The pattern which is slightly raised is formed by floats of spiral, ratine or other novelty filling (weft) yarns on a warp satin rayon background. Also made of all rayon and piece-dyed.

Denim.—Also known as dungaree cloth. Is the most important work clothing fabric made. A 3-harness, strong warp faced twill woven coloured yarn fabric. Usually made with indigo blue dyed warp (twist) yarns, unbleached filling (weft) yarns and known as white back denim. Also made with brown warp yarns and also in solid blue. Largely used for overalls, jackets, caps, etc. Similar fabrics are made with white and blue stripes and known as hickory stripes, pin stripes, also pin checks. Used for butchers' aprons, mechanics' overalls, caps, etc. Women's sportswear trade uses denims made with light shades of blue, tan, red, green, and known as faded denims. Usually given a firm starched finish and often a pre-shrunk finish. Denims are mill finished fabrics.

Diaper Cloth.—Or bird's eye cloth. A carded dobby woven fabric with a diamond design. The warp yarn is finer than the filling (weft) which, being softer and bulkier makes the fabric very absorbent. Another diaper cloth is the diaper flannel. A soft, absorbent, napped sheeting having a soft, twisted filling (weft) yarn. Usually bleached and given a pure absorbent finish. Uses, diapers, towels.

Dimity.—A combed yarn, sheer fabric, with distinctive fine warp cords. Formed by grouping or crowding of warp ends on plain woven ground. Also made with check effects. Usually bleached, mercerized and given a firm starched "lawn" finish. Also printed. Used for women's, children's blouses, waists, summer dress wear.

Drill.—British term generally applied to all warp faced cloths, twill woven, irrespective of the number of harnesses, *i.e.* florentine drill (4-harness warp twill). When single yarns are used they are made with left hand twill, running up toward selvage. Weft faced twill woven cloths are generally called twill (Beatrice twill, 5-harness).

Drill, American.—Always 3-harness, warp faced twill, medium and heavy weight strong fabric of carded yarns. Used in the gray state for pocketings, box spring covers, sailcloth, bags, base for coated fabrics. When bleached, dyed or printed, used for shoe linings, overalls, pants, uniforms, printed mattress ticking, summer trousering, painted awnings.

Duck.—Strong, heavy, closely woven carded yarn cloth usually made of ply yarns, also known as canvas. Made in many qualities and has dozens of uses in gray or converted state where utility and service are required. Two chief types made are, (*a*) wide number duck, army duck (made in narrower widths only), plain woven, ply yarns (2 or more ply); (*b*) Single filled, flat duck, double filled, flat duck. These always have single warp yarns woven in pairs (or double ends). Where filling yarns are single, known as single filled duck. If 2 ply, called double filling duck. Varieties of ducks include sail duck, hose duck, tent duck, shoe duck, army duck, enamelling duck. In the gray state used for folding cots, chairs, hammocks, mail bags, truck covers, overalls, base for coated fabrics. Bleached white, dyed, printed and used for work pants, washable clothing of all kinds, shoe linings, summer trouserings, bookbindings, painted awnings, army tents (khaki dyed).

Flannel-Flannelette.—Plain woven, soft, fleecy, warm, cotton fabrics resembling wool flannels. Made with fine warp yarn and soft spun filling (weft) yarns. The low twisted filling yarns are easily raised or napped. Bleached, dyed and printed. Also made with coloured yarn, plain and twill woven stripes, bright plaids. When printed also called flannelettes. Used for nightgowns, pajamas, linings, pocketings, baby blankets and diapers, dolls.

Flannel, Canton.—A 4-harness fine warp yarn left twill with heavy, soft, twisted filling. Has a soft, long, fleecy finish on back. Unbleached, used for work gloves; lighter weights are bleached, dyed and used for linings, bathrobes, pocketings.

Flannel, Outing.—American name for a plain woven, coloured yarn, striped short nap flannel. Plain, bleached flannels are also known as domett flannels. Used largely for sleeping garments, children's underwear.

Flannel, Suede.—A fine, smooth, flat, felted finish on one (or both) sides. After napping the nap is sheared down close to the ground of the cloth and the fibres "felted" into the ground of the cloth. Used for sport shirtings, linings, sleeping bags.

Flannelettes.—Similar napped soft, fleecy cloths made in Great Britain are called flannelettes. These are plain or twill woven and made with soft twisted weft. All white, printed, piece dyed, and woven with coloured yarn stripes and checks. Same uses as flannel.

Florentine (Drill).—British, heavy, strong, serviceable, carded, left hand, 4-harness warp faced 3/1 twill. American name is 4-leaf (harness) warp twill. Bleached, dyed khaki or other suitable shades for army uniforms, hunting outfits, tents, light tan shades for tropical uniforms, shorts. Piece dyed, printed and used for semi-dress slacks, summer camp clothing.

Gabardine-Gaberdine.—A steep angle, heavy, prominent 11- to 15-harness warp faced twill woven fabric, single or ply, carded or combed yarns. All white, piece dyed, printed, mercerized pre-shrunk finishes. Uses, riding habits, summer suits, slacks, sportswear. Single warp yarn gabardines generally have a left hand twill. Ply warp yarn gabardines have a right hand twill (running upwards to selvage).

Galatea.—British, 3-harness drill (warp face) woven with white and fast coloured yarn stripes, usually on solid blue ground. An old term used in American market for a converted Jean or warp sateen, with white and printed coloured stripes—also solid colours. Uses, shirts, nurses' uniforms.

Gingham.—Medium, lightweight, plain woven with carded or combed yarns. Woven on box looms with white and coloured yarns in balanced check and plaid effects, stripes and fancy weaves. Also known as apron checks, nurses' gingham. Fine combed yarn ginghams also known as Madras ginghams. Finest ginghams are made in Scotland. Uses, women's, children's wear, house dresses, aprons, pajamas, curtains, dolls, shirts.

Grandrelle Yarn Shirtings.—British shirting fabric, strong, long wearing, closely woven with stripes of both solid colour yarn and mottled Grandrelle yarn (one coloured and one white yarn plied together). White single soft twist weft yarns are used; twill or sateen woven.

Harvard.—A British shirting fabric usually made with a reversible 2/2 twill. Also made with fancy stripes and figures. Fine, coloured warp yarns and heavier soft white weft yarns. Has a soft texture.

Holland.—A firm coated, smooth, glazed finished window shade cloth. Print cloths and light-weight sheetings used as basic cloths; also made with corded effects. Heavily filled with starch and China-clay. Also painted with oil paints.

Hopsacking.—American cloth, name given to coarse, heavy, open, loose texture men's summer sportswear fabric. Similar to osnaburg but cleaner, lower thread count. Best qualities have 2-ply spiral yarns. Given a soft finish. Unbleached, also dyed, generally pre-shrunk.

Huckaback.—A narrow width huck towelling fabric made with a huckaback weave in which the heavier, softer, absorbent (weft) filling yarn floats to form the pattern. Bleached white, dyed pastel shades, also printed.

Jean.—Strong, closely woven 3-harness warp twill, finer yarn, higher thread count than American drill. Bleached—used for middy blouses, dyed—used for work shirts, semi-dress shirts, corset and shoe linings, camp clothing.

Jeanette.—British name for lighter weight, weft faced twill with almost square construction. Also made with more picks than ends. Similar American cloth is called 3-leaf filling twill, made of print cloth yarns, dyed and given friction calendered finish for "Silesia" lining finish. Also dyed khaki, used for work shirts.

Lappet.—Name of an embroidered, decorative design woven in the loom over a plain woven lawn type fabric. Design is formed by the weaving of extra (heavier) warp yarns by needles, in warpwise direction. The floats of these heavier warp yarns produce the pattern, which is repeated across the width of the cloth and also in the length of the cloth. Usually bleached or piece dyed, used for summer dress wear.

Lawn.—Basic, fine, combed yarn, plain woven gray fabrics of various qualities used in the converting of fine, closely woven and sheer fabrics used for dresses, uniforms, underwear, infants' wear. They are bleached, dyed, printed and often mercerized. Converted fabrics of this type include crisp lawn, stiff organdy (finish), muslin, lining plissé crepe, nainsook. Lawn is also the name of a starched, crisp finish. These finished lawns have various names such as India lawn, Victoria lawn and Persian lawn (which is the finest made). Handkerchief lawn is usually high thread count lawn with a soft finish.

Leno.—Also called gauze weave, in which cross weaving of warp yarns produces an open weave porous texture and prevents slipping or the displacement of the filling yarns. Used on mesh cloths, marquisettes, etc.

Limbric.—Flat, lustrous dress goods; curtain fabric (British) like casement cloth, has much finer warp yarn than weft, and usually has a higher thread count. Similar to cotton pongee (American) but has heavier yarns.

Longcloth.—Name of a finished, medium or fine thread count cloth in a pure finish. Heavier than lawns, cambric, muslin fabrics. Printers, print cloths and finer yarn plain woven cloths used for converting. Used for pillow cases, children's underwear, household uses, collars, hospital uniforms.

Madras.—Combed, single yarn shirting fabric, lighter weight than broadcloth, almost square thread count with dobby or Jacquard woven designs of fancy stripes or all-over patterns in all white or white and coloured yarns.

Curtain Madras or Curtain Grenadine.—An open texture fabric with leno woven ground cloth, usually a marquisette of fine yarns. On the face is a decorative design at spaced intervals, woven with extra picks of heavy white roving. In between the pattern repeats, the roving floats along the back of the cloth and is afterwards clipped or sheared off as closely as possible. Produces a "lace" effect. Dyed yarns often used for ground.

Marquisette.—Sheer, leno woven, open texture, curtain fabric. Best qualities made with combed mercerized and gassed ply yarns. Leno weave prevents slippage of filling yarns. Made with strong, closely woven wide tape selvages. Cheap qualities made with carded print cloth yarns (30s to 40s). Mostly dyed ecru and given plain or mercerized finishes.

Moleskin.—Also called Imperial sateen (in British market). Strong, smooth face, heavy, coarse yarn filling face twill (or sateen) has about twice as many picks as ends. Dyed and duplex printed (on both sides) to imitate woven striped suitings. Largely used for men's work trousers. Solid colours used for sheepskin-lined winter coats. Napped on back for bulk, warmth and softness. Given short close suede finish on face and used for windbreakers, suede jackets, winter shirts. This fabric belongs to the old British Fustian type of fabric.

Mull.—Very bright, pure starched, finished, plain woven, lightweight combed yarn, bleached fabric of lawn type. Finish similar to nainsook, muslin or batiste. Also known as Swiss mull, India mull. Largely used in Far Eastern markets.

Muslin.—Soft, pure, finished, plain woven cloth of the lawn type. Bleached, dyed or printed. In American market muslin is also a white piece goods finish. Staple bed sheetings are given a pure muslin finish. Somewhat dull and "clothy," cheaper qualities have back filling. Gray print cloths and lighter weight sheetings also called unbleached muslin.

Nainsook.—Bleached, also dyed pastel shades, soft finished, light weight, usually combed yarn, plain woven lawn type fabric, slight lustre, no sizing used. British nainsooks also known by general term of white shirtings in export markets. Embroidered, used for nightgowns, infants' dresses, underwear.

Organdy.—Very light, transparent, stiff, wiry, finished, plain woven, open texture, finer yarn, lawn type fabric. Is about the finest and sheerest fabric made. Generally bleached, also dyed, printed. Usually mercerized and given very crisp permanent Swiss organdy finish or a firm starched organdy finish. Same cloths also converted into a crisp blister crepe, a soft, Swiss, "cloudy" opal finish or lustrous mull finish.

Osnaburg.—Rough coarse uneven yarn, low thread count, plain woven gray cloth made of all low grade cotton or part waste cotton. When unbleached has dirty appearance due to presence of motes (particles of seed). Converted by bleaching, dyeing, printing and known as crash, suiting. Given mercerized and chased finishes. Has linen-like appearance. Largely used in unbleached state for bags, embroidery purposes. Similar but cleaner, lower count, soft finish, unbleached and dyed single and 2-ply yarn cloths called hopsacking.

Oxford.—Shirting fabric, heavier than broadcloth made of fine warp, heavy filling yarn. Every pair of warp ends runs together (or double ends) and weaves as one with each pick. Usually has twice as many ends as picks per inch. Generally bleached or dyed shirting shades. Also made with dyed warp yarns and white filling—known as chambray oxford. British oxfords also made with fancy stripes and checks. If made with single ends are known as single end oxfords.

Percale.—When applied to bed sheeting, an all combed, plain woven high thread count, smooth, soft finished fabric. Cheaper quality, called light percale, is lighter weight, carded yarn, lower thread count cloth. Is finer than muslin type sheeting. Percale sheetings never have less than 180 threads per square inch.

Percale (Printed).—In American market a widely used, plain woven, carded yarn printed fabric usually converted from standard print cloths, by bleaching and printing with designs suitable for dresses (house, street), pajamas, children's wear, sportswear, etc.

Pique.—American carded or combed yarn fabrics are always warp piques with narrow raised cords or wales running warpwise (lengthwise). Very narrow cord called pin wale. Pique is a lighter made Bedford cord. Better qualities have additional coarser warp ends woven along back only under each cord to help raise it.

Pique.—British, weft fabrics with distinct cords, also called Toilet Welts, similar in appearance to Bedford cords except cords or welts always run widthwise. Fancy piques are compound fabrics made with quilted or puffed designs also known as Vestings. Face fabric has closely woven fine yarn design. In places where both fabrics are separate, design has raised or embossed appearance. Plain corded piques and fancy piques are used for white dress shirts, shirt fronts, white waistcoats, dress goods, etc. Made all white and white with coloured yarns.

Poplin.—Plain woven fabric with ribs (running widthwise), in all white, solid colour, printed or yarn dyed stripe effects. Best qualities have ply or single combed yarns, also made with single carded yarns. Finer yarn and higher thread count poplins with finer ribs are called broadcloths (in American market only). Poplins have about twice as many ends as picks, the fewer spaced weft yarns producing the characteristic rib effect. This is more pronounced when heavier weft yarns are used. Light weight poplins used for shirtings, summer sportswear; heavier weights for raincoats, ski-wear, and sportswear.

Print Cloth.—American basic carded yarn, plain woven medium weight staple fabrics using yarns from 28s to 42s. In the American market the most widely used cotton fabrics for converting. Given many different kinds of finishes for various trades and uses, having different names. Often used as substitutes for better cloths of same name. Names of finished cloths include printed percale, cambric, lawn, organdy, printed shirting, muslin, crepe, lining, canvas, chintz, interlining, bias binding.

Printers.—British fabrics—known as Cheshire or Burnley printers. Basic gray cloths which are similar to print cloths. Bleached, dyed, printed for home, colonial, export markets. Finished cloths include printed shirtings, printed dress goods, drapery fabrics and a group of finished cloths referred to as white shirtings.

Pile Fabrics.—General name for velveteens, corduroys, cotton velvets, plush or velour having a cut pile surface. The pile is formed by extra warp or filling yarns which float on face and are afterwards cut, producing a surface of soft brush-like hairs which stand upright from ground of cloth. Pile can be an all-over effect as in velveteen or in cord effects warpwise as in corduroy. Pile fabrics can also have uncut loops as in turkish towelling or terry cloth.

(*a*) *Velveteen.*—This name always applies to a cotton or rayon filling pile fabric. British term for cheaper qualities of cotton velvets.

(*b*) *Plush or Velour.*—A warp pile fabric with a higher or longer pile than velvet or velveteen, made from a double (plush) fabric in which two fabrics are woven face to face and afterwards split producing two separate pile fabrics.

(*c*) *Velvet.*—British name for best qualities filling pile fabrics. In American market name for a warp pile fabric which is first woven double and then cut to form two separate velvets in similar manner to plush.

(*d*) *Corduroys.*—Filling pile fabric in which pile is in form of narrow or wide wales or cords running lengthwise. Pile fabrics are made of all cotton, rayon face, mohair face, silk face. The better qualities of pile fabrics have a twill back and a dense deep pile.

An old British term for heavy weft face cloths of either cut pile or flat woven fabrics was Fustian (*q.v.*).

Pongee.—Cotton pongee is smooth, flat, very lustrous, plain woven, usually made of combed yarns. Bleached, dyed ecru, other colours. Usually, mercerized and chased or mercerized and Schreinered for a high lustre. American pongee (also called soisette) is made with more picks than ends. Filling yarns are heavier than the warp, producing a very flat lustrous finished cloth. British pongees are usually made with heavier warp yarns than weft. They often have more ends than picks and also are made in square thread count construction.

Quilt Fabrics.—Dobby or Jacquard woven fabrics in all bleached white, or white and coloured yarns with quilted, raised or flat designs used for spreads, counterpanes. British-made quilt fabrics include Patent satin or Mitcheline, Toilet, Marseilles, Alhambra, Crochet, Honeycomb. Mitcheline or Patent satin, Marseilles and Toilet are heavy compound fabrics. Finer yarns are generally used for design on face cloth and heavy yarns for back cloth. Alhambra, Honeycomb and Crochet quilt fabrics are cheaper, lighter.

(*a*) *Mitcheline,* named after D. Mitchell, is a heavy double fabric made of white and coloured yarns in which the design is in solid colour. Also made all gray and bleached white.

(*b*) *Satin or Patent Satin.*—Very similar to and really an improvement or a modification of Mitcheline. All bleached white also white or coloured figures on a coloured ground. No satin weaves are used, however.

(*c*) *Toilet.*—A heavy, double woven, fancy woven, pique type fabric, all bleached white, has embossed or raised figures on face (plain woven fine yarns) on coarser rough plain woven ground cloth.

(*d*) *Marseilles.*—Double woven fabric, heavy, firm texture. Reversible quilted or raised patterns.

(*e*) *Alhambra.*—Has white and coloured large decorative designs. Lighter weight.

(*f*) *Honeycomb.*—Soft, loose texture, ply warp, soft twist weft yarns, lighter weight, raised and depressed patterns, resembling honeycomb or waffle effects. All bleached white.

(*g*) *Crochet.*—A medium weight, dobby or jacquard woven with fine crochet or lace like designs. All bleached white, lighter weight.

American-made quilt fabrics include a number of white and coloured yarn quilt fabrics of various weights made with flat or quilted designs which are referred to generally as Jacquard bedspreads or according to type of pattern used such as Colonial, Peasant, Dimity, Crinkle stripe, etc.

(*h*) *Ratine.*—Plain woven, bulky, soft, spongy texture fabric. Made of different size yarns irregularly plied. Also known as Eponge. British name for the type of yarn used is Gimp yarn.

(*i*) *Repp* (Weft or Filling).—Woven cloth with prominent ribs running widthwise. Heavy weights made for upholstery, drapery purposes; lighter weights for shirtings, dress goods. Has from two to three times more ends than picks. Similar to heavy poplin but has more prominent rib. Very coarse rib known as Grosgrain. Rib effects are formed by the use of fewer number of coarse ply filling yarns. Finer rib shirting repp made by tension and slack weaving of warp ends, with low number of picks, known as tension repp.

(*j*) *Warp Repp.*—British cloth. Has about half as many ends as picks with ribs running lengthwise. Also made with figured effects, also called Moreen.

Sateens, Cotton Satins, Satin Drills.—British fabrics of this type if formed by warp are called warp satins, satin drills. If formed by the weft are called weft satins, weft sateens or Italians (high count). American fabrics are called warp sateens, filling sateens. They are flat, smooth-faced cotton fabrics made with a satin weave, the third foundation weave. Made with 5 harnesses either warp faced or weft faced. In weaving a warp sateen each warp yarn floats over four weft yarns and interlaces with the fifth weft yarn (weft satins are made vice versa). The bindings or interlacings are as far apart as possible to obtain a smooth face and to avoid a diagonal line effect. Because of their smooth flat surface, especially the weft satins, they take a highly lustrous finish when mercerized and Schreinered. Usually dyed black and colours. Used for linings, underwear, umbrellas. Warp faced satins generally are stronger, firmer cloths of heavier carded yarns. British cloths of this type are called satin drills. Bleached firm finish used for tropical suitings, washable clothing. Dyed and used for outdoor sportswear, uniforms. Printed, used for mattress ticking, draperies. Light weight soft, silky fine combed yarn warp sateens when highly mercerized and Schreinered are called charmeuse satins or sateens. A twill faced weft sateen is also made by having repeat of weave run in same direction as that of twist in the weft yarn—also known as "French Twill Sateen." Eight-harness, warp satin called Venetian.

Scrim.—Plain woven, loose, open texture, curtain fabric of ply combed yarns woven with strong wide tape selvage, sometimes has fancy woven border. Heavier ply yarn (combed) fabric is also known as Hardanger cloth.

Seersucker.—Also called Crimp (British). Summer dress and suiting fabric with characteristic woven crinkle stripes formed by slack and tension weaving of alternating sections of warp ends. Made all white, white alternating with coloured stripes, checks. Given plain finish, pre-shrunk finishes.

Serge.—A reversible 2/2 or similar even sided cotton twill. When made with 2-ply yarns they resemble worsted serges in appearance. Very fine ply yarn, high thread count serge twills are used for highest grade raincoats (dyed and given water repellent finish). Dyed, printed, used for suitings; coarser yarn serges are napped for flannel effects.

Sheeting.—British sheetings are made in plain or twill weaves. The regular plain woven narrow sheetings are strong, serviceable cloths. Generally given a white Croydon finish. Medium weight narrow British sheetings also called domestics.

Wide bed sheetings usually have a high thread count. Twill woven sheetings usually have heavy condenser weft yarns which have a low twist giving the fabric a soft texture. Warp yarns used are generally finer and stronger. American sheetings are always plain woven, mostly of carded yarns. Narrow sheetings up to 40in. are largely used for converting into several standard finished cloths known by various names according to use or finish. These include canvas, cretonne, suiting, crash. Also used in unbleached state for grain, feed bags, base for coated fabrics, covers for mattresses, cushions.

(*a*) *Wide Bed Sheetings.*—Strong, higher thread count than narrow sheetings. Bleached and given a muslin finish. Cheaper, lower thread count qualities, are backfilled. Sold in unbleached state as brown sheeting. Standard muslin sheeting constructions are 68x72 and 64x64 threads per inch.

(*b*) *Percale Sheeting* is a combed yarn, fine, smooth texture sheeting having approximately 200 threads per square inch. Lighter weight, carded yarn, lower count sheeting also called lightweight percale, has a finer yarn and a higher thread count than the best muslin sheetings. Percale sheeting never has less than 180 threads per square inch. Sheetings generally have a balanced or square thread count.

Shirting.—General name for plain and fancy woven fabrics used for shirting purposes such as broadcloth, poplin, oxford, harvard, grandrelle. Given mercerized, chased, pre-shrunk finishes. White shirtings is also a general British term for white finished fabrics which include longcloths, cambrics, muslins, various pure sized and back filled finishes used in foreign export markets.

Ticking (*Bed Ticking*).—(*a*) Woven design ticking, (*b*) converted ticking. Strong, closely woven fabrics used for the covering of mattresses filled with hair, feathers, cotton, etc. Best tickings are closely woven, warp faced fabrics made in satin and twill weaves with coloured yarn warp stripes in various weights and constructions. Also made in elaborate Jacquard panel designs. Plain woven, coloured warp, white filling, lighter weight pillow ticking is known as Bohemian ticking.

Tickings, Converted.—Some of these are cheaper type tickings. Warp sateens, drills and light weight narrow sheetings are used. Usually printed with floral designs. The lower thread count qualities are given a backfilled finish to fill up the interstices and to add weight.

Twill is the second foundation weave. A warp twill is formed when the warp yarn floats over two or more weft yarns before interlacing [and vice versa for a weft (filling) twill]. These floats produce diagonal line effects which run upwards to left or to right selvage. Names of twills vary according to number of harnesses used, their origin, use, etc. To obtain most prominence the diagonal line in a twill usually runs in the same direction as the twist in the yarn. If warp yarn forming twill has Z or warp twist twill will run upward to left selvage. British twilled cloths are generally called drills if formed by warp and twills if formed by weft yarns.

Velvet-Velveteen.—See *Pile Fabrics.*

Venetian.—Strong, heavy, very lustrous, smooth surface, 8-harness warp faced satin. Usually made of combed 2 ply warp yarns with ZZ twist (ply yarn is twisted same direction as single), and combed or carded single weft yarn. Bleached, dyed, and given mercerized and Schreinered finishes. Used for overcoat linings, dress goods, drapes, cushion covers.

Voile.—Clear, open texture, wiry yarn, plain woven, combed yarn, square construction fabric. Best qualities made with combed, mercerized and gassed ply yarns which have ZZ twist. American voiles are usually combed single yarns with hard, medium or slack twist. British single yarn voile also called voilette.

IV. COTTON TRADE AND ORGANIZATION

A. COTTON YARN OUTPUT

Yarn.—Cotton yarn used as an article of commerce is made from raw cotton which has been prepared by carding, combing (in combed yarns only), drawing and spinning to form a compact single yarn strong enough for its particular use. Cotton yarns are made for weaving, knitting, plaiting operations and for conversion into thread, twine or cordage. There are two main divisions, carded and combed yarns.

Carded Yarn is made from cotton fibres cleaned of most of their impurities by carding, drawn out and evened up by drawing and doubling, twisted into yarn by spinning. Carded yarns generally run from 1s to 50s, American; up to 120s, British.

Combed Yarn is made from finer, longer fibres than used for carded yarn. In addition to being carded the fibres are combed to remove all short fibres, motes and all other impurities, drawn out and evened up by drawing and doubling, twisted into yarn by spinning. Combed yarns can be made in all counts. They are generally made from 10s up to 200s and for special purposes as fine as 300s. Most cotton yarns are spun from unbleached cotton. Three systems of cotton spinning are used: mule, ring, condenser.

Mule Spun Yarn.—In this system cotton fibres in the form of fine roving are drawn out finer, twisted or spun into yarns and wound onto bobbins—all three operations being intermittent. Produces a fuller, more even, rounder and a finer yarn from the same cotton spun on the ring frame. All numbers of yarn can be spun on the mule frame (up to 300s). Fine yarns (above 120s) can only be spun on it. Coarse, lofty, soft spun, bulky cotton waste yarns are also spun on the woollen mule and are called wool spun yarns.

Ring Spun Yarn.—On the ring frame the cotton (roving) is drawn out finer, spun into yarn and wound onto bobbins. All three operations being continuous. The ring frame has a greater production than the mule frame. Used for coarse, medium and fine yarns up to approximately 120s.

Cotton Waste Spun Yarn.—In the spinning of cotton waste yarn a coarse, heavy, soft, low twist, roving type yarn is produced. Because of the short fibres used (card and comber waste) they are not given the usual drawing operations. Also, depending upon which kind of waste used two different methods of carding are used: (*a*) where low grades of waste and fibres of mixed length are used they can only be carded on the wool card; (*b*) where better grades of cotton waste are used they are given regular cotton carding treatment. After carding, the card sliver is spun on one of the fly frames into heavy roving yarn—the drawing processes are left out. The later spinning frame operations also are omitted except for finer counts, *i.e.* 8s to 10s. Wool carded cotton waste yarns known as wool spun waste yarn are softer and fuller. Cotton carded waste yarns are cleaner, less even, but stronger. Some of the better cotton waste yarns are often superior in colour, cleanliness, etc., to some weaving yarns, *i.e.* used in Osnaburgs. Waste yarns are made from 1s to 6s and largely used in 4 to 6 ply for mops and for packing and for cheaper insulation purposes. Coloured waste yarns are made 1s to 10s used in 3, 4 ply for carpet yarns, hosiery.

Yarn Numbering.—Yarn is known by its number or counts. Method of numbering is universal. The number of hanks (each 840yd.) which equal 1lb. denotes the yarn number, *i.e.* in one pound of No. 10 cotton yarn (or 10s counts) there are 10 hanks or 8,400 yards. Cotton yarns generally start from 1s and are made as fine as 300s commercially.

Yarn Twist.—The number of twists or turns per inch given the yarn at the spinning frame depends upon its use—weaving, knitting, plaiting, cordage, etc. Constants are used which when multiplied by the square root of the yarn number give the number of twists per inch to be inserted, *i.e.* 9s warp yarn $\sqrt{9}=3\text{x}4{\cdot}75$ (warp constant) $= 14\frac{1}{4}$ turns per inch. Different constants are used for various types of yarn.

The direction of twist in the yarn is referred to in the American market as Z or S. Z twist is also called regular, warp twist or "twist way" (British). It has an oblique line or spiral (when held vertically) which runs from lower left to upper right as the up and down line in letter Z. S twist also called reverse twist or "weft way" (British) has a spiral line (when held vertically) from lower right to upper left as the up and down line in the letter S. American weaving yarns used in both warp and filling are generally spun with Z twist. British weaving yarns generally have Z twist for warp and S twist for weft.

Varieties of Cotton Yarns

Single Yarn.—A continuous length of compact twisted fibres in yarn form, strong enough for its particular use. Practically all American spun yarns have Z twist. S twist is used for special purposes only. British spun yarn when used for the warp has Z twist and is called "twist" yarn. Yarn for the filling is called "weft" yarn and is generally S twist unless otherwise specified.

Warp or "Twist" Yarn.—Weaving yarn given a determined number of twists per inch for strength in weaving. Constants used vary from 3·50 to 4·75. Has Z twist.

Filling or "Weft" Yarn.—Weaving yarn which generally has less twists than warp yarn and therefore a softer, fuller yarn and as a rule not as strong. Constants used vary from 3·00 to 4·25. Has S twist.

Soft Twist Filling or "Weft" Yarn.—Weaving yarn used in special twills and sheetings. Has a low number of twists per inch so that cloth can be easily given a raised nap, Flannel type finish. Constants used vary from 2·50 to 3·00.

Part Wool (Spun) Yarn made with (new) short staple China and some Indian cottons and wool fibres. Because of their harsh wiry nature these cottons are more easily run on the wool system of carding and spinning (mule). Varying percentages of wool fibres are generally mixed with these cottons for part wool mixture yarns for use in blankets, hosiery, etc.

Condenser Waste Yarns.—British waste yarns used for weft yarn in blankets, sheetings, twills, etc., (for napping) are made from: (*a*) soft waste (card and comber waste), (*b*) hard waste (cotton yarn or thread waste torn up into fibres, and treated with soft soap and water for processing). The waste fibres are carded, rubbed between leather covered rings into cylindrical or sliver form on a "condenser card" and without any drawing processes is spun on "condenser mule" into 1s to 12s yarns.

Knitting-Hosiery Yarns are carded or combed. Coarse, medium and fine count single and ply yarns made with "knitting" twist, softer than that used for weaving. Constants used 2·50 to 3·00. Yarns include 6s, 12s up to 50s single carded, 20s to 80s single combed, 36/2 to 120/2 ply combed, plain or mercerized.

Heather Carpet Yarns.—Blended coloured waste fibres from card strips mixed with good white cotton made 4, 5, 6s singles and then into ply yarns of 3, 4, or 5 ply.

Roving Yarn.—Heavy, soft, cotton waste roving yarn. Usually is flyer spun from carded sliver on one of the fly frames (slubber, intermediate or roving frames), with sufficient twist for strength for weaving. Higher grades are sometimes made from new cotton but generally roving yarn utilizes unbleached or coloured cotton waste. Used when plied for mop, some candlewick yarns, and for warp or filling yarn decorations, coloured (or unbleached) in curtain and drapery fabrics.

Multiple End Yarn.—Two or more single or ply yarns wound parallel alongside each other without twist. Used for maximum coverage for insulation purposes in wrap spinning of electrical copper wiring or flat or tubular braiding.

Ply Yarn (American), Folded Yarn (British).—Two or more ends (yarns) twisted together by plying or doubling. In the plying of Z twist yarns, S twist is generally used (or ZS). (2/80 is British, 80/2 is American way of expressing ply.) Majority of ply yarns made are 2-ply. Largely used where strength is required—in heavy, wide or number duck or canvas, army ducks. Also in finer cloths as aeroplane cloth, voiles, broadcloths.

Voile Yarn.—British voile yarns are fine, smooth, round, wiry yarns, hard twisted, mercerized, and gassed, 80/2 to 220/2. If Z twist is used in single, Z twist is also used in the ply so that yarn has "twist on twist" in it (or ZZ twist). In the American market, single hard twist or medium hard twist voile yarns are chiefly used. Single voile yarns in English market are known as "mock voile."

Crepe Twist Yarn.—Extra hard twisted cotton yarns, single or ply yarn, twisted so much that when woven into a fabric and wet out in finishing, considerable contraction takes place, creping the fabric permanently. Twist constants run up to 7. Made with both Z and S twist. In weaving, alternating pairs of each twist are used in both warp and filling for a balanced crepe fabric.

Multiple Ply Yarn.—A large number, *i.e.* up to 72 ends folded or plied together. Specialty ply yarns used for wrapping twine, cordage purposes. Polished butcher twine is made of 8s/72.

Cable Yarns.—These are made of two or more ply yarns twisted together. Several varieties are made for cordage, tying twine, fish nets, etc. When cable yarn is made with ZSZ twists it is known as cable twist. When cable yarn is made with ZZS or SSZ twists it is called Hawser twist and is a tighter, wiry yarn.

Cable Twist Yarn when made in 8/2/2 usually coloured, is sold as "Sea Island Twine." Made in 23/5/3 is a tire yarn used in rubber cord tires.

Hawser Twist Yarn when made 20/2/2 or 20/2/3 used for core of safety fuse.

Seine Net Twine.—Both cable and hawser twist yarns are used in making of fishing nets. In machine manufactured nets they are used alternately to balance the shrinkage or contraction. 10s single yarns are always in the first ply and these vary from 2 up to 32 ends used. In the second plying 3 plies are used. Always sold by a number which indicates the actual number of single yarns used. Starting with No. 6, in which 10/2/3 or a total of 6 singles are used, up to No. 96 in which 10/32/3 (or 96 singles) are used. Made in medium and hard textures (more twist used in latter).

Tobacco Twine.—Largely used for tying tobacco plant leaves. 8/3 or 8/4 ply used (put up 6 balls to a pound, 30 balls packed in 5lb. bags).

Thread or Spool Cottons.—Used for sewing and embroidery purposes, are specially twisted and processed, combed, ply or cable yarns. They are gassed, waxed and polished and in some cases mercerized. Only the finest and strongest cottons are used: Sea Island, various grades of Egyptian. Single yarns used vary from 32s up to 150s. These are twisted into 2-ply yarns, called 2-thread or 2-cord, 3 or 4-ply called 3-cord, 4-cord. These yarns are made with ZS twists. Sewing thread is also made in 6 cord thread. This is made 2-ply, and three of these are then plied together to make a cable yarn. Twists used are ZZS. In twisting the yarns, dry or wet doubling is used. In wet twisting the yarns are passed through a water trough. This sets the twist in the yarn and gives it smoothness and strength. After twisting, the yarn is gassed to remove projecting fibres, and is bleached or dyed or used in the natural. If no finish is given the thread it is termed soft finish. Most sewing thread is given a waxing treatment for "silk," polished or "glace" finishes. Thread is also mercerized for strength and lustre. The numbering or ticketing of thread is arbitrary. Where the term 2 thread is used the single yarns used are approximately 50% heavier, *i.e.* in 70 two thread 36s/2 are used. Where the term 3-cord is used the number often (but not always) indicates the actual yarn number used in the singles, *i.e.* in 30 three cord, three ends of 30s are used. Where the term 6-cord is used the number used is in some cases approximately twice as fine as the single yarns used, *i.e.* in 36 6-cord, 6 ends of 70s are used, in No. 50 6-cord, 6 ends of 100s are used. In No. 100, 6-cord, however, 150/6 are used. These variations in the counts of the single yarns used occur when strength of thread is specified, the yarns often being changed to meet this requirement. Also where silk or polished finishes are used the yarn is stretched, made harder and thinner and actually is a lighter yarn than the original.

Crochet Thread.—These are soft twist ply yarns of two, three or four ends, usually combed, also carded. In plying, the twist used is the reverse to that of the single. They are given a soft finish or a mercerized finish. Yarns include 3/2, 8/3, 12/4. Crochet thread is also made in 6-cord cable twist (50/2/3).

Lace Thread.—Combed and gassed hard twisted super combed yarns of Sea Island, Egyptian, fine American cottons 60/2, 100/2 up to 300/2, used for plaiting into fine nets, laces. (They are known as Brass Bobbin yarns which are flattened for use on Levers and Nottingham lace machines). Combed single yarns are also used. Carded yarns are used for the heavier laces: 12/2, 20/2, 30/2 up to 50/2 in both soft twist and hard twist.

Lisle Thread.—Combed, gassed, smooth, mercerized ply yarns of Egyptian and fine American cottons with harder twist than used as weaving yarns (from 50/2 to 80/2). The name lisle was originally applied to mercerized hosiery yarn made in Lisle, France.

Coloured Yarns.—Generally single yarns dyed in solid colours. They also can be made from stock dyed cotton fibres.

Blended or Mixture Yarns.—These are single yarns made from contrasting or white and coloured fibres blended to form Oxford grays, heather mixtures, etc. Fibres are stock dyed.

Mottled or Two-Tone Yarns.—These are single yarns of half white, half colour or of two contrasting colours. Spun from two rovings, one white, one coloured roving or two different coloured rovings. Called mock twist or mock grandrelle (British), used mostly in coverts, mottled flannels, etc.

Flecked or Random Yarn.—A single yarn throughout which appear flecks of coloured fibres. These are added at the delivery end of the card (or later processes) to form a coloured flecked white yarn. White fibres are also added to stock dyed cotton to form a white flecked coloured yarn.

Printed Yarn.—In which roving or single or ply yarn is printed with a pattern of one or more colours throughout. Used in warp for decorations, in flannels, shirtings, tie fabrics, warp printed cretonnes.

Resist Yarn.—Used as decoration, stripes, etc. in woven fabrics, clocks, in hosiery. Also known as immunized yarn. White or dyed yarns (or cotton fibres) chemically treated so that in dyeing of goods the ground cloth is dyed but resist-treated yarn is not affected.

Grandrelle Yarns.—British name for 2-ply shirting yarns, 1 white, 1 coloured yarn plied together. Also made with contrasting colours.

Novelty Yarns.—Are usually ply yarns with special effects formed by the plying or doubling of contrasting sizes of yarns, variations in speeds in feeding the yarns in plying. Usually referred to by number of yards per pound *i.e.* 1,600yd. per pound.

Spiral.—Two different size single yarns, one soft and heavy, one fine, plied together. In plying, the heavy yarn, called the effect yarn, is fed in excess of the fine yarn causing the heavy yarn to wind around the fine yarn in a spiral formation; are usually twist on twist.

Corkscrew.—Heavy and fine single and ply yarns plied evenly give similar effect to spiral yarn but effect is more pronounced. Yarns used may or may not be of opposite twists.

Seed Yarn.—Also called nub yarn. Has bunches of knots at regular intervals half-inch apart or more. A core yarn of 2 ply white yarns and one to three different coloured fine single yarns are used. Where three coloured yarns are used they are first evenly plied with the core yarn then one of the coloured yarns is fed in excess of the others, causing it to collect and form a knot or seed effect. All three yarns are then plied evenly with the core yarn, after which a seed effect of another colour is formed in the same way as before. This is repeated so that three different coloured seeds are formed, each successive seed effect being of a different colour.

Chenille Yarn.—This is not a spun yarn but is a yarn cut from a specially woven cloth known as chenille weft fabric. Made with fine, ply warp yarns Leno or plain woven in groups (with spaces in between) and soft twisted heavy filling yarns, carded or combed. The chenille yarn is produced by cutting the fabric lengthwise in between each group of warp ends. The cut yarn has projecting tufts (cut weft yarns) along its sides, held tightly in place by the firm woven warp ends. Chenille yarn is designated as 3-cut, 6-cut, etc. These represent number of cuts per inch—the more cuts, the finer the chenille yarn.

Ratine Yarn.—Uneven yarn with loop effects throughout. Made of three or more different size yarns, unevenly plied together. Where three yarns are used (6s, 20s, 20s) one of 20s, known as the core yarn and the 6s are plied together. The heavy, softer 6s yarn is plied in excess, causing it to wind itself in a loose loop formation around the core yarn. The other 20s is then plied evenly with the first ply to bind it (otherwise the loops would slip). The third yarn (20s) is called the binder or tie yarn. Coloured ratine yarns used in drapery, upholstery fabrics. Also made natural (unbleached) and used as warp and filling yarns or filling only in ratine fabric, already described in *Cotton Fabrics.*

Bouclé Yarn.—Similar to spiral yarn but has more of a spiral. A ply yarn of two fine yarns and one coarse yarn are twisted together (twists used are generally twist on twist). The heavier yarn is fed so that it winds in a very definite spiral around the outside of the ply yarn.

Slub Yarn (*Himalaya, Shantung, Cloud or Snowflake Yarn*).—Also called flake yarn. Usually single yarn which has thick places throughout, other places being regular spun yarn. Effect produced at spinning frame by special attachments or gears which cause variations in feeding. The heavy parts of the yarn are not twisted as much as the regular spun, thinner parts. Flake, snowflake, cloud or shantung is short, heavy slub. Himalaya slub is usually long continuous, heavy slub—as much as 36in. long and longer. Slub yarns are generally used for filling only in broadcloths, Osnaburgs, drapery fabrics. Slub yarns are also plied evenly with a single yarn for strength.

Bourette.—Variation of a slub yarn. Made from single or ply core yarn to which is added at the spinning frame, at intervals, pieces or portions of heavy roving yarn. Heavy places or slubs are formed wherever the pieces of extra roving have been combined with the core yarn. Natural or coloured rovings are used. Similar (British) yarn to which bunches of coloured fibres are added is called Knickerbocker or Knicker yarn.

Core Yarn.—Yarn made with a single cotton yarn as a core plied with a heavy, bulky cotton yarn (usually China or Indian cotton) covering the core. Used as filling yarn in blankets, which when napped retains most of its strength. Woollen or cotton and woollen mixture yarns are also made with cotton core.

Rubber Core Yarn.—These yarns have a round or flat rubber core of varying sizes around which are wound cotton yarns used for covering. A fine, single combed yarn (80s, 100s) is wound around the rubber core first in one direction and a second yarn is then wound in an opposite direction, giving complete coverage. Referred to by number of yarns to the pound *i.e.* 1,600yd. yarn.

Union or Mixed Yarn.—Single cotton yarns made of cotton and wool or other fibre mixed or blended together. Part wool yarns are made with varying percentages of wool and cotton for hosiery, underwear, etc. Other fibre mixtures used with cotton are linen, cut rayon fibres and silk fibres. The British name for fine wool and cotton mixture yarns is Angola.

Bump Yarn.—British local term for coarse, heavy blanket yarn, usually heavier than No. 1, and referred to in yards per ounce *i.e.* 50s bump yarn (or 50yd. per ounce). Also used for wadding yarns in heavy quilt fabrics. (J. He.)

B. COMMERCE IN COTTON YARNS

The term "cotton yarn" means yarn produced by spinning companies for sale to consumers who either finish it for further sale or manufacture the yarn into finished goods. The cotton sales-yarn business has been on the decline since 1926, due to an over-expansion in the industry during the decade just previous to 1926, and, in great measure, to the swing from cotton to silk and synthetic fibres in wearing apparel styles. In the United States, for example, in 1929 647,725,439lb. of yarn was produced for sale. This was 22% of the total yarn produced. But in 1937 (a "good" year) only 534,000,000lb. or 17% of the total production was manufactured for sale. Yarn is sold to the weaving, knitting, mercerizing, braid, narrow fabrics, wire-insulating, lace and other yarn consuming trades. Yarn may be carded or combed, single or ply. Combed yarn is of a higher quality than carded yarn, having been spun from longer staple cotton (usually 1⅛in. or longer) of strict middling grade. It goes through a process, beyond that necessary in manufacturing carded yarns, which combs out all the short fibres of cotton not taken out by the card machine. Combed yarn has high tensile strength, durability, lustre and smoothness—all brought about through the numerous doublings throughout the process of manufacture. Combed yarn in a fine number such as 100s has been doubled 1,500,000 times,—and numbers as high as 400s have been spun on mule-spinning in Great Britain. (The number of yarn denotes the size and is based upon the formula No. 1 yarn contains 840yd. and weighs one pound—No. 10 yarn weighs one pound and contains 10 times 840 yards.) Single yarn is one strand, plied yarn may be two or more strands twisted together to form one thread.

The problems of commerce in cotton yarns are multitudinous, mainly due to unintelligent competition either on the part of the mills selling the yarn or agencies through which yarn is bought and sold. To attempt an understanding of the yarn marketing problems we should know something about the set-up of the yarn producing industry. The two principal cotton yarn manufacturing countries of the world are Great Britain with 10,751,-

000 ring and 28,002,000 mule spindles; and the United States with 26,488,000 ring and 500,000 mule spindles (1935 figures). These spindles include those manufacturing all yarns. The United Kingdom is especially equipped for export trade and was in 1936 the largest exporter of cotton goods, in terms of value, in the world. It sold that year ten times as much yarn and piece goods in foreign markets as did the United States. This may be due in some degree to the lower labour costs in Great Britain.

The over-production of cotton yarns and a declining consumer demand since 1921 have affected the markets in the United States and Great Britain in much the same way. An intensive price-cutting era prevailed in both countries. Great Britain has done more to remedy the trouble in its industry than has the U.S.

In Manchester the average spinning mill has 60,000 to 80,000 spindles. About 25% of the total spindleage is located near Bolton, the section which spins Egyptian cotton entirely. The remaining 75%—which uses American Upland cotton, is centred near Oldham. Every mill is represented on the Manchester Royal Exchange and the entire yarn production is sold directly by the manufacturer or through agents on the floor of the exchange.

The Redundant Spindle Act, a "gentleman's agreement" on the part of 80% of the spinners to uphold prices, and finally the Enabling Act were efforts in solution of marketing problems of British spinners. Under the Enabling Act, passed 1939, the following things are aimed at: standardization of mill efficiency, price control, and research. Every mill is registered and those who do not adhere to standards set by the bill find their licenses revoked. Under the Enabling Act no one may sell second-hand machinery to anyone else. They may sell it, however, to a Central Committee (which the bill provides for) at a standard price and then the committee disposes of the redundant machinery as it sees fit. Also, under the bill a small levy is placed on every mill, and out of this fund approximately $450,000 per year will be available for research and advertisement. Price standards are arrived at by using differentials based on the price of cotton, plus half the legitimate depreciation, plus interest on capital of a reasonably priced mill—or in other words, depreciation and replacement value. This bill controls production and price policies to such an extent that commerce in British yarns may be on a completely new basis.

In the United States there are two distinct yarn manufacturing sections: New England and the southern States. In New England mills are large units, average 50,000 to 60,000 spindles, but in the South mills are for the most part small, 10,000 to 20,000 spindle plants. Mills in the United States sell to their customers either direct through their own sales organizations, or through selling agents and brokers. The great majority of yarn mills sell through agents. This is mainly because small units are unable to maintain adequate sales forces of their own. The commission or selling agent charges a flat 5% of the sales value of the yarn for his services, but in this case he also is supposed to guarantee accounts receivable. In other instances the broker may charge only 2%—the mill assuming the credit risk.

In determining prices yarn mills must take into consideration labour, office expenses, depreciation, power, taxes, upkeep of mill village (if the mill is in the South), packing costs, freight, supplies, repairs, percentage of cotton waste, raw cotton, insurance (including social security), fuel, interest. The object of the game is to pay all these expenses and add a profit in to the price figure. Under the price cutting era practices, somewhere along the line costs had to be cut. Up until the Federal Wage and Hour Bill was enacted (1938) the cutting generally came out of labour costs. Under the Wage-Hour Law labour costs are pretty well stabilized throughout the industry. Raw cotton is always the same price for the same quality to domestic consumers. The result is, with those two major cost items on a level for mills, buyers should look to quality standards. The determination of quality standards involve the number of yarn; grade and staple of cotton; finish of yarn (for it may be gassed, mercerized, bleached or dyed); and put-up which may be on ball-warps, warps, cones, tubes, perforated tubes for dyeing, skeins, cops, quills. The put-up is governed generally by the trade to which yarn is sold.

Yarn manufactured for sale goes to: weavers who buy it on section beams, or warps, which carry about 400 ends, or threads, to the warp. Several of these are put on the slasher and run onto a loom warp which will hold about 4,000 ends, each being from 12,000 to 22,000yd. long depending upon the number of the yarn. The weaver also buys yarn for filling, put up on cones which they quill onto a cop, or they buy it ready quilled or copped.

The mercerizing trade buys combed yarn from the mills for finishing purposes: mercerizing, gassing, bleaching, dyeing. Mercerizers buy yarn on ball warps. They finish it, quill it or wind it on cones and re-sell it to knitters and to some weavers.

A large percentage of yarn, both combed and carded, is sold direct to knitters, on cones. This yarn is knit into underwear, hosiery, outerwear, and for industrial uses such as meat coverings.

The sewing thread trade buys yarn which they bleach, dye, mercerize, glaze, or wax. It is wound on cones and tubes when re-sold to the manufacturers of sewed goods, and on wooden spools when it is for the retail or home-sewing trade.

Carded and combed yarns go into wire-insulating, and converters dye, glaze and re-sell it for this purpose. It is wound on tubes but instead of one thread, several threads are wound on the tube together, which is a special process in itself.

Commercial dyers, who buy sales yarn on warps, skeins, perforated tubes, and perforated cones, re-sell it after dyeing it to knitters, weavers, etc.

The braid trade which manufactures shoe laces, corset laces, etc., takes quantities of yarn, as do the narrow-fabrics manufacturers who convert yarn into tapes and ribbons. Some of the finest yarns spun go to the lace manufacturers who make curtains and embroidery laces. This yarn is especially put-up on prepared brass bobbins made to fit the lace machines. Its production in America is a recent development in the fancy goods field.

Both selling and merchandising of yarn are weak spots in the American textile industry. Selling, other than through the mill's own organization, has not proved satisfactory and the malpractices developed by various type agencies have undermined the entire market structure, until at times it is chaotic. For instance: short-selling is practiced by agents when they act as merchants and offer considerable quantities of the yarn of a given mill under the market price which the mill authorizes, in the belief that they can obtain the yarn at a lower price in time for delivery. The agent runs the risk that the mill will refuse the order. If the mill refuses, the agent may lose his commission or more. The agent protects himself against such an outcome by reserving the right to deliver to the customer equivalent yarn from one or two other mills. Again, a mill may be asking a certain figure for a certain yarn when one of its representatives quotes to a customer at a figure less, and accepts the customer's order withholding it from the mill for a time hoping that the mill price will weaken to fit his order. In the meantime he is hammering at the mill to weaken. Whether the mill takes that price or not, its original price has been broken without its consent, and the result is a depressant in the market. This type of selling seldom occurs when the mill has its own sales force.

Another serious evil in marketing yarn is the speculative buying of yarn in large quantities, with the hope that the market will advance and reap a profit to the purchaser. Often this purchaser is none other than the selling agent who is gambling at the mill's expense. If the mill takes such an order, which generally is "blanket" with counts and poundage per count unspecified, then it must deliver the low priced order, if the market advances, losing a chance to take higher priced business or if the market falls, the order must remain on the mill's books for an indefinite period.

In order to abolish this and other serious malpractices in the sales yarn business mills manufacturing yarn for sale (both combed and carded) in the South, the Carded Yarn Group, and the Southern Combed Yarn Spinners Association, and the members of the Association of Cotton Yarn Distributors, adopted a set of rules in 1938 which aim toward fair trade practices. This tends, at least, to make yarn contracts through most of the American yarn selling industry uniform.

Voluntary production control programs undertaken by some groups, and practiced with notable success by one yarn manufacturing group, have helped in marketing by stabilizing inventories and keeping the group in good statistical position.

Several causes lie behind merchandising weakness. The main reason is that operations are so split up among the various participants that the responsibility for the quality of the final retailed product rests on nobody's shoulders. There is such a keen competitive market that somewhere along the line between the manufacturer of yarn and the buyer of a finished product some processor or several may be tempted to skimp just a bit. To eliminate this, the Federal Trade Commission is undertaking to protect the consumer through proper labelling. In the yarn field garments labelled made of cotton yarn must specify whether the yarn is carded or combed. Other non-Federal agencies are undertaking a similar project. An outstanding job has been done by the Durene Association—a branch of the Mercerizers Association of America—in consumer education, thereby protecting purchasers through labelling. Garments made of mercerized cotton yarns of certain standard specifications are labelled "This garment is made of Durene mercerized yarn." Each garment is accompanied by a printed folder setting forth the good qualities contained in Durene, a combed cotton mercerized yarn.

Although in the United States anti-trust laws prohibit any effort at price control on the part of industry, movements toward consumer education, production control and stabilized inventory, plus adoption of selling rules, are steps in the right direction to bring order out of the demoralized yarn market. Other efforts such as industry-wide research programs and advertising should be vigorously promoted, for no industry can continue to survive unsound marketing policies. (M. G. B.)

C. WORLD TRENDS IN THE COTTON INDUSTRY

The purpose of this article is to isolate the most significant trends in the cotton industries of certain of the major countries. In every cotton manufacturing nation, sharp changes have occurred since the World War (1914–18), but in certain of these the potential effect of such change has been particularly important so far as the rest of the world is concerned. It is this type of change to which this article specifically refers.

The two decades immediately following the World War (1914–18) were featured by more drastic economic shifts in the cotton industries of the world than was probably any similar period heretofore. Then, at the end of those two decades came the outbreak of a new war in Europe, and the fierce rush of events which followed. Change was piled upon change, with the result that world trends in cotton manufacture which seemed clear prior to 1940 became obscured by the uncertainties surrounding the national and governmental fate of so many of the countries involved. No categorical statement can be made concerning the trends of the textile industries of the belligerent countries in the European war of 1939.

There are, however, very definite trends in certain of the countries outside of Europe—principally China, India, Japan, and the countries of South America. A consideration of the textile advance made in those countries forms one of the important parts of this article.

United States.—A detailed study of the cotton industry in the United States is given in another section of this article. Consequently, only brief reference is necessary here, to orient trends in the United States to world trends.

The economic revolution in the world textile industry during the two decades after the World War (1914–18), noted above, had a major influence upon the destiny of the United States industry. Not only were export markets involved, but the stirring chain of world events that started in the fall of 1939 was the signal for a major defence program in the United States, in which the textile industry naturally has a great stake. The prospect that, for years ahead, defence plans were to occupy a good part of the thinking and acting of industrialists in the United States completely changed the picture.

Generally speaking, there are no serious bottlenecks in textile production. The industry is equipped to produce as much, and as quickly, as any apparent need would create. There are some problems in raw materials, but these are being worked out. One was the question of possible substitutes for silk in parachute cloth. Successful experiments have been conducted with fine cotton cloth, and nylon and other synthetics have also been used. Incidentally, if there ever should be a shortage of cotton, the great growth of the synthetic fibre industry would rob such shortage of any national seriousness.

For details concerning the United States, see *Cotton Industry in the United States*. (D. G. Wo.)

Great Britain.—To Great Britain the world owes the cotton textile industry of today, for there the first textile power machines were invented, the first cotton textile mills built—two centuries ago. The modern machines of the industry are simply improvements upon or combinations of those early inventions.

A textile industry made up of hand spinners and hand weavers was already well established in England at the turn of the 18th century. So important had it become to Britain's economy that a mandate forbade the importation of India's more desirable cotton goods. But when the first mechanical devices were introduced in England, fear of labour displacement caused hysterical mobs to attack the inventors, and, over the first half-century of machine development (1733–85), many had to flee the country. But their inventions were there to stay and by the close of the 18th century power machines had been developed for each process of textile manufacture. In no industry has a half-century been more productive, for in 1733 Kay invented his fly-shuttle; in 1764 Hargreaves invented his jenny—the first practical spinning machine; and Wyatt invented his rollers in the same period. In 1769 Arkwright perfected his water-power spinning frame, and in 1771 built his cotton mill—the first factory employing mechanical devices for the spinning of cotton yarn. Other English inventions followed: Crompton's mule (1779), which was a combination of Wyatt's roller, Hargreaves' jenny, and Arkwright's horse-power frame. Cartwright's power loom in 1785 was the last to be added to this imposing list. With only two exceptions—Jacquard's pattern loom and Paul's carding machine—all the mechanical cotton manufacturing inventions of the time were created by Englishmen.

From these early beginnings of the cotton textile industry England attained, and held until 1933, eminence in that field. In 1913 the United Kingdom exported 210,000,000lb. of yarn and 7,000,000,000yd. of piece goods, representing a value of £126,500,000. However, since that year British cotton goods exports have steadily declined and in 1938 England exported only 122,000,000lb. of yarn, not quite 1,500,000,000yd. of piece goods, with a total monetary value of £49,000,000. This was the lowest level British exports of cotton goods had reached since 1850.

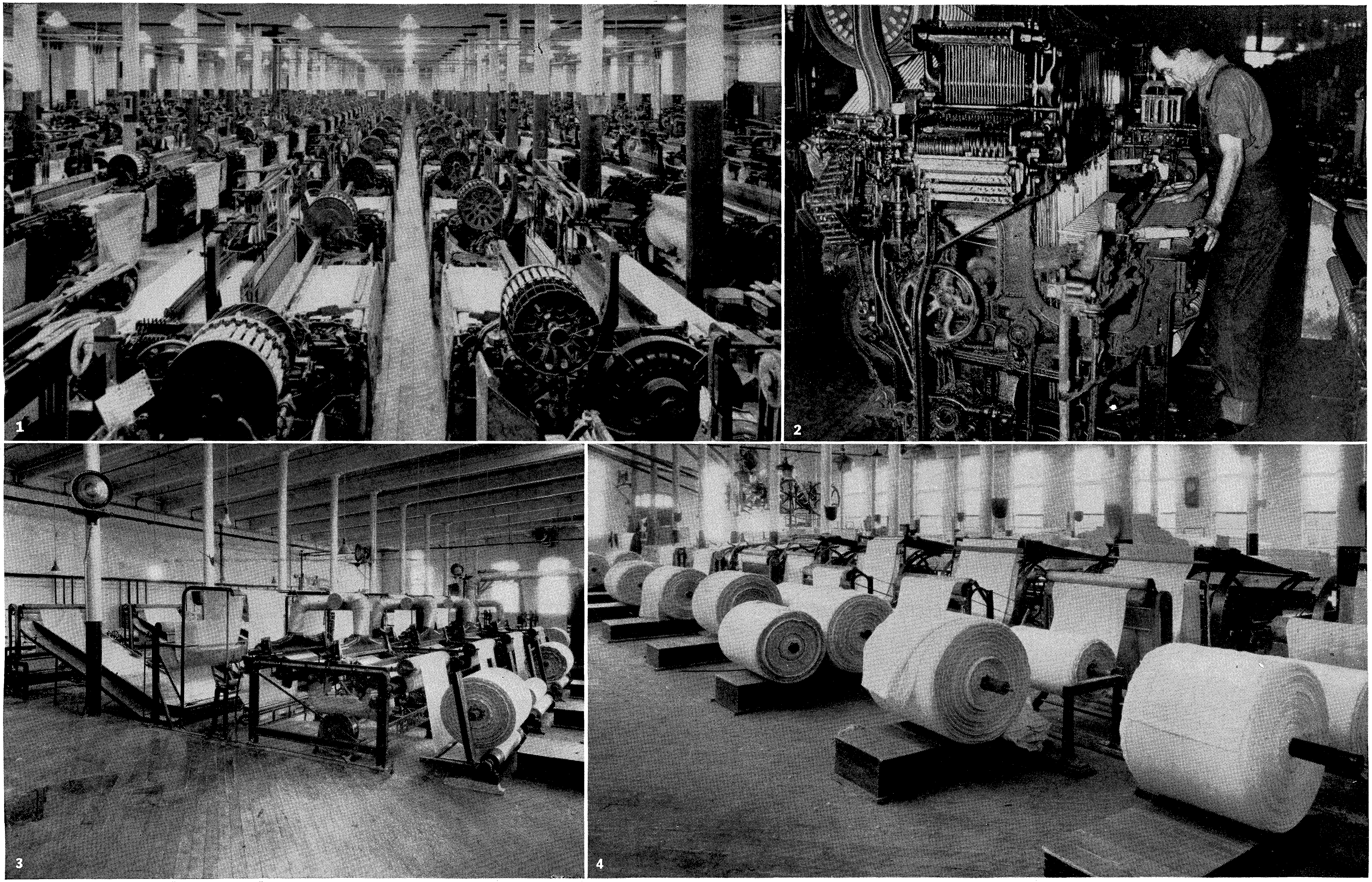
The fact that the British industry has suffered is shown by the following table from the Census of Production, which testifies to the industry's shrinkage in all fields:

	1924	*1930*	*1935*
Firms engaged in cotton spinning	1,114	911	818
Firms engaged in cotton weaving	1,456	1,123	1,057
Firms engaged in textile finishing	783	813	857

The British cotton textile industry has four outstanding characteristics: geographical segregation of each section of the industry; strong inclination to keep its industry in specialized fields, *i.e.*, spinning, weaving, finishing, with no attempt at vertical integration; widely scattered ownership of the plants; extreme individualism in management. Each of these factors has helped Britain to lose her export markets, as her industry could never, under the above circumstances, be a closely co-ordinating one.

When British cotton manufacturers awakened to the fact that their foreign markets had slipped away from them, frantic efforts were made to remedy the situation. A review of these efforts is interesting as a trend of the two decades—1920–40; but their failure, it must be acknowledged, is due to lack of complete industry organization as well as to outside forces.

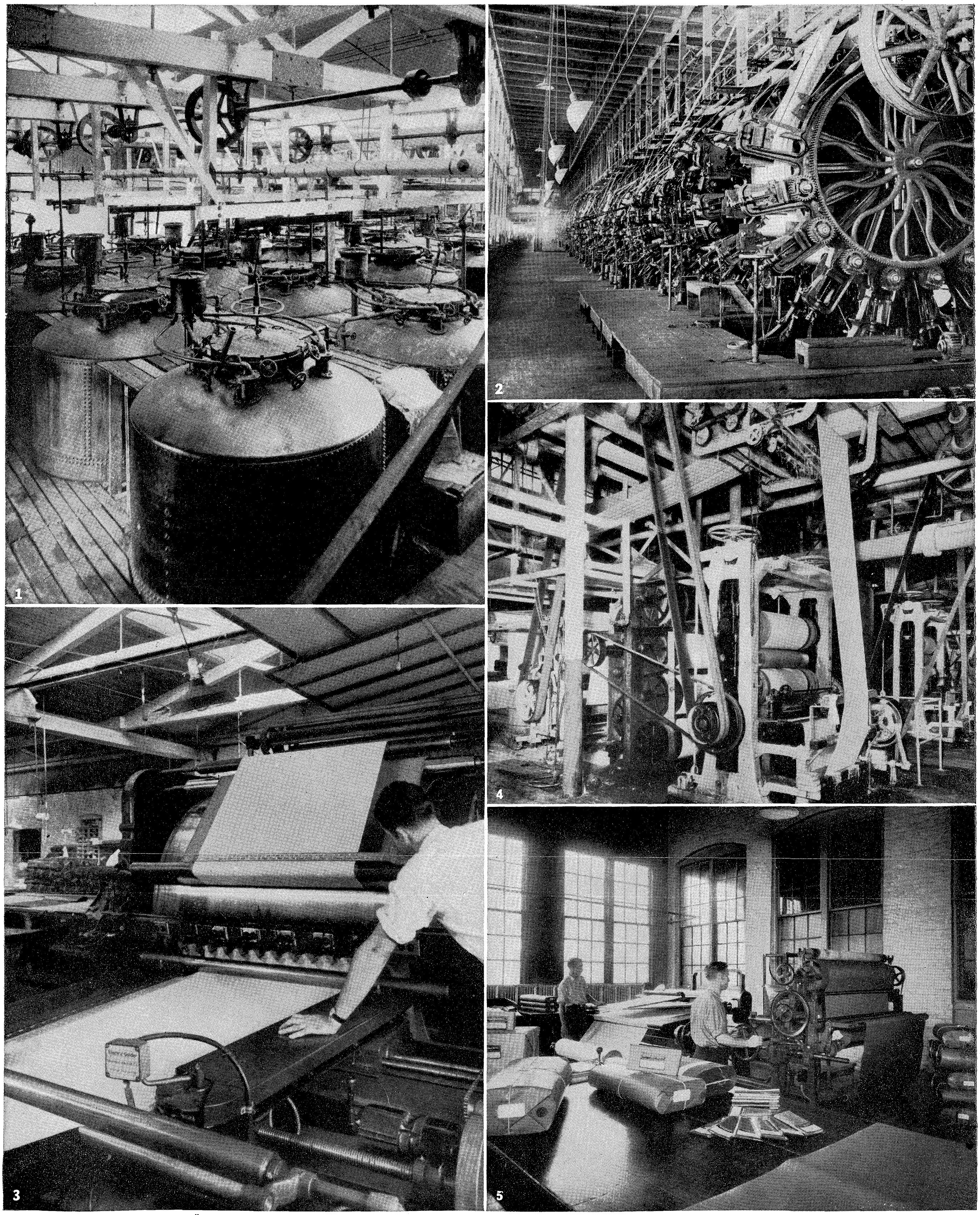
The first type of regulation attempted took the form of various



BY COURTESY OF (1, 3, 4) "TEXTILE WORLD," (2) SOUTHERN COMBED YARN SPINNERS ASSOCIATION

WEAVING AND CLOTH-ROOM PROCESSES

1. A large weave shed in a mill
2. Weaving a striped pique on a dobby loom
3. Shearing machines in a cloth room
4. Folding machines in a cloth room



BY COURTESY OF "TEXTILE WORLD"

LATER PROCESSES IN COTTON MANUFACTURE

1. Kier boiling, whereby impurities are removed from the cotton cloth as the first step in the finishing processes
2. Printing machines, which print patterns on cotton cloth
3. Sanforizing, an important process for pre-shrinking of cotton cloth
4. Finishing calenders, which impart the desired mechanical finish to cloth
5. The final stage in the mill where cloth is doubled, put on rolls and packaged

"gentlemen's agreements" which were entered into from time to time to stabilize prices. But one after another of these broke down due to lack of co-operation of a minority who preferred to practice individualism in their marketing policies.

In the latter part of the 1920s the industry experimented with another plan—this one having the financial backing of one of the largest banks in Great Britain. In theory it was to accept prevailing prices, but to cut costs of production by merging plants. The mergers were on a rather stupendous scale and unwieldy. For instance, one textile firm attempted to acquire 10,000,000 spindles in the section of the industry spinning American cotton, while another tried to merge 3,000,000 spindles in the section using Egyptian cotton. However, the mergers, based on weak financial structures and being composed of plants having outmoded physical equipment, failed to operate profitably and had to undergo further reorganization. The merger plan failed so completely to accomplish its purpose among large holdings that mergers among the small units were not attempted.

Upon realization that the mergers would not solve the industry's problems, still another type of solution was proposed. The formation of the Eastern Textile Association for the purpose of restoring the export trade by manufacture, by members of the association, of standard-construction cloths to be pooled and marketed on competitive terms with foreign producers was the result. Consignment stocks and extensive credits to foreign countries were the bait, but this plan failed also. The passage of the Import Duties Act, in 1932, the Ottawa Agreements, and the establishment of colonial quotas were the next steps. But coming during a world depression they were of no appreciable benefit to a very sick industry.

In 1934 the Cotton Manufacturing Act was passed by Parliament. This act was to fix, upon entire sections of the industry, wage rates and terms of employment arrived at by agreement between representatives of the trade unions and employer organizations. This act, intended to prevent wage cutting as a means of lowering costs of production, was, however, applied in actual practice only to the weaving section of the industry.

In a really desperate situation the industry again called upon Parliament and in 1936 the Redundant Spindles Act was passed. The purpose of this Act was to retire from the industry 10,000,000 spindles, the owners to be compensated out of a fund raised by an annual levy of $1\frac{1}{2}$d. per mule spindle on all spindles remaining in place.

After the passage of the Redundant Spindles Act another type of agreement was entered into by the yarn spinners. This one had legal enforcement behind it. About 80% of the Lancashire spinners signed the agreement, which was purely for price-fixing purposes, under which an administrative authority fixed margins between the price of raw cotton and yarns from time to time. The great bulk of British yarn was priced under this agreement, but the "20% group" not in agreement rendered it ineffective.

The net result of all these troubles was the passage by Parliament, in 1939, of the Cotton Industry Reorganization Bill. (Although passed, enactment was suspended until close of the European war.) Under this bill internal reorganization and mobilization of the industry are dealt with. It provides for regulation of prices, open competition in the interest of profits, retirement of redundant machinery and the promotion of trade. To carry out the latter an Export Development Committee and a Research Fund were provided. The Reorganization Bill, or Enabling Act, authorizes formation of a Cotton Industry Board of 15 members appointed by the Board of Trade. An advisory committee of 3 assists the board in making decisions. Any plan, approved by the advisory committee, regarding any section of the industry will be voted upon by the section concerned. If approved by that section of the industry the plan will then go to Parliament and if not rejected there, in a limited time, will become statutory.

Under this Act registration of all persons or firms in the textile industry is mandatory and those who do not co-operate in reports and operations will have their licenses revoked.

On the surface the Reorganization Act seems meritorious, but only time can prove its ability to help Great Britain compete with other countries which continue to export bulk cotton goods in greater volume at a lower price.

It must be emphasized that all statements made concerning the British industry are tentative in view of the cataclysmic world events which started in the fall of 1939. The future trends in that country, particularly, depend upon international developments.

Japan.—Of the three countries participating in the revolutionary Far Eastern expansion of the textile industry since 1920, China, India and Japan, the most successful expansion has been that of Japan. Among all cotton manufacturing countries it ranked (in 1940) third in number of spindles, second in quantity of cotton consumed and first in amount of cloth exported.

The first cotton mill was established in Japan in 1866, but not until 20 years later, when a protective tariff was placed on imported cotton yarn and the Japanese currency was stabilized, did any noticeable progress in the industry become evident. The World War (1914–18), which left the Orient and Asia free from European and American competition, and the international depression of the '30s, which enlarged the world's demand for low-priced bulk cloth, both gave considerable impetus to the growth of the Japanese industry. But the real impetus came from the industry itself, which through industry-organization, improved methods of operation, and other measures of industry-rationalization reduced production costs, and at the same time raised productive-efficiency of the workers. For instance, during the years 1925–33 the workers' productive-efficiency increased by 71% in the spinning section and 133% in the weaving industry, while at the same time labour costs per unit of production decreased by 60% and 68% respectively.

Such results were accomplished because the Japanese industry is a closely held one. A total of 71 companies, with 276 plants, are responsible for the entire yarn output. More and more the industry is being concentrated in the hands of a few through mergers and combines. For example, three mill combines control 60% of the industry, with five others controlling 20%—a concentration of 80% of the industry in less than 10% of the mills. The trend toward vertical integration is very evident in the most progressive spinning companies: another method by which costs are reduced.

The Japanese Cotton Spinners Association, representing 98% of the spindleage or 10,769,360 ring spindles, and 30% of the industry's weave capacity, or 92,416 looms, is actually the control-centre of the Japanese textile industry. Although it includes a minority of the looms, its control of the majority of the spindleage automatically governs cloth production. In addition to the looms included in the Japanese Cotton Spinners Association, it is estimated that 280,000 looms established in 50,000 small weave-units, employing not more than 10 persons each, supply about 40% of Japan's cloth production. These establishments necessarily buy yarn from members of the Spinners' Association.

The Japanese Cotton Spinners Association regulates production, prices, contracts, working conditions (including wages and employer-employee relations), quantity of goods and expansion of output capacity of its member mills. It also regulates trading details on raw cotton transactions. For instance, agreements entered into between the Association, raw cotton merchants and steamship companies transporting raw cotton prohibit merchant or shipping agencies from delivering cotton to non-Association members. Such agreements make membership in the Association mandatory for yarn spinning mills. The Association also has an agreement with the Japan Federation of Cotton Yarn Merchants Association whereby it exercises drastic control of sales, even to the point of limiting the number of dealers in yarn and cloth.

Far Eastern labour conditions are at their best in Japanese mills, where a high type of industrial relations is practiced. About 90% of the cotton mill workers in Japan are girls, between the ages of 14 to 17, drawn from farming areas. These girls generally work two or three years in order to build up their dowries and obtain an education. It is considered a meritorious achievement for a farm girl to obtain a job in a cotton mill, for the labour supply is plentiful and the personnel is very carefully chosen. Men are employed only in a supervisory capacity, or to act as mechanics.

The girls live, rent free, in dormitories in the mill compound. They are required to attend school two hours each day when they are taught Japanese and English grammar, history, mathematics, flower arrangements and tea ceremony. Recreational facilities are furnished, as well as free medical attention.

The Japanese Factory Law limits the work day to 9½hr., but all the mills run two shifts, seven days a week. Each operative is allowed two rest-days a month.

The average daily wage for a girl operative is 0.73 yen (21 cents)—1935 figures. Meals are furnished by the mill at a cost to the employee of about 4 cents a day, which leaves about 17 cents net daily income.

Because of the rapid turn-over in labour vigilant training is required and full-time instructors are part of the personnel of the mill.

The low labour costs in Japan, plus improved machinery and installation of mechanical labour devices not found in mills of other countries, have reduced the daily wage expenditure between 1922–35 per 10,000 spindles by 54%. The reduction per 100 looms was 56%. It is estimated, according to the International Institute of Agriculture, 1936, that "labour costs per bale in England are about 2½ times as high and in the United States about 3½ times as high as in Japan."

It is easy to see that the increase of cotton piece goods exported by Japan from 412,000,000yd. in 1913 to 2,382,520,000yd. in 1939 is no accident. While European nations and the United States were struggling in the World War (1914–18) Japan was getting a strong foothold in new market territories. When other nations again sought their old export fields Japan's low priced goods remained predominant and each year gained new importance. Smooth management, ability to get good results from cotton of a lower grade than that used by their competitors and the unusual Japanese industrial combination of cheap labour and high productive-efficiency, enable Japan to produce and sell cotton goods at a cheaper rate than any other exporting country. That formula is its simple secret of success.

In 1933 it passed the United Kingdom in exports, and since then Japan has remained the world's largest exporter; this despite heavy restrictions placed upon its goods by importing countries. Its danger to other manufacturing countries had become so obvious by 1936 that 78 of the 127 countries to which Japan exported cotton goods had placed restrictive measures on Japanese imports. For example, the United States had never imported an appreciable amount of Japanese goods until 1933, when due to a very low national income, plus increased operating costs resulting from the United States legislative program known as NRA, Japanese imports to the United States came to about 1,000,000 lineal yards, but by 1936, just three years later, Japanese imports to the United States amounted to 75,000,000sq.yd. and, during the month of Dec. 1936, orders were placed for 1937 delivery to the United States of 150,000,000 square yards.

The tremendous influx of Japanese cotton goods into the United States markets stagnated American cotton piece goods manufacturing. Existing rates of American tariff were completely inadequate in the face of the situation. After the breakdown of an attempt on the part of the United States and Japanese governments to establish a limitation agreement, tariff rates were raised, by President Roosevelt, on certain textile items as much as 42%. At this point Dr. C. T. Murchison, president of The Cotton-Textile Institute, Inc. (U.S.A.), and a group of members of the Institute went to Japan and met with a similar group from the Japan Spinners Association. As a result a two-year gentlemen's agreement was entered into which placed a quota limitation on Japanese imports to the United States at 155,000,000sq.yd. for 1937, and 100,000,000sq.yd. for 1938, with the option allowed the Japanese to transfer one-fourth of 1938's quota to 1937 if desired. This agreement simply amounted to pegging importations of Japanese goods at their highest level. It is problematical whether the agreement was of any benefit to American industry, although it was renewed by both groups at its expiration.

But all has not been smooth sailing for the Japanese. The increased restrictions placed on its goods by importing countries, along with its own "control system" inaugurated right after the beginning of the (1937) Sino-Japanese trouble, worked hardship on the industry. The control system was set up by the government to control imports and foreign exchange. Domestic consumption of cotton goods was limited and the Japanese Cotton Control Committee was placed in charge of raw cotton import permits and cotton stocks. In 1938 the system was improved by revision which attempted to balance the financial relations of exports of cotton textiles and imports of raw cotton. However, in this move attainment of volume of export seemed more desirable than actual value received, for often goods were sold below actual cost.

In Jan. 1939 the government's basic control system was reinforced by the formation of a Textile Distributing Council empowered to set quotas for mills producing all textiles except silk. Domestic consumption quotas were set up and production quotas were assigned the mills. A Yarn Distributing Control Ordinance was also passed Jan. 1939 in an effort to eliminate illegal transactions. Although price control on yarn for export was abolished the same month, prices of cotton yarn for authorized domestic use remained under control, according to an Ordinance of May 1938.

In April 1939, organization of a Cotton Yarn and Piece Goods Export Promotion Guild was perfected. It carried compulsory membership of all mills in the export trade. The object was to regulate production by withholding raw cotton import permits from members if they exported more than their allotted quota of gray cloth. Upholding prices is one of the chief functions of the guild and cotton goods offered for export at below cost prices are bought by the Guild, which has the privilege of buying and selling cotton goods for export on its own account.

Japan is certainly one of the most dominant factors in the international cotton textile situation. Its closely held industry, working under drastic regulations, and its ability to produce a tremendous volume of goods at lower costs than any other nation, has given its expansion an impetus which has worked detrimentally to all other volume producers, particularly Great Britain and the United States. With a new European situation created by the European war of 1939, there is a strong probability that Japan's eminence in the textile world may become even more important in the decade of 1940–50.

China.—A wheel within a wheel is the Chinese textile industry, for 43% of the total spindleage in that country is owned and operated by the Japanese, while only 53% is Chinese-owned. The remaining 4% represents three British-owned mills. This paradoxical situation is strange in many ways, and in order to understand the set-up of the textile industry in China one must study in a comparative manner both groups of mills: Chinese-owned and Japanese-owned.

The cotton textile industry is a relatively new one in China, for the first cotton mill was built there in 1890. After the Sino-Japanese War of 1894 foreigners were allowed to build cotton mills in treaty ports, and British, German and United States interests built mills in Shanghai. Up to 1913 the industry totalled only 1,000,000 spindles and China remained a great market for imports of cheap cotton goods.

After the World War, from 1918–25, the Chinese industry rapidly expanded, increasing its spindleage from 1,600,000 to 3,300,000—but of this increase 1,239,156 spindles were Japanese-owned. By the end of 1936 China had 151 cotton mills with a total of 5,120,000 spindles, but with nearly half of them owned and operated by the Japanese. The influx of Japanese capital and Japanese management was for two reasons: to sidestep the high protective tariff rates imposed by the Chinese Government on cotton imports, and to evade regulations of the Japanese Cotton Spinners Association in their own country.

Although the protective tariff was imposed at the request of Chinese mill men, after six successive increases on both yarn and piece goods in the period 1919–39, the net result has been increasing encroachment on the Chinese industry by Japanese capital plus Japanese efficiency.

The remarkable expansion of the cotton textile industry in China is simply a part of the industrial expansion throughout the Far East since the World War (1914–18). China, like India, experienced a parallel agricultural expansion and has become almost totally self-sufficient in that it is no longer an important importer of either raw cotton or cotton goods. The availability of Chinese short staple cotton from which is woven the bulk of piece goods used in Chinese markets, the abundance of cheap labour, and the pressing domestic demand for both yarn and cloth were the chief factors in the growth of the Chinese industry from 1918–38. Actually at the beginning of 1937 cotton manufacturing was China's greatest industry. It represented an investment of $160,000,000; it employed 200,000 workers; and the physical capacity of the industry included 5,000,000 spindles and 58,000 power looms. The production in yarn alone was over 1,500,000,000lb. annually.

Although China's industrial expansion has been spectacular, handicraft is still a dominant factor. The power looms in the mill centres are augmented by countless numbers of hand looms and foot looms in homes and very small factories in the agricultural regions of the interior. China is the only large nation where hand weaving still predominates over machinery work. It is estimated that in China hand looms using machine spun yarn still supply 75% of the total cloth output.

In matters of management, labour and profits in the Chinese mills and the Japanese-owned mills in China, the industry has a dual personality with the profitless Chinese on one hand and the financially successful Japanese-owned mills on the other. The reasons why the Chinese group seems decadent with few solvent plants, while at the same time the Japanese-owned mills are models of efficiency, are probably as follows:

The basic weakness in the set-up of the Chinese group seems to be lack of modern, streamlined methods of doing business. It has strangled itself through adhering to the easy-going Chinese philosophy of living.

However, specific weaknesses are: (*a*) lack of working capital; (*b*) high cost of raw material; (*c*) poorly trained management; (*d*) low productive efficiency of labour. Japanese mills have none of these difficulties, as is shown by the following comparative picture.

(*a*) *Lack of working capital.* Loans for operating expenses of Chinese mills are obtained only at exorbitant interest rates, 8% to 12% per annum. While on the other hand, Japanese-owned mills seem to be unhampered financially.

(*b*) *High cost of raw material.* Although the raw material is a domestic product its cost to Chinese mills is out of proportion, since often the cotton passes through several hands, each carrying an excess brokerage charge, before reaching the mill. Japanese-owned mills have solved this cost problem through more direct dealing methods. Similarly, the Japanese are better merchandisers of finished goods.

(*c*) *Poorly trained management.* While some Chinese mills are well managed the large majority operate on a hereditary managership basis with the job of manager being passed from one member of a family to another, or from family to friend, with no consideration of personal ability. These managers are paid relatively high salaries although few have been trained for the position they occupy. The result of this on the part of the majority tends to jeopardize the profit element of the entire Chinese-owned group. On the other hand, Japanese managers who draw lower salaries than Chinese managers are highly trained in managing efficiency, able to get the best results at the lowest cost to their mill.

(*d*) The final problem is the *low average productive efficiency of labour.* Drawn from an illiterate class, with women predominating and children making up 6% of the labour element, Chinese textile labour costs run high although wages are low. For instance, with two shifts of 11hr. each and monthly wage rates as follows:

	Men	Women	Children
Spinning	$6·40	$5·24	$3·38
Weaving	$9·86	$7·58	$4·90

it is shown by the Chinese Cotton Control Committee's study that in 1935 it cost a Chinese owner $16.00 to produce a bale of 20's yarn compared with Japanese-owned mill costs of $7.46 for the same goods, although wages in Japanese-owned mills are somewhat higher. This is due to more efficient machinery in the Japanese mills; and, most important, the well trained Japanese foremen, skilled in labour management, who have the knack of extracting greatest productive efficiency from mill workers. For instance, a worker in a Japanese-owned mill operates 24 spindles to a Chinese mill worker's 16, and, similarly, a worker in a Japanese-owned mill weaves more cloth; 786·38 pieces per year compared with a Chinese mill weaver's 261·73 pieces.

What the future holds for the Chinese mills under the present system seems to be eventual absorption by Japanese-owned mills, although government regulations are making a weak effort to stem the tide. During the 1937 Sino-Japanese hostilities discriminating levies were placed on Japanese-owned mills. But despite this they have continued to operate profitably while their neighbour Chinese mills operated at a loss.

India.—The story of the textile industry in India reminds one of the Mother Goose rhyme—"The King of France marched up the hill . . . and then he marched right down again." Centuries before power machinery was invented India's hand weavers and spinners had developed remarkable skill and technique in the production of rare and beautiful cotton fabrics. With the growth of trade the fame of these fabrics spread throughout the world and Indian prints and calicoes were much sought after, in the 16th and 17th and early 18th centuries, with Great Britain becoming one of India's most important markets. However, in the mid-18th century, with a budding cotton textile industry at stake, Great Britain restricted importations of India's fabrics. With the development and growth of power machinery India, in the course of time, found itself one of Britain's chief customers as machine-made, cotton piece goods from the United Kingdom flooded the country.

Just prior to the World War (1913–14) India imported 60% of its cotton cloth requirements, 3,104,000,000yd., practically every yard coming from Great Britain. In 1940 India's cotton textile industry, in a new cycle, has swung away from importations and has established itself again as a great textile producer in the Far Eastern industrial revolution which has taken place since 1918.

India's textile industry was a slow grower from the time of the founding of its first power mill in the 1850s to the outbreak of the World War (1914–18). But by 1920 India had 7,000,000 spindles and 120,000 power looms. Since then the spindleage has increased to 10,000,000 (1936) and power looms to 200,000

TABLE XVIII.—*India Cotton Cloth Production and Imports, 1913–14 and 1936–37**

Item	April		March	
	1913–14	1936–37	1913–14	1936–37
	Million yards	Million yards	Per cent	Per cent
Mill production†	1,164	3,572	21·6	65·1
Hand-loom production‡	1,016	1,152	18·9	21·0
Imports§	3,197	764	59·5	13·9
Total production and imports	5,377	5,488	100·0	100·0
Imports by source§				
United Kingdom	3,104	334	97·1	43·7
Japan	9	417	2·6	54·6
Others	84	13	·3	1·7

†From *Monthly Statistics of Cotton Spinning and Weaving in Indian Mills.*

‡Hand-loom production estimated on the basis of total yarn available for sale, *i.e.*, yarn production minus total mill consumption (total woven goods produced), minus exports and re-exports and plus imports. Final figure obtained by assuming 4yd. of cloth per pound of yarn estimated as available for sale.

§From *Annual Statement of the Sea-Borne Trade of British India.*

*Table from *U.S. Bureau of Agricultural Economics*, Vol. 11, No. 4.

(1936). The same year it was estimated that India also had 2,500,000 hand looms in operation, producing annually about 1,200,000,000yd. or 20% of the total cloth available for consumption.

It would seem that India's cotton textile industry should have an open road to prosperity. With an estimated population of 350,000,000 consuming 5,500,000,000yd. of cotton piece goods annually, Indian mills have right at hand one of the largest markets of cottons in the world. Its raw material costs should be low, for the coarse type piece goods used by the Indian native is manufactured almost entirely from Indian cotton—⅞in. and shorter.

That India is supplying its domestic market with domestic goods, displacing to a large extent cotton piece goods imports, is shown by Table XVIII.

Yet India's cotton textile industry is an unprofitable one, with two principal contributing causes: the managing-agency system and poor labour-efficiency. And from available evidence it seems that the former contributes heavily to the latter.

The custom of employing managing-agencies to conduct one's business is one of long standing in India, but indications are that the agency system has outlived its usefulness and has simply degenerated into a system of exploitation of industry. When the textile industry was trying to get a foothold in India many of the mills were capitalized by a managing-agency and no doubt the latter was a strong moving force behind the industry's founding and early growth. The agencies work on a long-term agreement—generally extending over 30 to 40 years, and in many cases such a contract develops into a permanent arrangement. Theoretically the agency furnishes operating capital, handles the purchase of raw material and actually manages the plant itself. For this service it receives a commission of 10 to 12½% of the gross annual profit; and sometimes in addition exacts a commission on the production of the mill. Naturally, the more production the higher the commission. Much evidence exists that rebates, or secret commissions, are taken by the managing-agency for additional services rendered.

Sometimes the managing-agencies actually enter speculative cotton deals by which any losses incurred are charged up to the mills, but any profits which accrue are kept by the agencies.

Poorly trained or untrained personnel seems to be the average in the managerial field of Indian cotton mills. In 1927 the Indian Tariff Board said that, in Bombay alone, out of 175 managers only 11 had received practical training. Often one agency may manage many mills or it may have more business than it can adequately handle, with consequent negligence to all of it. Therefore, it seems that the managing-agency system, by furnishing inefficient management for the mills and by "bleeding" the mills through excess commissions and other pieces of chicanery, has kept them in a precarious financial position.

In India, as in China, we find coupled with poor management, the problem of high production costs due to inefficient labour—and for the same reasons. The Indian cotton mill worker is drawn from the illiterate mass of people who know only the lowest standards of living. If anything, conditions in India, among the 418,000 mill labourers, are worse than in China. The day is shorter. For instance, the work day is 9hr. compared with China's 11, with a work week of 54 hours. But for this operation time the average monthly wage for a weaver runs from $5.63 to $6.75 if he watches one loom. If he tends two the wages are doubled. For all other workers the average monthly wage is less than $9.00. Since most of the workers are men, it is assumed a family must be supported on that wage. The managing-agencies, working on the theory that paid employees make a floating population, habitually keep wages a month to six weeks in arrears. The workers then are victimized by money lenders who charge 75% to 150% interest per annum. Topping this, monthly commissions have to be paid by the workers to the men who "hired" them, or in case of absence, or for other reasons, fines. Such a labour situation naturally results in low productive efficiency. It is not surprising that the total labour cost per pound of yarn of average count of 16's exceeds the cost of the same product in a Japanese mill by over 60%! Such a comparison was issued by the Indian Tariff Board, which also estimates that the labour cost per loom per day on gray cloth in a Bombay mill is over three times the cost of the same goods produced in a Japanese mill. No wonder that despite a protective tariff of 11% Japanese piece goods offer strongest competition in the Indian markets.

Such competition became so great that Japanese imports to India were finally put on a quota basis. However, neither quotas nor tariffs can dispel the weakness of structure of India's textile industry, which has expanded, but in an unhealthy manner.

(M. G. B.)

South America.—The cotton textile industry of South America has developed rapidly in some of the countries below the equator, a forerunner of general industrial development inevitable in coming years.

Historically, the manufacture of cotton fabrics in South America is not new. Indians were spinning and weaving cotton, indigenous in several countries, long before Columbus arrived in the Americas. These same fabrics, made on crude hand looms, can be seen under construction in remote parts of the interior. However, with the exception of Brazil, which has had an established industry for at least 50 years, it is generally true that most of the cotton textile mills in South America have been built in recent years.

Brazil, Argentina and Colombia are the three most important countries from the standpoint of cotton manufacturing at the present time (1940), although Venezuela, Chile, Peru and others are getting the industry under way. Growth has been particularly pronounced during the last few years as nationalistic trends have grown stronger.

Viewing the cotton textile industry of South America, it is necessary to consider each country individually because of geographic and political differences. Also, it is essential to study the size and condition of the mills rather than the number shown in trade lists.

Brazil, the largest country in South America, is the most important in cotton textile manufacturing. There are in Brazil perhaps 500 textile plants of all kinds—cotton, wool, rayon, silk, etc.—about 40% of the total in South America. Of these, it is estimated that 350 mills with over 2,500,000 spindles and 85,000 looms are engaged in the production of cotton textiles. Many of these mills are small and unimportant, but there are quite a few which would be considered large in either the United States or Great Britain.

Here and there can be found a mill modern and efficient mechanically, but these are the exception. It is estimated that at least 70% of the productive equipment in Brazil is obsolete, either from being in use for many years or because it was bought second-hand. Automatic looms, for example, are practically unknown.

Under normal conditions, many Brazilian mills consistently show substantial earnings, despite worn-out equipment and inefficient management according to American standards. This apparent paradox of profit from obsolete machinery is possible because of the large margin between manufacturing costs and the selling price of finished goods. Labour is as cheap in dollars as it is in Japan, taxes and power costs are reasonable, and most of the mills many years ago wrote depreciation of equipment off their books entirely. Savings in many instances are effected by selling directly to the retailer instead of paying a commission to a middleman. There is an ample supply of cheap domestic cotton and wool; some rayon and a little silk are produced at low cost.

Weak domestic exchange is another factor in the low cost of production.

On the other side of the picture, the Brazilian cotton textile industry has found itself more frequently undergoing what is known locally as a "crisis." This is described in manufacturing circles as the result of underconsumption and in Government circles as a simple case of overproduction brought on through a practice of operating 16 to 24 hours a day. Whatever the reason, there is no doubt that the domestic market since 1937 has been flooded with poor-quality goods priced too high.

Market conditions in Brazil are very disorganized, and most mills are forced to manufacture literally hundreds of different kinds of goods. This means that mass production is not common in the textile industry. Further, there is difficult competition for the legitimate manufacturer from small, family-operated plants with virtually no overhead and little conception of manufacturing costs. The industry is saddled with Government restrictions and regulations which are often changed several times a year.

Labour laws are complicated. The work week is restricted to 48 hours, which seems to be more or less standard in most South American countries. Payment ranging from 25% to 75% must be made for overtime. Each employee who has worked a year is entitled to a 15-day vacation with pay. There is a social security or pension law for industrial workers. A minimum-wage law has been proposed. Two-thirds of the employees of a foreign concern must be Brazilian. Companies employing more than 500 persons are supposed to provide medical clinics, cafeterias, rest rooms, etc. All of these laws were on the books in 1939, but there is considerable question as to how thoroughly they are enforced, especially in outlying areas.

Despite the "advanced" social laws of Brazil, the economic status of the textile labourer is not too good. He earns in industrial centres perhaps 5 cents an hour or $10 a month; 2 cents to 3 cents an hour in the interior. It is reported that wages are even lower than this in the north near Recife. However, such wages will buy about three times as much in Brazil as in the United States, and living costs are extremely low. Due to the low wages, no premium is placed on efficiency. The average Brazilian worker runs about 25% of the equipment run by the U.S. worker, although he is mentally and physically capable of handling a much larger job load.

There are no real labour unions in Brazil, although there are organizations of employees said to be more or less regulated by the Government. Occasionally there are local strikes, but not often.

There were restrictions on importation of productive machinery until fairly recently when this was repealed. Brazilians attempted to make their own machinery during this period, but with little success.

Sooner or later internal competition is going to force the majority of Brazilian mills to modernize their equipment or go out of business, and the more forward-looking companies for some time have been installing new machinery. Before outbreak of the European war in 1939 most of the new machinery bought was British and German, with American equipment increasing in popularity. The war naturally has caused an increase in the purchase of American equipment, although price is still a retarding factor.

Brazil produces all the cheaper grades of cotton cloth necessary for domestic consumption and exports a small quantity to other Latin American countries. Domestic production is protected by a high tariff wall, and relatively few textiles come into the country other than fine yarns and quality products—except when a bilateral or barter trade agreement dumps goods in the market.

The textile industry of Argentina, in contrast to that of Brazil, was in 1940 new, lusty and virile. Most of the spindles and productive equipment were installed within the last 10 or 15 years, and more than a few of the plants are comparable to those of the United States in efficiency. The industry is growing rapidly and there is room for further expansion, to possibly twice the present number of spindles.

The cotton textile industry of Argentina consists of some 20 plants, with a total of 350,000 spindles. The next census is expected to show at least 450,000 spindles. There are a few large plants, but the majority are small. Many are known as "faconiers"—one or two looms in a basement or barn.

The industry had a bad year in 1938 due to competition from Japan and Italy, but the situation improved in 1939 up to the outbreak of the European war. The outlook at the present writing (1940) is very uncertain. However, under normal conditions and with reasonable tariff protection, the industry is profitable.

One of the greatest concerns of the industry has been the fact that Argentina must keep its tariffs low in order to export agricultural products, which means that local manufacturers are never quite sure as to just what sort of competition they are going to have from other textile producing countries. There is considerable competition among the mills themselves and it is obvious that this competition is going to become more intensified as the market begins to approach the saturation point. The haphazard attitude toward old machinery that exists in Brazil is not in evidence in Argentina, and old equipment has a hard time competing.

Argentina is not a low-wage country in the sense of Brazil. Ordinary textile operatives in Buenos Aires earn $1.50 to $2.50 a day; skilled labourers more. Efficiency of the Argentine workers, many of whom are of Italian descent, is very high in comparison with other Latin American countries, especially those in warmer climates.

Argentina has its share of social laws, including a famous statute on the books known as "No. 11-7-29," which makes it practically impossible to discharge an employee without paying a substantial separation wage; guarantees employees in the larger plants a two-weeks' vacation with pay; requires the mill to furnish at least nine months employment each year; grants sick leave with pay, etc. Complications and penalties connected with this law are great.

Labour unions exist in Argentina, but are considered rather impotent.

Market conditions are complicated and demand a great many different styles in relatively small quantities, which intensifies production problems. There are a few commission merchants, but many of the mills sell directly to the retail trade.

Argentina produces all cotton used domestically and exports a part of the crop each year. Mills which agree to manufacture only Argentine cotton are given special tariff concessions concerning importation of machinery, which means that domestic cotton is used almost exclusively.

The foregoing gives some idea of the development of the cotton textile industry in the two leading countries of South America. In most of the other countries development of the industry has been on a smaller scale. For example, in 1939 the cotton textile industry of Chile consisted of less than 50,000 spindles and about 2,000 looms concentrated largely in two plants of importance. The Chilean industry is bound to develop further, but it is limited by the small population and low buying-power of the country. The same thing is true of several of the other smaller countries.

The immediate future of the cotton textile industry in South America depends obviously on the outcome of the European war of 1939. (W. G. As.)

V. THE DISTRIBUTION OF COTTON TEXTILES

A. WORLD COMMERCE IN COTTON MANUFACTURES

Commerce in Ancient Times.—In days gone by one of the chief evidences of the attainment of civilization was skill in fabric weaving and decoration. Although all the ancient civilizations produced textiles of one kind or another, from the earliest twines of the primitive savage down to the beautifully decorated woven fabrics of the Oriental and Inca civilizations, the arts of fine fabric production tended to be centred in small areas. In some instances this arose because of the development of special skills in a given locality, and in others from the availability of raw material. When commerce between areas and nations did begin, textiles and textile raw materials accordingly became one of the principal articles of trade, so that the early history of world commerce is, in many respects, also the history of world trade in textiles.

Cotton had been cultivated and cotton textiles produced in India for centuries before Alexander invaded India or the Roman Empire had even been thought of. During the Pax Romana cotton was grown on the shores of the Mediterranean, and cotton fabrics were produced under the slave economy of the time. It also seems likely that considerable trade in cotton textiles was carried on with India, continuing down into the post-Roman era when unsettled conditions in the Mediterranean interrupted trade in fabrics of local production. Even this trade, however, declined when the wealth of the Roman Empire was destroyed through the repeated barbaric invasions from the East, and by the close of the Roman era the ancient world commerce in cotton and its manufactures had almost wholly disappeared.

Not until the spread of the Saracens over the Mediterranean area and as far east as India during the 7th and 8th centuries did trade in cotton fabrics again attain substantial volume. The Arab merchants reopened the avenues of trade, established new caravan routes and linked together many peoples of the Near and Far East in a broad and comprehensive international commerce. It was these same Saracens who were responsible for the first recorded introduction of cotton cultivation into the western Mediterranean. During their occupancy of Spain cotton fabrics of the finest artistry in decoration were produced from cotton grown in Spain. Between Moorish Spain and the rest of Europe, however, there was little trade because of the constant religious warfare, and when the Mohammedans were expelled from Spain, their crafts were lost, and with them, the cultivation and manufacture of cotton.

The Beginning of Modern Commerce.—The Crusades (1096–1270) for the first time brought the peoples of Europe generally into touch with the arts and products of the East. During the period when the Crusaders held the land of Palestine, the exchange of goods between the Phoenician ports on the coast and the West helped stimulate the growth of the great trading centres of Genoa and Venice. Cotton had been cultivated in the Levant on a small scale since the Roman era, and now came to be produced for shipment to these cities where it was made into cloth for export to western and central Europe. Thus were begun the textile industries of northern Italy and southern France.

India the Leading Exporter.—With the increase in world trade during the 13th and 14th centuries, usually associated with the Hanseatic League, cotton and cotton textiles became more and more important as articles of world commerce. Most of the finer fabrics and all the printed calicoes consumed in Europe came from India itself, over the caravan routes through Baghdad and other Middle Eastern trading centres made famous and prosperous by the ever-growing trade of the Arab and Italian merchants.

The geographical basis for this trade was a century or two later undermined by the closing of the overland trade routes to the East. The great Mogul empire in Central Asia, which had looked with favour upon this commerce, was succeeded in 1368 by the Ming Dynasty. In 1453 Constantinople was captured by the Turks. Shortly after the Genoese route by way of the Golden Horn was shut off, the spread of the Turks into Syria and Egypt cut off the Venetian route to the East and reduced to a mere trickle the volume of goods that could be brought by caravan from the East.

The necessity for finding an all-water route to India started the remarkable series of voyages of trade and discovery that led Columbus to America and Vasco da Gama around the Cape of Good Hope and across the Indian ocean to Calcutta in 1497. Taking advantage of the new trade routes, the Portuguese built up a large and profitable trade in cotton with the Indies which amounted practically to a monopoly so far as European trade was concerned and lasted almost a century. The Dutch traded with Lisbon, and in this way Antwerp, Bruges, and Haarlem became the most important cotton ports of northern Europe. With the raw cotton for domestic spinning into coarser fabrics came the fine and richly coloured chintzes and calicoes it was impossible to duplicate in Europe and for which, partly because of their very scarcity, an insatiable demand sprang up.

The power of Spain in the 16th century made it difficult for the northern European countries to send their own merchant vessels to India and what trade the English and Dutch had with the East was surreptitious. With the defeat of the Armada in 1588 and the collapse of the Spanish power all obstacles from that quarter were removed. Shortly thereafter the great Oriental trading companies were founded: the British East Indies Company in 1600, the Dutch East Indies Company in 1602, and the French East Indies Company in 1664. Starting primarily as importers of Indian calicoes and similar products of the East for which European demand was steadily rising, these companies later assumed military and political aspects which led to the establishment of the Eastern empires of these three nations.

Britain Becomes the World's Leading Exporter.—Meanwhile textiles of all kinds were being manufactured in Great Britain on a growing scale. The religious wars on the Continent, especially the conflicts in the Low Countries, and the revocation of the Edict of Nantes in 1685, had led to the migration of many thousands of Protestant artisans to England, who brought with them the highest skill in weaving and designing known on the Continent. As Britain's trade with India grew, her domestic manufacturing industry expanded until by the end of the 17th century she had actually become an exporter of cotton fabrics. Europe was still dependent upon India for printed cotton goods, however, and not until after 1690, when the first British textile printing plant was built, did England begin to establish her leadership in the type of goods for which India had hitherto been the sole source.

In a sense the 17th century formed a bridge between the tradition of artistry in textiles of the Middle Ages, characterized by production on the handicraft system for one's own use or for the local market, and factory-made production for a world market. The discovery of the all-water route to the East, which during the 16th century had let in a flood of printed cottons from India, had opened the road. The mediaeval organization of production around local guilds began to give way, and by 1700 textile production in England was to a certain extent organized in terms of a national and even an international market. Cotton manufacturing had to overcome the resistance of the wool interests which keenly resented the intrusion of this new fibre and even succeeded in obtaining from the mercantilist Government in 1700 a law prohibiting the sale of cotton goods in England. Such resistance quite naturally only whetted the desire of everyone to wear cotton, and in 1736 the law was amended under the statute known as the Manchester Act which enabled Manchester to establish itself as the centre of the cotton manufacturing industry of Great Britain.

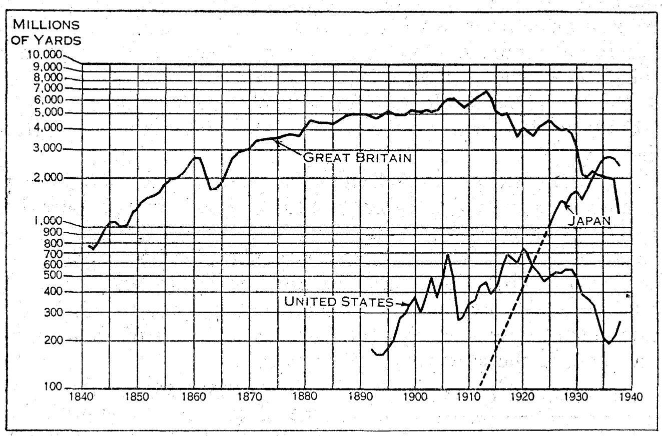
The economic history of the second half of the 18th century in Britain is bound up inseparably with the calico trade. The wave of inventions, which has come to be characterized as the Industrial Revolution and which completely transformed methods of production throughout industry, gathered its momentum in the series of textile machinery inventions that arose out of the inability of home spinners to produce enough cotton yarn to supply the growing demands of the British export market for cotton goods.

Beginning of the Industry in the United States.—Although the growing of cotton had early been introduced into the colonies of Virginia and the Carolinas, production had not, prior to the American Revolution reached a point where any volume of cotton was exported to the mother country. During the 18th century Britain obtained almost three-fourths of her cotton supply from the British West Indies and the rest from India, the Levant and Brazil. (Brazil had early been a source of raw cotton, the Portuguese importing the fibre to Europe as early as 1570.) Some cotton was grown in the American colonies but almost wholly for home use under the colonial handicraft system. One reason why American Upland cotton, the variety that had become predominant in the South through hybridization and soil and climatic conditions, was not used more widely was that the fibres clung tenaciously to the seeds. Cleaned by laborious hand pulling, this cotton could not compete with foreign varieties. The invention of the cotton gin in 1793 by Eli Whitney provided an easier method of preparing it for use, and cotton growing soon spread throughout the South for export to Britain. Consumption of cotton by the British cotton textile industry in 1791 amounted to about 23,000,000lb., being limited chiefly by the world supply of cotton. The total production of cotton in that year in the United States amounted to only about 2,000,000lb., practically all of which was consumed at home. By 1800 United States exports of cotton to England had increased to 18,000,000lb., and by 1811, 18 years after the invention of the cotton gin, to 62,000,000 pounds.

The construction of the first successful cotton mill in the United States in 1790 by Samuel Slater at Pawtucket, R.I., coincided with the period of textile machinery invention in Great Britain. When the Boston Manufacturing Company mill was built at Waltham, Mass., in 1814, it was able to use power-driven machinery throughout. Thus, the American industry began its rise about a quarter century after the great technical inventions in England.

The institution of a protective tariff on cotton goods in 1814, at the request of the American cotton textile industry, more or less drew a dividing line between the American and the British branches of the world cotton industry. Under its protective tariff the American industry continued to expand for a full century but was never quite able to meet the entire requirements of its domestic market, while the British cotton textile industry set out to capture for itself all the cotton textile markets of the world outside the United States.

The Supremacy of Lancashire.—For two centuries, or roughly from 1700 to 1914, the supremacy of Lancashire as the world's primary source of supply for cotton goods was unchal-



SOURCE: U.S. DEPT. OF AGRICULTURE, THE WORLD COTTON SITUATION (TWO-YEAR MOVING AVERAGE)

FIG. 10.—EXPORTS OF COTTON GOODS, GREAT BRITAIN, UNITED STATES AND JAPAN

lenged. This is brought out vividly in the accompanying chart, which shows comparative figures of cotton goods exported by the three principal exporting countries during the last century: Great Britain, the United States and Japan. The steady rise in the British export curve from 791,000,000yd. in 1840 to 7,080,000,000 in 1913, together with freedom from violent year-to-year fluctuation, illustrates forcibly the dependence of the world upon Lancashire. Even the American Civil War, which stopped raw cotton exports from the South to Great Britain, caused only a 40% decline in the total volume of her cloth exports.

The United States' position in the export market has never been of real importance compared with that of Great Britain. To begin with, the United States industry was occupied in meeting the needs of a rapidly expanding domestic market. A high protective tariff on cotton goods, furthermore, tended to keep prices for U.S. cotton goods on a higher level than British textiles sold in the world market. Forced to expand almost entirely out of earnings because of the sharp competition for capital in a new developing country, its rate of growth was slower prior to 1890 than that of Lancashire, which had access to large accumulated earnings of the industry itself, plus the reservoir of the investment capital of the British Empire. As late as 1890 the total *output* of the American cotton textile industry amounted to only 3,002,761,000 sq.yd. as compared with British *exports* of 4,912,000,000 square yards.

The era of British supremacy in the world markets for cotton textiles, which was brought to a close by the World War of 1914–18, was a period of expanding markets in which the first comer, once he had established himself, had a pronounced advantage. The industry's attention was necessarily focused on problems of production, of getting more sources for raw cotton, of opening new markets through the application of imperialist national policies, rather than upon distribution as the term has come to be used in the last two decades. World population was increasing at a rate exceeding anything previously known. The application of steam power to transportation was opening up hitherto untouched markets for the industry of Lancashire, markets that seemed to expand fully as fast as the industry itself grew. Furthermore, the technical progress of the industry kept reducing prices at a rate that made possible a gradual rise in living standards for the whole world, accompanied by a freeing of purchasing power to buy additional goods.

B. THE POST-WAR RECONSTRUCTION OF THE COTTON TEXTILE MARKETS

The World War Ushers in a New Era.—The World War of 1914–18 marked a turning point in consumer demand for textiles, which together with the launching of local textile industries in former importing countries, especially India and Japan, led to a radical transformation in world textile markets.

Population Trends.—Since the demand for textiles of most kinds tends to be proportional to the number of people in a given area, changes in population trends have a direct bearing upon textile demand. It is highly significant, therefore, that the rapid increase in population of the western countries which characterized the 19th century, has ceased. In the United States, population doubled about every 30 years from the founding of the republic until the World War, thereby practically doubling the market for textiles. In 1940 the rate of population increase was much lower, and it is expected that by 1960 or 1970 the United States will have reached the peak of its population, after which it will start to decline, as is already happening in Western European countries. This decline in the rate of population growth will retard the rate of increase in the size of the market for cotton goods.

Changes in Way of Living.—Demand for cotton textiles has been greatly affected also by changes in the way of living brought about by the automobile, motion pictures, improved methods of heating and heat insulation in buildings, the greater freedom achieved by women during the World War of 1914–18, and the increased importance of leisure resulting from shortened hours of work for the average person. All these together have created a different pattern of life than that known before, with different requirements as to amounts and types of clothing, of household textiles and textiles for industrial use.

Until rather recently these changes were most apparent in women's apparel. Before the War of 1914–18 costumes for almost all purposes followed a single fashion. The employment of women in industrial occupations during the World War encouraged the simplification of clothing and provided part of the stimulus toward the revolution in women's dress that characterized the early '20s. A more active mode of life demanded quite different clothes than those worn in pre-War times. It has been estimated that the young woman of modern times wears, at one time, no more than a third or a fourth the yardage of cloth worn by her mother. In weight it is even less, owing to improvements in heating of houses and public buildings.

The curtailment in yardage volume in the women's fabric markets brought about by this change in mode of dress has been made up in considerable part by the expansion of women's wardrobes. The development of the cutting trades, plus technological improvements in the textile industries, has made available a greatly increased assortment of apparel at much lower prices than ever before. Consequently, frequent change with less stress on durability and more stress on style has become economically feasible for the average consumer. Rayon and the use of more silk helped to shrink the market for cotton fabrics in women's apparel. Yet for all fibres as a whole, the women's apparel markets in the United States, for example, allowing for population increase, did not diminish more than 30% from 1918 to 1938.

In men's apparel the trend toward functionalization of clothing *i.e.*, making the design fit the needs of a specific use, has been much slower than in women's wear. Only since about 1935, when men's fashion magazines began to be popular, has the concept of varied and specialized types of men's apparel begun to take hold in the volume apparel markets. The chief stimulus has been the greater leisure of the average man which has created new needs and broader markets, particularly in specialized types of sports apparel.

Modern types of decoration, particularly the use of colour in the home, together with the growth of power laundries in place of home laundering, have radically altered the household textile markets. Higher standards of living in the home have resulted in doubling the consumption of sheets in the decade 1928–38, with similarly increased consumption of towels, blankets, bedspreads and related items.

To a certain degree these same trends have been evident in other western countries, varying in proportion to their own standards of living and the extent to which they have been influenced by mass production and distribution methods, by widespread popular ownership of automobiles, and by the American way of living as portrayed in American motion pictures. American standards of dress and decoration as shown in the films have been publicized throughout the world and will undoubtedly have a tremendous cumulative effect upon the use of textiles in all countries during the next generation.

Changes in Standard of Living.—With these changes in the way of living there has also been the culmination of a century-long rise in standards of living for the average man throughout the western world. For the first time in human history men have ceased to fear that their food supply might be curtailed, and no longer look upon food as a luxury or as a primary source of pleasure. A larger margin of income has thus become available for clothing and other former semi-luxuries at a time when technological advances have reduced the cost of machine-made textiles to levels where they are available even to those with lowest incomes.

For a relatively large number of families in both the United States and Great Britain, well-made, well-fitted, attractively styled clothing in good condition has ceased to be a luxury and is as much a necessity as food. For such elements of the population, the rate of increase in consumption of textiles will in the future be relatively small. Although there is not the upper limit to per capita consumption of textiles that there is to food, there is a limit determined in part by actual needs, and more important, by competition from alternative uses for the margin of income available after strict necessities have been taken care of. In terms of actual yards of textiles consumed, per capita consumption of this group of the population maintains a degree of stability that is comparable to the food consumption of the bulk of the population.

TABLE XIX.—*Production, Exports and Imports of Cotton Goods by Leading Producing Countries*

	Production				Exports				% Exported of total production	Imports				Available per capita consumption approximate sq. yd.
	1910	1927	1935	1937	1910 (c)	1927	1935	1937	1937 %	1910	1927	1935	1937	1937
		(Million sq. yd.)				(Million sq. yd.)					(Million sq. yd.)			
United Kingdom	8,050 L[j]	6,027[a]	3,384	3,806	6,665L	4,117	1,949	1,921	50	..	72	29	50	43
United States	6,814[b]	8,863	7,002	9,321	395	595	187	235	3	56[c]	63	64	147	75
Japan	..	3,095	4,908	4,794	156	1,419[f]	2,725	2,644	55	..	12	1	1	23
		(Million linear yd.)												
India	1,141[c]	2,372	3,555	3,951	89L / ..	187L / 94Q	68L / 115Q	149L / 136Q	7*	2,741 L[c]	1,965 L	1,033L	688 L	12*
China	150*	360	1,036	..	..	..	28Q	50Q	3*	140 S*	625 S[f]	119 S	92 S	3*
France	..	1,355	1,114[i]	..	405Q	632Q	347Q	342Q	31*	20 Q[c]	8 Q	6Q	8 Q	18*
Italy	..	886	824	..	412Q	495Q	234Q	448Q	28*	30 Q[c]	15 Q	5Q	5 Q	14*
Canada	100*	229	210	245	..	..	..	..	..	113 L[c]	98 Q	78Q	93 Q	33*
Brazil	425[d]	760	823	1,613[e]	..	..	..	..	..	118 Q	72 Q	3Q	5 Q	39*
U.S.S.R.	..	2,586	2,876	3,568	..	38Q[f]	192Q	200Q	6*	..	..	..	..	20*
		(Thousand Quintals)†				(Thousand Quintals)†					(Thousand Quintals)†			
Germany	..	2,247[f]	..	2,714[e]	399	184	96	212	8*	89	240	44	44	39*
Belgium	..	614[g]	380[h]	..	272	238	170	128	45*	52[c]	30	13	9	27*
Netherlands	..	631	420	595	..	287	103	227	38	..	81	30	39	50

Notes:—Unless otherwise indicated, units are those shown for statistics on production.
L=Linear yards (in millions); S=Square yards (in millions); Q=Quintals (in thousands).
*Approximations. †One thousand quintals very approximately equivalent to one million square yards.
[a]Year 1924; [b]Year 1914; [c]Years 1909–13 Average; [d]Year 1913; [e]Year 1936; [f]Year 1928; [g]Year 1929; [h]Year 1933; [i]Year 1932; [j]Year 1912.
Source: *The World Textile Industry.*

Nevertheless, a large part of the population even in the western world, because of low incomes, is unable to purchase enough textiles to bring it to this level. The total amount of textiles consumed varies from year to year with fluctuations in incomes.

Already, by the changes in the standard of living during the post-War (1914–18) period, textile consumption by this group of the population has risen. Reductions in costs due to competition, to technological advances, to the growth of the cutting trades, and to mass low-cost distribution through chain and similar organizations have reduced prices to consumers to an extent that has enabled this largest group of consumers to increase its purchases of textiles nearer to its actual needs. Further progress in this direction through continued lowering of costs and prices, which will enable the great masses of the population to increase their purchases of cotton textiles, represents the greatest hope for future expansion of the cotton goods markets.

Growth of Cotton Manufacturing in Former Importing Countries.—It was, of course, inevitable that other importing nations than the United States should eventually see the value of establishing their own cotton manufacturing industries and should take steps to encourage their growth. That greater progress had not been made prior to 1914 seems surprising today. Great Britain's foreign trade was so well organized, however, through her judicious purchase of the products of her customers in exchange for British cotton goods that few importing countries attempted to challenge Britain's position as their prime supplier of cotton goods.

The World War of 1914–18, however, seriously disrupted Great Britain's foreign trade. From 7,080,000,000yd. in 1913, British exports of cotton goods dropped to an average of about 5,000,000,000yd. in the first three years of the War and to only 3,700,000,000yd. in 1918. The United States picked up less than 10% of this loss. Its exports rose from about 450,000,000yd. in the years immediately preceding the war to an average of about 700,000,000yd. in the later years of the war.

The largest part of the shortage of cotton textiles resulting from Great Britain's preoccupation with the war was made up by increased production of cotton goods in former importing countries. What textile industries they had were operated at capacity and with high profits, so that they were able to expand out of earnings. By the end of the World War of 1914–18, the productive capacity in these former agricultural countries was definitely larger, and, most important, many of them had made an important start toward industrialization which they became determined to foster. India, China and Japan are the most striking examples of this trend, although it was also evident in Latin American countries and elsewhere.

Japan seized the opportunity presented by Great Britain's inability to supply Eastern markets to double her cotton manufacturing capacity and enter upon a career that has made her the world's largest exporter (1940).

While no yardage figures are available to trace the growth of Japan's production during the war, the installed spindle statistics show an increase from 2,300,000 in 1914 to 3,700,000 in 1920 and to 12,550,000 in 1938—almost a six-fold increase since before the war.

Relative Standing of Leading Producers in 1935.—The immediate effects of the World War of 1914–18 were to prove less crippling to the world leadership of Lancashire than the train of events it set in motion, which resulted in the world economic collapse of 1929. The sharp drop in commodity and security prices made it impossible for debtor nations to sell enough of their products to be able to service their debts or to buy manufactured goods freely. As the depression deepened, country after country either instituted exchange restrictions or embarked on a commercial policy based upon further protection for their own industries. As a result the total export market for cotton textiles shrunk despite increase in world population, forcing former exporting nations to reduce the size of their industries as well as develop their home markets on a larger scale.

At the same time other manufacturing countries, particularly Japan, but also the Soviet Union in some degree, succeeded in expanding the quantity of their cotton cloth exports despite the world crisis. Finally, a further factor that has influenced the structure of the cotton goods export market has been the evolution of new commercial devices and policies, such as barter, as a result of which existing channels of trade have been radically modified.

India.—In both India and China production on hand looms in the villages still accounts for a large part of domestic requirements. Part of this is made from home spun yarn, and part from machine spun yarn, of either domestic or foreign origin, sold to the peasants through regular distribution channels. Both countries have accordingly been important markets for yarn for home consumption as well as of cloth, both gray and finished.

In India production of cotton textiles has increased to a point where the volume of imported cloth is less than a third of what it was before the World War of 1914–18. For what India does import, Japan has supplanted Great Britain as the principal source of supply.

TABLE XX.—*The Indian Cotton Cloth Market, 1913–35*

	Million linear yards			
	1913–14	1928–29	1932–33	1935
Indian mill production	1,164	1,893	3,170	3,555
+ Retained imports	3,135	1,913	1,204	1,033
− Exports, Indian goods*	89	149	66	68
= Mill cloth available for consumption	4,210	3,657	4,308	4,520
Imports by sources:				
United Kingdom	3,044	1,439	586	489
Japan	9	352	570	526
All other	82	122	48	18
India's percentage of available mill cloth	27·6%	51·8%	73·6%	78·7%

*Excluding exports by land, about 4% of total available.

Sources: G. E. Hubbard, *Eastern Industrialization and its Effects on the West; Cotton Trade Statistics, 1936.*

China.—A country which some years ago was one of the greatest world import markets for cotton piece goods and cotton yarns, China had prior to the outbreak of the war with Japan in 1937 become able to supply almost the full effective home demand for cotton cloth. The extent of reduction of cotton goods imports is indicated in Table XXI.

TABLE XXI.—*China as a Cotton Piece-Goods Market, 1926–35*
(Thousands of £)

Imports from:	1926	1929	1932	1935
All countries	26,630	22,035	7,064	1,570
United Kingdom	6,288	4,810	2,303	389
Japan	17,917	14,646	4,369	1,131
Hongkong	1,281	1,489	48	1
U.S.S.R.	317	504	101	..
Other countries	827	586	243	49

Source: *Cotton Trade Statistics, 1936.*

The growth of Chinese textile production is indicated in the spindle statistics since 1890.

TABLE XXII.—*Cotton Spindles and Looms in China, 1890–1936*

	Spindles		Looms	
	in thousands	(1913 = 100)	in thousands	(1913 = 100)
1890	114·7	11·7	1·6	17·2
1900	638·0	64·9	8·9	94·5
1913	982·8	100·0	9·4	100·0
1920	2,052·6	208·9	17·0	181·0
1928	4,115·3	418·7	29·3	311·8
1934	4,680·0	476·2	44·0	468·1
1936	5,010·0	509·8	..	..

Source: H. D. Fong, *Cotton Industry and Trade in China* (1932); U.S. Tariff Commission, *Cotton Cloth Report, 1936; International Cotton Bulletin.*

From the high ratio of spindles to looms, 107 compared with about 40 in the United States, it is evident that a large part of the product of the Chinese spinning industry is sold as yarn for home weaving.

Japan.—From 1924 to the end of 1935, the volume of cotton cloth exports from Japan expanded without interruption in a market that was shrinking because of cyclical and structural developments. Most of these exports have been to regions lowest in the income scale: South Asia, the Far East, colonial Africa, etc. Thus between 1931 and 1935, Japanese shipments of cotton goods to colonial Africa multiplied threefold, shipments to India and Ceylon rose 40%, the decline in shipments to China was more than made up for by a greater than twofold increase in exports to other parts of the Far East. In part this has arisen from an actual expansion in the use of factory-made cloth made possible by the availability of cotton goods produced at costs and for sale at prices more nearly proportionate to other elements in the standard of living of these people. It has come also through replacement of low grade fabrics of British manufacture by Japanese goods made under wage scales both absolutely and relatively much lower.

As the volume of production rose, the quality of the Japanese product was gradually improved to a point where it was so nearly comparable to British and American goods as to be able to displace the products of those two countries in Latin American and other markets. Japanese bleached cotton goods even invaded the United States and took over the largest part of the market for that type of goods from American manufacturers despite the high tariff. Finally, in 1934, as shown on the chart (fig. 10), Japan passed Great Britain as the world's leading exporter of cotton goods.

That year marked also the beginning of restrictions upon the flow of Japanese cotton goods into her new markets. The vigorous campaign of Japan for exports, forced upon her by the collapse in the price of silk during the depression and the pressing need to obtain foreign credits to offset the deficit balance in her trade with the United States, led to the building up of unbalanced trade with other countries, whereby Japan exported cotton goods to them but took not nearly as large a volume of goods in exchange. This was in direct contrast to the type of foreign trade Great Britain had developed during the 19th century with these same markets and, had it been allowed to continue, would have had disastrous effects upon their economy.

In 1934, the first important restriction upon Japanese cotton goods exports was made by India in a new agreement between the two countries scaling the amount of Japanese cotton cloth that could be imported in proportion to the Japanese purchase of India raw cotton. In May of that same year the United Kingdom imposed quotas on imports of cotton and rayon piece goods into all the Crown colonies, which, because of the base years selected, fell chiefly on Japanese goods.

These were followed by further restrictions in the Netherlands Indies, the Philippines, Australia and, up to June 1936, in 56 markets out of 106 distinguished in Japanese export statistics. In 40 markets the restriction took the form of a quantitative limitation, while in the other 16 restriction took the form of a tariff preference in favour of Japan's principal competitor, the United Kingdom. The quantity of trade affected by the restriction was about 67% of total Japanese piece goods exports in 1935.

Latin America.—The expansion of cotton manufacturing in Latin America has proceeded slowly, but each year shows some slight expansion in one country or another. Brazil has the largest cotton textile industry in South America as well as being the largest producer of raw cotton. Today the industry is about twice as large as before the World War (1914–18), with the likelihood of expanding still more as raw cotton acreage is enlarged.

C. ORGANIZATION OF COTTON TEXTILE DISTRIBUTION

Although the woven product of the cotton textile industry is all collectively referred to as cloth, it is important to distinguish from the standpoint of distribution between three types, according to the last stage of manufacture through which the cloth has passed—gray goods, the immediate product of the weaving mill, often referred to as unbleached cloth; finished goods, including bleached, dyed and printed fabrics; and fabricated products, such as sheets, towels, blankets, made by textile mills and sold from the mill ready for use in the home.

Gray Goods.—A large volume of cotton goods is used in the gray state, although in western countries this is almost wholly confined to industrial uses, as in bags and for similar purposes where the application of some specific finish to the goods is not required. Fifty or more years ago many consumers in the United States purchased gray goods, or "brown" sheeting, as certain types were called, which they bleached themselves by wetting and spreading out on the grass in the sun. This was a survival of the handicraft methods used on fabrics spun and woven in the home prior to their replacement by low-priced machine-made goods.

The use of factory-bleached and coloured goods is still not possible for a large proportion of the low income population of the Orient. For that matter a large part of the people in those countries live under a subsistence rather than an exchange economy, and are unable to sell enough of the products of their labour to be able to buy the products of industry. Consequently a large part of the textile requirements of those countries is met by handicraft production starting in some cases with the raw cotton, which may be spun into yarn according to primitive hand spinning methods, or with factory-made yarn which is then woven into cloth in the home. Thus there are markets in those countries for yarn for sale to consumers for home weaving, for gray goods for home finishing, and for finished goods, *i.e.*, bleached, dyed and printed cotton goods.

Of Japan's total exports of 2,643,000,000 sq.yd. in 1937, 1,291,000,000 sq.yd., or 49%, consisted of gray goods. For Great Britain, unbleached cotton goods amounted to 317,000,000 sq.yd. out of a total of 1,921,000,000yd., or 16%. For the United States, the proportion of unbleached was 28%, or 88,000,000yd. out of 320,000,000.

Except for these export sales of gray goods to consumers and for sales to domestic industrial users, the largest part of all gray goods produced is sold in a gray goods market to converters. In both Great Britain and the United States the function of selecting appropriate patterns, colours and finishes for gray goods is performed not by weaving mills or by finishing plants as such, but by a group of specialists in styling, known as converters. In some instances, in the United States, converting establishments are operated as part of a vertical mill organization, or as an adjunct to a finishing plant, but more frequently they are independent. Converters are accordingly buyers of gray goods from weaving mills and constitute one of the most important demand elements in the market for gray goods.

The existence of a gray goods market is a natural corollary of an industry structure whereby the producer of the cloth is unwilling to take the final responsibility for its merchandising as finished goods, and is willing to dispose of his product in an unfinished state to specialist converters. This tendency toward performing the successive processes in textile manufacturing and fabrication by separate firms is somewhat more pronounced in Great Britain than in the United States. In the former it is carried to the point where most spinners of yarn dispose of their product in a yarn market to mills performing only the weaving operations, whereas in the United States these two processes are almost universally integrated within a single mill.

The needs of both buyers, who require an adequate number of sources of supply, and sellers desiring to maintain a uniform rate of operation in their mills, have inevitably tended toward the development of standard constructions of cloth in the more common types used by the converting trade and by industrial users of gray cloth. The greater the demand for a given type of cloth, the more inevitable it has been for the trade to standardize upon a relatively few constructions.

A further reason for concentrating upon standard constructions is indicated by the function of the gray goods markets in making price adjustments. A common illustration is found in the wide print cloth division of the cotton goods industry. As of a given day the four major print cloth constructions may be quoted as follows:

TABLE XXIII.—*Major Print Cloth Constructions*

Width	Yarn count, warp filling	Weight, linear yards per pound	Price, cents per yard
39in. . . .	80 x 80	4·00	$6\frac{3}{8}$
39in. . . .	68 x 72	4·75	$5\frac{1}{4}$
$38\frac{1}{2}$in. . . .	64 x 60	5·35	$4\frac{1}{2}$
$38\frac{1}{2}$in. . . .	60 x 48	6·25	$3\frac{7}{8}$

It will be noted that there is a steady downward progression of prices as one proceeds from heavier (fewer yards to the pound) to lighter constructions. This makes it possible for the cutting-up and retail trades to adjust for raw material price fluctuations by shifting from one standard construction to another without the necessity of changing the retail price of the finished article. A rise in the price of 80x80 gray cloth, for example, from $7\frac{1}{2}$ to 10 cents per yard would throw printed percales made from this construction out of the range the dollar dress cutter could pay. After the supply of goods he had purchased in anticipation of that price rise had been exhausted, he would be obliged to turn to the next cheaper construction of percales for his dollar dress line, *i.e.*, 68x72's and so on. Since 1925 all these constructions have been used for the dollar dress at one time or another.

Where the particular requirements of different uses vary widely so that different specifications are required in the construction of fabrics for each use, trading tends away from standard constructions to the purchase of fabrics on contract by specification. This is particularly true in the case of novelty weaves, where patterns are woven into the cloth as in fancy dress goods, clipped spot marquisettes, and similar goods where each pattern is a separate construction.

Efficiency in operation of the gray cloth market, in the absence of any formal organization, is achieved through concentration of the actual marketing in the hands of relatively few selling agents and brokers. It has been estimated that in the largest of the United States gray cloth markets, about 20 selling houses represent by far the largest part of the total product, and in some markets the number is less than half-a-dozen. Gray cloth markets are thus essentially brokers' markets. There are no list prices. Quotations are on a bid and asked basis, and the market price is the price at which a sale is made.

Finished Goods.—Finished cotton goods are more familiar to the average consumer than gray goods. They consist of two broad types: converted gray goods, and fabrics that reach the point of sale for the first time as finished goods. Under the first type are included all bleached, dyed and printed goods; under the second, all coloured yarn cotton goods, such as denims, chambrays, ginghams, and specialties like tapestries, pile fabrics and narrow fabrics. To these two groups might be added composition fabrics, in which the fabric is combined with other substances to produce a finished fabric with entirely new properties. Examples of this type are pyroxylin-coated and rubberized fabrics and oilcloth.

All types of finished goods have one thing in common—standardization of constructions is less prominent than in the preceding levels of production. This applies less to such fabrics as denims, which resemble gray goods more nearly than finished goods because (1) finished goods contain decoration which can impart to the cloth a wide range of values both intrinsic and subjective quite irrespective of the value of the cloth itself, (2) the finishing process tends to blur the construction of the cloth as it was woven so that it is difficult to determine from a finished sample just what the original construction may have been. A further cause for lessening the importance of standard constructions in finished goods lies in the changes that occur in cloth during the finishing process. As cloth is woven on the looms it is naturally under considerable tension both as to warp and filling. During the finishing operation, this stretch may be increased warpwise due to pulling the cloth through the finishing processes in rope form with resulting shrinkage in the filling. Also, if the cloth is woven with highly twisted yarn, such as crepe twist yarn, the resulting shrinkage may be very great. Even if the cloth is put through a pre-shrinking process to remove normal shrinkage, the resulting count of ends and picks per inch may have no readily determinable relation to the original gray construction of the cloth. Nevertheless, while not satisfactory in many respects, the only way by which finished goods can be identified as to construction is on the basis of the gray constructions from which they were derived.

Since 1920 important changes have occurred in the types of finished goods used by consumers. The change in women's apparel, and the introduction of first silk and then rayon for women's intimate wear, greatly reduced the size of the market for bleached cotton goods. Similarly the perfection by dyestuff manufacturers during the '20s of fast dyestuffs in a wide range of colours stimulated the use of more plain shade and printed fabrics, to the point where they almost completely replaced ginghams in the United States market. Since about 1930 the vogue for sportswear, beach apparel, and playsuits has further changed the women's cotton fabric markets by creating a demand for other types of fabrics. In men's apparel the perfection of pre-shrinking processes has revolutionized the work and sports clothing business, making possible the expansion of cotton fabrics into semi-dress apparel and tailored summer clothing. The growth of the leisure and sports apparel field has similarly created a demand for new types of fabrics. In household textiles, the greatly increased use of sheets, towels and similar articles has created a broader market for bleached goods, which has in part taken the place of what was lost of the bleached goods market in the women's apparel field.

Changes of this sort between the various types of finished goods are continually occurring.

Because the gray goods mill must be able to sense such changes in consumer demand and act in accordance with them, it is frequently proposed that the two processes of weaving gray goods and converting finished goods should be integrated. In the United States there are numerous mill organizations of this kind, although they represent a smaller part of the finished goods market than the independent converters. In Great Britain they are quite infrequent.

The findings of a research study of vertical integration in the textile industries, conducted under a grant from the Textile Foundation, indicate that the basis for deciding whether integration of weaving and converting is practicable is the effect it will have upon the flexibility of both the mill and the converting organization. The advantage of not being integrated lies in the complete freedom of each to operate as it pleases; for the gray mill to sell its product wherever it can and at the best price it can get; for the converter to handle whatever type of goods he expects to be able to sell at the highest profit and to buy from the mill that can make and sell them at the lowest price. Integration necessarily reduces this flexibility.

However, by partial integration, this flexibility may be maintained while at the same time bringing to each unit the combined advantages of a gray mill profit and close contact with the finished goods market. By this is meant the avoidance of complete balance between the two units, by either having the finished goods unit much larger than the gray mill or vice versa. In the first case the converting unit can operate the mill at capacity and still produce only part of its requirements, while in the second the mill can use its surplus capacity to produce lines that can be sold as gray goods which will not compete with the product of the converting unit. Other factors, of course, enter into the situation, such as the point at which style is introduced into the fabric, whether in the weaving of the cloth or in the finishing operation.

The finished goods selling organization, it is evident, tends to be quite different in character from that of a gray goods mill. Gray goods consist largely of standard constructions which may be sold through a broker by description. Customers are largely converters or large industrial users. Finished goods, on the other hand, are specialty products in that each converter's offering has different patterns which express the style ability of the designer and which must be sold to the cutter or wholesaler or retailer.

Also, because of the relatively large number of users who must be approached, a different type of selling organization must be employed.

Prior to the World War of 1914–18 the average consumer in the United States and Great Britain purchased a fairly large proportion of her textile requirements as finished goods. Most articles of women's apparel as well as textile articles for the home were either made in the home or by seamstresses or dressmakers. Ready-made articles in men's apparel, such as shirts, collars and suits were already widely worn, but the mass movement toward ready-made clothing did not get under way until after the war. As a result of this fundamental change in textile distribution the importance of consumer purchases of piece goods greatly diminished. Consumers now buy ready-to-wear, and converters sell less and less to wholesalers and retailers, and more to cutters of all kinds.

Fabricated Textile Products.—Today most textiles reach consumers as fabricated products. The term is used here to designate the product of a final manufacturing operation in which definite shape, size and design are imparted to it to fit it for a specific use. Textile fabricated products consist basically of two types: made-up articles produced by textile mills which combine in some way the fabricating process with preceding manufacturing operations; and made-up articles produced by the cutting trades. This is essentially a difference arising from integration of the fabricating process with cloth manufacture, although in some cases, such as hosiery manufacture, the operations of cloth formation and product fabrication are performed simultaneously.

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VI. COTTON MACHINERY

This section deals with the machinery used in the various departments of the cotton industry, beginning with cotton ginning machines and passing successively to cotton spinning machinery, cotton weaving machinery and cotton finishing machinery. Reference should also be made to the articles Spinning; Weaving; Carding; Combing.

A. COTTON-GINNING MACHINERY

Any method of separating cotton-seed from lint is known as ginning. The earliest machine for this purpose was the primitive "churka" gin used in India centuries ago, and still used there and in China to some extent. Several types of roller gins were developed prior to Eli Whitney's saw-gin, but it is to his invention in 1793 that we owe the development of the raw cotton industry, for almost all of the world's cotton crop is ginned today by improved adaptations of Whitney's principle. The large amount of machinery necessary in a modern gin is used, mostly, to clean seed cotton, carry it to the saws, and convey the lint cotton away from the saws.

Although ginning is a specialized process necessary to put cotton into a marketable condition, unless the cotton farmer has done his part, the ginner—no matter how efficient his plant—cannot deliver a bale of cotton up to standard. Care in harvesting and handling seed cotton on the farm is as necessary as care in ginning. For instance, the average gin, adequately maintained and efficiently operated, can only do a good job of ginning on dry, carefully picked clean cotton. Green, damp, or wet cotton, if ginned without drying, gives rough preparation and grade penalties that amount to as much as $1 to $10 or more, per bale, depending on moisture content and staple length of cotton and prevailing price. If the seed cotton is long staple, even a slight excess of moisture will cause gin-damage.

Wide varieties in harvesting practices have caused manufacturers of ginning machinery to make great strides in design and construction of cleaning and extracting machinery. Gins established in sections where cotton is "snapped" find it essential to incorporate excellent cleaning units. (During 1928–35 an average of 12% American crop was snapped.) The recent development of the Centrifugal Gin (Watson) was an effort toward better cleaning, but it is still in the experimental stage. Certainly better cleaning of cotton at the gin is the missing link between harvesting and a clean crop.

Since 1930 cotton ginning in the United States has undergone material modernization. The outstanding item in this has been the introduction of cotton conditioning apparatus at the gins which, under processes publicly patented by the United States Department of Agriculture, have decreased the moisture content of the cotton and improved the ginning and grade of cotton without impairment of the other fibre qualities. Designs of gins have changed to include higher saw speeds and associated looser seed roll operation, and improved designs of gin saw teeth, and the consequent smoother ginning. Power seed-handling systems have also been introduced into the gins to aid in guaranteeing purity of special planting seed and to avoid detrimental mixing which occurs in old style gins. Remarkable improvement has been made in the development of unit-extractor-feeder machinery for simplification of the cleaning and extracting of cotton at gins. Some of the best gins now have seed cleaners operating in conjunction with the ginning processes, and utilize chemical seed treatment along with them. All-steel construction, with simplified driving mechanism has also developed, helping to make the modern cotton gin a trim, neat, light, airy, fire-proof institution.

A modern saw gin contains from two to eight "gin stands." When the seed cotton is brought to the gin it is drawn by pneumatic elevators from the wagon or truck; suction tubes 10 to 12in. in diameter convey the cotton first to a drier, if the gin is so equipped, then to a cleaner where the cotton is thrown against a wire screen which action shakes some dirt and trash from the lint, then spiked rollers shake and tear the cotton apart, throwing it again against a wire screen which permits dirt to fall through.

Moisture in seed cotton is an important factor affecting the operation of a gin and quality of ginned cotton. The United States Cotton Ginning Laboratories have developed the vertical drier for seed cotton. The number of driers installed in commercial gins since 1931, when the drier was perfected, has increased from 15, which handled 25,000 bales, to 800 in 1938, which handled over 1,000,000 bales. In gins where driers are installed the cotton is dried and cleaned in joint process.

From the cleaner, or cleaner-drier, the cotton is automatically placed on a conveyor belt which supplies the feeders which in turn supply the stands with the proper amount of cotton. From the feeder the cotton is dropped into the gin-breast where it comes in contact with the saws.

Some gins are built with a lower roll-box or huller fronts into which fall bolls, hull, etc. This type of gin is used in ginning "bollies" or snapped cotton. At least 80% of central cotton belt gins and 100% of Western gins are so equipped. Gin saws are steel disks 10 to 12in. in diameter. The saw teeth on the circumference of the disks are hook-like in shape, to give maximum strength but with a minimum amount of damage to the cotton fibres. Saw teeth must be kept sharp and clean. The proper speed for 12in. saws approximates 400 revolutions per minute. One gin stand contains about 70 saws.

The lint may be removed from the saws by brushes or by air-blast. More than one-third of the gins in the United States were equipped with air-blast machinery during 1935. It is estimated that these gins took care of one-third of the United States crop, or 3,500,000 bales that year. Air-blast gins, properly gauged, can be operated economically and efficiently and are becoming increasingly popular.

Lint, after it is removed from the saws, goes to the condenser where the cotton is pressed into layers of compact "bats." It drops from the condenser into the press box where it is packed by mechanical trampers. When the box is filled pressure is applied, and the bale, over which bagging has been drawn, is securely tied with iron bands.

United States gin machinery is considered the most efficient the world over. Its export in great quantities would indicate that up-to-date and efficient methods throughout cotton growing countries of the world are similar to that described above.

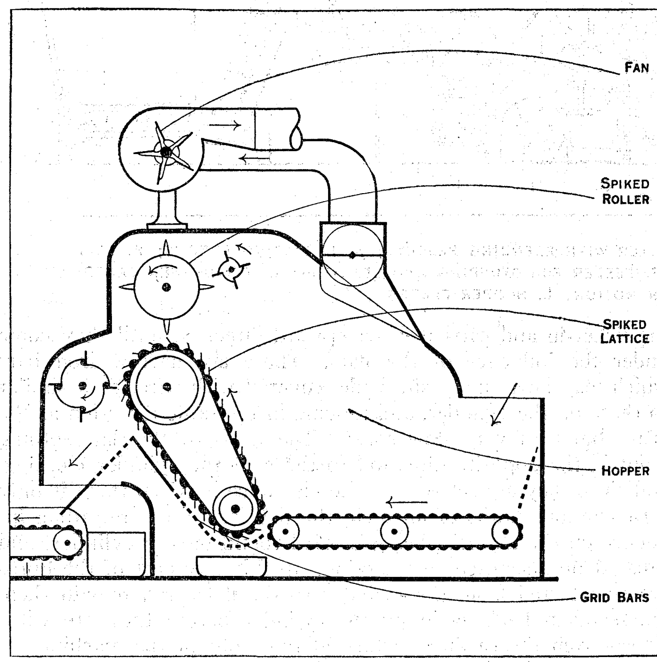
The modern roller gin is used exclusively in Egypt, and is employed for ginning the American Pima and Sea Island crops. It is small and simple in construction but it is power-driven. It consists of a leather covered roller and a large knife which is set so that its edge is parallel with the surface of the roller and barely touches it. Mechanical feeders carry the seed cotton to the rollers which pick it up, carrying it to the knife. The lint clinging to the roller goes under the knife, and thereby is pulled from the seed which falls to the floor. The long fibres of the strains of cotton ginned on roller gins slip readily from the seed leaving them quite clean. This type of ginning is slow and expensive, as only 50 to 80lb. of lint cotton are obtained per hour, per gin stand, but saw gins nep up extra long fibres and they become gin-cut and damaged. (M. G. B.)

B. COTTON-SPINNING MACHINERY

The functions of the processes in the mill are as follows: (1) to reduce the highly compressed cotton from the bales into the greatest possible state of division, *i.e.*, to the ultimate fibre, and at the same time to remove sand, leaf, broken seed and short fibres; (2) to form the fibres into a rope, or sliver, which can be attenuated by stages until it is thin enough to form the required thread; (3) to parallelize the fibres by drawing between rollers or by combing, and, at the same time, by combining and attenuating several slivers, to increase the regularity of the material; (4) to insert sufficient twist into the product of the final attenuation in order to make a firm thread; (5) where required, to combine one or more single threads into a folded yarn; and (6) to finish and prepare the yarn for transport. The fineness of a yarn is expressed by its count, which is the number of hanks (840yd.) of that yarn which weigh one pound. The principal machines are: bale breakers, openers and scutchers or pickers; carding engines or cards; drawframes or drawing frames, and, for high quality yarns, combers; flyer frames; ring frames or mules, and where folded or plied yarns are produced, winders and doublers or twisters, cleaning and gassing frames; reels and bundling presses.

The Bale Breaker.—The bale breaker, in the great majority of cases, is of the hopper type (fig. 11). The raw material in the form of hard, compressed slabs from the bale is fed by hand into the hopper, where it is then lifted by the spiked lattice until it comes under the influence of the spiked evener roller above.

The latter allows only a small portion to proceed, and throws the rest back into the hopper for further treatment; while the dust freed by the consequent agitation of the cotton is drawn off to a dust chamber by the fan. The tearing action of the two sets of spikes thus reduces the material into a fairly fluffy state, so that in passing over the grid bars some of the loosened heavy impurities are able to fall out. The cotton is then conveyed

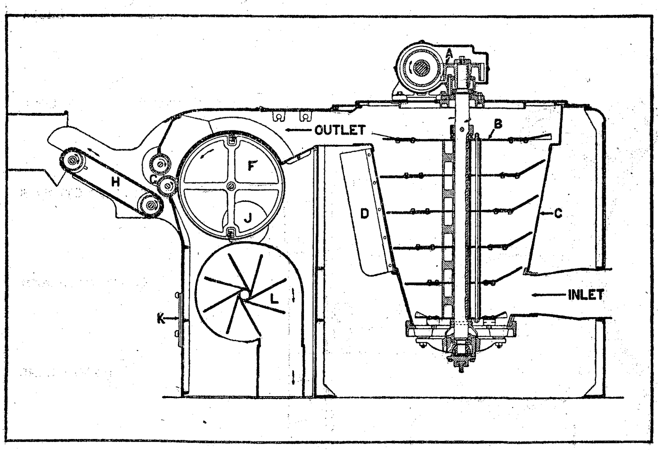


FROM TAGGART, "COTTON SPINNING" (MACMILLAN)

FIG. 11.—HOPPER BALE BREAKER FOR THE TEARING UP OF HARD, MATTED LUMPS OF COTTON FROM THE BALE INTO SMALLER PIECES

either by lattices or by pneumatic trunks to the opener machine which follows. This usually is of the vertical type.

Owing to its great variability, cotton from suitably chosen bales of different grades is mixed in the bale breaker in order to maintain a consistent quality of yarn, and for ordinary purposes, treatment by the subsequent machines is relied upon to make the mixture complete. In some cases, however, principally in mills spinning fine yarns, mixing is assisted by building up a stack of cotton from the breaker in horizontal layers, and after leaving it for two

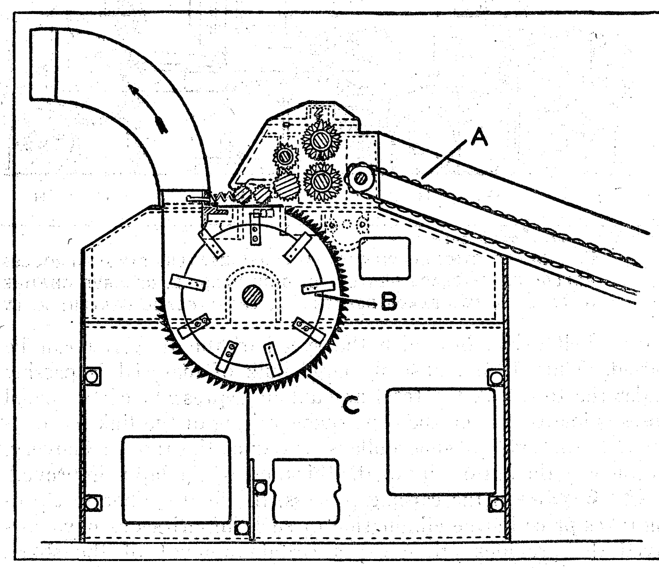


COURTESY OF WHITIN MACHINE WORKS

FIG. 12.—SECTIONAL VIEW OF VERTICAL OPENER WITH CONDENSER SECTION; A, BEATER DRIVE; B, BEATER; C, SCREEN SECTION; D, DUST CHAMBER; F, CONDENSER CAGE; G, STRIPPER ROLLS; H, DELIVERY APRON; J AND K, CLEAN-OUT OPENINGS; L, FAN

or three days to become aerated, pulling it down in vertical layers to be fed to the opener.

The Vertical Opener.—The opener (fig. 12) has a conical-shaped casing *C* of screens and grid bars, in which there is a rapidly revolving beater *B*. Cotton enters at the bottom in thick lumps and, as it is fluffed up by the beater, due to the shape of the beater and the arrangement of its fingers, the stock rises to the top. Dirt passes out through the screens and grid bars. Air is furnished by a fan in the condenser section. As the cotton rises to the top of the opener it passes through a condenser section to a horizontal cleaner.



COURTESY OF SACO-LOWELL SHOPS

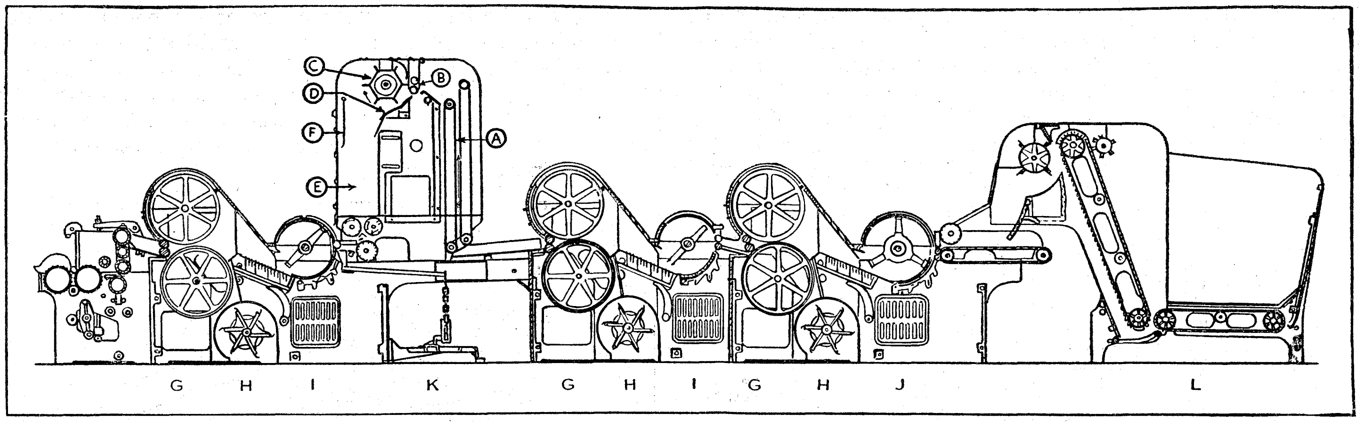
FIG. 13.—SECTIONAL VIEW OF A HORIZONTAL CLEANER WITH FEED APRON; A, FEED APRON; B, BEATER; C, GRID BARS

The Horizontal Cleaner.—The horizontal cleaner (fig. 13) has a rapidly revolving beater with flat strikers surrounded by grid bars. Dirt and impurities are thrown out through the grid bars and the cotton passes out through a trunk line to the picker.

The Single-Process Picker.—Since about 1925 single-process pickers have to a great extent superseded two- and three-process pickers in the United States. The picker is usually in the form of a combination of several machines. Its functions are, broadly speaking, the same as those of the bale breaker, opener and cleaner, by which treatment the cotton is still further opened up, freed from the greater part of its impurities, and made into the form of a rolled up sheet or lap, of about the thickness of a heavy blanket, ready for the next process. A typical example of a single-process picker is shown in fig. 14. The cotton is first fed to a hopper feeder, which serves to present it in the form of a sheet to a three-blade beater. The latter is about 20in. in diameter and revolves at a speed of about 800 revolutions per minute. The stock is flung by the blades against the grid bars through which a portion of the impurities are discarded. The beaten flakes of material are then withdrawn from the beater by pneumatic suction generated by the fan and, after passing over further grid bars, are deposited on the wire mesh cages, through the near surfaces of which the air is exhausted. The cotton then passes through a second beater and condenser section, a cleaning and blending reserve, and an evener motion, a third beater and condenser section, feed rolls, and heavy calender rolls, which, after a threefold compressing action, pass it on to be rolled up into a lap.

As the cotton enters the cleaning and blending reserve, it is carried by the elevating aprons *A* to the feed rolls *B* which feed it to a six-blade beater *C*, which removes impurities and passes the stock into the reserve chamber *E*. The amount of cotton allowed to accumulate in the reserve chamber is controlled by the feeler *F*.

The evener motion consists of a series of levers, 2 to 2½in. wide, arranged side by side across the width of the machine on a common fulcrum arm. The short arms or pedal noses are kept in contact with the feed roll by a weight hung at the end of a series of links which connect the long arms together. This arrangement of links integrates the movements of pedals and is connected to



COURTESY OF SACO-LOWELL SHOPS

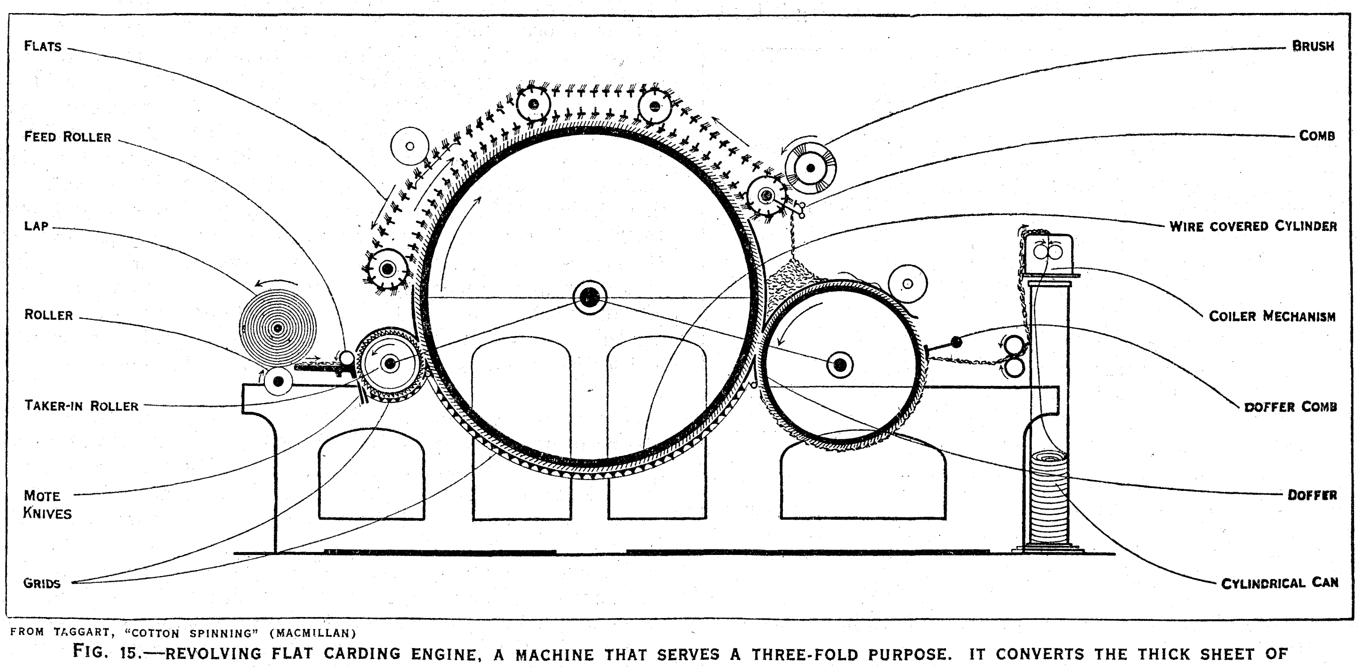
FIG. 14.—SECTIONAL VIEW OF A THREE-BEATER, SINGLE-PROCESS PICKER WITH BLENDING RESERVE; A, ELEVATING APRONS; B, FEED ROLLS; C, SIX-BLADE BEATER; D, GRID BARS; E, RESERVE CHAMBER; F, FEELER FOR STOPPING AND STARTING; G, CONDENSER CAGES; H, FANS; I, TWO-BLADE BEATERS; J, THREE-BLADE BEATER; K, EVENER MOTION; L, HOPPER FEEDER

a cone belt drive, by which the speed of the feed roll can be varied. Thus, if an unusually large bulk of material is passing under the feed roll, the total amount of depression of the pedal noses is increased, and the consequent raising of the link mechanism acts through the cone pulleys to reduce the rate of delivery. In this way the uniformity of the thickness of the lap is improved.

The Card.—In the carding process, the final deliberate cleaning takes place by the elimination of such impurities as have survived the previous processes; a certain amount of the short, broken and immature fibres are removed, and the heavy sheet or lap from the picker is reduced to a comparatively light and thin sliver. The revolving flat card which is the type used in cotton industry for all but very coarse yarns is shown in fig. 15. The sheet of cotton is unwound from the lap by the roller and is presented by the slow revolution of the feed roller to the action of the taker-in roller or licker-in. The latter is composed of a series of fine-toothed circular saws mounted side by side on a shaft, and has a surface speed of roughly 1,000ft. per minute. Its action is to tear away small portions of the fringe projecting from under the feed roller and carry them round in the direction of the arrow until they are acted upon by the surface of the cylinder, which is uniformly covered with closely set steel wire teeth secured in a cloth and rubber foundation. The cylinder has a surface speed of about 2,000ft. per min., so that the fibres are stripped from the licker-in and carried in an upward direction until they come under the influence of the flats. These are narrow iron bars which may be 1⅜in. to 2in. wide, covered with wire teeth similar to those on the cylinder, and moving in the same direction as the latter but at a very slow speed. The wires of the flat clothing point in the opposite direction to those of the cylinder clothing, and since they are set so that the clearance between them is only 6 to 10-thousandths of an inch, the flats exercise a retarding influence on the material being carried round on the cylinder, and thus set up a semi-combing action. In this way part of the fibres are transferred from the cylinder to the flats, and remain there unless taken back again by the cylinder before they are withdrawn from the carding surface at the front of the machine.

On leaving the influence of the flats, the fibres on the cylinder, now in fairly parallel order and uniformly distributed over its surface, are taken off in a continuous sheet by the doffer, which is also clothed with wire points, facing into those of the cylinder, but which has only about 1/25 the surface speed. The sheet is removed by means of the doffer comb and gathered together in the form of a sliver which is coiled into the cylindrical can by the coiler mechanism. The sliver is almost entirely free from impurities and its weight is some 100 to 120 times less than that of the picker lap.

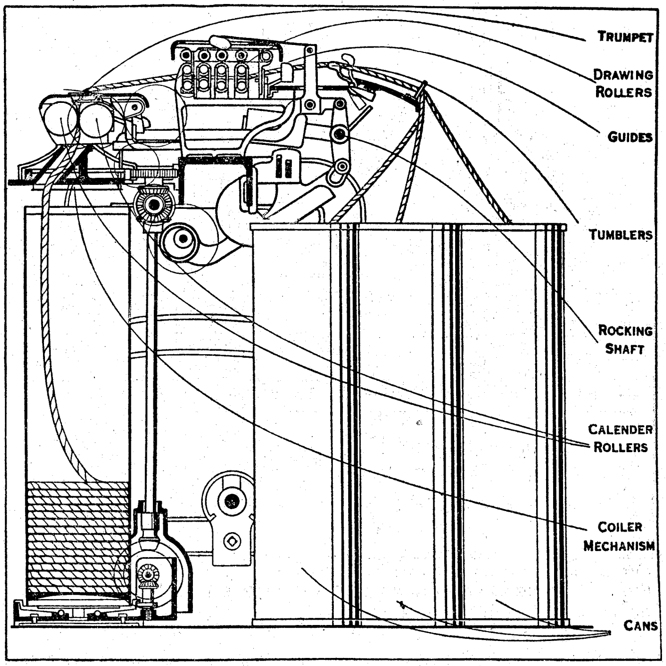
After the carding process, the treatment of the material depends



FROM TAGGART, "COTTON SPINNING" (MACMILLAN)

FIG. 15.—REVOLVING FLAT CARDING ENGINE, A MACHINE THAT SERVES A THREE-FOLD PURPOSE. IT CONVERTS THE THICK SHEET OF COTTON FROM THE SCUTCHER LAP INTO THE FORM OF A ROPE OF FIBRES, KNOWN AS SLIVER; REMOVES IMPURITIES AND OBTAINS MAXIMUM FIBRE SEPARATION

on the class of yarn to be spun. For counts of 60s and upwards, and for extra quality yarns of coarser count the cotton is subjected to a combing process whereby the shorter fibres are removed to the extent of some 15% to 20% of the total weight, according to the quality desired and the cotton being used. In other cases the card sliver is passed through two or three passages of drawing frames whose functions are to parallelize the fibres and increase the regularity of the weight per unit length of the material.



BY COURTESY OF PLATT BROTHERS & CO., LTD.

FIG. 16.—SECTION OF THE DRAWFRAME, A MACHINE WHICH PLACES THE FIBRES OF COTTON MORE PARALLEL, MAKING THE SLIVER AS UNIFORM AS POSSIBLE IN THICKNESS

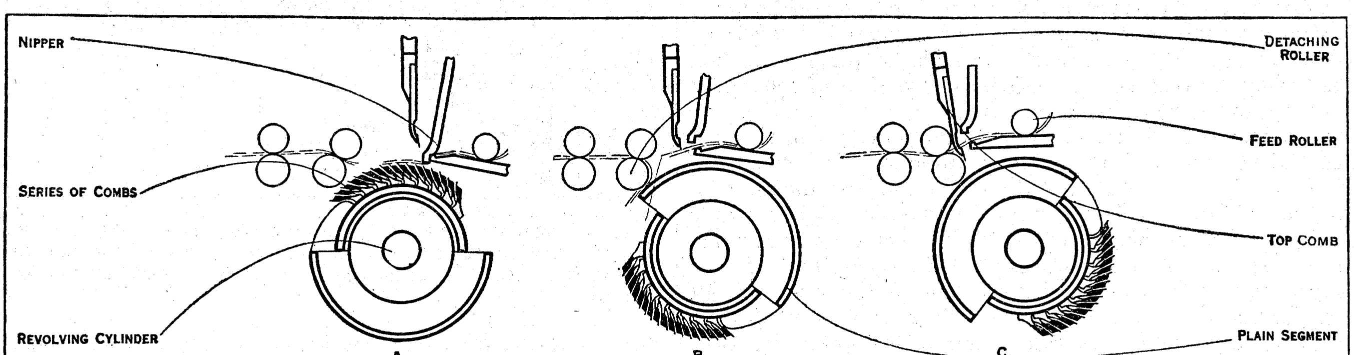
The Drawing Frame (fig. 16).—Four, six, or eight slivers from the cans are passed side by side over tumblers or spoons and through guides to four successive pairs of rollers suitably spaced and driven in such a way that the surface speed of each pair is greater than that of the preceding pair. In this way material passing from the grip of one pair to the next is stretched between them, thereby creating what is known as a draft. If the surface speed of the front pair of rollers is six times that of the back pair, there is constituted a total draft of six. The bottom rollers are of steel, longitudinally fluted, and positively driven by gearing, while the top ones, either fluted steel or leather covered, are driven by surface contact, being loaded by heavy weights hung on their bosses. If six slivers are fed in at the back, then the draft of the machine is arranged to be six or slightly less; so that throughout the drawing process the issuing drawframe slivers are only slightly more in weight per unit length than the original card slivers; but owing to the drawing or drafting action of the rollers the fibres are gradually drawn out into parallel order, and by making one sliver out of six, the regularity of the material is greatly increased. The material as it emerges from the nip of the front rollers is in the form of a narrow sheet which is drawn by the calender rollers through the trumpet and coiled in the can by the coiler mechanism. A section of a drawframe is shown in fig. 16. The products of the first passage of drawframes are then treated in a similar way in the second passage: and so on, until the requisite amount of regularizing and parallelizing has been accomplished.

Combing.—Cotton which has to be combed requires to be in the form of a lap which may vary from 7½in. to 12in. in width. Moreover, to avoid unnecessary waste, the fibres must be in parallel formation. To obtain these conditions there are two methods of procedure. One is to pass sliver which has been processed by one head of drawframes, through a sliver lap machine. The latter, in its functions, is identical with the drawframe except that the issuing sheet of cotton is rolled straight up into a lap instead of being formed again into a sliver by being drawn through a trumpet. In addition, the sheet is thicker, since the number of slivers fed together at the back of the frame may be as many as 20. The other method is to take the sliver straight from the card through a sliver lap machine to a ribbon lap machine, where six sliver laps are separately drafted by an arrangement of drawing rollers, superimposed and rolled up ready for combing. Whichever method is adopted the final product is known as a comber lap.

The Comber.—The comber is one of the most complicated and intricate pieces of mechanism used in the spinning processes, but while the settings and speeds of the various parts have to be regulated with the greatest care, the principle of its method of treating the cotton is relatively simple. The essential parts of the machine are: a device for feeding forward a fringe of comber lap at regular intervals; an arrangement of combs which at the right time pass through the fringe; and means for piecing up the successively combed fringes. Either the Heilmann comber or the development of it, the Nasmith comber, is used. Fig. 17 shows a Nasmith type comber. In a complete machine there are usually six deliveries of combed fibres, each of which is drawn through a funnel, and, by further drafting between rolls, combined with the other five to form a comber sliver. The slivers from the combers are then subjected to one or two passages of drawing, in continuation of the principle of making the material as regular as possible.

Flyer Frames.—Following on the last head of drawframes the process becomes one principally of attenuation. To this end the material is passed through two, three or four passages of machines collectively known as flyer frames, in which again the operation is carried out by means of drawing or drafting rolls. Up to this point the slivers have held together by virtue of the natural cohesive properties of the fibres; but any further attenuation makes it necessary to insert twist in order to maintain the material in the form of a continuous length. Hence the utilization of a revolving bobbin and flyer (fig. 18) which gives to these machines their names.

In the first of these frames, known as the slubbing frame or



BY COURTESY OF JOHN HETHERINGTON AND SONS, LTD.

FIG. 17.—MAIN FUNCTIONS OF A NASMITH COMBER IN THREE POSITIONS. A SHOWS THE COMBING OPERATION; B, THE BEGINNING OF THE PIECING-UP; C, THE BEGINNING OF THE SEPARATION OF THE COMBED FRINGE FROM THE MAIN BODY OF THE LAP

slubber, cans of sliver from the last drawframe are arranged behind the machine. Each sliver is drawn out by means of three pairs of rollers, and as it emerges from the front pair is drawn through a hole in the top of the flyer, down the hollow leg of the latter, shown on the left of the figure, and on to the bobbin. The flyer is attached to, and driven by, the spindle at a uniform speed, and inserts the amount of twist necessary to make the strand hang together. This twist, however, must be the minimum required for its purpose, since too much will make it impossible to continue the process of attenuation in the subsequent machines. The bobbin is loosely mounted upon, but driven independently of, the spindle, so that the difference between their respective speeds effects the winding on. This is done in closely wound spirals and in successive layers, by suitably raising and lowering the bobbin relative to the spindle.

The other machines of this group, known respectively as the intermediate, speeder and jack frames, differ from the slubbing frame in only three respects. First, instead of having cans of sliver put at the back, racks or creels of suitable size are provided to carry the bobbins on which the material is now wound. Secondly, the dimensions of all the frame parts, including bobbins and flyers, are reduced at each stage as the roving becomes more and more attenuated. And thirdly, it is usual to arrange for the strands from two bobbins to be fed together to the drawing rollers and combined into one at the front, thereby assisting to maintain the uniformity of the roving. The amount of attenuation effected by these machines, and, therefore, the number of stages in which it is done, depends on the count of yarn subsequently to be spun. For coarse yarns, the slubbing and intermediate frames only may be used, whereas for very fine yarns the work is carried out in the four stages finishing with the jack frame. In all cases the final product of this group of machines is known generally as roving.

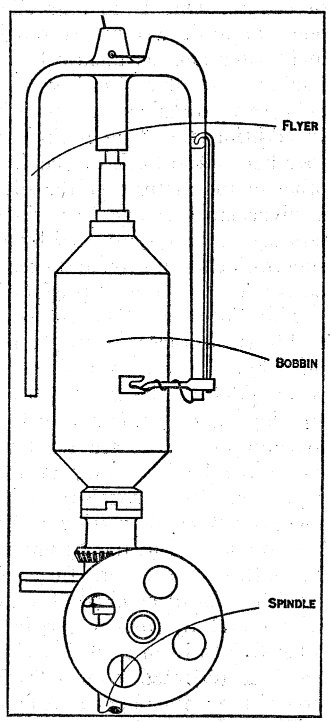
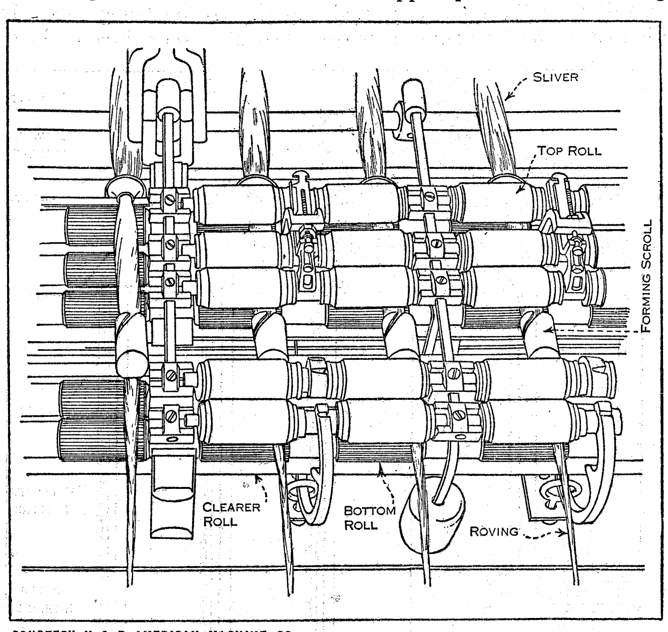


FIG. 18.—FLYER FRAME DIAGRAM
This machine twists the fibres of the roving axially and coils the twisted strand upon the bobbin

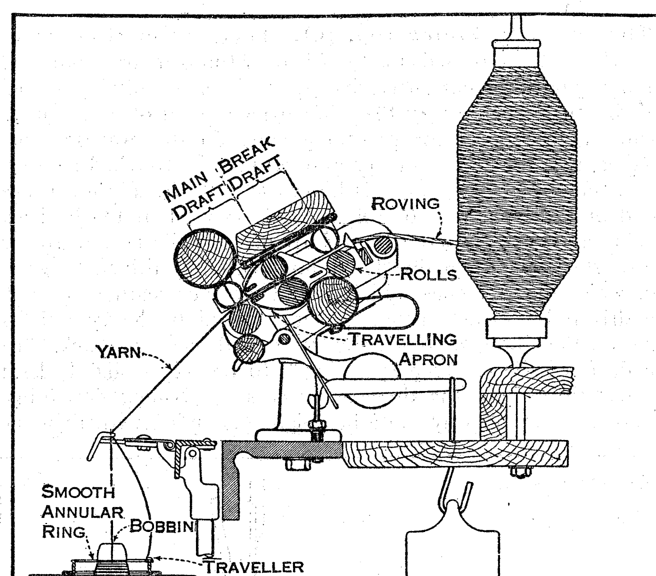
Within recent years a type of flyer frame known as high-draft or long-draft frames has come into widespread use. Only one or two stages of roving are required with these frames, since the amount of attenuation at each stage is much greater. They differ from the conventional frames mainly in the drafting section. This may consist of either four or five pairs of rolls, one or more of which may vary from the standard type drafting roll. In addition, usually there is some kind of roving guide or forming trumpet. One type of drafting section consisting of five pairs of rolls and a forming scroll is shown in fig. 19.

Spinning.—It only remains now to carry the attenuation one stage farther and to convert the drawn-out roving into a yarn by the insertion of sufficient twist to prevent any further slippage between the constituent fibres. The machine employed may be either a ring spinning frame or a mule. On the ring spinning frame (fig. 20), the processes consist of twisting and winding the yarn upon a bobbin simultaneously and continuously, as with the flyer frames. Here, however, the flyer is substituted by a smooth annular ring formed with a flange at its upper edge, over which is sprung a light C-shaped piece of wire known as a traveller. The spindle, to which the bobbin is firmly attached, projects vertically through the ring, and is supported on a fixed rail by a self-aligning and automatically lubricated bearing. Rotary motion is derived from the tin roller or cylinder by a band passing round the wharve or whorl, which is fixed to a sleeve on the spindle over the bolster or upper part of the bearing.



COURTESY H & B AMERICAN MACHINE CO.
FIG. 19.—LONG-DRAFT ROVING SECTION WITH FIVE PAIRS OF DRAFTING ROLLS AND A FORMING SCROLL

After it has passed through the rolls, the roving is twisted into a yarn which passes first through a guide-eye and then through the traveller onto the bobbin. As the latter revolves, the traveller is dragged round the ring by the yarn, and so inserts the necessary twist. The speed of the traveller, however, is less than that of the bobbin, owing to the lag which is permitted by the constant delivery of roving from the front roller. In this way the bobbin, acting through the traveller, not only inserts the twist but winds the material on to itself, the deposition of the coils being determined by the vertical movement of the rail which carries the



COURTESY OF WHITIN MACHINE WORKS
FIG. 20.—DIAGRAM OF RING SPINNING FRAME, SHOWING THE LONG-DRAFT ROLLS THROUGH WHICH THE ROVING PASSES TO THE BOBBIN, WHERE IT IS WOUND AT SPEEDS AS HIGH AS 12,000 REVOLUTIONS PER MINUTE

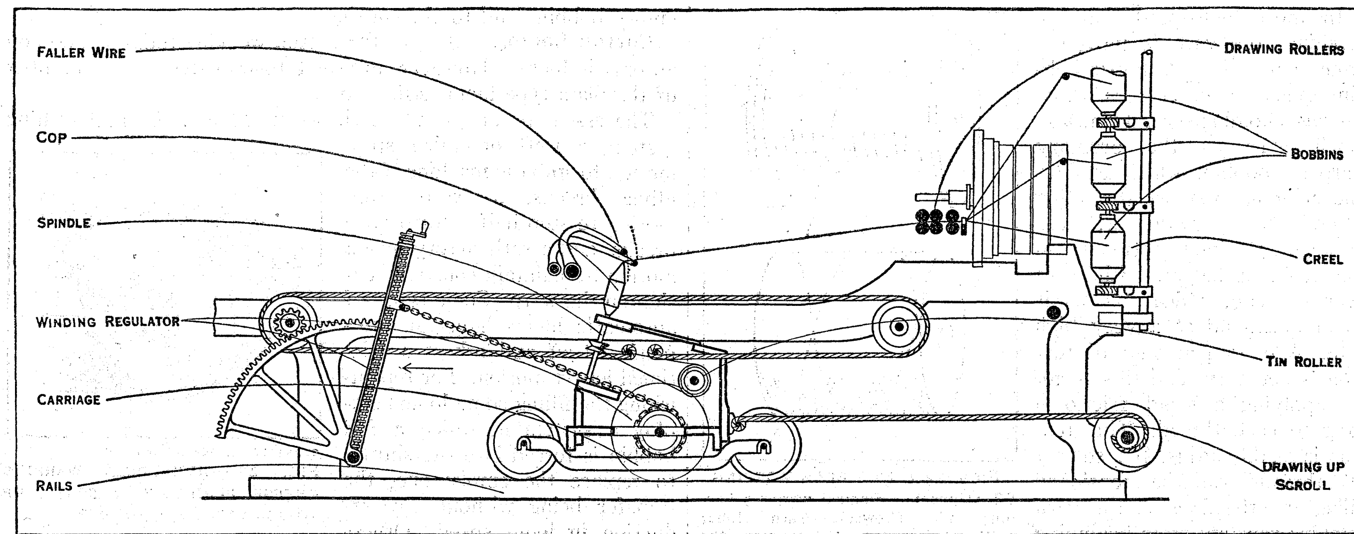


FIG. 21.—SECTION OF MULE USED FOR INTERMITTENT SPINNING. THE ROVINGS PASS FROM THE CREEL TO THE SPINDLES, WHERE THEY ARE TWISTED INTO YARN ON THE OUTWARD RUN OF THE CARRIAGE AND WOUND ON TO THE NOSE OF THE COP DURING THE RUN IN

ring.

The drafting section on most of the modern ring spinning frames is some form of the long- or high-drafting type, in which four pairs of drafting rolls or two pairs of drafting rolls and a pair of travelling aprons are used. These travelling aprons consist of two endless leather bands revolving about a pair of rolls and a two-armed part called the tensor (fig. 20).

In the mule (fig. 21) the action, unlike that of the ring frame, is intermittent; *i.e.*, first, a certain length of roving is drawn out and twisted, and then twisting ceases and winding-on takes place. The resulting cop of yarn is built upon the bare spindle in successive conical layers. At any instant during the twisting process, therefore, a portion of the already spun yarn is coiled in spiral fashion from the nose of the partly built cop to the top of the spindle: and, in order that no winding-on shall take place at the same time, the spindles are inclined slightly towards the rollers, thereby enabling the top coil to slip off at each revolution. Following the material through the machine: the roving from bobbins, mounted in the creel, is passed in the usual way through the drawing rollers and then between two faller wires to the spindle which is mounted on a carriage whose wheels run on rails called slips.

Spinning commences with the carriage close up to the rollers. As the attenuated roving is delivered by the latter the carriage moves away and the spindle, being rapidly revolved by bands passing from the tin roller, inserts the desired amount of twist into the regularly increasing stretch of material between the rollers and the spindle tip. The distance the carriage travels may be from 54in. to 66in., and is known as the draw or stretch. At the end of the stretch the mechanism driving the spindles during the outward journey is disengaged, the direction of rotation is reversed and backing-off takes place. In this operation the yarn coiled around the exposed part of the spindle is unwound and the "slack" produced by the added length of yarn is taken up by the operation of the faller wires. It then remains for the spindle but to reverse once more and, while the carriage moves back rapidly towards the rollers, to wind the spun thread in another layer on the cop. The upper faller wire shown in the figure is responsible for guiding the yarn in the correct manner, and is for that purpose controlled by a special cop-shaping device. All the motions of the mule are governed automatically and are regulated to succeed each other in their proper order, the termination of one operation being the initiation of the next. The foregoing is but a brief outline of the functions and possibilities of the machine.

Doubling or Twisting.—Where it is desired to combine two or more strands from the spinning machine to make the product more suited to a particular purpose, the single yarns from the cops or bobbins, as the case may be, are subjected to a process of doubling or twisting. To prepare the strands it may be necessary to wind the required number side by side upon a flanged bobbin, or upon a straight or a tapering spool, before twisting them into one. The twist may be inserted in fundamentally the same way as it is in the ring spinning frame. No attenuation is required: hence drawing rollers are substituted by feed rollers. The strands may be twisted in a dry condition, or may be moistened in some suitable manner so as to produce a firmer and smoother yarn.

Finishing and Making-up.—Yarns which are required to have a maximum of lustre and smoothness are subjected to a process of gassing or singeing. The yarn is passed several times through a bunsen flame at such a speed that the fibres projecting from the surface are burned off without injury to the rest. Such yarns may also be polished by repeated calenderings between a pair of heavily loaded rollers.

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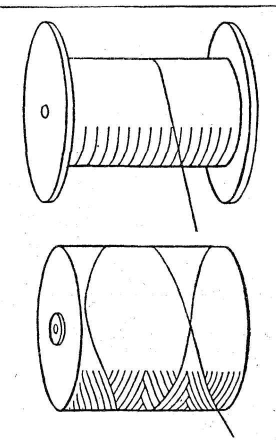
(W. E. M., W. W. CH.)

C. COTTON-WEAVING MACHINERY

The methods described under Weaving (*q.v.*) are by far the most widely used for the preparation of cotton warps, especially in Lancashire, but some modifications are used in other centres of the industry, and more productive methods are coming into use, particularly for the preparation of warps for gray or natural coloured cloth.

The beam warping process has been the subject of much experimental work, and in many places high-speed warping machines are in use by means of which the speed of warping is from 500 to 950yd. per minute. The chief difficulty in the ordinary system lies in the varying tension on the yarn during unwinding, and particularly when starting and stopping the machine. Neither the flanged warpers' bobbins (fig. 22), which are most commonly used, nor tubes (fig. 23) are very satisfactory when mounted in the creel and rotated by the drag of the unwinding yarn. The speed of the bobbin or tube, when nearly empty, is very high; the comparatively heavy bobbins overrun at a stoppage and throw stress on the yarn when restarting; tubes, on the other hand, become too light and are liable to bounce out of the creel, whilst the quick side-to-side traverse of the yarn on the tube is an additional cause of trouble. In American beam warping machines the speed of warping is gradually reduced as the beam fills and the bobbins empty, in order to reduce these variations in tension, but this means some loss of production.

In most high-speed warping machines the yarn is unwound from cones (fig. 24), bottle bobbins (fig. 25), or cheeses, these packages holding several times as much yarn as the ordinary warper's bobbin, which enables one creeling to suffice for filling several beams. Moreover, these packages are kept stationary in the creel and the yarn withdrawn over the end, which enables it to be unwound at a very high rate. A certain amount of tension is necessary and this is got by applying a small frictional drag to each thread. This tension is readily adjustable, so that all threads can be tensioned alike, and the drag on the yarn remains constant from beginning to end of the package. Also, when the machine stops, there are no bobbins to overrun and slacken the threads. An alternative system is to have the yarn wound on large cheeses, about 9in. in diameter, the cheeses rotating in the creel on ball-bearing spindles. Overrunning of these cheeses is prevented when the machine has to be stopped suddenly, by electrically controlled brakes which are applied to each cheese at the same time that the beam is braked.



FIGS. 22 & 23.—BEAM WARPING
22 (Upper).—Flanged warper's bobbin; 23 (Lower).—Yarn tube; neither being very satisfactory, as the first is apt to over-run when the machine stops, and the second to jump out of the creel

The drying of the warp yarn after sizing in the slasher sizing machine is sometimes done by passing it through a drying chamber instead of over steam-heated cylinders. The latter are used almost altogether in America. Many of these are equipped with various automatic control instruments.

Rewinding of gray weft yarn in cotton weaving is the exception rather than the rule, but when automatic looms are used, rewinding of the weft or filling on to pirns or quills is common. These pirns hold much more yarn than the cops or bobbins from the spinning frames, and this, together with the removal of faulty places, makes them much more suitable for automatic weaving. Modern pirn winding machines usually have horizontal spindles on which the pirns or tubes are held and driven by friction. The spindles rotate at a speed of 2,000–3,000 revolutions per minute, and, as the spindle speed is generally constant, the rate of winding the yarn is continually varying as the guider moves across the chase or traverse of the pirn (fig. 27). This varying rate of winding causes a considerable amount of trouble, due to the variation in yarn tension that it causes, and tensioning devices have to be used to counteract the changing speed.

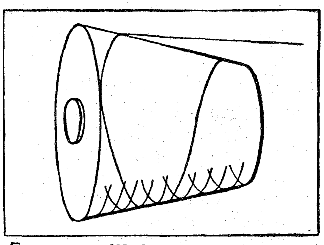


FIG. 24.—HIGH SPEED WARPING; WHEN THE YARN IS UNWOUND AT HIGH SPEED FROM THIS CONE IT GIVES THE THREAD A CONSTANT TENSION DURING ALL OF THE UNWINDING

Since about 1935, at least three types of automatic pirn or filling winders have been developed, and, shortly after their development, began being used in both Europe and the United States. These machines automatically remove full bobbins and start winding on empty bobbins without assistance from the operator. The spindle is stopped momentarily for doffing and loading the new bobbins from a magazine. Thus the duties of the operator are simply to keep the magazine filled with empty bobbins and to change the cones.

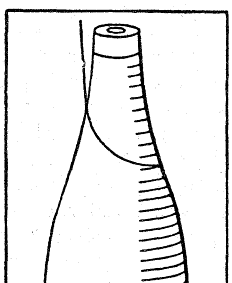
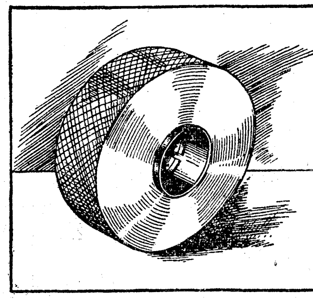


FIG. 25.—A BOTTLE-SHAPED BOBBIN

Cotton Looms.—Most of the cotton weaving today is done on automatic looms. However, in Great Britain there are a number of the plain type looms still in use.

The essentials of an automatic loom are a filling replenishing system, a weft or filling stop-motion to stop the machine if the filling breaks, a warp stop-motion to stop it if a warp yarn breaks, and a satisfactory let-off motion to maintain constant tension on the warp. Some types of automatic looms have an automatic let-off and others a frictional let-off motion. For replenishing the filling some looms employ a system in which a full bobbin is forced into the shuttle to replace the empty one, the transfer being without any reduction in loom speed. Others use some type of shuttle-changing system in which the loom is generally stopped for sufficient time to allow for the change from empty to full shuttle.



COURTESY BARBER-COLMAN CO.
FIG. 26.—HIGH-SPEED WARPING CHEESE, PERMITS YARN SPEEDS UP TO 950 YARDS PER MINUTE

Looms have undergone a great many refinements in recent years, especially since about 1930. Due to developments in metallurgy, the frames, gears and other metal parts are of better quality in both material and workmanship. Whereas these were formerly made of cast iron, they now are made of machined steel. The speeds of these looms over the older looms are considerably increased, normal operating speed for some types being approximately 200 picks per minute. Operating efficiencies of as high as 95% are not uncommon. (For further information and bibliography, *see* WEAVING.)

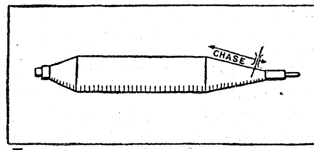


FIG. 27.—AUTOMATIC WEAVING, SHOWING ONE TYPE OF PIRN OR QUILL HELD ON HORIZONTAL SPINDLES WHICH ROTATE AT 2000–3000 REVOLUTIONS PER MINUTE

D. COTTON-FINISHING MACHINERY

Only a relatively small percentage of woven cloth is sold to the actual consumer in the condition in which it leaves the weave shed; *i.e.*, in the "loom state" or the "gray." Much of it is bleached, dyed or printed, and subjected to various finishing treatments. There is no standard finishing procedure, the exact routine depending on the construction of the fabric and the use for which it is intended. Following is a brief outline of some of the more important of the operations and equipment commonly employed in finishing cotton woven fabrics. The gray goods usually are received from the weaver in lengths of 120 or 240 yards. The pieces are inspected for imperfections, marked with a lot number for identification purposes, and sewn end-to-end to permit processing in continuous lengths. They are then passed over a gas or electric singeing machine, where the short fibres protruding from the surface of the cloth are burned off. The goods may next go to a desizing machine, where the starch employed in sizing the warp yarns before weaving is removed.

Bleaching and Mercerizing.—Previous to bleaching, cotton piece-goods are usually boiled for several hours with dilute caustic soda solution in a closed tank, called a "kier," to remove the natural oils and waxes and other impurities from the fibre. Next the goods are removed from the kier, rinsed, "soured" in a dilute solution of sulphuric or hydrochloric acid, rinsed, "chemicked" by passing through a solution of sodium hypochlorite, piled in bins to permit the bleaching action to take place, rinsed, passed through a solution of sulphurous acid or other "anti-chlor" to remove the last traces of chlorine, again rinsed, passed through a water mangle to squeeze out excess water, and dried on a set of revolving steam-heated cylinders or dry cans. Bleaching can also be carried out in the kier by means of an alkaline solution of hydrogen peroxide, after which the cloth is rinsed and dried.

Mercerizing of cotton piece-goods with a solution of caustic soda having a concentration of about 25% imparts a permanent lustre to the cloth and gives it a greater degree of affinity for certain classes of dyes. Two types of mercerizing machines are in common use, both of which are designed to exert tension on the fabric and thus prevent it from shrinking during the caustic soda treatment.

Dyeing and Printing.—Dyeing of cotton fabrics is carried out by the batch method in jigs or in dye becks or by the continuous method on padders or continuous dyeing machines. Fabrics which are to be dyed in light or medium shades are bleached before dyeing. Bleaching is frequently omitted if the fabrics are to be dyed in dark shades.

Printing of cotton fabrics is usually carried out on roller printing machines, although some fabrics are screen printed. In the machine method engraved copper rollers impart the design to the fabric. After printing with some classes of colours, the fabric is passed through an ager and then through a continuous washer before drying.

Finishing.—After dyeing or printing, the goods are dried on dry cans or in air driers, and are then ready for finishing. Aside from the chemicals employed to produce water-repellent, flameproof, crease-resisting, and other special finishes, the finishing agents commonly employed include starches, dextrines, gums, talc, China-clay, and sulphonated oils and fats. More recently various types of synthetic resins, water- and alkali-soluble cellulose derivatives, fatty alcohol sulphates, quaternary ammonium compounds and other new finishing materials have become increasingly important. The various finishing compounds are employed alone or in combination with one another to impart stiffness, softness, body, flexibility, or other desired characteristics to the fabric. Two types of equipment used for applying the finishing agents are starch mangles and backfilling machines, the latter type being designed to apply the finish to one side of the cloth only. After the finishing agents have been applied, the cloth is partially dried, then passed over a stenter or tenter where drying is completed and the fabric is stretched to the desired width.

Calendering.—Various types of calenders are employed to give smooth, lustrous, or embossed effects, as desired. The machines consist essentially of metal, paper, or fibre rolls through which the cloth is passed. A linen-like appearance is obtained by use of a beetle—a machine which subjects the cloth to the hammering action of wooden fallers.

Preshrinking machines of various types are employed to counteract the stretching effect of preceding operations and thus to prevent the fabric from shrinking upon laundering. Certain fabrics, such as cotton blankets, are run over a napping machine to produce a nap or pile.

The functions of folding and inspecting machines are evident from the name. (W. W. Ch.)

VII. COTTON INDUSTRY IN THE UNITED STATES

The birth of the cotton manufacturing industry in the United States about 1790, in New England, marked the real origin of the industrial era of that country. During the relatively slow development of industry from that time until about 1870, and through the spectacular boom during the last quarter of the 19th century and the first quarter of the 20th century, the cotton industry was a leader in this progress. Before the first quarter of this century had run out, however, cotton manufacture engaged upon a private depression of its own, antedating the general crash of 1929 by several years. During the 15 years following 1925, it went through a series of depressions, with intermittent revivals, but with the general trend downward.

The best way to visualize this rise and fall of an industry is by means of a comparison of the number of establishments, the number of wage earners, the wages paid, and the value of products, from 1850 through 1937. This comparison is shown in Table XXIV.

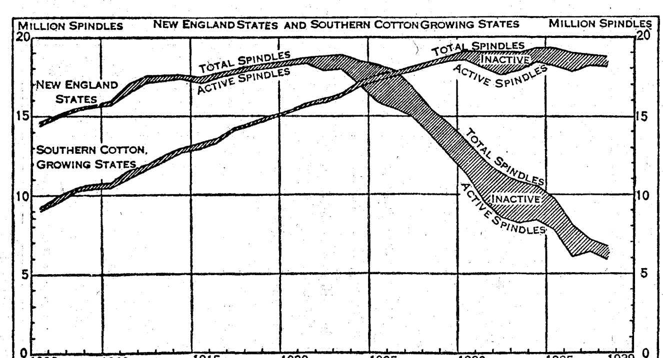
Confining an analysis of this table to the 20th century, the following facts stand out: Number of establishments increased 40% from 1899 to the peak in 1923, but then dropped to a low

TABLE XXIV.—*Cotton Industry in U.S.A.: Number of Establishments, Wage Earners, Wages Paid, Value of Products, 1850–1937*

Year	Mills	Wage earners (average for the year)	Wages paid	Value of products
1850 . .	1,094	92,286	$ 16,275,000	$ 65,502,000
1860 . .	1,091	122,028	23,940,000	115,682,000
1870 . .	956	135,369	39,044,000	177,490,000
1880 . .	756	172,544	42,041,000	192,090,000
1889 . .	905	218,876	66,025,000	267,982,000
1899 . .	973	297,929	85,126,000	332,806,000
1904 . .	1,077	310,458	94,378,000	442,451,000
1909 . .	1,208	371,182	129,790,000	615,218,000
1914 . .	1,179	379,366	146,130,000	676,569,000
1919 . .	1,288	430,966	355,475,000	2,125,272,000
1921 . .	1,328	412,058	328,227,000	1,278,221,000
1923 . .	1,375	471,503	396,603,000	1,901,126,000
1925 . .	1,366	445,184	353,883,000	1,714,368,000
1927 . .	1,347	467,596	380,910,000	1,567,401,000
1929 . .	1,281	425,916	324,289,000	1,524,177,000
1931 . .	1,140	329,962	219,680,000	305,792,000
1933 . .	1,057	379,445	216,384,000	861,170,000
1935 . .	1,042	369,062	236,339,000	983,572,000
1937 . .	1,072	422,310	312,488,000	1,227,713,471

in 1935, during which drop 75% of the original gain was lost. There was a slight recovery in 1937 but the number was still nearly 25% below the peak. Number of wage earners increased 60% from 1899 to the peak in 1923, and then dropped to a low in 1931, losing about 80% of the previous gain in that drop. Good recovery was made subsequently so that in 1937 the number of wage earners was only 10% below the peak in 1923. Wages paid advanced spectacularly—about 365% increase—to a peak in 1923 but nearly 60% of this gain was lost in the drop to a low in 1933. Subsequent recovery brought wages paid in 1937 to a point only 20% below the peak of 1923. Value of products also made a sensational spurt from 1899 to a peak in 1919—the advance amounting to 540%. (1919 was the first post-war year.) The subsequent drop was equally spectacular and by the low year of 1931 approximately 75% of this advance had been lost. Despite the recovery in 1937, the value of products that year was still more than 40% below the high of 1919. (These figures are taken from the *Biennial Census of Manufactures* and refer to what was known prior to 1935 as the cotton goods industry, comprising cotton woven goods over 12in. in width, and cotton yarn and thread.)

A more detailed picture of the decline and partial recovery of the cotton textile industry during the 15 years following 1925 is shown in Table XXV, based on statistics compiled by the Association of Cotton Textile Merchants of New York.



FROM GOVERNMENT PUBLICATION "WAGES IN COTTON-GOODS MANUFACTURING," BULLETIN NO. 663 OF U.S. DEPT. OF LABOR

FIG. 28.—TOTAL ACTIVE AND INACTIVE COTTON SPINDLES 1906–38

This table shows that during the period from 1925 to 1939, nearly 12,000,000 spindles were liquidated. Despite this liquidation, the production in square yards in 1938 was approximately the same as that in 1925. The answer is obvious. Longer operating time for machinery, and technological improvements made the productive capacity per spindle materially greater. For example

TABLE XXV.—*Statistics of U. S. Cotton Industry, 1925–39*
(Figures in thousands)

	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939
Equipment															
Spindles in place at beginning of year	37,940	37,872	37,365	36,466	35,267	34,541	33,608	32,327	31,442	30,938	30,889	29,253	27,700	26,704	25,987
Increase or decrease from preceding year	319	68	507	899	1,199	726	933	1,282	884	504	49	1,636	1,553	996	718
New installations, additions and replacements	343	217	496	255	321	252	205	144	349	530	215	469	773	178	..
Operation															
Spindles active at any time during year ending July 31	35,032	34,750	34,410	33,570	32,417	31,245	28,980	27,272	26,895	27,742	26,701	24,664	25,419	24,774	..
Spindles idle during same period	2,908	3,122	2,955	2,896	2,850	3,296	4,629	5,055	4,547	3,196	4,189	4,589	2,281	1,930	..
Average number of active spindles based on twelve monthly reports	32,642	32,352	32,547	29,962	30,409	27,269	25,674	23,251	24,873	25,119	23,421	23,373	24,080	22,042	..
Intermittent spindles (being the difference between average active spindles and those active at some time during year)	2,390	2,398	1,863	3,608	2,008	3,976	3,306	4,021	2,022	2,623	3,280	1,291	1,339	2,732	..
Percentage relation of average active spindles to spindles in place	86·04%	85·43%	87·11%	82·16%	86·22%	78·95%	76·39%	71·92%	79·11%	81·19%	75·82%	79·9%	86·93%	82·54%	..
Spindle hours run	94,600,128	97,028,630	104,450,216	92,728,881	99,899,724	66,702,655	77,793,299	70,218,348	86,580,233	75,711,413	76,017,362	91,773,253	95,591,132	75,925,187	..
Hours run per average active spindle*	*2,898	*2,999	*3,209	*3,095	*3,285	*2,813	*3,030	*3,020	*3,481	*3,014	*3,246	*3,926	*3,970	*3,444	..
Market															
Production in square yards	7,741,568	7,936,942	8,980,415	7,972,551	8,398,616	6,448,392	6,955,391	6,278,222	7,866,040	6,878,579	7,135,276	8,613,837	9,445,736	7,502,168	..
Exports in square yards	543,317	513,299	565,021	546,847	564,444	416,285	366,959	375,446	302,042	226,306	186,565	200,501	236,251	319,634	..
Imports in square yards	109,249	60,680	53,002	61,295	61,185	35,517	34,732	29,436	41,348	41,533	63,674	114,195	147,320	58,282	..
Available for domestic consumption	7,307,500	7,484,323	8,478,396	7,486,999	7,895,357	6,067,624	6,623,164	5,932,212	7,605,346	6,693,806	7,012,385	8,527,531	9,356,805	7,240,816	..
Population at July 1	114,867	116,483	118,197	119,798	121,526	123,091	124,113	124,974	125,770	126,626	127,521	128,429	129,257	130,215	..
Available for per capita consumption in square yards	63·62%	64·25%	71·73%	62·50%	64·97%	49·29%	53·36%	47·47%	60·47%	52·86%	54·99%	66·40%	72·39%	55·61%	..

*These figures are complete and not abbreviated.

it will be noted that in 1925 the hours run per average active spindle were 2,988, which advanced to a peak of 3,970 in 1937.

North-to-South Shift.—Turning from a picture of the industry as a whole, to that of the shift from one section of the country to another, fig. 28 shows dramatically the changed position as between the New England States and the southern cotton-growing States commencing approximately in 1925. (This is from "Wages in Cotton Goods Manufacturing," a publication of the U.S. Department of Labor.) The most interesting feature of this shift of so large a part of the cotton manufacturing industry from the North to the South is the fact that it reflected, in a relatively limited area, the world trend of decentralization of industry which was responsible for so much of the economic instability in cotton manufacture during the two decades following the end of the World War (1914–18). In fact, even if there had not been specialized causes for what might be called the stampede of cotton mills from the North to the South, commencing in the early 1920s, it is safe to state that sooner or later the South would have demanded and gotten its share of industry. It has been increasingly evident to the world that no section or country can long hold its monopoly in the manufacture of any type of goods. Its erstwhile customers sooner or later become industrially conscious and turn to the creation of a new industry as a means toward economic advancement. That was the impulse underlying the North-to-South shift in cotton manufacture. However, there were several circumstances which greatly accelerated this trend—and in fact probably anticipated by several decades what might have been the course of normal decentralization. The most important of these immediate causes was differential in labour costs. The northern mills were located to a considerable extent in congested areas where living costs were high and where the threat of unionization to some extent held up wage levels. The South, on the other hand, offered an apparently unlimited supply of labour, practically of pure Anglo-Saxon type, from the mountains, at relatively lower wage levels than those prevailing in the North, with immeasurably lower living costs, and with little threat of unionization at the time.

Coupled with this attractive differential in wage costs, was a definitely lower cost of construction and taxation in the South as compared with the North. Consequently, during the period of expansion in the cotton industry which followed the World War of 1914–18, it was natural and inevitable that more and more companies turned to the South as the locale for their new plants or for the establishment of entirely new organizations.

As these mills came into operation, another factor asserted itself. Although some of the plants were equipped with second-hand machinery moved from other sections, a great deal of the southern industry contained equipment newer and more efficient than the average equipment in the North. This, obviously, added to the manufacturing differential between the two sections. The result is shown in fig. 28, previously mentioned. Incidentally, the layman will possibly wonder why the above analysis did not include reference to a factor which was popularly supposed to have been the real reason for the North-to-South shift. Probably nine out of ten people believed that the proximity to the raw material was the chief attraction—and visualized cotton manufacture moving to the cotton fields. This was of extremely limited importance in the shift. In fact there were cases where this was a liability rather than an asset because it sometimes cost more to ship cotton by rail from one point in the South to another point in that section, than by water from a southern port to a New England mill.

The use of the phrase "North-to-South shift" makes this industrial dislocation seem more simple than it was, and is. There was not merely the competition between two sections of the United States. Increasingly, there developed competition among different areas within one section, and particularly within the South itself. When the first period of expansion in the 1920s had been completed, a great deal of the cotton manufacturing area in the Piedmont section of North Carolina, for example, had experienced sharp rises in living costs, construction costs, taxation, etc. Mills in that section saw the differential between their total costs and the costs in northern mills shrink. They also saw other mills in more rural areas in Georgia and Alabama, for example, present competition to North Carolina approximate to that which the latter had at first presented to the North. Similarly, new areas in States like Mississippi, particularly with the organized encouragement of the State Government, presented new types of competition to Georgia and Alabama. This successive shift toward new sections which get what might be termed the industrial bug is the most fascinating, and potentially the most important, phase of this whole trend toward industrial decentralization.

The Southern Mill Village.—The shift of a considerable part of the nation's cotton manufacturing to the South brought with it an extension of the southern mill village system which was significant not only from the sociological standpoint but also from its economic bearing on the most controversial phase in the cotton industry of the United States during the post-World War period.

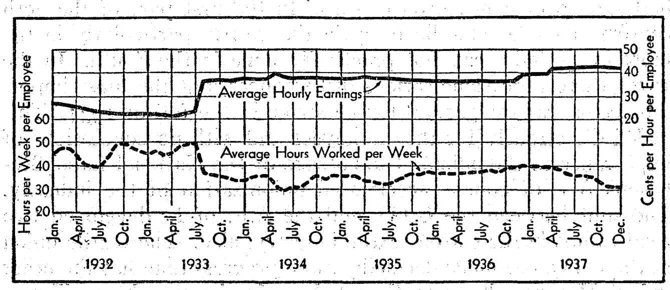
As most of the new plants in the South were built in rural areas, and as a good portion of the prospective employees had to be secured from mountain areas—as previously noted—the average southern cotton manufacturing company found it necessary to build and maintain practically a complete community. It was first forced to build homes for the workers, and then to add the other elements of life—such as stores, schools, churches, recreation centres, etc. Since these facilities were made available to employees far below cost, they represented a material burden upon the plant operating budget. The amount of this burden differed widely among different sections and different plants within one section. During the height of the North-South trek, the cost per week per employee was figured at \$3.36 by a particular manufacturer. This was in the high zone but all mills had costs probably ranging from \$1.00 or \$1.50 per week per employee and higher.

Always a difficulty in view of the fact that wage envelopes in southern mills could not contain the full amount of the payments made to employees, this mill village cost became a most active irritant in the establishment of wage minima under two governmental agencies: (1) the National Recovery Administration (NRA) from 1933 until its invalidation by the Supreme Court in 1935; and (2) the Wage-Hour Division of the Department of Labor, under the Fair Labor Standards Act passed in 1938.

Wage and Hour Trends.—One of the most radical adjustments in wage and hour standards was that experienced by the cotton manufacturing industry in the United States during the years following the start of the NRA in 1933. Under the leadership of the Cotton-Textile Institute, the industry took the lead and voluntarily offered to reduce its work week to 40 hours and to accept a minimum wage determined under the new law. The result was it received NRA Code No. 1. Prior to the code, mills in certain States were limited to 48 hours per week, but in others the work week ran as high as 55 hours or above. A voluntary acceptance of a 40-hour maximum work week was therefore a very radical change for a great many mills and their employees. In addition, the industry accepted in Code No. 1, after hearings before the Administrator in Washington, a minimum wage of \$12.00 a week (or 30 cents an hour) in the South and \$13.00 a week (or $32\frac{1}{2}$ cents an hour) in the North. Final settlement of this differential of \$1.00 per week or $2\frac{1}{2}$ cents per hour between the North and the South represented the conclusion of the most difficult phase of code-making for the cotton textile industry.

The effect of this change in labour standards is best shown by a simple statistical comparison. Average hourly earnings in the cotton goods industry in the pre-NRA year, 1932, amounted to 23.9 cents. In the first full year under the NRA (1934) this advanced to 37.8 cents—an increase of nearly 60% of the average hourly earnings of the worker. Despite the invalidation of the NRA, the standards were kept voluntarily thereafter, with the result that the average for 1935 was 37.6 cents and for 1936 it was 36.8 cents. In 1937, due to improved business conditions it reached a high level of 41.3 cents—or an increase of nearly 75% from the low point in 1932. This advance is shown, graphically, in fig. 29.

After the general business boom of 1937, followed by the collapse in the latter part of that year and in 1938, the need for the re-establishment of some agency for the maintenance of labour standards was evident, and the Fair Labor Standards Act of 1938 was passed. As was true under the NRA, the cotton textile industry became the first guinea-pig under the new act. This was logical, in that labour costs represent such a material part of total cotton manufacturing costs, and also because wages have always



COURTESY "TEXTILE WORLD," BASED ON COTTON-TEXTILE INSTITUTE FIGURES

FIG. 29.—CURVES PREPARED BY COTTON-TEXTILE INSTITUTE FROM GOVERNMENT FIGURES SHOWING WAGES-AND-HOURS TREND (JULY 1933 MARKS THE START OF NRA)

been the principal competitive battleground in that industry. Cotton manufacturers and their organizations co-operated with the Administrator of the new act. However, when the final recommendation was made—a minimum wage of $32\frac{1}{2}$ cents an hour, which corresponded to that established for the North under the NRA, failure to set up a differential for the South created dissension in the industry. Certain southern mills instituted suits to enjoin the Wage-Hour Administration from putting the proposed minimum into effect. Just about that time, in 1939, however, war broke out in Europe and a wave of buying set in in the United States which, temporarily at least, diverted industry attention away from the problem of the wage-hour law.

The effect of both these governmental agencies, and of the experience of the cotton textile industry under them, has been to raise the status of employees materially and to curtail the possibilities of wage chiselling as a form of competition. Some observers feel that the decrease in hours and advance in wages in cotton manufacture have been too sharp and the adjustment too sudden, but all agree that the advance has represented most important sociological progress. In fact, the socializing influence of the cotton industry, particularly in the South, has been of major significance.

Employer-Employee Relationships.—From what has been said previously with regard to the origin of the southern cotton mill village, it will be readily evident that the relationship between employers and employees was based at the start, at least, upon a more or less paternalistic attitude. This was not a choice on the part of management, but rather the result of necessity. Forced to provide for the physical, mental and spiritual needs of the workers, the average manufacturer recognized and accepted a sense of responsibility toward them which inevitably verged on the paternalistic. This was particularly inevitable in connection with the first generation that came down from the mountains. However, as new generations arose, and as the educational processes, set into motion by the manufacturers themselves, began to take effect, both the need for and the receptivity toward paternalistic activities decreased. Some manufacturers were slow to adjust themselves to this change but the far-seeing ones planned ahead to meet it. Thus, there was a gradual abatement of so-called "welfare" plans—and a tendency to leave activities, other than those connected with the job proper, more and more to the employees themselves—or at least, to limit management support of such activities to those for which there was a conscious demand on the part of the workers, and a continuing support. The most recent manifestation of this change of attitude was the decision on the part of many mill organizations in the South to sell their mill villages to their employees. At first it was difficult to work out a formula for this, since rents had been on such a low basis that there was no particular incentive toward home ownership. This was gradually corrected and in 1938 a great many mills made sales arrangements with their workers—and this tendency has been on the increase. It is felt that this will eventually mean more stable labour conditions, and the shedding of the last vestiges of paternalism.

The above has to do with relations between employers and employees within individual plants. So far as relations between management and organized labour are concerned, unionization has had slow growth in cotton textiles. In the first part of the 20th century it made some headway in the North, particularly in the more congested areas, but practically none in the South. In the 1920s there were some serious disturbances, but the most important crisis was the general textile strike in the fall of 1934. This ended disastrously for the employees and with no concessions of importance to the union. The passage of the National Labor Relations Act, of course, accelerated unionization of the industry. The split between the C.I.O. and the A.F. of L. developed two rival camps in the cotton textile industry, also. The textile union of the C.I.O. has made decidedly more progress than has the other union. However, by 1940, the number of union members still represented a very small minority.

Textile Education.—The textile industry has an unchallenged position in specialized education. No other industry in the United States has developed anything approaching the highly organized group of textile schools which supply their graduates for the filling of top management and operating executive jobs. Since many of these schools are located in primarily cotton manufacturing areas, the cotton division is without question the most important part of textile education. There are 12 major textile schools: A. French Textile school of Georgia School of Technology, Atlanta, Ga.; Department of Textile Engineering of Alabama Polytechnic institute, Auburn, Ala.; Clemson Textile school of Clemson Agricultural college, Clemson, S.C.; Bradford-Durfee Textile school, Fall River, Mass.; Lowell Textile institute, Lowell, Mass.; Textile department of Massachusetts Institute of Technology, Cambridge, Mass.; New Bedford Textile school, New Bedford, Mass.; Philadelphia Textile school, Philadelphia, Pa.; North Carolina Textile school of North Carolina State college, Raleigh, N.C.; Rhode Island School of Design, Providence, R.I.; Textile Engineering department of Texas Technological college, Lubbock, Texas; and Textile department of Texas Agricultural and Mechanical college, College Station, Texas. In addition, there are textile public high schools throughout the country—notably the Straubenmuller Textile High school in New York, and other associated branches of textile education.

Most of the textile schools proper were organized for the primary purpose of developing overseers for textile mills. Consequently their courses emphasized the purely technical phases of textile manufacture. As the industry became more and more complicated, however, and as the economic necessities of cotton manufacture began even to supersede the technical phases in urgency, the schools found themselves called upon more and more to extend their courses into the fields of management and economics. Commencing in 1933, an organized approach to the filling of this need was made under the auspices of the Textile Foundation which sponsored a survey of textile education. The report was submitted in 1934, and was the forerunner of a continuing program of industry-wide co-ordination and improvement of its textile educational institutions. Regular meetings of the deans of the textile schools help greatly to make this program an effective one.

Textile Research.—The economic emergency which the cotton textile industry experienced during the 1920s developed a recognition of the need for organized research into both the technique and the economics of the industry. Two organizations with that end in view were launched in 1930: the United States Institute for Textile Research and the Textile Foundation. There was no connection between the creation of the two. The United States Institute for Textile Research is a private organization which has sponsored several special technical studies on such problems as warp sizing, drying, etc.; and whose Economic Research committee has supervised the conduct of several studies in economics. The Textile Foundation is a semi-public organization, created by an Act of Congress in 1930. Its program in the first ten years of its existence included such undertakings as the textile education survey mentioned previously in this article; the establishment of a large number of fellowships for scientific research; and the financing of several investigations into economic trends, all of which were proposed and supervised by the Committee on Economic Research of the United States Institute for Textile Research. In that way, and in the production of the institute's publication *Textile Research,* the Foundation and the Institute participated jointly in certain enterprises. Students of the industry recognized that the research program represented by these two organizations, and by some specialized bodies such as the American Association of Textile Chemists and Colorists, is not a final answer to the industry's need, but rather an approach to the fulfilment of that need. It is also recognized that the Textile Foundation, through its sponsoring of broad-gauged projects, has done much to arouse and keep alive the research attitude among individual manufacturers.

Textile Associations.—Just as the cotton textile industry is highly organized from the standpoint of textile education, so is its associational structure an effective one. The two major associations, representing the two important geographical sections of the industry are the National Association of Cotton Manufacturers in Boston, Mass., representing the New England mills, and the American Cotton Manufacturers Association in Charlotte, N.C., representing the southern mills. In addition to these broad geographical units, there are many State or other sectional associations, especially in the South, including the Alabama Cotton Manufacturers Association, Montgomery, Ala.; Cotton Manufacturers Association of Georgia, Atlanta, Ga.; Cotton Manufacturers Association of North Carolina, Charlotte, N.C.; Cotton Manufacturers Association of South Carolina, Clinton, S.C.; Southern New England Textile Club, Providence, R.I. Then there are group organizations, representing specialized divisions of the industry, rather than geographical sections of the country, such as the Association of Cotton Textile Merchants of New York; Association of Cotton Yarn Distributors, Philadelphia; Cotton Thread Institute, New York; Durene Association of America, New York; Mercerizers Association of America, New York; National Association of Finishers of Textile Fabrics, New York; Narrow Fabrics Institute, New London, Conn.; Southern Combed Yarn Spinners Association, Gastonia, N.C.; Textile Fabrics Association, New York (representing the converters); Textile Export Association of United States, New York. Operating executives also have what might be termed technical organizations, such as the Southern Textile Association, Charlotte, N.C., and the Textile Operating Executives of Georgia and of Alabama. Then there are associations in specific cities, such as the Fall River Cotton Manufacturers Association, Fall River, Mass., and the New Bedford Cotton Manufacturers Association, New Bedford, Mass.

A top organization, enjoying the co-operation of most of these groups, is the Cotton-Textile Institute, New York, which was formed in 1926 to attempt to effect a measure of stabilization in an industry which needed it badly. This did not supersede the old-line associations but on the contrary was aided by the latter. Under the leadership of the Cotton-Textile Institute, a great many of the outstanding accomplishments between 1926 and 1940 were realized. These included the voluntary elimination of night employment of women and minors; the initial reduction of the work week to a maximum of 55 hours on day shift and 50 hours at night; the further reduction of the work week to 40 hours under the NRA; the development and efficient administration of NRA Code No. 1, covering cotton textiles; the development of a new uses program and a general promotional activity; and finally the development of greater co-ordination among the various units of the industry. This latter took the form, in 1939, of the formation of the National Council of Textile Industries, New York, under the sponsorship of the Institute, which is composed of several associations touching upon the cotton textile industry. Here again the individual associations are not superseded but the council acts as an effective co-ordinating group for them. The Cotton-Textile Institute has had the successive leadership of Walter D. Hines, general administrator of railroads during the war; George A.

Sloan, who led the industry through the NRA code-making days; Goldthwaite H. Dorr, counsel for the Institute and a partner of Mr. Hines during the latter's life; and Dr. Claudius T. Murchison, formerly of the faculty of the University of North Carolina, and also formerly director of the Bureau of Foreign and Domestic Commerce of the Department of Commerce, Washington, D.C.

Under the direction of all of these various associations, the cotton textile industry has experienced a type of self-government which has done much to avert far more serious consequences which might have come to it under the textile depression in the '20s and the '30s had it not been so organized. (D. G. Wo.)

COTTON BELT, a name applied to that region of the United States in which the bulk of the cotton crop of that country is produced. Cotton is grown extensively in this area because of its warm climate, moderate amount of summer and fall rain, long growing season and fertile soil. The area includes south-eastern Virginia, the eastern three-fourths of North Carolina, South Carolina, Georgia, northern Florida, Alabama, Mississippi, western Tennessee, south-eastern Missouri, Arkansas, most of Louisiana, most of Oklahoma, the greater portion of Texas and south-eastern New Mexico. In 1939 this area produced 94·5% of the total cotton crop of the United States and 39·4% of the commercial cotton crop of the world. Most of the remaining 5·5% of the total for the United States in 1939 was produced in south-western Arizona and southern California. (A. H. Ge.)

COTTON CONTROL BOARD, THE. The Cotton Control Board, which controlled the Lancashire cotton industry during the later phases of the War of 1914–18, was appointed by the Board of Trade in June 1917. For some time previously imports of cotton from the United States had been drastically curtailed by the shipping authorities, in order to conserve tonnage for more urgent needs; and an acute shortage of American cotton had developed. To deal with the problems arising from this situation, the Control Board was set up, a body representative of the various organized trade interests, the employers and trade unions in spinning and weaving, the Liverpool Cotton Association and the Manchester Chamber of Commerce, together with two representatives of the Board of Trade. The dominating figure in determining the Board's policy was its chairman, Sir Herbert Dixon, who, though the largest employer in the industry, commanded in a remarkable degree the confidence of the operatives.

The problems before the board were twofold. First, it must prevent a chaotic scramble for the limited supplies of raw material, and secure for each concern a fair and steady share. This was a problem with which many "war controls" in other industries had also to deal. But the peculiarities of the cotton industry gave rise to a second important problem. The reduced scale of production which was inevitable would throw out of work a large number of operatives, who could not readily be absorbed in war-time employment, on account of the highly-localized character of the industry.

The main features of the scheme of control were as follows: Spinners and manufacturers were forbidden to work more than a certain percentage of their machinery except under licence from the Control Board. After some months licences were required to work any machinery at all. These licences were granted only on payment of "levies" of so much per spindle or per loom; and the funds which were raised in this way were used to finance a system of unemployment benefits. The details of the scheme varied from time to time as conditions changed with a prevailing tendency, as shipping difficulties became more acute, to more drastic curtailment of output. At first, spinners of American cotton were restricted to 70% of their machinery, while manufacturers and spinners of Egyptian cotton were allowed (on payment of the levies) to work 100% if they desired. But by March 1918, spinners in the American section had been cut down to 50% and manufacturers to 60%; while in June compulsory short-time was added to these restrictions, with the result that production in the American section was reduced to less than 40% of its normal. Under these conditions of restricted supply, the trade became extremely profitable. While the price of raw cotton was limited by the enforcement of maximum prices, no control was exercised over the prices of yarn and cloth, which soared to unprecedented heights; and the profits reaped by spinners and manufacturers during 1918, though they were to pale before those of the post-armistice boom, were the highest recorded hitherto.

The system of unemployment benefits was worked on lines which made it extremely popular with the operatives. The trade-unions were entrusted with the task of paying the money out in accordance with rules laid down by the Control Board. The scale of benefits was, by all previous standards, high. At the outset, the scale was 25*s.* for a man, 15*s.* for a woman, and 12*s.* for young persons; and these benefits were soon supplemented by allowances of one shilling a week for dependent children. In Aug. 1918, the whole scale was increased by 20%. But the most popular feature was the so-called "rota system" which became established in the greater part of the industry. The "rota system" meant that none of the workpeople, to whom it applied, were unemployed in the ordinary sense, but all took it in turn to "play off" for periods of a week. Thus, in a mill which had only work for 75% of its available operatives, each operative would work three weeks, and for the fourth week would "play off" and receive the Control Board benefit. This system was naturally highly congenial to the operatives; it had the effect of turning unemployment from a hardship into a positive blessing; and the rota week, breaking the monotony of factory life, became a cherished institution.

This arrangement was, however, open to the objection that it served to check the tendency for surplus cotton operatives to obtain other work; and this objection, at a time of national emergency and shortage of labour for urgent tasks, was formidable. In May 1918, accordingly, the Control Board decided to abolish the rota system. This decision which took effect in August, caused widespread resentment among the operatives, and dissipated a large part, though by no means the whole, of the remarkable popularity which the Control Board enjoyed among them. It led indeed to a strike on the part of the spinners which lasted for a week.

The Control Board exercised its authority by virtue of orders made from time to time by the Board of Trade under the Defence of the Realm Regulations. In Feb. 1919, these orders were revoked, and the Cotton Control Board ceased to exist as such, being converted into an advisory council under the name of the Cotton Reconstruction Board. When the system of levies and unemployment benefits came to an end, the Control Board had accumulated a large surplus—it had budgeted to meet the possibility of grave developments—of no less than £1,500,000. This money was converted into a special fund, the Cotton Trade War Memorial Fund, administered by a body of trustees appointed by the Board of Trade to be used for purposes of general benefit to the cotton trade and its employees. (H. D. H.)

COTTON DUTIES (INDIAN). The controversy with regard to these duties dates back to 1894 when the Government of India, finding itself in financial difficulties as the result of the position of the exchanges, wished to reimpose the customs tariff which had been dropped since 1882, but decided to omit cotton yarns and fabrics from the new list of dutiable articles. This exception provoked a great deal of criticism in India where it was maintained that the exclusion of cotton goods and yarns was intended to favour Lancashire to the prejudice of the Indian budget. After two years' discussion a further act was passed in Jan. 1896 which imposed an import duty of $3\frac{1}{2}$% (as opposed to the general rate of 5%) on all cotton piece goods, but not yarns; but in order to prevent the new duties having a protective effect on the growing cotton mill industry in India, an equivalent excise duty was imposed on all cotton goods manufactured in the Indian mills, and it was these excise duties that later became the focus of criticism. India maintained that they were intended to give protection to Lancashire against Indian producers, while Lancashire maintained that they were merely intended to prevent the Indian industry protecting itself against Lancashire.

The agitation against the duties never quite died down, and in 1916 it broke out afresh, partly as the result of the tariff reform movement in England. At the same time the position of the Indian mills was being rendered more difficult by the competition of the Japanese mills, not only in India but also with Indian products in China. In 1917 the question came to a head in connection with India's contribution towards the cost of World War I. In order to raise the additional revenue required, further taxation was necessary and it was proposed to raise the import duty on cotton goods from $3\frac{1}{2}\%$ to $7\frac{1}{2}\%$, but leaving the excise duty at the previous figure of $3\frac{1}{2}\%$, thus giving the Indian mills protection to the extent of the difference of 4%. This proposal aroused great protests in Lancashire, but it was carried through parliament with the support of the opposition on the understanding that it would be reconsidered at the end of the war. In 1921, the import duty was raised to 11%, with 5% on yarns (1922). In 1925–26, however, the position of the Indian budget having become more favourable, the general duty was reduced to 5% and the excise duty first suspended and then abolished altogether. In 1927 the import duty of 5% was modified in the case of the cheaper yarns worth less than 30 annas per lb. to a specific duty of $1\frac{1}{2}$ annas per lb. which was said to be an attempt to differentiate against the cheaper imported yarns from Japan.

COTTON FAMINE, 1861–1865. Never in the history of modern industry has such a cataclysm overtaken any great trade as the cotton famine which devastated the Lancashire cotton industry during the years 1861–65 as the result of the American Civil War, when the supply of American cotton, which then formed 85% of its total consumption of raw material, was almost entirely cut off.

The years 1859 and 1860 had been a period of great activity in the cotton trade. There was a boom which was probably in sight of its inevitable termination when the Civil War began. Large stocks of cotton had been imported and the stocks of yarns and manufactured goods were unusually large. Had there been no war it is probable that the trade would have been compelled to face a reaction involving a severe spell of depression and short time, for it appears that even in those days periods of overproduction had already been reached in the cotton trade.

Blockade of 1861.—It was not therefore till well into the autumn of 1861 (the blockade of the southern ports was established in July of that year) that the pinch first began to be felt in Lancashire. The rise in the price of cotton, which had been the first effect of the war, had enabled the spinners and manufacturers to dispose of large stocks of goods, and it was probably the cessation of demand rather than the lack of supplies of the raw material which first began to produce stagnation in the trade. In the opening weeks of 1862 the trouble really became acute. Widespread appeals for contributions were sent out with very satisfactory results.

The total amount spent in relief of the distressed was for those days colossal. In all nearly £1,750,000 was distributed by the various relief committees, not including contributions in kind (which were estimated at about £112,000 in value) and relief granted by the boards of guardians.

In three years the latter spent just under £2,000,000. The total loss incurred by the whole trade in wages, profits, etc., is incalculable, but must have exceeded £10,000,000.

By the time that the large pre-famine stocks had disappeared (some cotton was actually reshipped to the northern states where the shortage was, of course, equally bad) other supplies especially from India were coming into the country, though in comparatively small quantities. The Indian crop, which at one time had supplied a large proportion of Lancashire's needs, had fallen off very badly both in quantity and quality; and when it became practically the only alternative, difficulty was at first experienced in getting large quantities of Indian cotton. The quality also proved exceedingly unsatisfactory, involving a great loss both in time and in waste, while it required much readjustment of the machinery. For a time, however, it was almost the only new supply available, as the blockade soon began to prove unpleasantly efficient, and it was some time before the organization of a fleet of small but fast steamships as blockade runners developed to such an extent as to produce any satisfactory quantity. The rise of the price of cotton from below *7d.* in the early months of 1861 to $31\frac{3}{4}$*d.* in 1864 naturally proved a great stimulus to the growing of cotton in other countries, as well as its extension in India.

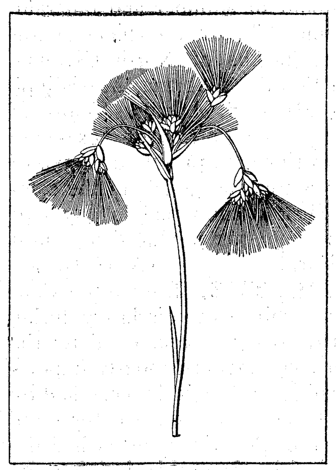
The greatest success was achieved in Egypt, where, though the quantity was comparatively small, the quality proved better even than American (except Sea Island).

The stimulus extended, however, to practically every potential cotton-growing country in the world, *e.g.*, Australia, Brazil, and various parts of the Turkish empire, but at best the total supplies were never more than enough to keep the industry running about half-time. Even after the conclusion of peace in April 1865 it was a long time before supplies reached anything like normal.

(J. A. T.; X.)

See R. A. Arnold, *History of the Cotton Famine* (1864).

COTTON-GRASS or **COTTON-SEDGE** is the name applied to species of *Eriophorum*, a genus of the sedge family (Cyperaceae). There are 15 species, four being British and 10 North American. They are generally found on wet and boggy moors. The flowers are massed together into heads and each has four or more hair-like bristles at the base. After fertilization these grow out into long conspicuous cottony hairs which serve to distribute the seed which is contained in a small dry achene. The alpine cotton-grass (*E. alpinum*) and the slender cotton-grass (*E. gracile*) occur both in Great Britain and in North America. The Virginia cotton-grass (*E. virginicum*), with dingy-brown, rarely white, hairs, grows from Newfoundland to Manitoba and southward to Florida and Nebraska. The sheathed cotton-grass (*E. callithrix*), found from Newfoundland to Pennsylvania and Wisconsin and northward to the Arctic, and also in Asia, forms in Alaska the summer food of reindeer.



COTTON-GRASS (ERIOPHORUM POLYSTACHION), ABOUT ⅓ NATURAL SIZE, SHOWING MATURE FLOWER-CLUSTERS CLOTHED WITH WHITE COTTONY HAIRS

COTTONSEED. The seed of the cotton plant is egg-shaped, measuring about three-eighths of an inch in length and three-sixteenths of an inch in width. In weight, cottonseed averages about 3,500 to the pound. For each pound of fibre, cotton plants yield approximately two pounds of seed. The commercial importance of cottonseed lies in the four principal products which can be obtained from it through processing—namely, oil, cake or meal, linters, and hulls.

Although cotton fibre has been a product of commerce for centuries, large-scale commercial utilization of cottonseed is a comparatively recent development. In ancient times the Chinese and Hindus used cottonseed oil as a medicine and in lamps and developed crude methods for its recovery, but it was not until the production of cotton began its rapid increase following the invention of the cotton gin in 1794 that systematic and continuing efforts were made to develop machinery for the commercial processing of cottonseed. Even as late as 1875 the principal use of cottonseed was for planting purposes, while the remainder over and above these requirements was regarded mainly as a waste product which was frequently disposed of by burning or dumping into streams near the cotton gins. This practice created a serious health problem, and several states passed laws making it a punishable offense to accumulate seeds around gins to the detriment of the health of the nearby inhabitants, or to dump cottonseed into streams which were used by inhabitants for drinking or fishing.

The history of the development of the cottonseed industry is almost wholly a history of the development of the industry in the United States. In the 18th century, various individuals and organizations recognized the potential value of cottonseed as a source of oil and other products and urged producers to develop feasible methods for obtaining these products. Among the first in the United States was a Dr. Otto of Bethlehem, Penn. In

1768 he presented the American Philosophical society with samples of oil he had obtained from cottonseed. In 1783, the Society for the Encouragement of Arts, Manufactures and Commerce, in England, offered a gold medal to any planter in the West Indies who was able to express one ton of oil and produce 500 lbs. of cake from cottonseed. Two years later, a premium was offered by the South Carolina Agricultural society in an effort to encourage the expressing of oil from cottonseed. There is no record that either of these awards was ever claimed.

Between 1800 and 1825 several cottonseed oil mills were built in various parts of the south in the U.S., but they were all financial failures and none of them was very long in operation. The first mill which could be called successful was established in Natchez, Miss., about 1833, and continued in operation for nearly ten years.

Beginning about 1850 a number of improvements were made in cottonseed processing machinery which led to a more successful operation of the mills. By 1860 there were seven active mills crushing a total of approximately 50,000 tons of seed annually. Progress was stopped by the Civil War, but in the years following the industry again began to expand. By 1870 there were 26 active mills and in 1940 the industry had expanded to 446 mills.

In 1876, only 5% of the cottonseed crop was crushed for oil and other products, but after 1910, 80% of the crop reached the oil mills. No cottonseed is now wasted. The 20% not crushed remains on the farms and is used for planting and as fertilizer for crops and as farm feeds. In 1876, 98,000 tons of seed were crushed while the annual crush since 1910 has averaged 4,500,000 tons. The sale of cottonseed provides American cotton farmers with an average annual cash income of more than $100,000,000, while one-half of the total United States production of edible vegetable oils, one-third of the total production of protein meal feeds, and practically all of the highest grades of industrial cellulose are obtained from cottonseed.

Processing.—The processing of cottonseed consists essentially of (1) cleaning, (2) removal of linters, (3) separation of the oil-bearing kernels from the hulls, (4) flaking and cooking of the kernels to facilitate oil recovery, and (5) expressing or extracting the oil from the flaked and cooked kernels which then become known as cottonseed cake. The oil is further processed to remove impurities.

When cottonseed are received at the oil mills they contain a considerable amount of trash. In the cleaning process they are passed over revolving screens to remove the larger trash and over shaker screens to remove the smaller particles. Suction fans or blowers are frequently used to aid in the cleaning and magnets are often used to remove metallic substances.

The seed are then fed to a delinter machine, which is very similar to a cotton gin but with much finer teeth in the saws. This machine removes most of the short fibres which remain on the seed after the ginning process. When the linters are all removed in one passage through the delinter they are known as the "mill-runs." When they are removed in two successive cuts they are known as "1st-cuts" and "2nd-cuts." Each type has different industrial uses.

The delinted seed are next conveyed to the hullers where a series of knives cuts the hulls and loosens them from the kernels. Beaters and shakers complete the separation of the hulls from the kernels. Lack of an efficient hulling process was a major handicap in early attempts at establishing a cottonseed oil industry. The kernels go next to the press room where they are processed to recover the oil which they contain.

In order to obtain maximum recovery of oil, the kernels are first flaked and cooked. Flaking is accomplished by passing the kernels through heavy steel rollers which reduces the stock to an average thickness of about .007 inch. Cooking is done in steam-jacketed kettles operated at a temperature of about 235° F. and equipped with mechanical agitators to ensure uniform heating. Cooking time is from 30 to 90 min.

For recovery of oil the hydraulic press method is the one most generally used in the United States. The flaked and cooked kernels are wrapped in a thick haircloth and formed in molds to fit the steel press boxes. The hydraulic press consists essentially of a number of these boxes, with perforated bottoms, set one above the other. A hydraulic ram, which pushes upward when pressure is applied, forces each box, containing the cloth-wrapped oil-bearing stock, against the one above and the top box against a head plate. The expressed oil flows out through the cloth wrappings and down into a collecting pan from which it is piped to tanks. For some markets the pressed meats are broken up into smaller pieces and sold as cottonseed cake but most of it is ground and sold as meal.

Many oil mills use the expeller process, a continuous screw process introduced into the industry shortly after 1900. With the expeller process cooking is eliminated, although some method of preheating is often employed. The use of haircloth is eliminated and there is also a saving of time and labour, since the process is continuous and almost automatic. The flaked and preheated stock is fed into a slotted cage or barrel made up of steel bars set a few thousandths of an inch apart. A revolving screw carries the stock along inside the barrel. High temperatures and a pressure of from 5 to 10 tons per square inch are built up as the stock moves to the discharge end. The oil flows out through the openings between the bars and is collected in a receiving chamber beneath the press while the cake is discharged at the end of the barrel.

Oil is the most valuable product obtained from cottonseed and as a consequence considerable attention has been given to improved methods for its recovery. Although both the hydraulic press and the expeller produce oil of acceptable quality, both processes leave from 5% to 7% of oil in the cake. It has been shown that by solvent extraction the residual oil content of the cake can be reduced to about 1%; and in view of this consideration, attempts have been made to develop a satisfactory solvent extraction process for use with cottonseed. Solvent extraction has been successfully applied to the processing of soybeans, but owing to certain physical properties of the cottonseed kernel, efforts to adapt this process to the commercial extraction of cottonseed oil had not been successful up to 1943.

The crude cottonseed oil as it comes from the presses is dark red in colour and has many constituents which must be removed before it can be used for edible purposes. These substances are removed by refining, bleaching, winterizing, and deodorizing processes.

On reaching the refinery, the crude oil is sampled for analysis and then pumped to large conical kettles where it is treated with sodium hydroxide and gradually raised to a temperature of about 150° F. The free fatty acids combine with the sodium hydroxide to form a soap stock and settle to the bottom after standing for 12 to 24 hrs. The oil is drawn off and washed with water to remove any remaining soap particles.

A newer, quicker, and more efficient refining process, which is also widely used in the industry, is based on the centrifuge principle. In this process the crude oil is fed to a high-speed mixer along with the proper proportion of sodium hydroxide and then passed through a tubular heater operating at a temperature of about 150° F. The emulsion of oil and sodium hydroxide remains in the heater about two minutes and passes from there to a high speed centrifuge which separates the soap stock from the oil continuously. The refined oil is then mixed with water for washing and subsequently separated from the water by another centrifuge followed by vacuum drying.

When the oil is to be used as a salad or cooking oil, it is further purified by bleaching, winterization, and deodorization. The principal bleaching agents are fuller's earth and acid activated bleaching clays, the latter sometimes being used in combination with activated charcoal. Filtering removes the bleaching agents and the absorbed colouring substances. Winterization is a process by which a portion of the refined and bleached oil is solidified by chilling and filtered off. The process is slow, requiring about five days for each batch. Deodorization is accomplished by distilling off the odoriferous substances which have a different boiling point from the oil. Deodorization is generally a batch process but after 1937 a number of refineries installed continuous deodorizers.

By far the most important use for cottonseed oil is in shortening and margarine products. For this use the oil is put through a process known as hydrogenation, which converts the oil from a liquid into a solid with a melting point of any desired temperature up to about 140° F. The hydrogenation reaction is effected by passing hydrogen gas into the oil in the presence of a nickel catalyst. The hydrogenation process was discovered about 1900 and from 1910 onward its adaptation by the cottonseed oil industry was rapid.

Utilization of Cottonseed Products.—The relative amounts of cottonseed products obtained from each ton of seed varies from season to season, from one locality to another, and with the variety of the cotton. During the five years ending with 1939 an average of 309 lbs. of oil, 905 lbs. of cake and meal, 515 lbs. of hulls, and 148 lbs. of linters was obtained per ton of seed crushed, with a waste and manufacturing loss of 123 lbs. For the ten crop years ending with 1942, cottonseed oil mills produced annually an average of 1,400,000,000 lbs. of oil valued at $92,-700,000, 2,000,000 tons of cake and meal valued at $51,200,000, 1,000,000 bales of linters valued at $20,100,000, and 1,100,000 tons of hulls valued at $8,100,000, or products with a total annual average value of $172,000,000. Cottonseed products from the 1932–33 crop had a total value of $87,300,000 as compared with a value of $260,100,000 from the crop of 1941–42.

Oil.—Cottonseed oil accounts for slightly more than half of the total value of cottonseed products. During early attempts to establish a cottonseed oil industry, producers were mainly interested in the oil as an illuminant, but with the rise of the petroleum industry efforts along this line were abandoned. About 1850, interest was shifted to the use of cottonseed oil as a food product and since that time the industry has grown largely on that basis. In 1942, 52% of the cottonseed oil produced went into the manufacturing of shortening, 13% into margarine products, 28% into salad oil, salad dressing, mayonnaise, cooking oils, and other edible products, and 7% into inedible products such as soap, paint, and varnishes. The use of cottonseed oil in inedible products is limited mostly to off-grade oils and foots. Since 1931, cottonseed oil has encountered increasing competition from soybean oil in shortening and mayonnaise.

Cake and Meal.—Cake and meal rank second in order of value of cottonseed products, accounting for about 30% of the total. Its principal use is for cattle feed where its high, easily digestible protein content makes it ideal for mixture with roughage or as an ingredient of mixed feeds. Cottonseed meal is also used to some extent as fertilizer and small quantities are used in making starch-free flour for human consumption.

Hulls.—Hulls, which represent about 5% of the value of cottonseed products, are used almost exclusively as a livestock feed, either alone, in which case they have a feeding value comparable to dry Johnson grass and Bermuda hay, or in mixture with cottonseed meal. A small proportion of the total hulls produced is further processed to recover what is known as "hull fibre." This is the fibre remaining on the seed after the delintering operation. Hull fibre has properties similar to those of low grade linters and goes into similar uses.

Linters.—Although linters represent only about 10% of the total value of cottonseed products, they provide important raw materials for many other industries. First-cut linters are used in making high-quality mattresses and in the manufacture of coarse cotton yarns. The automotive and furniture industries use large quantities of mill-run linters as a padding material. Second-cut linters, after mechanical and chemical purification, are used in the manufacture of cellulose acetate rayon and plastics, ethyl cellulose, cuprammonium rayon, high-strength viscose rayon, lacquers, smokeless powder, sausage casings, and other cellulose products in which high quality cellulose is required.

(D. F. J. L.)

COTTON SPINNERS AND MANUFACTURERS' INTERNATIONAL FEDERATION. The International Federation of Master Cotton Spinners' and Manufacturers' Associations was established in 1904 to watch over and protect the common interests of the cotton industry of the world, and to advise the affiliated associations of actions to be taken against any common danger. The means employed in peacetime for carrying out this purpose are:—

(1) The holding of congresses of delegates representing all countries affiliated with the federation.

(2) The appointment of a committee of management, which controls the work and expends the moneys of the federation under the instruction of the congress, distributes information of practical value in improving the conditions of the cotton trade, and assists in the formation, strengthening and assimilating of associations in all spinning and manufacturing centres.

The following countries were affiliated with the Federation in Aug. 1939 (headquarters: 26 Cross Street, Manchester): Bohemia and Moravia, Denmark, Britain, France, Germany, Holland, Hungary, India, Italy, Norway, Poland, Spain, Sweden, Switzerland, Belgium, Finland, China, Egypt, Estonia, Greece and Yugoslavia. Thus the greater part of the world's cotton industry was represented.

The principal questions of mutual interest to all the cotton countries are those connected with the supply of raw cotton. To stimulate cotton-growing, missions have visited, under the auspices of the federation, the United States, India, Egypt, Sudan, Brazil and Colombia. The federation's half-yearly statistics on cotton-mill consumption and stocks are recognized throughout the world. It is of special interest to add that panels of arbitrators to deal with disputes arising out of yarn or cloth transactions have been set up; a significant international trade development. Eighteen international cotton congresses had been held down to 1939 under the auspices of the federation. The *International Cotton Bulletin* is published quarterly.

COTTONTAIL, the common name in America for several species of rabbit (*q.v.*) of the genus *Sylvilagus.*

COTTON WASTE. Every process in cotton manufacturing, from the picker room through the spinning room and the weaving shed, results in some form of cotton waste. These wastes, including thirty-odd different types, are sold by the mills as by-products of their cotton manufacturing. The sales value of a cotton mill's waste often represents the difference between a profit and a loss for the mill, and waste has become of such commercial importance that the business of merchandising waste is one of the largest allied with the cotton spinning industry.

The principal raw cotton consuming countries—the United States, Japan, India, the United Kingdom and the U.S.S.R.—are naturally the greatest waste producing countries. Although high grade comber noils and card strips from Egyptian Sak cotton are imported by the United States from the United Kingdom, and vast quantities of willowed fly and picker waste are supplied to the United States by the Orient, a very valuable export business is done by the United States, its most important customers in cotton waste being Germany, Canada and the United Kingdom. A comparative table follows:

TABLE I.—*Cotton Waste:* Summary of United States production, imports and exports, by crop years, 1935–36 to 1938–39

(Quantity in thousands of pounds)

Cotton Crop, Year Beginning Aug. 1	Estimated production	Imports	Exports
	Total cotton waste		
1935–36	536,673	89,208	56,899
1936–37	671,782	113,124	75,599
1937–38	485,671	13,662	88,912
1938–39*	579,691	14,803	75,365

*Preliminary.

It is estimated that on a basis of an annual world cotton consumption of 12,000,000,000lb. of cotton, the world production of cotton waste is approximately 2,000,000,000lb., of which three-fourths would be spinnable waste, and, it is estimated that all recoverable cotton waste in carded yarn mills amounts to about 16% to 17% of the total cotton consumption, while the total recoverable waste in combed yarn mills is over 30 per cent.

Broadly speaking, cotton waste is divided into two groups: spinnable and unspinnable waste. The former class, including card strips, comber, lap, sliver and roving, is waste from cotton manufacturing processes after the cleaning has been done, the waste accruing from the twisting and spinning processes. Unspinnable waste, including motes, fly and sweepings, is made up of items from cleaning processes and has comparatively small commercial value. Approximately 70% of the production of waste is in spinnable grades. Of these, comber noils and card strips are commercially the most important types.

The quality of spinnable waste is governed by the grade and staple length of the cotton from which it is derived and on the percentage of the original fibre taken out in the carding and combing processes. Spinnable wastes are directly competitive with low grade and short staple cotton and for that reason its prices are based on spot cotton markets, while lesser grades are sold on a flat rate per pound.

A ten-year average annual price, 1928–38, for No. 1 grade Peeler Comber waste was from 80% to 99% of the average annual New York spot price of Middling $\frac{7}{8}''$ cotton for the same period. The average annual price during the same time for No. 1 Upland Card Strips was from 65% to 82% of New York spot price Middling $\frac{7}{8}''$ cotton. (Beginning Aug. 1, 1940, however, prices are based on New York spots on Middling 15/16″ cotton.)

TABLE II.—*Cotton Waste:* Dealers' average selling prices, f.o.b. shipping points, of specified kinds of cotton waste (in cents per lb. and in percentages of New York spot prices of Middling ⅞″ cotton).*

Period	New York spot price, Middling ⅞″ cotton	No. 1 Peeler Comber	No. 1 Upland Strips	Ratio of price of waste to New York spot price of Middling ⅞″ cotton: No. 1 Peeler Comber	Ratio of price of waste to New York spot price of Middling ⅞″ cotton: No. 1 Upland Strips
	Cents per pound			Percent	
Crop years					
1928–29	19.73	16.96	14.88	86	76
1929–30	16.60	13.49	11.19	82	68
1930–31	10.38	8.82	6.98	85	67
1931–32	6.34	5.70	4.58	92	73
1932–33	7.37	7.28	6.03	99	82
1933–34	11.09*	12.03	9.85	80*	65*
1934–35	12.44*	13.83	11.97	84*	73*
1935–36	11.75*	11.97	10.70	90*	80*
1936–37	12.93	11.38	9.90	88	76
1937–38	8.75	7.46	6.07	85	69
1938–39	8.99	7.16	6.52	80	73

*(From August 1933 to January 1936 raw cotton processed was subject to a tax of 4.2 cents per pound. The New York prices here shown do not include the tax; the actual cost to the mill was the price, plus the tax. Percentage grades of cotton waste continued to be quoted on the basis of New York spot cotton quotations, without tax, and as the cotton waste was not subject to the tax, the percentage ran over 100. The percentages here shown for that period have been recalculated on the basis of the New York spot price, plus the tax, in order to reflect more exactly the competitive position between cotton waste and raw cotton.)

Ways in which cotton waste may be utilized are innumerable. A break-down of the more important items and uses of each is as follows:

Comber Noils and Card Strips: When bleached and cleaned make absorbent cotton for medicinal purposes; but in their natural state used for wadding, padding for fine upholstery, bed quilts, etc. A new use is for insulation purposes in building construction after the waste has been chemically treated for inflammability. These items also have high re-spinning value

Roving: When broken up and garnetted it has high re-spinning value and is used for manufacture of twines, cordages, osnaburgs and cheap fabrics.

Thread Waste: Single thread waste is garnetted and mixed with Indian cotton and re-spun for use in the manufacture of flannelette and cotton blankets. Ply thread waste is used primarily as a wiping and polishing material, for packing journal boxes and for automobile oil filters.

Clearer Waste: Is used primarily for a cheap grade of absorbent cotton.

Card Fly: After being willowed is used as padding in the mattress and upholstery trade.

Motes: After being willowed is used for stuffing in upholstery and mattress trade; the waste from the willowing process is sold for fertilizer.

Short Remnants and Mill Ends or Rags: Are used for wiping and polishing cloths and in the manufacture of fine bond paper. Large remnants or mill ends are sold at heavy discounts to the wholesale and retail dry goods trade. (Anything short of a full bolt, or approximately 50 yards, is considered a "mill end.")

Sweepings: From the floor of the mill are used primarily in the manufacture of composition roofing. (M. G. B.)

COTTONWOOD: *see* POPLAR.

COTYS, king of Thrace from 383 to 360 B.C., disputed with the Athenians the possession of the Thracian Chersonese. He was assisted by the Athenians, Iphicrates and Charidemus, to the former of whom he had given his daughter in marriage. On the revolt of Ariobarzanes from Persia, Cotys opposed him and his ally, the Athenians. In 358 he was murdered.

See Cornelius Nepos, *Iphicrates, Timotheus;* Xenophon, *Agesilaus;* Demosthenes, *Contra Aristocratem.*

COUCY, LE CHÂTELAIN DE, French *trouvère* of the 12th century. He is probably the Guy de Couci who was castellan of the castle of that name from 1186 to 1203. Some 26 songs are attributed to him, and about 15 or 16 are undoubtedly authentic. They are modelled very closely on Provençal originals, but are saved from the category of mere imitations by a grace and simplicity peculiar to the author. The legend of the love of the Châtelain de Coucy and the Lady of Fayel, in which there figures a jealous husband who makes his wife eat the heart of her lover, has no historical basis, and dates from a late 13th century romance by Jakemon Sakesep. It is worth noting that the story, which seems to be Breton in origin, has been also told of a Provençal troubadour, Guilhem de Cabestaing, and of the minnesinger Reinmar von Brennenberg. Pierre de Belloy, who wrote some account of the family of Couci, made the story the subject of his tragedy *Gabrielle de Vergy.*

The songs of the Châtelain de Coucy were edited by Fritz Fath (Heidelberg, 1883). For the romance see Gaston Paris, in the *Hist. litt. de la France* (vol. 28, pp. 352–360).

COUCY-LE-CHÂTEAU-AUFFRIQUE, a village of northern France, in the department of Aisne, 18 m. W.S.W. of Laon on a branch of the Northern railway. Pop. (1936), 855. It had extensive remains of fortifications of the 13th century, the most remarkable feature of which was the Porte de Laon. It also had a church of the 15th century, preserving a façade in the Romanesque style. The importance of the place was due, however, to the ruins of a feudal fortress (*see* CASTLE), which was bombarded and destroyed in 1917 and 1918.

Coucy gave its name to the sires de Coucy, a famous feudal house. The founder of the family was Enguerrand de Boves, who, at the end of the 11th century, seized the castle of Coucy by force. Later his son, Thomas de Marle, succeeded him in 1115 and was subdued by King Louis VI. in 1117. Enguerrand III., the Great, fought at Bouvines under Philip Augustus (1214), but was accused of aiming at the crown of France, and took part in disturbances which arose during the regency of Blanche of Castile. These early lords of Coucy remained till the 14th century in possession of the land from which they took their name. Enguerrand IV., sire de Coucy, died in 1320 without issue and was succeeded by his nephew Enguerrand, son of Arnold, count of Guines, and Alix de Coucy, from whom is descended the second line of the house of Coucy. Enguerrand VI. had his lands ravaged by the English in 1339 and died at Crécy in 1346. Enguerrand VII. was sent as a hostage to England, where he married Isabel, the eldest daughter of King Edward III. Wishing to remain neutral in the struggle between England and France, he went to fight in Italy. He took part in the crusade of Hungary against the Sultan Bayezid, during which he was taken prisoner, and died shortly after the battle of Nicopolis (1397). His daughter Marie sold the fief of Coucy to Louis, duke of Orleans, in 1400. The Châtelain de Coucy did not belong to the house of the lords of Coucy, but was castellan of the castle of that name.

COUÉ, EMILE (1857–1926), French psychotherapeutist, was born at Troyes, France, on Feb. 26, 1857. From 1882 to 1910 he was a chemist at Troyes, and studied hypnotism and suggestion from 1901 onwards with Bernheim and Liébault. He then developed his own psychotherapeutical method of healing. In 1910 he established a free clinic at Nancy and there put his theories into practice. Coué's system of therapeutics deals principally with the power of imagination as opposed to that of the will, and he claimed that by means of auto-suggestion ideas which tend to cause illness and disease may be eliminated from the will. He further claimed to have effected organic changes. Coué invariably stated with emphasis that he was not primarily a healer, but one who taught others to heal themselves. His teaching and methods became widely known and he delivered lectures in England and the United States. His famous formula, "Every day, and in every way, I am becoming better and better," is now proverbial (*see* PSYCHOTHERAPY). He died at Nancy on July 2, 1926. *See* C. Baudouin, *Suggestion and Auto-suggestion* (1920).

COUES, ELLIOTT (1842–1899), American naturalist, was born in Portsmouth, N.H., Sept. 9, 1842. He was graduated in 1861 from Columbian (now George Washington) University, Washington, D.C., and from the Medical School of that institution in 1863. In 1864 he was appointed assistant surgeon in the U.S. Army. At the age of 30, he published his *Key to North American Birds,* which, with its revisions (1884 and 1901), and his revision of *New England Bird Life* (Stearns), has done much to promote the systematic study of ornithology in America. This was one of the first works to introduce the "key" method of botanical manuals into zoölogy and it is beyond criticism for its accuracy and completeness of citation and the convenience of its concise descriptions. In 1873–76 Coues was attached to the United States Northern Boundary commission, and in 1876–80 to the United States Geological and Geographical Survey of Territories, the publications of which he edited. His journeys enabled him to publish admirably annotated editions of the Lewis and Clark expedition (1804–06), and of Zebulon Pike's exploration of the upper Mississippi and Rocky Mountain regions (1805–07). He was a lecturer on anatomy in the Medical School of the Columbian University in 1877–82, and professor of anatomy there in 1882–87. He resigned from the Army in 1881 to devote himself entirely to scientific research. He was a founder of the American Ornithologists' Union and edited its organ, *The Auk,* and several other ornithological periodicals.

In addition to ornithology he did valuable work in mammalogy; his book, *Fur-Bearing Animals* (1877) being distinguished by the accuracy and completeness of its description of species. He attained eminence in several literary fields. He worked on the *Century Dictionary* for several years, was associate editor of the magazine of ornithology, *The Osprey,* and edited journals of exploration. It has been said that his beneficent influence on North American ornithology has never been excelled. He died in Baltimore, Md., Dec. 25, 1899.

A complete bibliography of his writings, which include more than 500 titles, dealing almost exclusively with the birds of North America, will be found in the *Biographical Memoirs of the National Academy of Science,* pp. 426–446.

See J. A. Allen, *Biographical Memoirs of the National Academy of Science,* vol. 6, pp. 397–425.

COULISSE, a term for a groove in which a gate of a sluice, or the side-scenes in a theatre, slide up and down, hence applied to the space on the stage between the wings, and generally to that part of the theatre "behind the scenes" and out of view of the public.

It is also a term of the Paris Bourse, derived from a *coulisse,* or passage in which transactions were carried on without the authorized *agents de change.* The name *coulissier* was thus given to unauthorized *agents de change,* or "outside brokers" who, after many attempts at suppression, were finally given a recognized status in 1901. They bring business to the *agents de change,* and act as intermediaries between them and other parties. (*See* STOCK EXCHANGE: *Paris.*)

COULOMB, CHARLES AUGUSTIN (1736–1806), French physicist, was born in Angoulême on June 14, 1736. He was a military engineer, and after spending nine years in the West Indies he returned to France with his health much impaired. In 1789, on the outbreak of the Revolution, he retired to a small estate at Blois and devoted himself to scientific research. In 1802 he was appointed an inspector of public instruction; he died in Paris on Aug. 23, 1806.

Coulomb designed the torsion balance independently of Michell in 1777. He published papers on friction as applied to machinery (1779); on windmills (1781), and on the torsional elasticity of metal and silk fibres (1784). His electrical papers were published in the *Mémoirs de l'Académie royale des sciences* between 1785 and 1789; these formed the basis of the mathematical theory of electricity of Poisson. The first three memoirs appeared in 1785, the following numbers in 1786, 1787, 1788 and 1789. In these memoirs Coulomb gave an account of his work with the torsion balance in verifying Priestley's law of electrical repulsions. He extended the case to include attractions and finally stated that the force is proportional to the product of the charges and inversely proportional to the square of the distance between them. He also verified the inverse square law for particles of magnetic fluid; he believed in the two-fluid theory, but assumed that the magnetic fluids could not be separated but that the electric fluids were separable. In the fourth memoir Coulomb showed that an electric charge is confined to the surface of a conductor and he compared the distribution of charge on the surface of conductors. He virtually established the result that the electric force near a conductor is proportional to the surface density of electrification (this was later proved by Poisson); he also stated that in the case of action at a distance the intervening medium played no part. Cavendish had anticipated Coulomb in the statement of the inverse square law, but this work was unpublished until many years after his death.

COULOMMIERS, a town of northern France, in the department of Seine-et-Marne, 45 mi. E. of Paris by rail. Pop. (1936), 6,687. It is situated in the fertile district of Brie, in a valley watered by the Grand-Morin. The disused church of St. Denis dates from the 13th and 16th centuries. The town suffered considerably during the campaigns of 1914. Printing is the chief industry and trade is in agricultural products, especially in cheeses named after the district.

COULTER, JOHN MERLE (1851–1928), American botanist, was born at Ningpo, China, on Nov. 20, 1851. He graduated at Hanover college, Hanover, Ind., in 1870 and pursued further study there and at Indiana university, receiving from the latter in 1882 the degree of doctor of philosophy. After serving as botanist with the U.S. geological survey in the Rocky Mountains in 1872–73, he was professor of natural sciences in Hanover college in 1874–79, professor of biology in Wabash college in 1879–91, president and professor of botany in Indiana university in 1891–93 and president of Lake Forest university in 1893–96. From 1896 to 1925 he was professor and head of the department of botany in the University of Chicago. In 1923 he was made a member of the national research council and in 1925 became adviser of the Boyce Thompson institute of plant research at Yonkers, New York. For more than a half-century he was an active botanical investigator and educator, producing early in his career valuable manuals for the study of Rocky Mountain and Texan plants and later building up an important graduate department in botany in which many leaders of plant research in America were trained. In 1875 he founded the *Botanical Gazette,* of which for more than 50 years he was editor. He died at Yonkers, N.Y., Dec. 23, 1928. His longer works include: *Manual of Rocky Mountain Botany* (1885); *Botany of Western Texas* (1891–94); *Plant Relations* (1899); *Plant Structures* (1899); *Morphology of Gymnosperms* (1901, ed. 3, 1910) and *Morphology of Angiosperms* (1903), both with C. J. Chamberlain; *New Manual of Botany of the Central Rocky Mountains,* with A. Nelson (1909); *Funda-*

mentals of Plant Breeding (1914); *Evolution of Sex in Plants* (1914); *Plant Genetics* (1918); and *When Evolution and Religion Meet,* with Merle C. Coulter (1924).

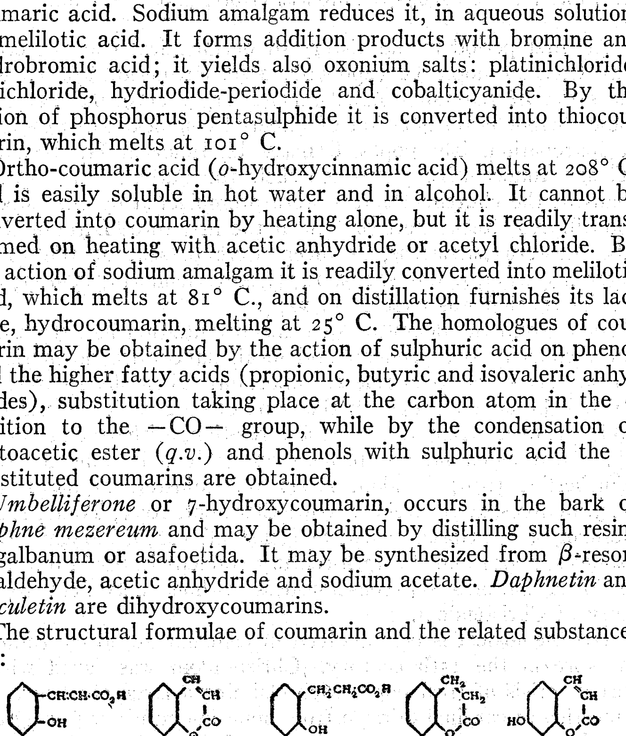
See *Bot. gaz.*, vol. lxxxvii (1929).

COUMARIN, an odorous substance which occurs in sweet woodruff (*Asperula odorata*), in the tonka bean and in yellow melilot (*Melilotus officinalis*); it can be obtained from the tonka bean by extraction with alcohol. Coumarin, $C_9H_6O_2$, is prepared artificially by the action of acetic anhydride and sodium acetate on salicyl aldehyde (W. H. Perkin, Sr. 1875). It can also be prepared by heating a mixture of phenol and malic acid with sulphuric acid. It forms rhombic crystals (from ether) melting at 67° C. and boiling at 290° C., which are readily soluble in alcohol, and moderately soluble in hot water. It is applied in perfumery for the preparation of the *Asperula* essence. On boiling with concentrated caustic potash coumarin yields the potassium salt of ortho-coumaric acid. Sodium amalgam reduces it, in aqueous solution, to melilotic acid. It forms addition products with bromine and hydrobromic acid; it yields also oxonium salts: platinichloride, aurichloride, hydriodide-periodide and cobalticyanide. By the action of phosphorus pentasulphide it is converted into thiocoumarin, which melts at 101° C.

Ortho-coumaric acid (*o*-hydroxycinnamic acid) melts at 208° C. and is easily soluble in hot water and in alcohol. It cannot be converted into coumarin by heating alone, but it is readily transformed on heating with acetic anhydride or acetyl chloride. By the action of sodium amalgam it is readily converted into melilotic acid, which melts at 81° C., and on distillation furnishes its lactone, hydrocoumarin, melting at 25° C. The homologues of coumarin may be obtained by the action of sulphuric acid on phenol and the higher fatty acids (propionic, butyric and isovaleric anhydrides), substitution taking place at the carbon atom in the α position to the $-CO-$ group, while by the condensation of acetoacetic ester (*q.v.*) and phenols with sulphuric acid the β substituted coumarins are obtained.

Umbelliferone or 7-hydroxycoumarin, occurs in the bark of *Daphne mezereum* and may be obtained by distilling such resins as galbanum or asafoetida. It may be synthesized from β-resorcylaldehyde, acetic anhydride and sodium acetate. *Daphnetin* and *aesculetin* are dihydroxycoumarins.

The structural formulae of coumarin and the related substances are:



Orthocoumaric acid. Coumarin. Melilotic acid. Hydrocoumarin. Umbelliferone

COUMARONE or BENZOFURAN, a colourless liquid which boils at 171°–172° C., and is readily volatile in steam, but is insoluble in water and in solutions of potassium hydroxide. It has the molecular formula C_8H_6O and the structure $C_6H_4\langle{}^{CH}_{O}\rangle CH.$ It occurs in the fraction of coal tar that boils at 160°–200° C., and it is converted by sulphuric acid into coumarone resin (*see* RESINS: *Synthetic Resins*). It may be obtained also by the distillation of coumarilic acid with lime, this acid being prepared from bromocoumarin by the action of alcoholic potassium hydroxide. (G. W. WD.)

COUNCIL (L. *concilium,* a meeting; from *cum,* together, and *calare,* to call), a convocation, assembly, meeting; specifically, like synod (Gk. σύνοδος), an assembly of ecclesiastics called together to discuss and decide on disputed questions of doctrine, discipline and (sometimes) relations with secular authority. The meaning of the word has varied by reason of the confusion between *concilium* and *consilium* (counsel). Thus a council of state (F. *conseil d'état*) is ordinarily advisory only, but the council of state appointed by the British parliament in 1649 was executive. The A.V. rendering of Matt. xii, 14, "held a council," (corrected in the R.V. to "took counsel") was a mistaken translation of συμβούλιον ἔλαβον, influenced by the Vulgate, *consilium faciebant.* (*See* the Oxford dictionary, *s.v.* Council, for such uses as Great Council, Privy Council, Town Council, etc.)

Ecclesiastical synods and councils have been distinguished as diocesan, endemic (σύνοδοι ενδημοῦσαι), provincial, patriarchal, primatial, national, mixed, plenary, general, oecumenical; but the meanings of some of these words have been far from uniform. A diocesan synod is today a purely advisory board. Formerly, provincial councils, presided over by metropolitan bishops exercised independent authority over the daughter churches in wide areas. From 1589, in Roman Catholic canon law, the decisions of such provincial councils as those of Baltimore (1829), Paris (1849), Lyons (1850), Westminster (1852), Vienna (1858) and Cologne (1860) have been valid only after correction and confirmation by a Roman commission.

The meaning of the word plenary has varied greatly. Today a plenary council (*e.g.*, the Plenary Councils of Baltimore of 1852, 1866, 1884) is a provincial council under the presidency of a papal legate. A general council is sometimes loosely distinguished from an oecumenical council by the fact that the decisions of the former fail to gain universal acceptance, while those of the latter are so accepted. Thus the council of Constantinople (381) was convoked as a general council of the east (without any representation of the west), but it was later reckoned as oecumenical in so far as its decisions were accepted by other oecumenical councils and by the pope. In current canon law an oecumenical council is one that is summoned by papal authority, presided over by the supreme pontiff in person or by his delegates, and whose decrees, after papal confirmation, bind the whole church. In the middle ages, mixed councils of bishops and barons were common. Thus the council of Clarendon (1164) issued a number of famous constitutions dealing with the relations of church and state. National councils often served an important historical function in fostering national unity.

A prototype of the later councils may be found in the assemblies mentioned in the Acts of the Apostles. Thus, "the twelve called the multitude of the disciples unto them" (Acts vi, 2), for the purpose of discussing and instituting the new ministry of deacons. The reunion described in Acts xv has even more the appearance of the later councils. J. D. Mansi, editor of the *Sacrorum conciliorum nova et amplissima collectio,* enumerates four such apostolic councils (vol. i, 21 *ff.*). Theologians find in Matt. xviii, 20 ("where two or three are gathered together in my name, there am I in the midst of them") the germinal idea of conciliar authority.

The continuous history of ecclesiastical councils begins in the second half of the 2nd century. Bishop Apollinaris of Hierapolis (*Mansi* i, 691) is recorded as convoking a synod to deal with the doctrinal difficulties arising from the Montanist heresy. Certain of the early synods of the east were convoked at the suggestion of Pope Victor (189 A.D.–198 A.D.) to deal with the disciplinary question of the dating of Easter. In the 3rd century the calling of councils became frequent and widespread. The historian Eusebius (*Ecclesiastical History*, v, 16, 23) speaks as though annual and even semiannual synods were of regular occurrence. The letters of St. Cyprian of Carthage (*e.g.*, i, xvi, xvii, xix, lxx, lxxi, lxxii, lxxiii) are full of references to the councils of North Africa. Thus the council of Carthage of 256 A.D. brought together no less than 87 bishops, together with a number of presbyters and deacons and certain of the laity. As the system of synodal legislation became more organized, only bishops (or the delegates of bishops) were considered constituent members with decisive votes. Thus at the council of Elvira in 305, priests were present but only the bishops signed the decrees.

The rise of the Donatist schism in North Africa was the occasion for introducing the secular element of imperial authority into the conciliar system. The Emperor Constantine, not yet baptized, and, therefore, without any rights in the Christian society of the church, convoked a council in Rome in 313, to settle the rival claims of Caecilian and Majorinus, the Donatist, to the see of Carthage. Though the decision of the council was made under the presidency of Pope Melchiades, the right of the emperor to convoke the synod passed unchallenged. It was Constantine who convoked the larger council of Arles in 314, to which bishops from distant Britain were summoned. Most important of all it was an emperor who convoked each of the first eight oecumenical councils: Nicaea I (325), Constantinople I (381), Ephesus (431), Chalcedon (451), Constantinople II (553), Constantinople III (680), Nicaea II (787), Constantinople IV (869).

The first of the oecumenical councils, that of Nicaea in 325, became a model for many that followed. It was oecumenical in the sense that bishops were summoned from the whole inhabited world (ἡ οἰκουμένη). It was oecumenical in the more technical sense that its decisions were meant to be binding on all Christians, and not merely on those of this or that diocese or patriarchate. It was called in the face of the special crisis arising from the spread of the Arian heresy. It was conducted by means of free debate; but when the decisions were reached (*e.g.,* to define Jesus Christ as "true God of true God, begotten not made, of one substance with the Father"), the bishops who were recalcitrant were subject to ecclesiastical excommunication and political exile. Although the emperor convoked the council, paid the expenses, was present at some of the sessions and punished the recalcitrants, it seems to have been understood that he had acted with the consent of the bishops (Rufinus, *Ecclesiastical History,* i, 1) and, particularly, of Pope Sylvester (*Liber Pontificalis* xxxiv).

The precise relations of pope and emperor to the first eight oecumenical councils have been a matter of debate among the historians and canonists. It is generally agreed, after the careful demonstration by Franz-Xavier Funk ("Die Berufung der ökumenischen Synoden des Altertums" in *Kirchengeschichtliche Abhandlungen und Untersuchungen* pp. 30–86, Paderborn, 1897) that, historically speaking, the writs of convocation to all these councils went out in the name of the emperor, and not in the name of the pope. On the other hand, it is no less clear that the canonical necessity of papal co-operation was never lost sight of. Thus at Ephesus (431) the president of the council, St. Cyril of Alexandria, is described by the acts of the council as taking "the place of Celestine, the most holy and most sacred archbishop of the Romans." At Chalcedon (451) the legates of Pope Leo, Paschasinus, Lucentius and Boniface, were the acknowledged leaders among the constituent members of the council, even though Emperor Marcian or his commissioners ranked as honorary presidents. So, too, at Constantinople III (680), the legates of Pope Agatho, Theodore, George and John, were the acknowledged leaders. At Nicaea II (787), the legates of Adrian I presided. What is more important, from the point of view of canonical oecumenicity, all the dogmatic decisions of the early councils were either antecedently formulated or subsequently accepted by papal authority (Funk, "Die päpstliche Bestätigung der acht ersten allgemeinen Synoden," in *op. cit.,* pp. 87–121). Even in the case of the fifth oecumenical council (Constantinople II, 553), which was convoked by Emperor Justinian against the will of Pope Vigilius, the decrees were subsequently accepted by the papal *Constitutum* of 554.

A special interest attaches to the first four oecumenical councils, Nicaea (325), Constantinople (381), Ephesus (431) and Chalcedon (451), by reason of the fact that the dogmatic definitions regarding the persons of the Trinity are shared by Roman Catholic, Greek Orthodox and Protestant Christians. Latins, Greeks and many Anglicans accept the decrees of the first seven oecumenical councils. The Greeks, after the Photian schism, repudiated the eighth council (Constantinople IV, 869–70), except during brief periods of reunion with Rome. Modern Roman Catholic canonists and theologians recognize 20 councils as oecumenical. They are listed for reference. (For details *see* separate articles, NICAEA, etc.)

Place	Date (A.D.)	Principal matters discussed
1. Nicaea I	325	Arian heresy; dating of Easter
2. Constantinople I	381	Divinity of Holy Spirit
3. Ephesus	431	Nestorianism; Mary as Mother of God
4. Chalcedon	451	Two natures in Christ
5. Constantinople II	553	"Three Chapters"; errors of Origen
6. Constantinople III	680	Divine and human wills in Christ
7. Nicaea II	787	Veneration of holy images
8. Constantinople IV	869	Schism of Photius
9. Lateran (Rome) I	1123	Lay investiture; crusade
10. Lateran II	1139	Errors of Arnold of Brescia
11. Lateran III	1179	Albigensians; Waldensians
12. Lateran IV	1215	Confession of faith; reform
13. Lyons I	1245	Deposition of Frederick II; crusade
14. Lyons II	1274	Reunion of east; papal elections
15. Vienne	1311–12	Knights Templars; Fraticelli
16. Constance (in part)	1414–18	Schism; Hus and Wyclif
17. Basel (in part)-Ferrara-Florence	1431–45	Reunion; peace; reform
18. Lateran V	1512–17	Pragmatic Sanction of 1438; crusade
19. Trent	1545–63	Doctrinal definitions; reform
20. Vatican	1869–70	Modern errors; papal infallibility

The first period in the history of oecumenical councils ended with Constantinople IV (869–70); a second period opened with the series of Lateran Councils, 1123, 1139, 1179 and 1215. In these there was no question of imperial convocation, presidency or approbation. The popes, Calixtus II, Innocent II, Alexander III and Innocent III, exercised their full authority as supreme heads of the church. Decrees were promulgated by the pope in council. No Greeks were present at the first three Lateran councils. Eastern patriarchs, however, were present at the fourth Lateran (1215), Lyons (1245, 1274) and Vienne (1311–12); and a brief reunion was effected in 1274.

Apart from the definition of transubstantiation in 1215, mediaeval councils, both general and local, have little dogmatic interest. Their historical rolè is important. Their decisions throw much light on mediaeval methods of dealing with ecclesiastical problems of doctrine, discipline and relations with secular authority. Great assemblies of bishops and abbots in England (*e.g.,* Winchester, 1076; London, 1102; Westminster, 1138), France (*e.g.,* Bourges, 1031; Reims, 1049; Clermont, 1095; Tours, 1229), Germany (*e.g.,* Goslar, 1019; Seligenstadt, 1027), Hungary (*e.g.,* Szoboles, 1092) and the 13th-century councils in Spain did much to foster national self-consciousness without detriment to the unity of Christendom.

The theological issues involved in conciliar authority came to the fore in the 15th century. Christendom was faced with a chronic crisis of rival popes each claiming a large obedience. At a meeting of cardinals, drawn from opposing curias, it was agreed, in July 1408, to call an assembly to heal the schism. The council which met at Pisa in 1409 declared itself (May 18) to be canonically convoked and oecumenical in authority, deposed the rival popes, Benedict XIII and Gregory XII, and empowered the cardinals at Pisa to proceed to the election of a new pope. The outcome was that Christendom had three popes instead of two. The efforts of Emperor Sigismund led to the convocation of another council at Constance in 1414. This assembly declared itself to have authority directly from God over all Christians including the pope. The schism was happily ended by the election of Pope Martin V; and the new pope, by accepting a number of decisions, gave the character of oecumenicity to certain decrees of the earlier sessions, and to all the decrees of the 42nd to 45th sessions. Although the council assembled at Basel in 1431 declared itself superior to the pope, Eugenius IV did not dissolve it until a quarrel arose as to the place for effecting a reunion with the Greeks. While a rump council remained in session at Basel, the legitimate council at Ferrara and Florence worked out agreements with Armenians, Jacobites, Maronites and others. Canonical opinion today admits as oecumenical only those decrees of the first 25 sessions of Basel which concern heresy, reform and the peace of Christendom.

The fifth Lateran council (1512–17) proved of little significance in its main purpose of reform; but it approved the declaration that the pope has full authority to convoke, transfer and dissolve general councils. The other 16th-century oecumenical council, that of Trent (1545–63), attempted to deal with the issues in doctrine and discipline raised by the Protestant revolt. The precision of its canons and decrees exerted a marked influence on Roman Catholic thought and action during the last four centuries. Nevertheless, the "conciliar theory" found expression in the Gallican Assembly of 1682 and in the synod of Pistoia of 1786.

The last of the oecumenical councils, that of the Vatican, was assembled on December 8, 1869 and was prorogued in July 1870. It has never been formally dissolved. (For details *see* VATICAN COUNCIL, THE.) It brought into clear light all the implications of the papal headship of the church and, in particular, the relations of the pope to the council. The council was convoked by the pope, was presided over by the pope, and its decisions were promulgated in the name of the pope, "the bishops of the whole world being assembled and judging with us." In the light of the Vatican decrees a more precise theological connotation attaches to the term oecumenical council. It is considered to be one that acts not merely in the name, but with the whole authority, of the teaching body (*magisterium*) instituted by Jesus Christ. Since the pope is the head of that body, the members, without his co-operation, cannot have oecumenical authority. Nor can there be a juridical convocation, obliging all bishops to attend and constituting those who come into a council competent to deal with affairs beyond the jurisdiction of any of the individual members, unless it issue from the successor of Peter in the primacy. Still less can there be any legitimate presidency of an oecumenical council save that of the pope or his legates. Least of all, can the decisions have oecumenical validity unless accepted by the pope. On the other hand, papal infallibility does not diminish the infallibility of an oecumenical council in which a great majority of the episcopate should bear unequivocal witness to the faith of the church. Such a clear witness would not, in fact, need confirmation; and could not, by the very nature of the pope's office, be opposed by him.

The mode of conducting conciliar business and debate has varied throughout the centuries. A number of novel techniques were introduced in the 15th century; and some of these were further developed at Trent. In the case of the Vatican Council rules of procedure were carefully prepared in advance, and not left to the determination of the council itself. Before the council met, seven commissions (*congregationes*) of theologians had prepared the drafts of decrees to be discussed. When the council assembled, these prepared drafts (*schemata*) were amended in the light of objections by a number of elected committees (*deputationes*). Final drafts were voted on in general congregations. Not until the final public sessions, were definitive votes taken. The right to vote in these sessions was limited to cardinals, bishops and generals of religious orders.

Protestant Councils.—The churches of the Reformation have all had a certain measure of synodal life. The Church of England has maintained its ancient provincial synods or convocations, though for the greater part of the 18th and the first part of the 19th centuries they transacted no business. In the Lutheran Churches of Germany there was no strong agitation in favour of introducing synods until the 19th century, when a movement, designed to render the churches less dependent on the governmental consistories, won its way, until at length Prussia itself fell into line (1873 and 1876). As the powers granted to the German synods were very limited, many of their advocates were disillusioned; but the Lutheran Churches of America, being independent of the state, have developed synods both numerous and potent. In the Reformed Churches outside Germany, synodal life is vigorous; its forms were developed by the Huguenots in days of persecution, and passed from there to Scotland and other Presbyterian countries. Even many of the churches of congregational polity have organized national councils (*see* CONGREGATIONALISM); but here the principle of the independence of the local church prevents the decisions from binding those congregations which do not approve of the decrees. Moreover, in the last decade of the 19th century a growing desire for a rapproachement between the Free Churches in Great Britain as a whole led to the annual assembly of the Free Church council for the consideration of all matters affecting them. This body has no executive or doctrinal authority and is rather a conference than a council. In general it may be said that synods are becoming more and more powerful in Protestant lands, and that they are destined to still greater prominence because of the growing sentiment for Christian unity (*see* REUNION, CHURCH).

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COUNCIL BLUFFS, a city of southwestern Iowa, U.S.A., on the east bank of the Missouri river, opposite Omaha; county seat of Pottawattamie county. Fifth largest railroad centre in the United States and located at the conflux of the major highways of the midwest. Eight main trunk lines serve the city with 64 passenger and 72 freight trains daily. Railroads comprise the Burlington, Chicago-Milwaukee, Chicago and North Western, Chicago Great Western, Illinois Central, Union Pacific, Rock Island and Wabash. Highways include federal 75, 39, 6 and 275. Population (1940 census) was 41,439, with 83% native white, 14% foreign-born white and 3% Negroes. The city has a land area of 15.3 sq.mi. and lies 980 ft. above sea level, on the broad flood plain of the Missouri river, at the foot of high loess bluffs.

The site upon which Council Bluffs has grown was first recorded in the report of the Lewis and Clark expedition, when in 1804 they stopped at a hill-surrounded spot overlooking the Missouri river to hold council with the Indians. This spot became known as council-hill or council-bluff. In 1846 the Mormons settled on the site and built a town they called Kanesville, but after the majority of the Mormons had left, in 1853, the name was changed to Council Bluffs. During the California gold rush of 1849–50 it became one of the chief outfitting points for gold-seekers. Abraham Lincoln visited Council Bluffs in 1859 and was so impressed by the possibilities for transportation that he later designated the city as eastern terminus of the Union Pacific railroad. A wholesale and retail centre with industrial plants manufacturing a host of items, including oils, truck bodies, car wheels, baskets, playground and floodlighting equipment, cereals and batteries. Elevators with 10,000,000-bu. storage capacity make Council Bluffs a leading grain centre, while greenhouses with 1,500,000 sq.ft. under glass produce some of the world's finest flowers. It was incorporated as a city in 1853.

COUNCIL OF NATIONAL DEFENCE, U.S., a peacetime advisory body, "established for the co-ordination of industries and resources, for the national security and welfare, and the creation of relations which will render possible in time of need the immediate concentration and utilization of the resources of the nation." Although a Council of National Defence was recommended to the House by the General Staff of the Army as early as 1910, no definite action resulted until six years later, when the Council was created under the Army Appropriation Act of Aug. 29, 1916 (39 Stat. 619). This Act provided for a Council with a membership of seven, composed of the secretaries of War, Navy, Interior, Agriculture, Commerce and Labour, and the appointment of an advisory committee of seven to the council, each of whom should be a specialist in "some industry, public utility, or development of some natural resource or otherwise specifically qualified for the duties." That the council was intended as a peace-time advisory body is evidenced by the provision that not more than half of the general staff should be in Washington at one time and that the appropriation for its activities was limited to $200,000. The Council met for the first time on Dec. 7, 1916, and soon thereafter appointed an advisory committee on transportation and communication; raw materials, minerals and metals; munitions, manufacturing and industrial relations; supplies; engineering and education; labour; medicine and surgery.

Although hampered by lack of funds and executive powers, and presumably undertaking a peace-time explorative and experimental task, it had achieved a quite definite and comprehensive programme for the nation's defence by April 6, 1917, the date of the official declaration of war with Germany. It then became, in effect, a war emergency cabinet directing the intensive and extensive organization and mobilization of the nation's resources. From its committees and subordinate bodies emerged the War Industries Board, the War Labor, Food and Fuel Administrations, the Aircraft Production Board, and other war-time bureaux, to which Congress granted executive powers explicitly denied to the Council of National Defence. Building up a field machinery of State, county, community and municipal councils of defence throughout the United States, the council became the medium through which the war needs and measures of the National Government were made known to the people, and the varying moods and reactions of the different sections of the country were registered in Washington. The appointment of a Woman's Committee of the Council of National Defence on April 21, 1917, "to co-ordinate the woman's preparedness movement" resulted in a nation-wide organization of State and local units of women for war work. After the signing of the Armistice, the council, through its field machinery, took up the problems of readjustment, and after 1920 was engaged in the development of a permanent peace-time procedure and in research on national problems.

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COUNCILS OF ORANGE. The most important of these is the council of 529, when fifteen bishops, under the presidency of Caesarius of Arles, assembled primarily to dedicate a church, the gift of Liberius, the lieutenant of Theodoric, in Gaul, at what proved to be one of the most important councils of the 6th century. Caesarius had sought the aid of Rome against semi-Pelagianism, and in response Pope Felix IV. had sent certain *capitula* concerning grace and free-will, drawn chiefly from the writings of Augustine and Prosper. These to the number of twenty-five the synod subscribed, and adopted a supplementary statement, reaffirming the Augustinian doctrines of corruption, human inability, prevenient grace and baptismal regeneration. Its acts were confirmed by Boniface II. on the "25th of January 530," a date which is open to question.

See F. H. Woods, *Canons of the Second Council of Orange* (Oxford, 1882).

COUNSEL AND COUNSELLOR. The term "counsel" is employed in England as a synonym for a barrister (*q.v.*). Counsellor or, more fully, counsellor-at-law, is an obsolete term in England, but is still in use in Ireland as an equivalent to barrister. In the United States, a counsellor-at-law is, specifically, an attorney admitted to practice in all the courts; but as there is no formal distinction of the legal profession into two classes, as in England, the term is more often used loosely in the same sense as "lawyer," *i.e.,* one who is versed in, or practises law.

COUNT, the English translation of foreign titles equivalent generally to the English "earl." In Anglo-French documents the word *counte* was at all times used as the equivalent of earl, but, unlike the feminine form "countess," it did not find its way into the English language until the 16th century, and then only in the sense defined above. The title of earl, applied by the English to the foreign counts established in England by William the Conqueror, is dealt with elsewhere (*see* EARL). The present article deals with (1) the office of count in the Roman empire and the Frankish kingdom, (2) the development of the feudal count in France and under the Holy Roman empire, (3) modern counts.

1. The Latin *comes* meant literally a companion or follower. In the early Roman empire the word was used to designate the companions of the emperor (*comites principis*) and so became a title of honour. The emperor Hadrian chose senators as companions on his travels and to help him in public business. They formed a permanent council, and Hadrian's successors entrusted these *comites* with the administration of justice and finance, or placed them in military commands. The designation *comes* thus developed into a formal official title of high officers of State, some qualification being added to indicate the special duties attached to the office in each case. Thus in the 5th century, among the *comites* attached to the emperor's establishment, we find, *e.g.,* the *comes sacrarum largitionum* and the *comes rei privatae;* while others, forming the council, were styled *comites consistorii.* Others were sent into the provinces as governors, *comites per provincias constituti;* thus in the *Notitia dignitatum* we find a *comes Aegypti,* a *comes Africae,* a *comes Belgicae,* a *comes Lugdunensis* and others. Two of the generals of the Roman province of Britain were styled the *comes Britanniae* and the *comes littoris Saxonici* (count of the Saxon shore).

At Constantinople in the later Roman empire the Latin word *comes* assumed a Greek garb as κόμης and was declined as a Greek noun (gen. κόμητος); the *comes sacrarum largitionum* (count of the sacred bounties) was called at Constantinople ὁ κόμης τῶν σακρῶν λαριγιτιώνων and the *comes rerum privatarum* (count of the private estates) was called κόμης τῶν πριβάτων. The count of the sacred bounties was the lord treasurer or chancellor of the exchequer, for the public treasury and the imperial fisc had come to be identical; while the count of the private estates managed the imperial demesnes and the privy purse. In the 5th century the "sacred bounties" corresponded to the *aerarium* of the early empire, while the *res privata* represented the fisc. The officers connected with the palace and the emperor's person included the count of the wardrobe (*comes sacrae vestis*), the count of the residence (*comes domorum*), and, most important of all, the *comes domesticorum et sacri stabuli* (graecized as κόμης τοῦ στάβλου). The count of the stable, originally the imperial master of the horse, developed into the "illustrious" commander-in-chief of the imperial army (Stilicho, *e.g.,* bore the full title as given above), and became the prototype of the mediaeval constable (*q.v.*).

An important official of the second rank (*spectabilis,* "respectable" as contrasted with those of highest rank who were "illustrious") was the count of the East, who appears to have had the control of a department in which 600 officials were engaged. His power was reduced in the 6th century, when he was deprived of his authority over the Orient diocese, and became civil governor of Syria Prima, retaining his "respectable" rank. Another important officer of the later Roman court was the *comes sacri patrimonii,* who was instituted by the emperor Anastasius. In this connection it should be observed that the word *patrimonium* gradually changed in meaning. In the beginning of the 3rd century *patrimonium* meant crown property, and *res privata* meant personal property: at the beginning of the 6th century *patrimonium* meant personal property, and *res privata* meant crown property. It is difficult to give briefly a clear idea of the functions of the three important officials *comes sacrarum largitionum, comes rei privatae* and *comes sacri patrimonii;* but the terms have been well translated by a German author as *Finanzminister des Reichsschatzes* (finance minister of the treasury of the empire), *F. des Kronschatzes* (of the Crown treasury), and *F. des kaiserlichen Privatvermögens* (of the emperor's private property).

The Frankish kings of the Merovingian dynasty retained the Roman system of administration, and under them the word *comes* preserved its original meaning; the *comes* was a companion of the king, a royal servant of high rank. Under the early Frankish kings some *comites* did not exercise any definite functions; they were merely attached to the king's person and executed his orders. Others filled the highest offices, *e.g.,* the *comes palatii* and *comes stabuli* (*see* CONSTABLE). The kingdom was divided for administrative purposes into small areas called *pagi* (*pays,* Ger. *Gau*), corresponding generally to the Roman *civitates* (*see* CITY). At the head of the *pagus* was the *comes,* corresponding to the German *Graf.* The *comes* was appointed by the king and removable at his pleasure, and was chosen originally from all classes, sometimes from enfranchised slaves. His essential functions were judicial and executive, and in documents he is often described as the king's agent (*agens publicus*) or royal judge (*judex publicus* or *fiscalis*). As the delegate of the executive power he had the right to military command in the king's name and to take all the measures necessary for the preservation of the peace, *i.e.,* to exercise the royal "ban" (*bannus regis*). He was at once public prosecutor and judge, was responsible for the execution of the sentences of the courts, and as the king's representative exercised the royal right of protection (*mundium regis*) over churches, widows, orphans and the like. He enjoyed a triple wergeld, but had no definite salary, being remunerated by the receipt of certain revenues, a system which contained the germs of discord, on account of the confusion of his public and private estates. He also retained a third of the fines which he imposed in his judicial capacity.

Under the early Carolings the title count did not indicate noble birth. A *comes* was generally raised from childhood in the king's palace, and rose to be a count through successive stages. The count's office was not yet a dignity, nor hereditary; he was not independent nor appointed for life, but exercised the royal power by delegation, as under the Merovingians. While, however, he was theoretically paid by the king, he seems to have been himself one of the sources of the royal revenue. The counties were, it appears, farmed out; but in the 7th century the royal choice became restricted to the larger landed proprietors, who gradually emancipated themselves from royal control, and in the 8th century the term *comitatus* begins to denote a geographical area, though there was little difference in its extent under the Merovingian kings and the early Carolings. The count was about to pass into the feudatory stage. Throughout the middle ages, however, the original official and personal connotation of the title was never wholly lost; or perhaps it would be truer to say, with Selden, that it was early revived with the study of the Roman civil law in the 12th century. The unique dignity of count of the Lateran palace, bestowed in 1328 by the emperor Louis IV. the Bavarian on Castruccio de' Antelminelli, duke of Lucca, and his heirs male, was official as well as honorary, being charged with the attendance and service to be performed at the palace at the emperor's coronation at Rome (Du Cange, *s.v. Comites Palatii Lateranensis;* Selden, *op. cit.* p. 321). This instance, indeed, remained isolated; but the personal title of "count palatine," though honorary rather than official, was conferred on officials—especially by the popes on those of the Curia—had no territorial significance, and was to the last reminiscent of those early *comites palatii* whose relations to the sovereign had been purely personal and official (*see* PALATINE). A relic of the old official meaning of "count" still survives in Transylvania, where the head of the political administration of the Saxon districts is styled count (*comes, Graf*) of the Saxon Nation.

2. The process by which the official counts were transformed into feudal vassals almost independent is described in the article FEUDALISM. In the confusion of the period of transition, when the title to possession was usually the power to hold, designations which had once possessed a definite meaning were preserved with no defined association. In France, by the 10th century, the process of decomposition of the old organization had gone far, and in the 11th century titles of nobility were still very loosely applied. That of "count" was, as Luchaire points out, "equivocal" even as late as the 12th century; any castellan of moderate rank could style himself *comte* who in the next century would have been called *seigneur* (*dominus*). Even when, in the 13th century, the ranks of the feudal hierarchy in France came to be more definitely fixed, the style of "count" might imply much, or comparatively little. In the oldest register of Philip Augustus counts are reckoned with dukes in the first of the five orders into which the nobles are divided, but the list includes, besides such almost sovereign rulers as the counts of Flanders and Champagne, immediate vassals of much less importance—such as the counts of Soissons and Dammartin—and even one mediate vassal, the count of Bar-sur-Seine. The title was still in fact "equivocal," and so it remained throughout French history. In the official lists it was early placed second to that of duke (Luchaire, *Manuel,* p. 181, note 1), but in practice at least the great *comtes-pairs* (*e.g.,* of Champagne) were the equals of any duke and the superiors of many. Thus, too, in modern times royal princes have been given the title of count (Paris, Flanders, Caserta), the heir of Charles X. actually changing his style, without sense of loss, from that of duc de Bordeaux to that of comte de Chambord. From the 16th century onwards the equivocal nature of the title in France was increased by the royal practice of selling it, either to viscounts or barons in respect of their fiefs, or to rich *roturiers.*

In Germany the change from the official to the territorial and hereditary counts followed at the outset much the same course as in France, though the later development of the title and its meaning was different. In the 10th century the counts were permitted by the kings to divide their benefices and rights among their sons, the rule being established that countships (*Grafschaften*) were hereditary, that they might be held by boys, that they were heritable by females and might even be administered by females. The *Grafschaft* became thus merely a bundle of rights inherent in the soil; and, the count's office having become his property, the old counties or *Gauen* rapidly disappeared as administrative units, being either amalgamated or subdivided. By the second half of the 12th century the official character of the count had quite disappeared; he had become a territorial noble, and the foundation had been laid of territorial sovereignty (*Landeshoheit*). The first step towards this was the concession to the counts of the military prerogatives of dukes, a right enjoyed from the first by the counts of the marches (*see* MARGRAVE), then given to counts palatine (*see* PALATINE) and, finally, to other counts, who assumed by reason of it the style of landgrave (*Landgraf, i.e.,* count of a province). At first all counts were reckoned as princes of the empire (*Reichsfürsten*); but since the end of the 12th century this rank was restricted to those who were immediate tenants of the Crown, the other counts of the empire (*Reichsgrafen*) being placed among the free lords (*barones, liberi domini*). Counts of princely rank (*gefürstete Grafen*) voted among the princes in the imperial diet; the others (*Reichsgrafen*) were grouped in the *Grafenbänke*—originally two, to which two more were added in the 17th century—each of which had one vote. In 1806, on the formation of the Confederation of the Rhine, the sovereign counts were all mediatized (*see* MEDIATIZATION). Even before the end of the empire (1806) the right of bestowing the title of count was freely exercised by the various German territorial sovereigns.

3. Any political significance which the feudal title of count retained in the 18th century vanished with the changes produced by the Revolution. It is now simply a title of honour and one, moreover, the social value of which differs enormously, not only in the different European countries, but within the limits of the same country. In Germany, for instance, there are several categories of counts: (1) the mediatized princely counts (*gefürstete Grafen*), who are reckoned the equals in blood of the European sovereign houses, an equality symbolized by the "closed crown" surmounting their armorial bearings. The heads of these countly families of the "high nobility" are entitled (by a decree of the federal diet, 1829) to the style of *Erlaucht* (illustrious, most honourable); (2) Counts of the empire (*Reichsgrafen*), descendants of those counts who, before the end of the Holy Roman empire (1806), were *Reichsständisch; i.e.,* sat in one of the *Grafenbänke* in the imperial diet, and entitled to a ducal coronet; (3) Counts (*a*) descended from the lower nobility of the old empire, titular since the 15th century, (*b*) created since; their coronet is nine-pointed (*cf.* the nine points and strawberry leaves of the English earl). The difficulty of determining in any case the exact significance of the title of a German count, illustrated by the above, is increased by the fact that the title is generally heritable by all male descendants, the only exception being in Prussia, where, after 1840, the rule of primogeniture prevailed and the bestowal of the title was dependent on a rent-roll of £3,000 a year. The result is that the title is very widespread and in itself little significant. The style *Altgraf* (old count), occasionally found, is of some antiquity, and means that the title of count has been borne by the family from time immemorial.

In mediaeval France the significance of the title of count varied with the power of those who bore it; in modern France it varies with its historical associations. It is not so common as in Germany or Italy; because it does not by custom pass to all male descendants. The title was, however, cheapened by its revival under Napoleon. By the decree of March 1, 1808, reviving titles of nobility, that of count was assigned *ex officio* to ministers, senators and life councillors of state, to the president of the Corps Législatif and to archbishops. The title was made heritable in order of primogeniture, and in the case of archbishops through their nephews. These Napoleonic countships, increased under subsequent reigns, have produced a plentiful crop of titles of little social significance, and have tended to lower the status of the counts deriving from the *ancien régime*. The title of marquis, which Napoleon did not revive, has risen proportionately in the estimation of the Faubourg St. Germain. As for that of count, it is safe to say that in France its social value is solely dependent on its historical associations.

Of all European countries Italy has been most prolific of counts. Every Italian prince, from the pope downwards, created them for love or money; and, in the absence of any regulating authority, the title was also widely and loosely assumed, while often the feudal title passed with the sale of the estate to which it was attached. Casanova remarked that in some Italian cities all the nobles were *baroni*, in others all were *conti*. An Italian *conte* may or may not be a gentleman; he has long ceased, *qua* count, to have any social prestige, and his rank is not recognized by the Italian government. As in France, however, there are some Italian *conti* whose titles are respectable, and even illustrious, from their historic associations. The prestige belongs, however, not to the title but to the name. As for the papal countships, which are still freely bestowed on those of all nations whom the holy see wishes to reward, their prestige naturally varies with the religious complexion of the country in which the titles are borne. They are esteemed by the faithful, but have small significance for those outside. In Spain, on the other hand, the title of *conde,* the earlier history of which follows much the same development as in France, is still of much social value, mainly owing to the fact that the rule of primogeniture exists, and that, a large fee being payable to the state on succession to a title, it is necessarily associated with some degree of wealth. The Spanish counts of old creation, some of whom are grandees and members of the upper house, naturally take the highest rank; but the title, still bestowed for eminent public services or other reasons, is of value. The title, like others in Spain, can pass through an heiress to her husband. In Russia the title of count (*graf,* fem. *grafinya*), a foreign importation, had little social prestige attached to it, being given to officials of a certain rank. In the British empire the only recognized counts are those of Malta, who are given precedence with baronets of the United Kingdom.

See Selden, *Titles of Honor* (1672); Du Cange, *Glossarium Med. Lat.* (ed. Niort, 1883) *s.v.* "Comes"; *La Grande Encyclopédie, s.v.* "Comte"; A. Luchaire, *Manuel des institutions françaises* (1892); Brunner, *Deutsche Rechtsgeschichte,* Band ii. (Leipzig, 1892); P. Guilhiermoz, *Essai sur l'origine de la noblesse en France au moyen âge* (1902).

COUNTERFEIT MONEY. The imitation of money for gain has been practised by unscrupulous persons ever since representatives of value supplanted material of value such as food, clothing and other articles used in simple barter.

The constitution of the United States expressly provides in Section 8, paragraph 6, that "The Congress shall have power to provide for the punishment of counterfeiting the securities and current coin of the United States." The federal agency charged with the suppression of counterfeiting in the United States is the United States secret service, a division of the treasury department, which was established July 5, 1865. (*See* SECRET SERVICE, U.S.)

Records of amounts of counterfeit money seized during those early years are not available, but for the year ended June 30, 1876, the representative value of counterfeit coins and bills captured by the secret service approximated $232,000. At that time the government and the people themselves were handicapped in the suppression of counterfeiting because of the great number of national banks on which notes were issued, and the variations in the engraved designs. New notes placed in circulation were quickly counterfeited before the public became acquainted with the appearance of the genuine, and when counterfeits drawn on one national bank began to be widely detected, the counterfeiters would circulate new issues under the name of some other bank.

Crime Prevention Through Education.—During the four peak fiscal years 1933 to 1936, inclusive, victims of passers of counterfeit notes in the United States lost an average of $771,000 yearly. Although banks were all warned to be on the alert for certain dangerous counterfeit bills, there was no concerted effort to warn retail merchants or others about such counterfeits, and the general policy of the secret service with regard to counterfeiting was one of secrecy, since it was feared that alarms about extensive circulation of counterfeits would tend to shake the faith of some of the people in the currency of their country.

In 1937, when Henry Morgenthau, Jr., appointed Frank J. Wilson as chief of the secret service, the secretary requested that strenuous efforts be made to reduce to a minimum the losses suffered by victims of counterfeiters. As a departure from the age-old methods of investigation, prosecution and imprisonment, Chief Wilson decided to fight the crime of counterfeiting by teaching the public how to detect bogus money. In a trial of this idea, the secret service printed and distributed to banks and retail stores hundreds of thousands of warning circulars bearing descriptions of counterfeit bills currently in circulation. These warning notices bore diagrams showing the denomination and type of the counterfeit described, the particular defects to aid in checking a suspected bill and directed attention to the "check letter" and "face plate number" appearing in the lower right corner of the face of the bill.

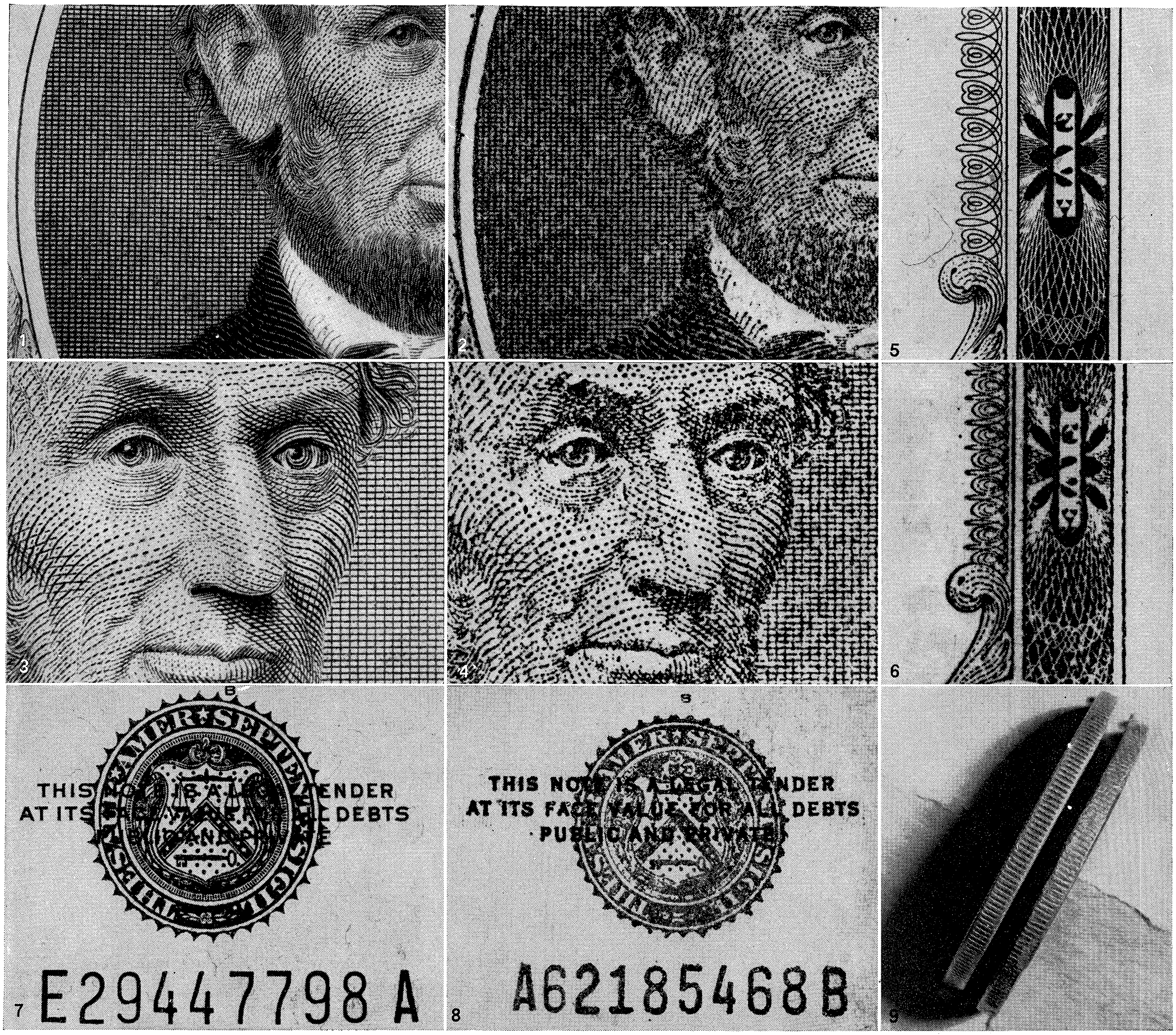
As has already been stated, the average yearly losses suffered by victims of counterfeiters from 1933 to 1936 were $771,000. For the fiscal year 1937 these losses were reduced to $519,366, and it was evident that the dissemination of the secret service descriptive warnings had had some good effect. Chief Wilson decided to pursue his idea further and early in 1938 sent a picked group of secret service agents to New York city, where they made a door-to-door canvass of some 100,000 retail stores and taught merchants and employees how to tell the difference between good and bad money. For the fiscal year 1938, losses to victims of counterfeiters fell to $407,320.

In 1938–39, secret service agents began a series of instructive lectures to retailers, bankers and others in all parts of the country. For the fiscal year ended June 30, 1939, counterfeiting losses had dropped to $294,057, and the secret service decided to intensify its efforts. Late in 1939 the secret service began a campaign against the counterfeiter, under the slogan "Know Your Money." Secret service agents produced a sound motion picture entitled *Know Your Money,* which graphically portrayed methods of detecting counterfeit bills and coins and the *modus operandi* of passers of counterfeit bills. The federal laws prohibit the photographing of United States money in whole or in part, but Henry Morgenthau, Jr., secretary of the treasury, granted special permission to the secret service to film genuine and counterfeit bills and portions thereof, for this educational campaign.

To supplement the motion picture, the secret service produced millions of copies of a four-page leaflet telling how to detect counterfeit money, and arranged to give one leaflet to every person who saw the picture, and to distribute copies to banks and business houses for their information and protection. More millions of the pamphlets were reprinted by banks and stores for distribution to their customers.

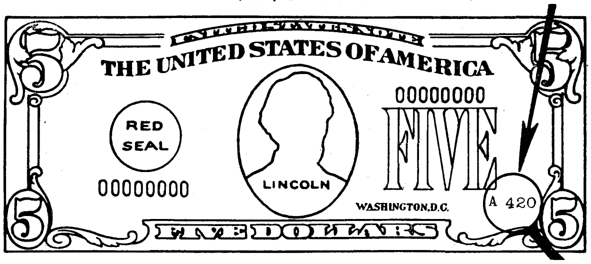
For the fiscal year 1940, counterfeiters' victims lost only $145,644, and the secret service decided to make its campaign a long-range program of crime prevention through education, with a three-fold purpose: (1) to remove from the youth of the country the temptation to engage in "easy money" criminal careers through counterfeiting; (2) to bring to a minimum the losses suffered by victims of counterfeit money, and (3) to reduce the load carried by the American taxpayer by decreasing the public costs for court trials, prosecutions and imprisonments, including the maintenance of offenders while confined in penal institutions.

In Sept. 1940 the secret service produced a 32-page *Know Your Money* booklet, illustrated with pictures of counterfeit bills, and telling in detail how to detect bogus notes and coins. Having



UNITED STATES SECRET SERVICE
TREASURY DEPARTMENT

NEW COUNTERFEIT $5 UNITED STATES NOTE



CHECK LETTER AND FACE PLATE NUMBER | A | 420

BACK PLATE NUMBER | 1227

SERIES | 1928 C

PRINTED ON ONE SHEET OF POOR QUALITY PAPER, THIS IS A FAIR REPRODUCTION.

THE RED SERIAL NUMBERS AND SEAL ARE BETTER THAN OTHER PARTS OF THE BILL.

JUST UNDER THE TITLE "LINCOLN", BENEATH THE PORTRAIT, THE LEGEND WHICH SHOULD READ "WILL PAY TO THE BEARER ON DEMAND" READS INSTEAD: "WILL PAY TO THE REARER ON DEMAND".

IF YOU KNOW YOUR MONEY THIS COUNTERFEIT WILL NOT DECEIVE YOU.

CAREFULLY COMPARE A SUSPECTED NOTE WITH ANOTHER OF THE SAME TYPE AND DENOMINATION.

Crime Prevention Through Education

KNOW
YOUR
MONEY

Appeared: 11-17-42
SS #1059

CURRENCY REPRODUCTIONS MADE BY SPECIAL PERMISSION OF HENRY MORGENTHAU, JR., SECRETARY OF THE TREASURY. FURTHER REPRODUCTION IN WHOLE OR IN PART FOR ANY PURPOSE IS PROHIBITED BY LAW WITHOUT SUCH AUTHORITY

Fig. 1. Enlarged section of the Lincoln portrait on a genuine U.S. $5 note. Fig. 2. The same section on a counterfeit note. Fig. 3. Face of Lincoln on a genuine $5 note. Fig. 4. Counterfeit reproduction of the face. Fig. 5. Section of the border on a genuine note. Fig. 6. Counterfeit border. Fig. 7. Enlarged treasury seal on a genuine $5 note. Fig. 8. Seal on a counterfeit note. Fig. 9. Genuine (left) and counterfeit coin. At lower left is shown reproduction of card issued by the U.S. secret service to assist in detection of counterfeit notes

in mind its first objective of removing temptation from the youth of the country to engage in criminal careers, the service inaugurated efforts to have this booklet adopted by high schools in all parts of the country as a part of their regular curricula. This was a productive effort, and by 1942 many schools were instructing their students in the detection of counterfeit money.

With the crime prevention program in full swing, the victims of counterfeit note passers lost only $48,000 during the fiscal year ended June 30, 1942—an impressive drop of 93% compared with the 1933–36 yearly average.

How to Detect Counterfeit Bills.—Years of experience have proved to the secret service that the best detector of counterfeit money is the properly trained human eye. The person who is best able to see the difference between the bogus bill and one that is genuine must know just what a genuine bill looks like. The only way such knowledge can be gained is through a careful examination of all parts of a genuine bill, and it is such a study that is advocated by the secret service to help Americans defend themselves against the counterfeiter.

The average individual can and does look at a bill without really seeing it. He does not realize that genuine United States paper money is produced by the combined efforts of several craftsmen, all masters of their respective types of work. The plate from which good bills are printed is not made by one man. At the bureau of engraving and printing in Washington, D.C., where paper money is produced, one engraver makes the portrait, one engraves the denominational numerals, one does the lettering, and so on. After each engraver completes the work assigned to him the individual impressions are transferred to a steel roll or die in their proper places, until the entire impression of the note is complete. The roll is then hardened and under heavy pressure is used to roll the complete impression on a flat plate, preparatory to printing. Since each engraver is a master at his particular type of work, the finished plate represents the very finest example of the engraver's art, far beyond the ability of a counterfeiter to reproduce accurately.

The logical point raised by persons who are interested in acquiring a knowledge of money is that they do not know what should be studied. The answer is simple—they should study all parts of any genuine bill. The portion most difficult of good reproduction is the portrait on the face of every note. The portraits of famous Americans on United States paper money identify the denominations of the bills on which they appear, as follows:

$1	Washington
$2	Jefferson
$5	Lincoln
$10	Hamilton
$20	Jackson
$50	Grant
$100	Franklin
$500	McKinley
$1,000	Cleveland
$5,000	Madison
$10,000	Chase

The genuine portraits are lifelike and distinct, and the shading which characterizes the facial features consists of numerous delicately executed dots and dashes. The oval background surrounding each portrait comprises a series of tiny squares, formed by the crossing of very fine vertical and horizontal lines. On most counterfeits, the portraits are defective in the shading in the face, and many of the little squares in the background are filled with ink or are flecked with white where the vertical and horizontal lines are broken (Pl., figs. 1, 2). In the genuine portrait, the eyes are always clear and expressive, but in most counterfeits they are dull, distorted or otherwise executed so that they do not compare favourably with the genuine (Pl., figs. 3, 4).

These differences alone between the genuine and counterfeit portraits prompt the secret service advice to the individual to compare any questionable bill with another of the same type known to be genuine. Such a comparison will make evident any differences between the two to such an extent that if one is a counterfeit it can be classified as such.

As of 1942 there were only three types of currency issued by the United States—(1) silver certificates, (2) United States notes and (3) federal reserve notes. Part of the design of every genuine bill includes the treasury seal, a small circle edged with sharp points like the teeth of a saw, enclosing an angle square under which is a key and over which is a balance scale, all mounted upon a dotted white shield within the circle. Surrounding the design are the Latin words *Thesaur. Amer. Septent. Sigil.*, representing the "Seal of the Treasury of North America." On silver certificates, the seal and the serial numbers are printed in blue; on United States notes they are in red, and on federal reserve notes, in green. Thus, the type of any bill may be quickly determined merely by the colour of the treasury seal and the serial numbers. In addition, the words "Silver Certificate," "United States Note," or "Federal Reserve Note," as the case may be, are engraved at the top centre of the face of a bill.

On many counterfeits, the sharp points around the outer edge of the treasury seal are blunt or broken. Here again, a comparison of the seal on a questionable bill with the seal on a genuine bill will show the difference (Pl., figs. 7, 8).

The serial numbers on genuine United States paper money are printed in a distinctive type style, and numbering blocks of the kind used for this purpose cannot be obtained except by the bureau of engraving and printing. Therefore, in producing a counterfeit, the counterfeiter must either use numbers unlike the genuine, or must try to copy the genuine numerals. In the first instance a comparison will show the difference in the style, and in the second instance the copies or imitated numbers are usually poorly spaced or crookedly aligned, so that a comparison will indicate they are not authentic.

The border design of every genuine bill includes an intricate lace-like network of fine white lines. The patterns for these lines are produced by a machine known as a geometric lathe, and the lines are technically called geometric lathework. In a genuine bill these lines are clear and unbroken, but on most bogus notes the border is too dark because many of the spaces between the lines are filled with black ink due to inferior etching, or perhaps too light because the white lines are thicker than the genuine, creating a bleached appearance (Pl., figs. 5, 6).

It is believed by some that rubbing a bill on a piece of paper will prove whether it is genuine or counterfeit, through removal of the colour. This is definitely a fallacy, because the ink can be rubbed from a good bill as well as a bad one.

How to Detect Counterfeit Coins.—The manufacture of spurious coins does not involve losses as great as those suffered by victims of counterfeit bills. This is due, of course, to the fact that there is a wide margin of difference between the value of metal money and the representative value of paper money.

The passer of counterfeit coins depends upon the carelessness of his victims in the same way as does the passer of counterfeit bills. Genuine silver coins have a corrugated outer edge, known as the reeding. Consisting of evenly spaced ridges, this feature was included on silver coins originally to prevent unscrupulous persons from cutting or filing from the edges of the coins small bits of silver, which they would then sell for the intrinsic value of the metal so derived. Later, however, the reeded edges of silver coins formed considerable protection against counterfeiting, since the corrugations on most bogus coins are only partially executed, or unevenly spaced, or entirely missing in places. Thus, a comparison of a questionable coin with one known to be genuine, or even a careful scrutiny of the ridges around a questionable coin, will usually indicate whether it is good or bad (Pl., fig. 9).

Most counterfeit coins are made of metal alloy which does not ring as clearly as genuine coins when dropped on a hard surface, and which is usually much softer than silver. Therefore, questionable coins should be dropped on a hard surface to test their ring, and should be cut with a knife to test their quality. If a coin sounds dull or is easily cut, it is undoubtedly a counterfeit.

It is also a fact that most counterfeit coins feel greasy, so it is wise to feel all coins, and if one feels slippery or greasy it should be further examined for defects in the reeding or other characteristics.

Bogus silver coins may be detected with a mixture of ingredients in a liquid solution, the formula for which is as follows:

Nitrate of silver	10 grains
Nitric acid	1 c.c.
Distilled water	30 c.c.

This "silver test" may be obtained for a few cents in any drug store. A drop applied to a counterfeit coin which does not have a high silver content will turn black. The solution will not discolour a genuine silver coin, and will not react on a counterfeit coin which is made of silver, or which contains a great deal of silver, but since most counterfeits are made of base metal the acid will detect them. It cannot be used to detect counterfeit nickels, or gold coins.

Stamps.—Secret service agents have arrested makers and users of counterfeit United States internal revenue tax stamps, which were usually affixed to bottles of taxable alcoholic beverages in an effort to evade the required tax payments. Such counterfeiting is now negligible, but the stamps described are issued by the government and are protected by the laws which provide for the suppression of counterfeit money.

The secret service, in co-operation with post office inspectors, has also captured plants for the manufacture of counterfeit United States war savings stamps and postage stamps, but this type of counterfeiting is somewhat unusual and has never been very extensive.

If You Receive Counterfeit Money:

1. Do not return it.
2. Notify police at once.
3. Try to delay the passer under some natural excuse.
4. Avoid argument. If necessary, say the police will handle the matter.
5. If the passer leaves, write down his description.
6. Write down the licence number of any automobile used by the passer or his accomplices.

Confiscation of Counterfeits.—The federal laws for the protection of obligations of the United States provide that anyone having custody or control of any counterfeits of such obligations who shall fail or refuse to surrender them to an authorized agent of the treasury department, shall be fined not more than $100, or imprisoned not more than one year, or both. All banking institutions are authorized agents of the treasury department within the meaning of this statute, and as such are legally authorized to confiscate counterfeit money from their customers or other persons who present it.

Penalties For Counterfeiting.—Counterfeiting is a felony. The laws of the United States provide that any person who has knowledge of the commission of a felony recognized by the federal courts, and who does not at once make such knowledge known to the authorities, shall be fined not more than $500, or imprisoned not more than three years, or both. Therefore, one who has any knowledge of counterfeiting activities should, for his own protection, promptly report such knowledge to the secret service. (Section 286, title 18, U.S. code.)

The manufacture or passing of counterfeit bills is punishable by a fine of not more than $5,000 and imprisonment not to exceed 15 years. (Sections 264 and 265, title 18, U.S. code.)

The punishment for the manufacture or possession of dies or moulds for counterfeit coins is a maximum fine of $5,000 and imprisonment for not more than ten years. (Section 283, title 18, U.S. code.)

(F. J. W.)

Great Britain.—The statute law against offenses relating to the coin was codified by the Coinage Offenses act, 1861 (England) which provides that whoever falsely makes or counterfeits any coin resembling or apparently intended to resemble or pass for any current gold or silver coin of the realm, or gilds, silvers, washes, cases over or colours with materials capable of producing the appearance of gold or silver a coin or a piece of any metal or mixture of metals, or files or alters it, with intent to make it resemble or pass for any current gold or silver coin, or who buys, sells, receives or pays a false gold or silver coin at a lower rate than its denomination imports, or who receives into Great Britain any false coin knowing it to be counterfeit, or who, without lawful authority or excuse, knowingly makes or mends, buys or sells, or has in his custody or possession, or conveys out of the royal mint any coining moulds, machines or tools, is guilty of felony. The punishment for such offenses is either penal servitude for life or for not less than three years, or imprisonment for not more than two years, with or without hard labour. Whoever impairs, diminishes or lightens current gold or silver coin, with intent to pass same, is liable to penal servitude for 14 years, and whoever has in his possession filings or clippings obtained by impairing or lightening current coin is liable to penal servitude for seven years. The statute also makes provision against tendering or uttering false gold or silver coin, which is a misdemeanour, punishable by imprisonment with or without hard labour. Provision is also made with respect to falsely making, counterfeiting, tendering or uttering copper coin, exporting false coin, or defacing current coin by stamping names or words on it, and counterfeiting, tendering or uttering coin resembling or meant to pass as that of some foreign state. The act of 1861 applies to offenses with respect to colonial coins as well as to those of Great Britain. Making or selling medals or coins resembling current coin is made a misdemeanour by the Counterfeit Medal act, 1883.

COUNTERFORT. A form of buttress used for the strengthening of walls of mediaeval fortifications. It was found that with the introduction of cannon as siege weapons in the 15th century, the ordinary types of masonry walls backed with earth were not sufficiently strong to stand battering by artillery. They were therefore strengthened with buttresses or counterforts from the inside of the wall. Later the counterfort often took the form of an arched gallery, built behind the wall under the rampart. (*See* further FORTIFICATION AND SIEGECRAFT.)

COUNTER-GUARD. An outwork of a system of fortifications built in front of the face of a bastion or ravelin to protect it from breaching fire (Fr. Contre-garde). A counter-guard usually consisted of a V-shaped work with two ramparts meeting at an angle and an open gorge. (*See* further FORTIFICATION AND SIEGECRAFT.)

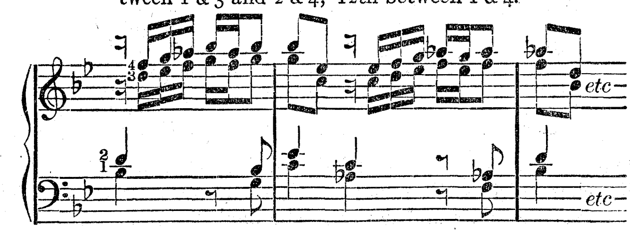
COUNTERPOINT, in music, the art defined by Sir Frederick Gore Ouseley as that of "combining" melodies (Lat. *contrapunctus,* "point counter point," "note against note"). This neat definition is not quite complete. Classical counterpoint is the conveying of a mass of harmony by means of a combination of melodies. Thus the three melodies combined by Wagner in the *Meistersinger* prelude do not make classical counterpoint, for they require a mass of accompanying harmony to explain them. That accompaniment explains them perfectly and thereby proves itself to be classical counterpoint, for its virtue lies in its own good melodic lines, both where these coincide with the main melodies and where they diverge from them. From this it will be seen that current criticism is always at fault when it worries as to whether the melodies are individually audible in a good piece of counterpoint.

What is always important is the peculiar life breathed into harmony by contrapuntal organization. Both historically and aesthetically "counterpoint" and "harmony" are inextricably blended; for nearly every harmonic fact is in its origin a phenomenon of counterpoint. Instrumental music develops harmony in unanalyzed lumps, as painting obliterates draughtsmanship in

I. *Double Counterpoint in the 8ve, 10th and 12th*

(a) BACH. *Das Wohltemperirte Klavier* II 16.

(b) Combination of all inversions; 8ve between 2 & 3; 10th between 1 & 3 and 2 & 4; 12th between 1 & 4.



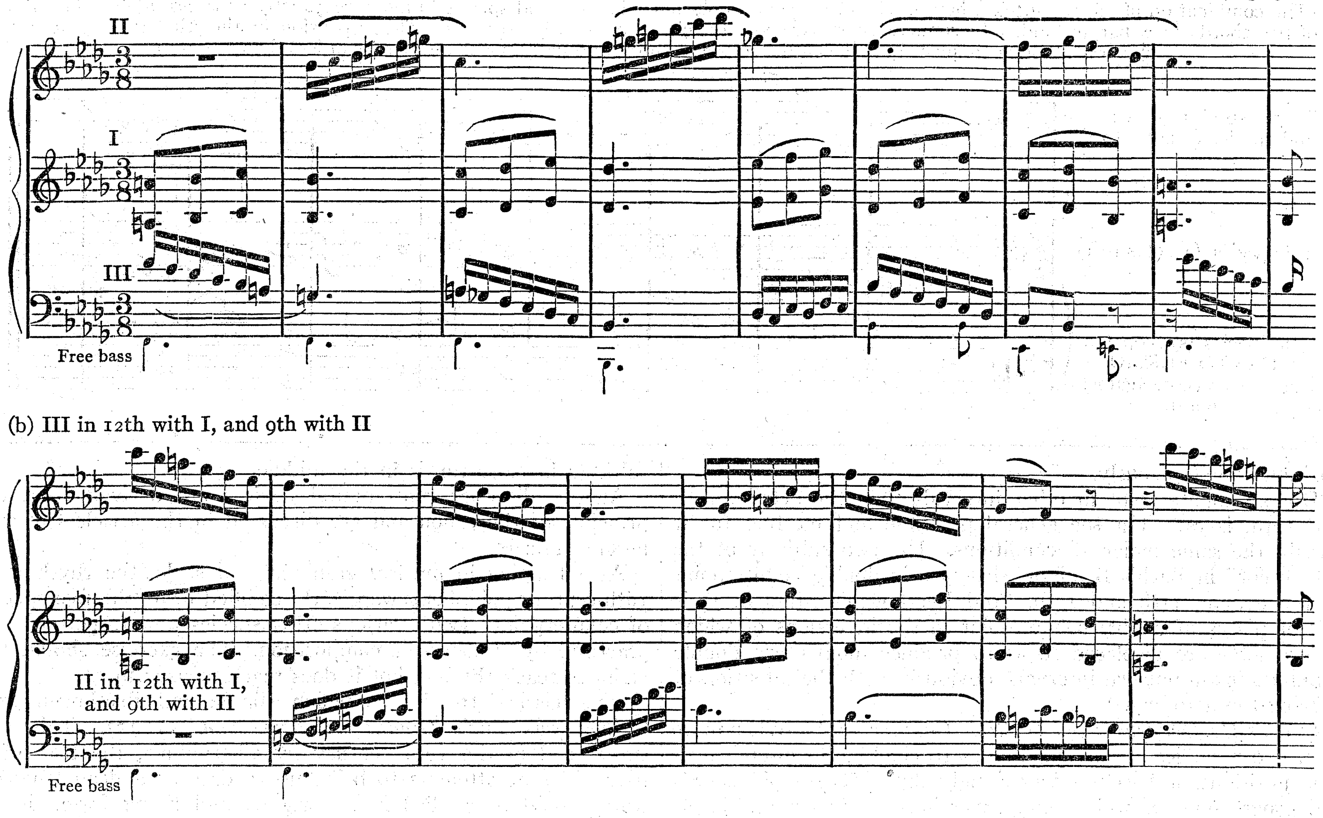
masses of colours; but the underlying concepts of counterpoint and draughtsmanship remain.

In so far as the laws of counterpoint are derived from harmonic principles—that is to say, derived from the properties of concord and discord—their origin and development are discussed in the article HARMONY. In so far as they depend entirely on melody they are too minute and changeable to admit of general discussion; and in so far as they show the interaction of melodic and harmonic principles it is more convenient to discuss them under the head of harmony. All that remains, then, for the present article is the explanation of certain technical terms.

(1) *Canto Fermo* (*i.e.,* plain chant) is a melody in long notes given to one voice while others accompany it with quicker counter-

II. *Triple Counterpoint in the 12th and incidentally the 9th*

(a) BRAHMS, op. 56



points (the term "counterpoint" in this connection meaning accompanying melodies). In the simplest cases the canto fermo has notes of equal length and is unbroken in flow. When it is broken up and its rhythm diversified, the gradations between counterpoint on a canto fermo and ordinary forms of polyphony, or indeed any kind of melody with an elaborate accompaniment, are infinite and insensible.

(2) *Double Counterpoint* is a combination of melodies so designed that either can be taken above or below the other. When this change of position is effected by merely altering the octave of either or both melodies (with or without transposition of the whole combination to another key), the artistic value of the device is simply that of the raising of the lower melody to the surface. The harmonic scheme remains the same, except in so far as some of the chords are not in their fundamental positions, while others, not originally fundamental, have become so. But double counterpoint may be in other intervals than the octave; that is to say, while one of the parts remains stationary, the other may be transposed above or below it by some other interval, thus producing an entirely different set of harmonies.

Double Counterpoint in the 12th has thus been made a powerful means of expression and variety. The artistic value of this device depends not only on the beauty and novelty of the second scheme of harmony obtained, but also on the change of melodic expression produced by transferring one of the melodies to another position in the scale. Two of the most striking illustrations of this effect are to be found in the last chorus of Brahms's *Triumphlied* and in the fourth of his variations on a theme of Haydn. Inversion in the 12th also changes the concord of the 6th into the discord of the 7th; a property used with powerful effect by Bach in Fugue 16 of Bk. II. of *Das Wohltemperirte Clavier*.

Double Counterpoint in the 10th has the property that the inverted melody can be given in the new and in the original

III. *Quintuple Counterpoint; capable of 120 permutations.*

(a) MOZART. Finale of "Jupiter" Symphony

IV. *Scholastic Exercise in the Five Species of Counterpoint.*

(The combination of all five species, here used to save space, does not allow the 2nd species to move conjunctly as is desirable. The use of two chords in a bar, forbidden by some teachers, is good if the chords are clearly expressed. The suspension in the 7th bar (4–3 over a $^6_4$ chord), though frequent in 16th century music, is considered licentious in an exercise of less than 6 parts.)

positions simultaneously.

Double counterpoint in other intervals than the octave, 10th and 12th, is rare, but the general principle and motives for it remain the same under all conditions. The two subjects of the "Confiteor" in Bach's B minor Mass are in double counterpoint in the octave, 11th and 13th. And Beethoven's Mass in D is full of pieces of double counterpoint in the inversions of which a few notes are displaced so as to produce momentary double counterpoint in unusual intervals, obviously with the intention of varying the harmony.

(3) *Triple, Quadruple and Multiple Counterpoint.*—When more than two melodies are designed so as to combine in interchangeable positions, it becomes increasingly difficult to avoid chords and progressions of which some inversions are incorrect. Triple counterpoint is normally possible only at the octave; for it will be found that if three parts are designed to invert in some other interval this will involve two of them inverting in a third interval which will give rise to incalculable difficulty. This makes the fourth of Brahms's variations on a theme of Haydn appear almost miraculous. The whole variation beautifully illustrates the melodic expression of inversion at the 12th; and during eight bars of the second section a third contrapuntal voice appears, which is afterwards inverted in the 12th, with natural and smooth effect. But this involves the inversion of two of the counterpoints with each other in the almost impracticable double counterpoint in the 9th. Brahms probably did not figure this out at all but profited by the luck which goes with genius.

Quadruple Counterpoint is not rare with Bach; and the melodically invertible combination intended by him in the unfinished fugue at the end of "Die Kunst der Fuge" requires one of its themes to invert in the 12th as against the others. (*See* D. F. Tovey's edition published by the Oxford University Press.)

Quintuple Counterpoint is admirably illustrated in the finale of Mozart's "Jupiter symphony," in which everything in the successive statement and gradual development of the five themes conspires to give the utmost effect to their combination in the coda. Of course Mozart has not room for more than five of the 120 possible combinations, and from these he, like all the great contrapuntists, selects such as bring fresh themes into the outside parts, which are the most clearly audible.

Sextuple Counterpoint may be found in Bach's great double chorus, "Nun ist das Heil," in the finale of his concerto for three claviers in C, and probably in other places.

(4) *Added Thirds and Sixths.*—This is merely the full working out of the sole purpose of double counterpoint in the 10th, namely, the possibility of performing it in its original and inverted positions simultaneously. The "Pleni sunt coeli" of Bach's "B minor Mass" is written in this kind of transformation of double into quadruple counterpoint; and the artistic value of the device is perhaps never so magnificently realized as in the place, at bar 84, where the trumpet doubles the bass three octaves and a third above while the alto and second tenor have the counter subjects in close thirds in the middle.

Almost all other contrapuntal devices are derived from the principle of the canon and are discussed in the article CONTRAPUNTAL FORMS.

As a training in musical grammar and style, the rhythms of 16th-century polyphony were early codified into "the five species of counterpoint" (with various other species now forgotten) and practised by students of composition. The exercise should not claim to teach rhythm, but it does teach measurement.

The classical treatise on which Haydn and Beethoven were trained was Fux's *Gradus ad Parnassum* (1725). This was superseded in the 19th century by Cherubini's, the first of a long series of attempts to bring up to date as a dead language what should be studied in its original and living form. R. O. Morris has thoroughly exposed the humbug and illustrated the true severe scholarship in *Contrapuntal Technique in the 16th Century* (Oxford University Press). (D. F. T.)

COUNTERPOISE, in wireless, a system of wires or other conductors in a radio circuit, forming the lower capacity area of an antenna of the condenser type (*see* ANTENNA). The counterpoise conductors are elevated above and insulated from the ground and are substantially as extensive as the aerial.

COUNTERSCARP (="opposite scarp," Fr. *contrescarpe*) a term used in fortification for the outer slope of a ditch; *see* FORTIFICATION and SIEGECRAFT.

COUNTERSIGN, a military term for a sign, word or signal previously arranged and required to be given by persons approaching a sentry, guard or other post as a means of establishing that they are not hostile or unauthorized. In some armies the "countersign" is strictly the reply of the sentry to the password given by the person approaching.

COUNTERVAILING DUTIES. The underlying idea of a countervailing duty is one which is imposed for the purpose of setting off or compensating some other duty. The form in which it was first used was that of a duty imposed on goods imported into the country, where similar goods produced in the country had to pay an excise or other inland revenue duty, the idea being to put the producers of the home-made goods on exactly the same footing as the importers of the foreign goods. The idea was so carefully applied that the amount of the import duty was not necessarily exactly the same as the amount of the inland duty. Thus while spirits made in Britain were charged 10/6d. per proof gal., the duty on similar spirits imported was 10/10d., the extra 4d. being supposed to compensate the home producer for the loss and inconvenience caused to him by having to carry on his trade under the regulations of an excise duty, which interfered with the free conduct of the trade and resulted in additional expense. Under the commercial treaty with France in 1860 this additional duty was fixed at 2d.; it was later raised to 5d., and then reduced to 4d. (see 28th report, Commissioners of Inland Revenue), and after the War again raised to 2s.10d. Similar duties were imposed on imported articles containing spirits; but in the case of methylated spirits, which paid no duty but were manufactured under regulations, only the countervailing duty of 4d. was levied.

In all cases the idea was that the countervailing duty must be no more than just what was required to place the home producer on an exactly equal footing with the importer of the foreign goods.

The name of countervailing duty has also been applied where articles made in a country without duty were also imported from other countries where they were subject to some fiscal assistance; *e.g.,* in the form of a bounty. Thus when the Continental beet sugar system was found to result in a bounty to the producers, enabling them to send these bounty-fed sugars into Britain at less than cost, it was argued that such imported sugar should be subject to a countervailing duty in Britain in order to equalize their cost with that of the home-produced article. The World War stopped the British import of beet sugar, and since then the situation has been complicated by the imposition of war duties on sugar, and later by the adoption of a subsidy system on beet sugar grown in England, the subsidy amounting between 1931 and 1938 to £21,164,399.

From the close of the War, however, until the coming into force on March 1, 1932 of the Import Duties Act, 1932, as modified by the Ottawa Agreement, the entire absence in the British system of protective duties gave place to a policy under which they were regarded as a defensive measure justified by the abnormal conditions of post-war times. In this sense, the term "countervailing duties" sometimes included duties on imports intended as a set-off against the fact that the foreign producer was in some way more favourably placed than the home manufacturer; *e.g.* by the position of the foreign exchanges or the existence of a lower level of wages, or some other item in the cost of production.

Countervailing duties have also been levied to check the tendency of strongly organized industries to sell goods in foreign markets at rates below the price in the home market; as when in 1904 Canada levied a countervailing duty on steel rails imported from the United States.

COUNTRY, an extent of land, a region with some peculiar character, *e.g.,* the "black country," "fen country," etc. (Late Lat. *contrata,* a tract of land spread out to view in the foreground, from *contra,* opposite, over against); hence it came to mean the land inhabited by a particular nation or race. It is used, also, in the sense of land not occupied by large towns, whence such expressions as "country house," "country town," etc. The word appears in many phrases, in the sense of the whole population of a country, especially the general body of electors, as in the expression "go to the country," for the dissolution of Parliament preparatory to a general election.

COUNTRY DANCE, a popular English dance of earlier centuries, which gave its name in due course, though in a corrupted form, to the French *contredanse* and the German *contretanz.* In the matter of its steps and figures it seems to have varied greatly, being sometimes of the "round" character, sometimes "up and down," sometimes introducing "realistic" figures, and so on, while as regards its music equal latitude prevailed, so that it could be danced to almost any kind of popular air of a brisk character and well-marked rhythms. A well-known collection of such tunes is that contained in Playford's *English Dancing Master* (1651).

COUNTY, the Norman equivalent of the old English "shire" (*q.v.*), which has survived as its synonym, though occasionally also applied to divisions smaller than counties, *e.g.,* Norhamshire, Hexamshire and Hallamshire.

In the period preceding the Norman Conquest two officers appear at the head of the county organization. These are the ealdorman and the *scirgerefa* or sheriff (*q.v.*). The shires of Wessex appear each to have had an ealdorman, whose duties were to command its military forces, to preside over the county assembly (*scirgemot*), to carry out the laws and to execute justice. The ealdorman gave away to the earl, probably under Danish influence, in the first half of the 11th century, and it is probable that the office of sheriff came into existence in the reign of Canute (1017–35), when the great earldoms were formed and it was no longer possible for the earl to perform his various administrative duties in person in a group of counties. After the Norman Conquest the earl was occasionally appointed sheriff of his county, but in general his only official connection with it was to receive the third penny of its pleas, and the earldom ceased to be an office and became merely a title. In the 12th century the office of coroner (*q.v.*) was created, two or more of them being chosen in the county court as vacancies occurred. In the same century verderers were first chosen in the same manner for the purpose of holding inquisitions on vert and venison in those counties which contained royal forests. The county was from an early period regarded as a community, and approached the king as a corporate body, while in later times petitions were presented through the knights of the shire. It was also an organic whole for the purpose of the conservation of the peace. The assessment of taxation by commissioners appointed by the county court developed in the 13th century into the representation of the county by two knights of the shire elected by the county court to serve in parliament, and this representation continued unaltered save for a short period during the Protectorate, until 1832, when many of the counties received a much larger representation, which was still further increased by later Acts.

The royal control over the county was strengthened from the 14th century onward by the appointment of justices of the peace (*q.v.*). This system was further developed under the Tudors, while in the middle of the 16th century the military functions of the sheriff were handed over to a new officer, the lord-lieutenant, who is now more prominently associated with the headship of the county than is the sheriff. The lord-lieutenant now usually holds the older office of *custos rotulorum* (*q.v.*). The justices of the peace are appointed upon his nomination, and until lately he appointed the clerk of the peace. The latter appointment is now made by the joint committee of quarter sessions and county council. The Tudor system of local government received little alteration until the establishment of county councils by the Local Government Act of 1888 handed over to an elected body many of the functions previously exercised by the nominated justices of the peace. For the purposes of this Act the ridings of Yorkshire, the divisions of Lincolnshire, east and west Sussex, east and west Suffolk, the soke of Peterborough, London, the Isle of Ely and the Isle of Wight are counties, making 62 administrative counties of England and Wales. Between 1373 and 1692 the Crown granted to certain cities and boroughs the privilege of being counties of themselves. There were in 1835 eighteen of these counties corporate, Bristol, Chester, Coventry, Gloucester, Lincoln, Norwich, Nottingham, York and Carmarthen, each of which had two sheriffs, and Canterbury, Exeter, Hull, Lichfield, Newcastle-upon-Tyne, Poole, Southampton, Worcester and Haverfordwest, each of which had one sheriff. All these boroughs, with the exception of Carmarthen, Lichfield, Poole and Haverfordwest, which remain counties of themselves, and 47 others, were created county boroughs by the Local Government Act 1888, and are entirely dissociated from the control of a county council. The City of London is also a county of itself, whose two sheriffs are also sheriffs of Middlesex, while for the purposes of the Act of 1888 the house-covered district which extends for many miles round the City constitutes a county.

See *Statutes of the Realm;* W. Stubbs, *Constitutional History of England* (1874–78); F. W. Maitland, *Domesday Book and Beyond* (1897); Pollock and Maitland, *Hist. Eng. Law* (1895); H. M. Chadwick, *Studies on Anglo-Saxon Institutions* (1905), and *The Victoria History of the Counties of England.* (G. J. T.)

COUNTY CLERK, in the United States, the chief clerical official of the county. He is elected by the qualified voters of the county for a term, provided by the State Constitution or statute, of two, three or four years. He is eligible for re-election. The county clerk acts as custodian of records of the county court and sometimes of the circuit and district courts for such terms as are held in the county for which he is chosen. He also acts as secretary of the county board of commissioners or supervisors and keeps minutes of their proceedings. In most States other than those of New England, he issues marriage, hunting and other licences, and in many he acts as recorder of legal instruments. The county clerk ordinarily has one or more deputies whom he appoints, often partly because of political work performed on his behalf. Occasionally his assistants are under civil service regulations.

See H. G. James, *Local Government in the United States* (1921).

COUNTY COURT, in England, a local court of civil jurisdiction. The county court, it has been said, is at once the most ancient and the most modern of English civil tribunals. The Saxon Curia Comitatus, maintained after the Norman Conquest, was a local court and a small debts court. It was instituted by Alfred the Great, its jurisdiction embracing civil, and, until the reign of William I., ecclesiastical matters. The officers of the court consisted of the earldorman, the bishop and the sheriff. The court was held once in every four weeks, being presided over by the earl, or, in his absence, the sheriff. The suitors of the court, *i.e.,* the freeholders, were the judges, the sheriff being simply a presiding officer, pronouncing and afterwards executing the judgment of the court. The court was not one of record. The appointment of judges of assize in the reign of Henry II., as well as the expensive and dilatory procedure of the court, brought about its gradual disuse. Accordingly, with the view of making justice cheaper and more accessible the County Courts Act 1846 was passed. This act had the modest title of "An Act for the Recovery of Small Debts and Demands in England." The original limit of the jurisdiction of the new courts was £20, extended in 1850 to £50 in actions of debt, and in 1903 (by an act which came into force in 1905) to £100. Thirteen amending acts were passed, which were consolidated with some amendments in the year 1888. This is now the code or charter of the county courts.

The grain of mustard-seed sown in 1846 has grown into a goodly tree, with branches extending over the whole of England and Wales; and they embrace within their ambit a more multifarious jurisdiction than is possessed by any other courts in the kingdom. England and Wales were mapped out into 59 circuits (not including the city of London).

Circuits are divided into districts, in each of which there is a court, with a registrar and bailiffs. The City of London court, though not strictly a county court, has the same jurisdiction (County Courts Act 1867 and §185 of the act of 1888) and constitutes the county court for the City of London. It was amalgamated with the mayor's court by the Mayor's and City of London Court Act 1920.

The ordinary jurisdiction of the county courts may be thus tabulated:—

Subject matter	*Pecuniary limit of jurisdiction*
Common-law actions, with written consent of both parties	Unlimited
Actions founded on contract (except for breach of promise of marriage, unless remitted from the High Court under S. 65)	£100
Actions founded on tort (except libel, slander, and seduction, unless remitted from the High Court under S. 65 or 66)	£100
Counter claims (unless plaintiff gives written notice of objection)	Unlimited
Ejectment or questions of title to realty . .	£100 annual value
Equity jurisdiction	£500
Probate jurisdiction	£200 personalty and £300 realty
Admiralty jurisdiction	£300
Bankruptcy jurisdiction	Unlimited
Replevin	Unlimited
Interpleader transferred from High Court . .	£500
Actions in contract transferred from High Court	£100
Actions in tort transferred from High Court .	Unlimited
Companies (winding up), when the paid-up capital does not exceed	£10,000

The above table is not by any means an exhaustive statement of the jurisdiction of the county courts. For many years it has been the practice of parliament to throw on the county court judges the duty of acting as judges or arbitrators for the purpose of new legislation relating to social subjects. A list of all the acts will be found in the *Yearly County Courts Practice*. A county court judge may determine all matters of fact as well as law, but either party may as a rule apply to have his case tried by jury. The number of jurymen is eight. There is an appeal from the county courts on matters of law to a divisional court of the High Court (*see* APPEAL). The County Courts Act of 1888 was amended by the Acts of 1903, 1919 and 1924.

In all of the States in the United States, there is a county court, which however, in some jurisdictions, such as Pennsylvania, is called the district court. Generally it is known as the county court. In many cases it is a court of general original jurisdiction, but in others it is limited as to the amount in civil cases, and to misdemeanours in criminal cases. The judge ordinarily is elected by the voters of the county.

See *County Courts Practice* (annual); also Sir T. W. Snagge, "Fifty Years of the English County Courts," in *Nineteenth Century,* Oct. 1897.

COUNTY FARM, POOR FARM, COUNTY HOME, POOR HOUSE or **ALMSHOUSE** are public institutions maintained as shelters for the aged poor. "Almshouse" is generally used as the generic term covering these institutions. Though in name almshouse means a shelter for the aged poor, the inmates are, in many States, a heterogeneous group of insane, feeble-minded, epileptics, blind, deaf-mutes, orphans, and deserted children as well as the aged poor. In 1923 there were 2,183 publicly owned almshouses with a population of 78,090 persons. There is no comparable data since that date. The almshouse is the oldest public welfare institution in America, the theory of institutional relief having been incorporated into the constitution of several of the early States, particularly in New England. As of 1929 there were almshouses in every State except one. Responsibility for the administration of almshouse care rested with the county in most States, though in New England control was vested in the town. The growth of almshouses, and later the institutions designed to care for special groups of dependents, gave rise to State supervisory agencies, forerunners of the modern State public welfare departments. These State agencies, however, had little actual authority and their rights were generally limited to inspection and recommendation, with administrative responsibility remaining nearly exclusively local. In general, almshouses operated under two systems: (1) direct management by local officials; (2) contract system. Under the first system which controlled the majority of the institutions, a superintendent was employed at a specified salary to manage the almshouse. The farm produce belonged to the institution, and the proceeds of any unused surplus reverted to the local treasury or to the almshouse. Under the contract system, the farm and almshouse were leased to an operator for the care of the poor, while the proceeds of any unused surplus produce reverted to the lessee.

There have been few changes since 1929, save that in some instances State supervision over almshouse administration has been strengthened. In general, however, there has been no significant alteration in the number, population, administration or function of almshouses. Public attention, focused for a period on almshouse problems following a study of the cost of almshouses made in 1923 by the U.S. Department of Labor, shifted soon after that date to the more urgent problems of unemployment relief and programs of outdoor assistance which have entirely overshadowed almshouse care. It was thought that the introduction of the old age assistance program might reduce the number of almshouses and their population, but this has not markedly occurred. The increasing use of almshouses to provide medical and nursing care for the chronically ill and destitute, and the consolidation in some States of almshouses into institutions providing such care and serving a wider area, are recent trends. *See* POOR LAW: *U.S.*

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COUP D'ÉTAT, a French phrase denoting a sudden and violent action by which power is seized by a member or section of a dominant class or party, in defiance of the constitution of the country. The *coup d'état* of Nov. 9, 1799 (18 *Brumaire*), when Napoleon (*q.v.*) overthrew the Directory and became First Consul, and that of Dec. 2, 1851, when Louis Napoleon (*see* NAPOLEON III.) dissolved the Assembly of the Second Republic, are famous instances in French history. Cromwell's forcible dissolution of the Long Parliament (April 20, 1653) is a comparable example in English history.

COUPÉ, a small closed carriage of the brougham type, with four wheels and seats for two persons; the term is also used of the front compartment on a *diligence* or mail-coach on the continent of Europe, and of a compartment in a railway carriage with seats on one side only. In the United States the name is used to designate a type of automobile having one fixed cross seat in an enclosed single-compartment body. Two or three persons can be accommodated in the main seat, and often additional passengers may be accommodated in an open "rumble-seat" in the rear, or in an auxiliary seat behind the driver in the closed compartment. Two doors, one on each side, with movable glass windows, a permanent roof and a rear-end luggage compartment make up the conventional body of the coupé. Among variations is the cabriolet, the chief distinguishing feature of which is a folding top of canvas or similar material.

COUPERIN, FRANÇOIS (1668–1733), French composer, was the most famous member of a family of musicians which may be traced from the generation born in 1626 to the death of Mlle. Céleste Couperin, organist at St. Gervais, 1850.

François Couperin (dubbed "le grand") is the chief of the many French clavecinists whose ranks include a greater composer, Rameau (*q.v.*). The clavecin works and chamber-music of Couperin have earned the reward of an art which, undertaking to satisfy natural desires, sets itself the narrowest possible limits and within these limits finishes its work to the utmost perfection. The natural desires which Couperin satisfies are those for melody and beautiful playing; the limits he sets himself are those of self-repeating four-bar and eight-bar tunes; and the perfection of the music is translated to sight by the exquisite engraving of the first edition of his four books of *Pièces de Clavecin* of which the proof-reading of the first book occupied him a whole year. Bach's admiration for Couperin is shown in his frequent use of the cross-rhythmed French Courante which occurs as often in his suites as the easier Italian kinds. His rondo-form is Couperin's (*see* RONDO); and some of Couperin's rondos exist in Bach's handwriting, sometimes to the confusion of editors.

Couperin's chamber-music is written for combinations of soft instruments (*e.g.*, gamba instead of violoncellos) with harpsichord and it borrows freely from the *Pièces de Clavecin* or vice-versa. The fantastic titles of his pieces represent a prevailing fashion among French court composers and could probably be interpreted by infinite research as a mass of compliment and persiflage aimed at and around personages at court.

Couperin's treatise, *L'art de toucher le clavecin,* is disappointing. The *Pièces de Clavecin,* in spite of their frequent references "Voyez ma methode, p. 76" shed more light on the method than the method sheds on them. The career of Couperin was an uneventful affair of court appointments; he was 25 when he became *organist du roi* in 1693; and in 1717 he was *Ordinaire de la musique de la chambre du roi* till his death in 1733.

Brahms co-operated enthusiastically with Chrysander in a careful edition of all four books of the *Pièces de Clavecin,* with all the ornaments as Couperin (who left no detail to discretion or chance) wrote them. It is indispensable to musicians who wish to understand the harpsichord music of Bach's age. (D. F. T.)

COUPERUS, LOUIS (1863–1923), Dutch writer, was born at The Hague. His life as a boy was spent in the Dutch East Indies, where his father was a prominent government official. His first novel *Eline Vere,* written under the influence of Tolstoy, appeared in 1889, and was followed by *Noodlot* (*The Footsteps of Fate*) in 1894 and *Extaze,* the first of his novels to be translated into English (1892). He next produced some imaginative and idealistic works, such as *Majesteit* (1895) and several volumes of prose poems. The work by which he is best known to the English-speaking world is the series of "Books of the Small Souls," four novels entitled *Die Kleine Zielen* (*The Small Souls*), *Het Late Leven* (*The Later Life*), *Zielen-schemering* (*The Twilight of the Soul*), *Het Helge Weten* (Eng. version *Dr. Adriaan*), which together with *Van Oude Menschen, de dingen de voorbijgaan* (*Old People and the Things that Pass*, Eng. version, 1919) raised him to the first rank of European novelists. Couperus travelled much in Greece and Italy and embodied his classical researches in historical romances such as *De Berg van Licht* (*The Mountain of Light*), *De Komedianten* (*The Comedian*) and mythological romances such as *Dionyzos* (1905) and *Herakles* (1913), as well as volumes of essays, sketches and short stories. The greater part of his work has been rendered into English by A. Teixeira de Mattos. His historical novel *Iskander* (concerning Alexander the Great) appeared in 1920. He died at De Steeg, near Arnhem, Holland, July 16, 1923.

COUPLE, a tie, ligament, a pair, in buildings a principal rafter, a chevron. In mechanics (*q.v.*) two parallel forces equal in intensity but opposite in direction acting at different points in a body constitute a *couple.*

COUPLER, in a radio circuit, an apparatus used to transfer radio-frequency power from one circuit to another, by associating together portions of these circuits. Couplers are of three types, inductive, capacitive and resistance.

COUPLET, a pair of lines of verse, which are welded together by an identity of rhyme. In rhymed verse two lines which complete a meaning in themselves are particularly known as a couplet. Thus, in Pope's *Eloisa to Abelard*:—

> Speed the soft intercourse from soul to soul,
> And waft a sigh from Indus to the Pole.

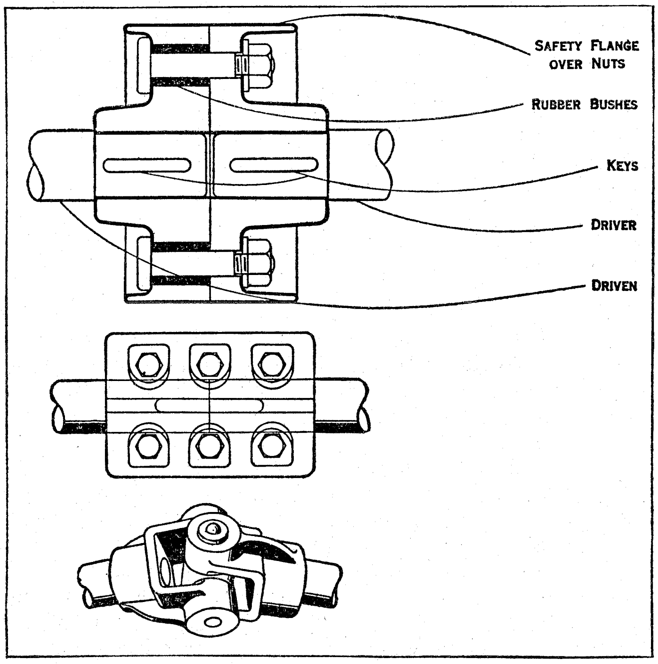
In French literature, the term couplet is not confined to a pair of lines, but is commonly used for a stanza. A "square" couplet in French, for instance, is a strophe of eight lines, each composed of eight syllables. In this sense it is employed to distinguish the more emphatic parts of a species of verse which is essentially gay, graceful and frivolous, such as the songs in a vaudeville or a comic opera. In the 18th century, Le Sage, Piron and even Voltaire did not hesitate to engage their talents on the production of couplets, which were often witty, if they had no other merit, and were well fitted to catch the popular ear. This signification of the word *couplet* is not unknown in England, but it is not customary; it is probably used in a stricter and a more technical sense to describe a pair of rhymed lines, whether serious or merry. The normal type, as it may almost be called, of English versification is the metre of ten-syllabled rhymed lines designated as *heroic couplet.* This form of iambic verse, with five beats to each line, is believed to have been invented by Chaucer, who employs it first in the Prologue *The Legend of Good Women,* the composition of which is attributed to the year 1385. That poem opens with the couplet:—

> A thousand times have I heard men tell
> That there is joy in heaven and pain in hell.

This is an absolutely correct example of the heroic couplet, which ultimately reached such majesty in the hands of Dryden and such brilliancy in those of Pope.

COUPLING. When lengths of shafting have to be joined up, in factories or ships, couplings are employed, as they are also to connect a prime mover to a machine. Usually the coupling connection is permanent; if frequent disconnections are required, a clutch has preference. Flange couplings are the most often used, the end of the shaft being forged into a flange, or a flange being keyed on and united to a companion one by bolts. Split muff couplings fit over each end of the shaft and are contracted by bolts, while the split compression type is also quick to apply and remove, being tightened by three bolts. These draw hoods together over the tapered exterior of a split sleeve causing the latter to grip the shaft ends and drive without need for keys. When one shaft has to assume various angular relations, a universal joint coupling is preferred, having two pivots located at right angles, and connected either through a steel member or a composition plate (*see* MOTOR CAR). Huge universal couplings of a rather elaborate kind are needed in rolling-mill drives, to compensate for the varying heights of the rolls.

Flexible couplings on shafts are extensively utilized. They protect engines, electric motors, or machines, against the shocks due to variations in the driving power or in the loads; and their flexibility also allows for slight irregularities in the alignments of shafts. A favourite class is the flange coupling above alluded to, but with leather or rubber bushings surrounding the bolts in one flange, and sometimes with soft washers interposed between the faces of the flanges. Another kind has rims with interlocking lugs; these do not touch, but the drive is transmitted by rubber blocks, or a long leather belt is interwoven between the lugs so as to take



TYPES OF COUPLINGS, DEVICES THAT COUPLE TOGETHER ADJACENT PARTS

Above: The flange flexible coupling, which is keyed onto each shaft; Centre: The split muff coupling, with key and clamping bolts; Below: The universal joint coupling, providing free horizontal and vertical movement

the drive flexibly without any metal-to-metal contact occurring. These also electrically insulate the motor from the machine which is coupled to it. Steel springs in some instances perform a like service.

A coupling is employed to join up the ends of hose, being either a screw type with nut turned by a spanner, or a hand instantaneous grip, for fire-hose or the brake-hose of trains. The railway carriage and wagon coupling is either of hand-tightened screw type, or automatic in action.

COUPON. A certificate entitling its owner to some payment, share or other benefit; more specifically, one of a series of interest certificates or dividend warrants attached to a bond running for a number of years. The word coupon (a piece cut off) possesses an etymological meaning so comprehensive that, while on the Stock Exchange it is only used to denote such an interest certificate or a certificate of stock of a joint-stock company, it may be as suitably, and elsewhere is perhaps more frequently, applied to tickets sold by tourist agencies and others.

The coupons by means of which the interest on a bond or debenture is collected are generally printed at the side or foot of that document, to be cut off and presented for payment at the bank or agency named on them as they become due. The last portion, called a "talon," is a form of certificate, and entitles the holder, when all the coupons have been presented, to obtain a fresh coupon sheet. They pass by delivery, and are as a rule exempt from stamp duty. Coupons for the payment of dividends are also attached to the share warrants to bearer issued by some joint-stock companies. The coupons on the bonds of most of the principal foreign loans are payable in London in sterling as well as abroad. The word is originally French, meaning "a piece cut off" (from *couper,* to cut)

A coupon is also that part of an advertisement which contains spaces for the name and address of the prospective purchaser, who fills in these details, clips the advertisement from the page, and sends it by mail to the advertiser, thus obviating the necessity of writing a letter. Coupons have been used in American advertising since about 1895. The addition of well prepared coupons has been known to triple the response to an advertisement.

COURANTE, a dance in 3–2 time much in vogue in France in the 17th century (*see* DANCE). It is also a musical term for a movement or independent piece based on the dance. In a suite it followed the Allemande (*q.v.*), with which it is contrasted in rhythm.

COURAYER, PIERRE FRANÇOIS LE (1681–1776), French Roman Catholic theologian, was born in Rouen on Nov. 17, 1681. While canon regular and librarian of the abbey of St. Geneviève at Paris he corresponded with Archbishop Wake on the subject of episcopal succession in England and so gained material for his *Dissertation sur la validité des ordinations des Anglais* . . . (Brussels, 1723; Eng. trans. by D. Williams, London, 1725; reprinted Oxford, 1844, with memoir of the author), which tried to prove the apostolic succession of the English clergy. Being persecuted he fled to England, where the doctorate was conferred on him at Oxford. In 1736 he published a French translation of Paolo Sarpi's *History of the Council of Trent,* and later, one of Sleidan's *History of the Reformation.* He died in London on Oct. 17, 1776. In his will of 1774 he declared himself still a Roman Catholic.

COURBET, GUSTAVE (1819–1877), French painter, was born at Ornans (Doubs) on June 10, 1819. He went to Paris in 1839 and worked at the studio of Steuben and Hesse; but he preferred to work out his own way by the study of Spanish, Flemish, and French painters. He painted his own portrait with his dog and "The Man with a Pipe," both of which were rejected by the jury of the Salon; but the younger school of critics, the neo-romantics and realists, loudly sang the praises of Courbet. The Salon of 1850 found him triumphant with the "Burial at Ornans," the "Stone-Breakers," and the "Peasants of Flazey." Though Courbet's realistic work is not devoid of importance, it is as a landscape and sea painter, especially as a painter of forest scenes, that he will be most honoured by posterity. When Courbet had made a name as an artist he tried to promote democratic and social science, and under the Empire he wrote essays and dissertations. He refused the cross of the Legion of Honour offered to him by Napoleon III., and in 1871 was elected a member of the Paris Commune. Thus it happened that he was responsible for the destruction of the Vendôme column. A council of war, before which he was tried, condemned him to pay the cost of restoring the column, 300,000 francs (£12,000). Courbet went to Switzerland in 1873 and died at La Tour du Peilz, on Dec. 31, 1877.

See Champfleury, *Les Grandes Figures d'hier et d'aujourd'hui* (1861); Mantz, "G. Courbet," *Gaz. des beaux-arts* (1878); Zola, *Mes Haines* (1879); C. Lemonnier, *Les Peintres de la Vie* (1888); J. Meier-Gräfe, *Corot und Courbet* (Stuttgart, 1906).

COURBEVOIE, a town of northern France, in the arrondissement of Saint-Denis, department of Seine, 5 mi. W.N.W. of Paris on the railway to Versailles. Pop. (1936) 58,638. It is a residential suburb of Paris, and has a fine avenue opening on the Neuilly bridge, and forming with it a continuation of the Champs Elysées. It carries on bleaching and the manufacture of drugs and biscuits.

COURCI, JOHN DE (d. 1219?), Anglo-Norman conqueror of Ulster, was a member of a celebrated Norman family of Oxfordshire and Somersetshire. It appears that he accompanied William FitzAldelm to Ireland when the latter, after the death of Strongbow, was sent thither by Henry II., and that he immediately headed an expedition from Dublin to Ulster, where he took Downpatrick, the capital of the northern kingdom. De Courci ultimately established his power over that part of Ulster comprised in the modern counties of Antrim and Down. After the accession of Richard I., de Courci in conjunction with William de Lacy seems to have offended the king by his proceedings in Ireland. De Lacy made his peace with Richard, while de Courci defied him; and the subsequent history of the latter consisted mainly in the vicissitudes of a lasting feud with the de Lacys. In 1204 Hugh de Lacy took de Courci prisoner, but after his release he again appeared in arms on hearing that Hugh de Lacy had obtained a grant of Ulster with the title of earl; and in alliance with the king of Man he ravaged the territory of Down. He was routed by Walter de Lacy, and disappeared from the scene till 1207, when he obtained permission to return to England. In 1210 he was in favour with King John, from whom he received a pension, and whom he accompanied to Ireland. Both de Courci and his wife Affreca were benefactors of the Church, and founded several abbeys and priories in Ulster.

See J. H. Round, "Courci, John de," in *Dict. Nat. Biog.*

COURIER, PAUL LOUIS (1773–1825), French Hellenist and political writer, was born in Paris on Jan. 4, 1773. Brought up on his father's estate of Méré in Touraine, he would never take the name "de Méré," to which he was entitled, lest he should be thought a nobleman. At the age of 15 he was sent to Paris to complete his education; his father's teaching had already inspired him with a passionate devotion to Greek literature, and although he showed considerable mathematical ability, he continued to devote all his leisure to the classics. He entered the school of artillery at Châlons, however, and in Sept. 1793 joined the army of the Rhine. He served in various campaigns of the Revolutionary wars, especially in those of Italy in 1798–99 and 1806–07, and in the German campaign of 1809. He became *chef d'escadron* in 1803.

In 1803 appeared his *Éloge d'Hélène,* a free imitation rather than a translation from Isocrates, which he had sketched in 1798. Courier resigned his commission in the autumn of 1808, but he attached himself to the staff of a general of artillery for the campaign of 1809. He was horror-struck by the carnage at Wagram (1809), refusing from that time to believe that there was any art in war. He hastily quitted Vienna, escaping the formal charge of desertion because his new appointment had not been confirmed. After leaving the army he went to Florence and discovered in the Laurentian library a complete manuscript of Longus's *Daphnis and Chloe,* an edition of which he published in 1810. The rest of his life was spent on his estate at Véretz (Indre-et-Loire), with frequent visits to Paris.

After the second restoration of the Bourbons the career of Courier as political pamphleteer began. He had before this time waged war against local wrongs in his own district. He now became one of the most dreaded opponents of the Government of the Restoration. In 1819–20 he wrote a series of political letters of extraordinary power, published in *Le Censeur Européen,* advocating a liberal monarchy. The proposal, in 1821, to purchase the estate of Chambord for the duke of Bordeaux called forth from Courier the *Simple Discours de Paul Louis, vigneron de la Chavonnière,* one of his best pieces. For this he was fined and imprisoned. His *compte rendu* of his trial had a still larger circulation than the *Discours* itself. In 1823 appeared the *Livret de Paul Louis,* the *Gazette de village,* followed in 1824 by his famous *Pamphlet des pamphlets,* called by his biographer, Armand Carrel, his swan-song. Courier published in 1807 his translation from Xenophon, *Du commandement de la cavalerie et de l'équitation,* and had a share in editing the *Collections des romans grecs.* In the autumn of 1825, on a Sunday afternoon (Aug. 18), Courier was found shot in a wood near his house. The murderers, who were servants of his own, remained undiscovered for five years.

The writings of Courier have solid historical value, and their curious style, derived partly from his Hellenism and partly from his loving study of the French writers of the 16th century, gives them an enduring literary interest.

A *Collection complète des pamphlets politiques et opuscules littéraires de P. L. Courier* appeared in 1826. *See* edition of his *Oeuvres* (1848), with an admirable biography by Armand Carrel, which is reproduced in a later edition, with a supplementary criticism by F. Sarcey (1876–77); also three notices by Sainte-Beuve in the *Causeries du lundi* and the *Nouveaux Lundis;* and A. Lelarge, *Origine et fortune de sa famille* (1925).

COURIER. Properly, a running messenger, who carried despatches and letters (O.Fr. *courier,* a runner); a system of couriers, mounted or on foot, formed the beginnings of the modern post office (*see* Post and Postal Services). The despatches which pass between the Foreign Office and its representatives abroad, and which cannot be entrusted to the postal service or the telegraph, are carried by special couriers, styled, in the British service, King's Messengers. "Courier," more particularly, is applied to a travelling attendant, whose duties are to arrange for the carrying of the luggage, obtaining of passports, settling of hotel accommodation, and generally to look to the comfort and facility of travel. The name "courier" and the similar word *courant* (Ital. *coranto*) have often been used as the title of a newspaper or periodical (*see* Newspapers); the *Courier,* founded in 1792, was for some time the leading London journal.

COURLAND or **KURZEME,** a coastal district of Latvia, lying between 56° and 57° 45′ N. and 21° and 23° E. It is bounded east by the district of Zemgale, north by the Gulf of Riga, west by the Baltic and south by Lithuania. In World War II, it passed alternately under German and Russian control. The surface is part of the northern Baltic lowland, with boulder clay soil, low and undulating, and coastlands flat and marshy. The interior has wooded dunes, covered with pine, fir, birch and oak, with swamps and lakes, and fertile patches between. The surface nowhere rises more than 700 ft. above sea-level.

The Windau river flows diagonally across the district northwestwards and is navigable in parts. The chief towns are Ventspils (Windau), Kuldiga (Goldingen), Talsi (Talsen) and Aizpute (Hazenpot). The climate is damp and often foggy, and the winter severe. Agriculture is the chief occupation, the principal crops being rye, barley, oats, wheat, flax and potatoes. Courland before 1917 was one of the Baltic provinces of Russia with an area of 10,435 square miles.

Anciently Courland was inhabited by the Cours or Kurs, a Lettish tribe, who were subdued and converted to Christianity by the Brethren of the Sword, a German military order, in the first quarter of the 13th century. In 1237 it passed under the rule of the Teutonic Knights owing to the amalgamation of this order with that of the Brethren of the Sword. Under the increasing pressure of Russia (Muscovy) the Teutonic Knights in 1561 found it expedient to put themselves under the suzerainty of Poland, the grandmaster Gotthard Kettler (d. 1587) becoming the first duke of Courland. But by the marriage in 1710 of Kettler's descendant, Duke Frederick William (d. 1711), to the princess Anne, niece of Peter the Great and afterwards empress of Russia, Courland came into close relation with the latter state. The celebrated Marshal Saxe was elected duke in 1726, but only managed to maintain himself by force of arms till the next year. The last Kettler, William, titular duke of Courland, died in 1737, and the empress Anne bestowed the dignity on her favourite Biren, who held it from 1737 to 1740 and again from 1763 till his death in 1772. Eventually in 1795 the assembly of the nobles placed it under the Russian sceptre. In Nov. 1918 Courland was incorporated in the new Latvian Republic. (*See* Latvia.)

COURNOT, ANTOINE AUGUSTIN (1801–1877), French economist and mathematician, was appointed assistant professor at the Academy of Paris in 1831, professor of mathematics at Lyons in 1834, rector of the Academy of Grenoble in 1835, inspector-general of studies in 1838, rector of the Academy of Dijon and honorary inspector-general in 1854, retiring in 1862. Cournot was the first economist who, with a competent knowledge of both subjects, endeavoured to apply mathematics to the treatment of economic questions. His *Recherches sur les principes mathématiques de la théorie des richesses* (Eng. trans. by N. T. Bacon, with bibliography of mathematics of economics by Irving Fisher, 1897) was published in 1838. The foundations of the mathematical treatment of economic questions laid by Cournot, provided the essential basis of much of the work of later economists. He was concerned primarily with an analysis of partial market equilibrium, based on the assumption that participants in the process of exchange are producers, or merchants whose end is the maximization of money profit. He, therefore, ignores the concept of utility. His most important contributions were his discussions of supply and demand functions and of the establishment of equilibrium under conditions of monopoly, duopoly and perfect competition; his analysis of the shifting of taxes which he treated as changes in cost of production and his discussion of problems of international trade. Although his chief contributions were in the field of mathematical economics, he was a fruitful philosopher.

In this latter field he was preeminently a protagonist of the theory of chance occurrences.

His works include: *Traité élémentaire de la théorie des fonctions et du calcul infinitésimal* (1841); *Exposition de la théorie des chances et des probabilités* (1843); *De l'origine et des limites de la correspondance entre l'algèbre et la géometrie* (1847); *Traité de l'enchaînement des idées fondamentales dans les sciences et dans l'histoire* (1861); and *Revue sommaire des doctrines économiques* (1877).

Bibliography.—Irving Fisher, "Cournot and Mathematical Economics," *Quarterly Journal of Economics,* Vol. xii (1897–98), pp. 119–138.

COURSING. It is known that coursing is one of the most ancient of British sports, and there is evidence to show that it must have been practised in other countries before the history of Great Britain began; but its actual origin is lost in obscurity. In its earliest stages it apparently comprised the hunting of various animals with dogs bearing a strong resemblance to the modern greyhound, which confines its hunting to the hare. The sport became very popular during the reign of Queen Elizabeth, and at some time in this period the first known set of rules was drawn up by the duke of Norfolk. The "Laws of the Leash," as they were called, were 16 in number, and apart from their quaint phraseology they laid down very clearly and simply the principles upon which the sport has since been based. In 1776 the first known club came into existence at Swaffham, through the enterprise of Lord Orford. This was followed by the Ashdown Park club in 1780 and the Malton club in 1781; but there appear to have been no others until the beginning of the 19th century. Then a considerable number sprang into existence, including the Altcar club (1825), founded by Viscount Molyneux on the estates of his father, Lord Sefton, near Liverpool, where regular meetings have been carried on ever since. With clubs increasing rapidly the need of an authoritative governing body was felt, and when in 1858 the National Coursing Club was formed for this purpose it received the ready support of all classes of coursers. It was composed of two representatives from every club which had not less than 24 members, and its constitution remains practically the same to-day. It drew up revised laws, and its rulings were universally accepted; though in 1923 the Irish Coursing Club severed its connection with the parent body and established itself as a separate governing body for Ireland.

Coursing received a somewhat serious setback with the passing of the Ground Game Act in 1880, which led to the number of hares being so depleted in some districts that many of the smaller clubs were driven out of existence. This gave a stimulus to enclosed coursing, which had been introduced at Plumpton in 1877, and it enjoyed some popularity for a few years. It has long since died out in England but has remained in Ireland, chiefly owing to the difficulties of preserving hares there. Scotland used to boast many notable clubs, but since 1880 the sport has declined until it has almost disappeared. On the other hand, coursing has flourished in Australia and other British territories, as well as in many foreign countries.

Conduct of Meetings.—The coursing season lasts about six months, beginning in the middle of September. Before any greyhound may be entered for a meeting under National Coursing Club rules, it must be registered, with its pedigree, in the Greyhound Stud Book, which was instituted in 1882. Irish dogs were included in the Stud Book until 1923, when a separate Stud Book was established by the Irish Coursing Club. Meetings usually extend over one, two, or three days; and the number of stakes to be competed for, and the number of entries to be accepted for each stake, will vary according to local conditions. The dogs are run in couples which are drawn by lot. The winner of the first course meets the winner of the second, and so on until the last two dogs left in compete for victory; but if two or more dogs belong to the same owner, they are "guarded" (that is, kept from competing against one another, by re-arranging the ties) as far as possible. The hares may be either driven by a staff of beaters towards a pre-arranged running ground, as in the Waterloo Cup and other big meetings, or the dogs may be walked over a selected area until a hare is disturbed naturally, as at meetings of most of the smaller clubs. In any case the hare must be given a clear run of not less than from 60 to 80 yards before the dogs are released. The slipper releases them simultaneously by means of specially devised slip collars attached to a single lead.

The Dogs.—In the years immediately prior to the outbreak of the World War, coursing had shown a remarkable increase of prosperity and popularity, and in 1914 the number of registrations in the Greyhound Stud Book, 5,443, was the highest recorded since 1883, the year after the Stud Book was founded. The sport was kept alive by a few clubs throughout the war but breeding was badly affected, with the result that there was a shortage of high class greyhounds when the war ended, and extraordinary competition for them took place at public sales. Prices soared to previously unheard-of heights, and at a sale in April 1920 a first season dog named "A," which had reached the semi-final round in the Waterloo Cup that year, was sold for 620 guineas, only to die from distemper shortly after reaching the kennels of his purchaser, Sir Woodman Burbidge. These prices were further enhanced in 1927 by the sudden popularity of greyhound racing with a mechanical hare.

The Waterloo Cup.—The Waterloo Cup meeting, held usually in February, is the Derby of coursing, and, like the Derby, arouses annual interest among many thousands of people who in the ordinary way take little account of coursing. Named from the Waterloo Hotel, Liverpool, where the first promoters met, the event was first held in 1836, when eight greyhounds competed for the Cup. From that modest beginning the meeting grew rapidly in importance. In 1837 the number of entries was increased to 16, and in 1838 to 32. In 1856 the number was again doubled, and there have been 64 entries each year ever since. The only break in the continuity of annual meetings occurred in 1917, when the event was discontinued until 1920 owing to the war. To be elected as one of the 64 nominators of dogs to run for the Cup is in itself regarded as an honour by greyhound owners, and the meeting has a very large influence in the propagation of the best blood in breeding. For the best type of greyhound the competition provides a very exacting test, and generally speaking luck plays a bigger part in it than in most other sporting events. It is noteworthy that very few dogs have succeeded in winning the Cup more than once; but two famous winners stand out in the history of the event—Master M'Grath, which won the trophy in 1868, 1869 and 1871; and Fullerton, which divided the honour of victory with another dog belonging to the same owner, Col. J. T. North, in 1889, and went on to win outright in 1890, 1891, and 1892. The Waterloo Cup of 1927 provided something of a record, for Golden Seal, the winner, was the youngest dog ever to have won the trophy, being a puppy less than 20 months old, whelped late in June, 1925.

Bibliography.—Coursing was fully described in Arrian's *Cynegeticus,* translated by the Rev. W. Dansey (1831); and among the earlier books were T. Goodlake, *Courser's Manual* (1828), containing a history of the sport and chief clubs, and records of greyhounds; T. Thacker, *Courser's Companion and Breeder's Guide* (1835); T. Thacker, *Courser's Annual Remembrancer* (1849–51); D. P. Blaine, *Encyclopaedia of Rural Sports* (3rd ed. 1870); and J. H. Walsh's, *The Greyhound* (3rd ed. 1875). Other books include the *Coursing Calendar* (since 1857), the official record of the season's results; *Coursing and Falconry* (Badminton Library, 1892); *The Hare* ("Fur and Feather" series, 1896); and *The Greyhound Stud Book* (since 1882); L. Hall, *Fifty-six Waterloo Cups* (1922) containing recollections of Waterloo meetings from 1863 to 1921. (F. I. W.)

COURT, ANTOINE (1696–1760), French Protestant divine, known as the "Restorer of Protestantism in France," was born in Villeneuve-de-Berg (Ardèche). At the time of the suppression of the Camisard revolt he was a child of eight and was taken to the secret meetings of the persecuted Calvinists. When he was 17 he began to exhort the scattered congregations, but after a time he came to the conclusion that some of the inspired persons of the persecuted church were in fact dupes and that the small communities must be organized into churches. On Aug. 21, 1715, he called a meeting of all the preachers in the Cevennes and Lower Languedoc at Monoblet. At this synod elders were appointed, prophecy and the preaching of women were forbidden, and it was arranged to send Pierre Corteiz to Zürich to seek ordination. From him Court himself received ordination. He then began to address small prayer meetings "in the desert" in Languedoc, the Vivarais and Dauphiné. The persecuted Calvinists were gradually reorganized, and, although in 1724 Louis XV. again prohibited the most secret exercise of the reformed religion, Court was able to address in 1744 meetings of 10,000 people. In the meantime a price had been set on Court's head. He escaped in 1730 to Lausanne and there created the theological college of which he was director for the last 30 years of his life. At this seminary the ministers of the Reformed Church in France were educated down to the days of the First Empire.

Court died in Lausanne on June 13, 1760. His principal work is *Histoire des troubles des Cevennes ou de la guerre des Camisards* (1760), and he left materials, which are preserved in the public library at Geneva, for a history of Protestantism.

Bibliography.—For details of his life see Napoléon Peyrat's *Histoire des pasteurs du désert* (1842; Eng. trans. 1852); Edmond Hugues, *Antoine Court, histoire de la restauration du protestantisme en France au XVIIIe siècle* (2nd ed. 1872), *Les Synodes du désert* (1885–86), *Mémoires d'Antoine Court* (1885); E. and E. Haag, *La France protestante*, vol. iv. (1884 ed.); H. M. Baird, *The Huguenots and the Revocation of the Edict of Nantes*, vol. ii. (1895); cf. *Bulletin de la société de l'histoire du protestantisme français* (1893–1906).

COURT, a word originally denoting an enclosed place, and so surviving in its architectural sense (courtyard, etc.). It is aptly used as a term for judicial tribunals, which originally were in fact enclosures within which sat the judges and their officials, whilst counsel, attorneys and the general public stood outside. At first these enclosures were temporary structures in the open field; later, fixtures in a large room or hall.

Before the separation of judicial from legislative and administrative functions, the king and his chief councillors sat in his palace for the exercise of all these functions and so the household of the king was also called "the court." And since all judicial authority is derived from the king, his presence is assumed in all the courts, which were not any part of the *curia regis*, but the *curia regis* itself.

Their history affords a remarkable illustration of the continuity characterizing English institutions. It might perhaps be too much to say that all the courts now sitting in England may be traced back to a common origin, but at any rate the higher courts are all offshoots from the Curia Regis; *see* Exchequer; Common Pleas, Court of; King's Bench, Court of; Chancery; Star Chamber; High Commission, Court of; Privy Council, Judicial Committee of.

The courts exercising jurisdiction in England are divided by certain features which may here be briefly indicated. We may distinguish between (1) superior and inferior courts. The former are the courts of common law and the court of chancery, now high court of justice. The latter are the local or district courts, county courts, etc. (2) Courts of record and courts not of record. "A court of record is one whereof the acts and judicial proceedings are enrolled for a perpetual memory and testimony, which rolls are called the records of the court, and are of such high and supereminent authority that their truth is not to be called in question. For it is a settled rule and maxim that nothing shall be averred against a record, nor shall any plea or even proof be admitted to the contrary. And if the existence of the record shall be denied it shall be tried by nothing but itself; that is, upon bare inspection whether there be any such record or no; else there would be no end of disputes. All courts of record are the courts of the sovereign in right of the crown and royal dignity, and therefore any court of record has authority to fine and imprison for contempt of its authority" (Stephen's *Blackstone*). (3) Courts may also be distinguished as civil or criminal. (4) A further distinction is to be made between courts of first instance and courts of appeal. In the former the first hearing in any judicial proceeding takes place; in the latter the judgment of the first court is brought under review. Of the superior courts, the high court of justice in its various divisions is a court of first instance. Over it is the court of appeal, and over that again the House of Lords. The high court of justice is (through divisional courts) a court of appeal for inferior courts. (5) There is a special class of local courts, which do not appear to fall within the description of either superior or inferior courts. Some, while administering the ordinary municipal law, have or had jurisdiction exclusive of their superior courts; such were the common pleas of Durham and Lancaster. Others have concurrent jurisdiction with the superior courts; such are the lord mayor's court of London, the passage court of Liverpool, etc.

The distribution of judicial business among the various courts of law in England may be exhibited as follows:

Criminal Courts.—(1) The lowest is that of the justice of the peace (*q.v.*), which has jurisdiction over certain minor offences. (2) The justices in quarter sessions are commissioned to determine felonies and other offences (*see* Quarter Sessions, Court of). The corresponding court in a borough is presided over by a recorder. (3) The more serious offences are reserved for the judges of the superior courts sitting under a commission of oyer and terminer or gaol delivery for each county (*see* Circuits). In London, the central criminal court was established by the Central Criminal Court Act 1834. (4) The court of criminal appeal, to which all persons convicted on indictment may appeal, was established by the Act of 1907. (*See* Criminal Law.)

Civil Courts.—In certain special cases, civil claims of small importance may be brought before justices or stipendiaries. Otherwise, and excepting the special and peculiar jurisdictions above mentioned, the civil business of England and Wales may be said to be divided between the county courts (taking small cases) and the high court of justice (taking all others).

The effect of the Judicature Acts on the constitution of the superior courts may be briefly stated. There is now one supreme court of judicature, consisting of two permanent divisions called the high court of justice and the court of appeal. The former inherits the jurisdiction of the court of chancery, the three common law courts, the courts of admiralty, probate, and divorce, the courts of pleas at Lancaster and Durham, and the courts created by commissions of assize, oyer and terminer, and gaol delivery. The latter inherits the jurisdiction of the court of appeal in chancery (including chancery of Lancaster), the court of the lord warden of the stannaries, and of the exchequer chamber, and the appellate jurisdiction in admiralty and heresy matters of the judicial committee; and power is given to the sovereign to transfer the remaining jurisdiction of that court to the court of appeal. By the Appellate Jurisdiction Act of 1876 the House of Lords is enabled to sit for the hearing of appeals from the English court of appeal and the Scottish and Irish courts during the prorogation and dissolution of parliament. The lords of appeal (*q.v.*), of whom three must be present, are the lord chancellor, the lords of appeal in ordinary, and peers who have held "high judicial office" in Great Britain or Ireland.

There are also many obsolete or decayed courts, of which the most noticeable are the court Baron, court Leet, etc. (*qq.v.*).

United States.—The Federal judicial system of the United States is made by the Constitution independent both of the legislature and of the Executive. It consists of the Supreme Court, the circuit courts, and the district courts.

The Supreme Court is created by the Constitution, and consisted in 1928 of nine judges, who are nominated by the President and confirmed by the Senate. They hold office during good behaviour, *i.e.*, are removable only by impeachment, thus having a tenure even more secure than that of English judges. The court sits at Washington from Oct. to July in every year. The sessions of the court are held in the Capitol. A rule requiring the presence of six judges to pronounce a decision prevents the division of the court into two or more benches; and while this secures a thorough consideration of every case, it also retards the despatch of business. Every case is discussed twice by the whole body, once to ascertain the view of the majority, which is then directed to be set forth in a written opinion; then, again, when the written opinion, prepared by one of the judges, is submitted for criticism and adoption by the court as its judgment.

The other Federal courts have been created by Congress under a power in the Constitution to establish "inferior courts." The circuit courts consist of 34 circuit judges, acting in nine judicial circuits, while to each circuit there is also allotted one of the justices of the Supreme Court. Circuit courts of appeals, established to relieve the Supreme Court, consist of three judges (two forming a quorum), and are made up of the circuit and district judges of each circuit and the Supreme Court justice assigned to the circuit. Some cases may, however, be appealed to the Supreme Court from the circuit court of appeals, and others directly from the lower courts. The district courts number (1928) 114, in most cases having a single justice. There is also a special tribunal called the court of claims, which deals with the claims of private persons against the Federal government. It is not strictly a part of the general judicial system, but is a creation of Congress designed to relieve that body of a part of its own labours.

The jurisdiction of the Federal courts extends only to those cases in which the Constitution makes Federal law applicable. All other cases are left to the State courts, from which there is no appeal to the Federal courts, unless where some specific point arises which is affected by the Federal Constitution or a Federal law. The classes of cases dealt with by the Federal courts are as follows:—

1. Cases in law and equity arising under the Constitution, the laws of the United States, and treaties made under their authority;
2. Cases affecting ambassadors, other public ministers and consuls;
3. Cases of admiralty and maritime jurisdiction;
4. Controversies to which the United States shall be a party;
5. Controversies between two or more States, between a State and citizens of another State, between citizens of different States, between citizens of the same State claiming lands under grants of different States, and between a State or the citizens thereof and foreign States, citizens or subjects (*Const.*, Art. III., s. 2).

Part of this jurisdiction has, however, been withdrawn by the 11th amendment to the Constitution, which declares that "the judicial power of the United States shall not be construed to extend to any suit commenced or prosecuted against one of the United States by citizens of another State, or by citizens or subjects of any foreign State."

The jurisdiction of the Supreme Court is original in cases affecting ambassadors, and wherever a State is a party; in other cases it is appellate. In some matters the jurisdiction of the Federal courts is exclusive; in others it is concurrent with that of the State courts.

As it frequently happens that cases come before State courts in which questions of Federal law arise, a provision has been made whereby due respect for the latter is secured by giving the party to a suit who relies upon Federal law, and whose contention is overruled by a State court, the right of having the suit removed to a Federal court. The Judiciary Act of 1789 (as amended by subsequent legislation) provides for the removal to the Supreme Court of the United States of "a final judgment or decree in any suit rendered in the highest court of a State in which a decision could be had, where is drawn in question the validity of a treaty or statute of, or an authority exercised under the United States, and the decision is against their validity; or where is drawn in question the validity of a statute of, or an authority exercised under, any State, on the ground of their being repugnant to the Constitution, treaties or laws of the United States, and the decision is in favour of their validity; or where any title, right, privilege or immunity is claimed under the Constitution, or any treaty or statute of, or commission held, or authority exercised under the United States, and the decision is against the title, right, privilege or immunity specially set up or claimed by either party under such Constitution, treaty, statute, commission or authority." If the decision of the State court is in favour of the right claimed under Federal law or against the validity or applicability of the State law set up, there is no ground for removal, because the applicability or authority of Federal law in the particular case could receive no further protection from a Federal court than has in fact been given by the State court.

The power exercised by the Supreme Court in declaring statutes of Congress or of State legislatures (or acts of the Executive) to be invalid because inconsistent with the Federal Constitution, has been deemed by many Europeans a peculiar and striking feature of the American system. There is, however, nothing novel or mysterious about it. As the Federal Constitution, which emanates directly from the people, is the supreme law of the land everywhere, any statute passed by any lower authority (whether the Federal Congress or a State legislature), which contravenes the Constitution, must necessarily be invalid in point of law, just as in Great Britain a railway by-law which contravened an act of parliament would be invalid. Now, the functions of judicial tribunals—of all courts alike, whether Federal or State, whether superior or inferior—is to interpret the law, and if any tribunal finds a Congressional statute or State statute inconsistent with the Constitution, the tribunal is obliged to hold such statute invalid. A tribunal does this not because it has any right or power of its own in the matter, but because the people have, in enacting the Constitution as a supreme law, declared that all other laws inconsistent with it are *ipso jure* void. When a tribunal has ascertained that an inferior law is thus inconsistent, that inferior law is therewith, so far as inconsistent, to be deemed void. The tribunal does not enter any conflict with the legislature or Executive. All it does is to declare that a conflict exists between two laws of different degrees of authority, whence it necessarily follows that the weaker law is extinct. This duty of interpretation belongs to all tribunals, but as constitutional cases are, if originating in a lower court, usually carried by appeal to the Supreme Court, men have grown accustomed to talk of the Supreme Court as in a special sense the guardian of the Constitution.

The Federal courts never deliver an opinion on any constitutional question unless or until that question is brought before them in the form of a lawsuit. A judgment of the Supreme Court is only a judgment on the particular case before it, and does not prevent a similar question being raised again in another lawsuit, though of course this seldom happens, because it may be assumed that the court will adhere to its former opinion. There have, however, been instances in which the court has virtually changed its view on a constitutional question, and it is understood to be entitled so to do.

COURTAULDS, LIMITED. This British joint-stock company has had a continuous existence since 1825, and the old firm of Samuel Courtauld and Company, Limited, the predecessors of the present company, had a wide reputation for mourning crepes manufactured from natural silk. In 1904 the company commenced the manufacture of rayon yarns by the viscose process at Coventry.

The company produces not only yarn but fabrics; the productions range from delicate natural silk georgette and crêpe-de-Chine to furnishing brocades for upholstery purposes. The weaving mills are situated in Essex at Braintree and Halstead, in Yorkshire at Halifax, and in Lancashire at Leigh. The dyeing of both yarn and fabrics is conducted in Essex and Lancashire.

For the manufacture of rayon yarns, the company operates two large mills at Coventry, two at Flint, and two at Wolverhampton; an up-to-date unit at Preston in Lancashire was ready for production in 1939. Processing of yarns is also carried out in special mills at Coventry, Nuneaton and Flint. Rayon staple fibre is produced on a large scale at Greenfield, near Holywell. Courtaulds also own chemical works at Trafford Park, Manchester. Abroad Courtaulds (Canada) Ltd. have rayon yarn mills at Cornwall, Ont., and there are yarn processing works in Spain and India. The head offices are in St. Martin's-le-Grand, London.

The capital of the concern is £32,000,000, consisting of 24,000,000 ordinary shares of £1 each and 8,000,000 5% preference shares of £1.

COURT BARON, an English manorial court dating from the middle ages. According to Maitland it means *curia baronis, "la court de seigneur,"* and there is no evidence for there being more than one court. His conclusion is that the "court baron" was not even differentiated from the "court-leet" (*q.v.*) at the close of the 13th century, but that there was a distinction of jurisdictional rights, some courts having only feudal rights, while others had regalities as well. When the court-leet was differentiated the court baron remained with feudal rights alone. These rights he was disposed to trace to a lord's jurisdiction over his men rather than to his possession of the manor, although in practice, from an early date, the court was associated with the manor. Its chief business was to administer the "custom of the manor" and to admit fresh tenants who had acquired copyholds by inheritance or purchase, and had to pay, on so doing, a "fine" to the lord of the manor. It is mainly for the latter purpose that the court was kept. The steward of the manor, a lawyer, usually presided, and the proceedings were recorded on "the court rolls."

See *Select Pleas in Manorial and other Seignorial Courts,* vol. i., and *The Court Baron* (Selden Society). (J. H. R.)

COURT DE GEBELIN, ANTOINE (1728–1784), French scholar, son of Antoine Court (*q.v.*), was born at Nîmes, and became, like his father, a pastor of the Reformed Church. After long years of research, he published in 1775 the first volume of his encyclopaedic work, *Le Monde primitif, analysé et comparé avec le monde moderne.* The ninth volume appeared in 1784, leaving the work still unfinished. In 1760 he published a work entitled *Les Toulousaines,* advocating the rights of the Protestants. He co-operated with Franklin and others in the periodical work entitled *Affaires de l'Angleterre et de l'Amérique* (1776 *seq.*), which was devoted to the support of American independence. He died in Paris on May 10, 1784.

See C. Dardier, *Court de Gebelin* (Nîmes, 1890).

COURTENAY, the name of a famous English family. French genealogists head the pedigree of this family with one Athon or Athos, who is said to have fortified Courtenay in Gâtinois about 1010. His great grandson, Renaud, was one of the magnates who followed Louis le Jeune to the Holy Land and the last lord of Courtenay of the line of Athon. Elizabeth, his elder daughter, carried Courtenay to her husband Pierre, youngest son of the French king, Louis VI. the Fat. Among the lines of the royal Courtenays, sprung from Pierre of France, were the short-lived dynasty of emperors of Constantinople, which ended in 1261, and the lords of Champignolles, Janlai, Yerre, Bleneau, La Ferté Loupière and Chevillon. Roger de Courtenay, abbé des Eschalis, who died in 1733, was the last recognized member of this royal line. A younger branch of the first house of Courtenay came from Josselin, second son of Josselin, son of Athon. This Josselin, a notable crusader, was the first count of Edessa.

In England a house of Courtenay has flourished with varying fortunes since the reign of the first Angevin king, and that it probably sprang from a younger son of Josselin I. of Courtenay is suggested by the name Reinaud, borne by the first known ancestor of the English house. Reinaud de Courtenay was a favourite with Henry II., who gave him Berkshire lands at Sutton, still known as Sutton Courtenay. His son, Robert, died childless in 1209. Of his second son, Reynold, little is known save that he was a married man in 1178 when he and his wife, Hawise, were given by the pope a licence for a free chapel at Okehampton. Reynold's son, Robert, married Mary, daughter of William de Vernon, earl of Devon and of the Isle of Wight. He was succeeded in 1242 by his son John, who by Isabel, a daughter of Hugh de Vere, earl of Oxford, had issue Hugh, whose wife was Eleanor, daughter of the earl of Winchester. The son of this marriage, another Hugh, became known as earl of Devon. Hugh, his son, the second earl, a warrior who drove the French back from their descent on Cornwall in 1339, made another of the brilliant marriages of this family, his wife being Eleanor, granddaughter of Edward I. Their eldest son, Sir Hugh de Courtenay, shared in the honours of Crécy and Calais, and was one of the knights founders of the order of the Garter, the stall-plate of his arms being yet in St. George's chapel, Windsor. This knight died in the lifetime of the earl, who was therefore succeeded by his grandson, Edward (son of Edward, his third son), earl marshal of England in 1385. Hugh, a second son of Earl Edward, succeeded as fourth earl of the Courtenay line. By his wife, a sister of the renowned Talbot, earl of Shrewsbury, he had issue Thomas the fifth earl, a partisan of Henry VI., whose wife was Margaret Beaufort, daughter of John, earl of Somerset. Both sons of this marriage fell in the Wars of the Roses, Thomas, the sixth earl, being taken at Towton by the Yorkists and beheaded at York in 1462, his younger brother, Henry, having the same fate at Salisbury in 1466.

The earldom being extinguished by attainder, Sir Humphrey Stafford was created earl of Devon in 1469, but in the same year, having retired with his men from the expedition against Robin of Redesdale, another earl of Devon suffered at the headsman's hands, his patent being afterwards annulled by a statute of Henry VII. On the restoration of Henry VI., John Courtenay, only surviving brother of Thomas and Henry, was restored to the earldom by the reversal of attainder. He, too, died in the Lancastrian cause in 1471. Beside him at Tewkesbury died his cousin, Sir Hugh Courtenay of Boconnoc, son of Hugh, a younger brother of Earl Edward, leaving a son Edward, who thus became the heir male of the house, though not its heir general. By a patent of 1485 he was created earl of Devon with remainder to the heirs male of his body, and by an act of 1485 he was restored to all honours lost in his attainder by the Yorkist parliament. He defended Exeter against Warbeck's rebels and was a knight of the Garter in 1489, dying 20 years later, when the earldom became again forfeit by his son's attainder. That son, William Courtenay, had drawn the jealousy of Henry VII. by a marriage with Catherine, sister of the queen and daughter of King Edward IV., the Yorkist sovereign, whose hand had been so heavy on the Courtenays. After the queen's death Henry sent his wife's brother-in-law to the Tower on a charge of corresponding with Edmund Pole, an attainder following. But on the accession of Henry VIII. the young king released his uncle, who although styled an earl was not fully restored in blood at his death in 1511. His son, Henry Courtenay, obtained from parliament in 1512 a reversal of his father's attainder, thus succeeding to the earldom of his grandfather. But Cromwell was his enemy, the royal strain in his blood a dangerous thing. Involved in correspondence with Cardinal Pole, he was sent to the Tower with his wife and his young son, and in 1538 he was beheaded as a traitor. Queen Mary took the son into favour, created him earl of Devonshire by a patent of 1553, and restored him in blood. But, disappointed in his hopes, he formed some wild plans for marrying the Lady Elizabeth and making her queen, the result being that he was sent back to the Tower and thence to Fotheringhay. At Easter of 1555 he was released on parole and exiled, dying suddenly at Padua in 1556. His heir male was Sir William Courtenay, his sixth cousin once removed, head of a knightly line of Courtenays whose seat was Powderham Castle. Sir William, who is said to have been killed at St. Quintin in 1557, was succeeded by his son, another Sir William, one of the undertakers for the settling of Ireland, where the family obtained great estates. William Courtenay of Powderham, was created a baronet by writ of privy seal in 1644, the patent being never enrolled. His great grandson, Sir William Courtenay, was on May 6, 1762, ten days before his death, created Viscount Courtenay of Powderham Castle.

Since the death at Padua in 1556 of Edward, earl of Devon, that ancient title had been twice revived. Charles Blount, Lord Mountjoy, who was created earl of Devon in 1603, died without lawful issue in 1606. In 1618 Sir William Cavendish, son of the famous Bess of Hardwick, was given the same title, which is still among the peerage honours of the ducal house descending from him. For the Courtenays, who had without protest accepted a baronetcy and a viscounty, their earldom was dead. In the reign of William IV. the third and last Viscount Courtenay was living unmarried in Paris, an exile who for sufficient reasons was keeping out of the reach of the English criminal law. In the name of this man, his presumptive heir male, William Courtenay, clerk assistant of the parliament, succeeded in persuading the House of Lords that the Courtenay earldom under the patent of 1553 was still in existence, the plea being that the terms of the remainder—to him and his heirs male for ever—did not limit the succession to heirs male of the body of the grantee. After the death of the exile in 1835 the clerk of the parliament succeeded him as an earl by force of the House of Lords decision of March 1831. His second son, the Rev. Henry Hugh Courtenay (1811–1904), succeeded, as 13th earl, a nephew whose extravagance had impoverished the estates. He in turn was followed, as 14th earl, by his grandson, Charles Pepys Courtenay (b. 1870). There is now no other recognized branch of this house, once so widely spread in the western counties.

See charter, patent, close, fine and plea rolls, inquests *post mortem* and other records. *Dictionary of National Biography; Notes and Queries,* series viii. vol. vii.; J. H. Round's *Peerage Studies; Calendars of State Papers;* Machyn's *Diary* (Camden Society); Chronicles of Capgrave, Wavrin, Adam of Usk, etc.

COURTENAY, PETER (d. 1492), a grandnephew of Richard Courtenay (*q.v.*), attained high position in the English Church. Educated at Exeter college, Oxford, he became dean of Windsor, then dean of Exeter; in 1478 bishop of Exeter; and in 1487 bishop of Winchester in succession to William of Waynflete. With Stafford, duke of Buckingham, and others he attempted a rebellion in 1483, and fled to Brittany when this failed. Courtenay was restored to his dignities in 1485 by Henry VII., whom he had accompanied to England. He died Sept. 23, 1492.

COURTENAY, RICHARD (d. 1415), English prelate, was a son of Sir Philip Courtenay of Powderham castle, near Exeter, and a grandson of Hugh Courtenay, earl of Devon (d. 1377). Educated at Exeter college, Oxford, Courtenay held several prebends, was dean of St. Asaph and then of Wells, and became bishop of Norwich in 1413. As chancellor of Oxford university in 1407 and again in 1410, Courtenay asserted the independence of the university against Thomas Arundel, archbishop of Canterbury, but the archbishop, supported by Henry IV. and Pope John XXIII., eventually triumphed. Courtenay was a personal friend of Henry V., who, in 1413, made him treasurer of the royal household. He went twice on diplomatic errands to France, and was also employed by Henry on public business at home. He died on Sept. 15, 1415.

COURTENAY, WILLIAM (*c.* 1342–1396), English prelate, son of Hugh Courtenay, earl of Devon (d. 1377), and great-grandson of Edward I., studied law at Stapledon Hall, Oxford, and became chancellor of the university in 1367. Having been made prebendary of Exeter, of Wells and of York, he was consecrated bishop of Hereford in 1370, translated to the see of London in 1375, and became archbishop of Canterbury in 1381. From the first Courtenay opposed John of Gaunt, duke of Lancaster; he upheld the rights of the English Church, and was eager to root out Lollardry. In 1373 he declared in convocation that he would not contribute to a subsidy until the evils from which the Church suffered were removed; in 1375 he incurred the displeasure of the king by publishing a papal bull against all Florentines; and in 1377 his decided action during the quarrel between John of Gaunt and William of Wykeham ended in a temporary triumph for the bishop. Wycliffe was another cause of difference between Lancaster and Courtenay. In 1377 the reformer appeared before Archbishop Sudbury and Courtenay, when an altercation between the duke and the bishop led to the dispersal of the court, and during the ensuing riot Lancaster probably owed his safety to the good offices of his foe. Having become archbishop of Canterbury in 1381, Courtenay summoned a council which condemned the opinions of Wycliffe; he then attacked the Lollards at Oxford, and urged the bishops to imprison heretics. He was for a short time Chancellor of England during 1381. He upheld the papal authority in England, although not to the injury of the English Church. He protested against the confirmation of the statute of provisors in 1390, and he was successful in slightly modifying the statute of praemunire in 1393. In 1386 he was one of the commissioners appointed to reform the kingdom and the royal household. Courtenay died at Maidstone on July 31, 1396, and was buried in Canterbury cathedral.

See W. F. Hook, *Lives of the Archbishops of Canterbury,* vol. iv. (1860–76); and W. Stubbs, *Constitutional History,* vols. ii. and iii. (1895–96).

COURTESY, manners that suit a court, politeness. The expression "by courtesy" is used where something is granted out of favour and not of right, hence "courtesy" titles, *i.e.,* those titles in the British peerage given to the eldest sons of dukes, marquesses and earls, and to the younger sons and the daughters of dukes and marquesses. Another form of the word "curtsey," once confined to the expression of courtesy by a gesture, is now used only of the reverence made by a woman. *See* Forms of Address.

In English law, courtesy (curtesy) was the life interest which a husband had in certain events in the lands of which his wife was in her lifetime actually seised for an estate of inheritance. The requisites for tenancy by the curtesy were: (1) a legal marriage; (2) an estate in possession of which the wife must have been actually seised; (3) issue born alive, capable of inheriting as heir to the wife, while (4) the title to the tenancy vested only on the death of the wife. Curtesy was finally abolished by the Administration of Estates Act, 1925, and the Copyhold Act (Law of Property), 1922; but like dower, it still obtains in some colonies, while in others it has been superseded by the Homestead Acts. Curtesy still survives in some States of the United States, but it is usually limited to lands of which the wife is seised at her death.

See Pollock and Maitland, *Hist. Eng. Law;* Goodeve, *Real Property.*

COURTHOPE, WILLIAM JOHN (1842–1917), English writer and historian of poetry, whose father was rector of South Malling, Essex, was born on July 17, 1842, and died on April 10, 1917. From Harrow school he went to New College, Oxford, where he gained many honours. His most important works were the continuation of the edition of Pope's works, begun by Whitwell Elwin (1816–1900), which appeared in ten volumes from 1871–89, and his elaborate *History of English Poetry* (6 vols., 1895–1910) which arose out of his tenure of the chair of poetry at Oxford (1895–1901). He was a civil service commissioner from 1887 onwards. In 1911 he was Warton lecturer on poetry.

COURT LEET, an English petty criminal court for the punishment of small offences. It has been usual to make a distinction between court baron (*q.v.*) and court leet as being separate courts, but in the early history of the court leet no such distinction can be drawn. At a very early time the lords of manors exercised or claimed certain jurisdictional franchise. Of these the most important was the "view of frankpledge" and its attendant police jurisdiction. Some time in the later middle ages the court baron when exercising these powers gained the name of *leet,* and, later, of "court leet." The *quo warranto* proceedings of Edward I. established a sharp distinction between the court baron, exercising strictly manorial rights, and the court leet, depending for its jurisdiction upon royal franchise. The court leet was a court of record, and its duty was not only to view the pledges, but to present by jury all crimes committed within the jurisdiction, and punish the same. The steward of the court acted as judge, presiding wholly in a judicial character, the ministerial acts being executed by the bailiff. The court leet began to decline in the 14th century, being superseded by the more modern courts of the justices, but in many cases courts leet were kept up until nearly the middle of the 19th century. Indeed, it cannot be said that they are now actually extinct, as many still survive for formal purposes, and by s. 40 of the Sheriffs Act, 1887, they are expressly kept up.

COURT-MARTIAL, a court for the trial of offences against military or naval discipline, or for the administration of martial law. In England courts-martial have inherited part of the jurisdiction of the old *Curia militaris,* or court of chivalry, in which a single marshal and at one time the high constable proceeded "according to the customs and usages of that court, and, in cases omitted according to the civil law, *secundum legem armorum*" (Coke, 4 *Ins.* 17). The modern form of the courts was adopted by ordinance in the time of Charles I. It is first recognized by statute in the first Mutiny Act of 1689. The Mutiny Act and the statutory articles of war continued until 1879, when they were codified in the Army Discipline and Regulation Act 1879, which was, in turn, superseded by the Army Act 1881. This act is re-enacted annually by the Army (Annual) Act.

Naval Courts-Martial.—In 1645 an ordinance and articles concerning martial law were passed for the government of the navy. Under this ordinance Blake, Monk and Penn issued instructions for the holding of general and ship courts-martial with written records. Under an act of 1661 the high admiral again received power to issue commissions for holding courts-martial—a power which continues to be exercised by the board of Admiralty. During the 18th century the jurisdiction was greatly extended. The Naval Articles of War have always been statutory, and the whole system now rests on the Naval Discipline Act 1866, as amended by the Naval Discipline Act 1922. Under the acts a court-martial must consist of from five to nine officers of a certain rank, and must be held publicly on board of one of H.M. ships of war, or in certain cases at a port at such convenient place on shore as the admiralty or the officer who ordered the court-martial shall direct. A judge-advocate attends, and the procedure resembles that of military courts. The sentence, if not one of death, does not require the confirmation of the commander-in-chief abroad or of the Admiralty at home. The board of Admiralty have, under the Naval Discipline Acts, a general power of suspending, annulling and modifying sentences which are not capital. The jurisdiction extends to all persons belonging to the Navy, to land forces and other passengers on board, ship-wrecked crews, spies, persons borne on the books of H.M. ships in commission, and civilians on board who endeavour to seduce others from allegiance. The definition of the jurisdiction by locality includes harbours, havens or creeks, lakes or rivers, in or out of the United Kingdom; all places within the jurisdiction of the admiralty; all places on shore out of the United Kingdom; the dockyards, barracks, hospitals, etc., of the service wherever situated; all places on shore in or out of the United Kingdom for all offences punishable under the Articles of War except those specified in section 45 of the Naval Discipline Act which are punishable by ordinary law. The Royal Marines, while borne on the books of H.M. ships, are subject to the Naval Discipline Acts, and, by an order in council 1882, when they are embarked on board ship for service on shore; otherwise they are under the Army Acts.

Royal Air Force Courts-Martial.—These proceedings are governed by the principles laid down in the Manual of Air Force Law (Air Publication 804) in compliance with the Air Force Act, the Rules of Procedure, and the King's Regulations and Air Council Instructions for the Royal Air Force.

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UNITED STATES

The extraordinary jurisdiction of courts-martial is conferred by the Constitution which makes the President commander-in-chief of the Army and Navy, empowers Congress to make rules for the government and regulation of the land and naval forces and exempts from the requirement for presentment or indictment of a grand jury "cases arising in the land or naval forces, or in the militia, when in actual service in time of war or public danger." Courts-martial are not part of the Federal judiciary, and are not, *proprio vigore,* governed by constitutional limitations or statutory enactments applicable to the Federal civil courts. The proceedings and sentences of courts-martial, acting within their judicial powers and in accordance with law, are free from control or revision by the civil courts.

The jurisdiction of courts-martial is wholly criminal. The specific objective of the courts is to insure discipline in the armed forces. The jurisdiction embraces members of the Army and Navy and in certain cases civilians closely connected with these services (such as retainers to the camp outside the territorial jurisdiction of the United States) or interfering with their operation (such as spies). Jurisdiction is not limited by the place of the offence or by the locality of the offender. Courts-martial are primarily distinguishable through non-use of the traditional grand and petit juries. Otherwise their composition and processes are patterned after civil tribunals and are designed to safeguard fundamental procedural and substantive rights of accused persons, such as the right to a thorough and impartial investigation before trial and to a speedy trial by an unbiased court, and the right to protection from double jeopardy, compulsory self-crimination and unreasonable searches and seizures. Courts-martial are governed with respect to procedure and punishments by special enactments of Congress, those applicable to the Army being called Articles of War, and those applicable to the Navy, Articles for the Government of the Navy. These statutes are supplemented by a detailed Manual for Courts-Martial for the Army and a manual for the Navy entitled Naval Courts and Boards. The articles and prescribed procedure are in general similar to corresponding British enactments and regulations. The original articles, enacted in 1775, were patterned after those governing the British Army and Navy at that period. On June 4, 1920, the Articles of War were substantially amended and re-enacted. The Articles for the Government of the Navy, in effect Dec. 1, 1873, were codified as of that date as section 1624, Revised Statutes.

The articles of War provide three types of Army courts-martial —general, special and summary. General courts-martial are composed of not less than five officer members, including a law member specially versed in the law, a prosecutor designated as trial judge advocate, and a defence counsel. Their jurisdiction as to persons (subject to military law), offences and punishments, is unlimited. Special courts-martial are composed of not less than three officer members, a judge advocate and a defence counsel. They have jurisdiction over all persons subject to military law and over all offences not punishable by death. They may not adjudge sentences to dishonourable separation from the service or to confinement in excess of six months, etc. Summary courts-martial, consisting of one officer, are limited in jurisdiction to the trial of enlisted men. They may not adjudge sentences in excess of confinement for one month, etc. Generally corresponding to these courts, in the order as described, are Navy general and summary courts-martial and deck courts.

Courts-martial are of transitory nature, called into being by the commanding officer authorized by law to appoint them and dissoluble at the will of the appointing authority. A sentence adjudged may not be carried into execution until approved by the appointing authority or his successor in command, and, in some cases, until confirmed by higher authority. The approving or reviewing authority and confirming authority thus become parts of the courts on whose proceedings they pass judgment. Appellate review, automatic in operation, is provided in cases involving serious punishment, with power in the War and Navy departments and in the President to take remedial action. In the War department a board of review composed of officers trained in law, acting in collaboration with the judge advocate general, is vested with statutory powers of a final court of appeals with respect to the administration of military justice. Powers of mitigation, suspension and remission of sentences, extending, in appropriate cases, to honourable restoration to the colours of persons sentenced to dishonourable discharge or dismissal, are afforded by the articles and regulations.

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COURTNEY, LEONARD HENRY COURTNEY, 1ST BARON (1832–1918), British statesman and man of letters, eldest son of J. S. Courtney, a banker, was born at Penzance on July 6, 1832. He won a sizarship at St. John's college, Cambridge, graduated second senior wrangler, and became a fellow of his college. Called to the bar at Lincoln's Inn in 1858, he devoted himself to economics and journalism, and in 1865 became leader-writer on *The Times* under Delane. He was professor of political economy at University college, London, from 1872 to 1875. He entered the House of Commons for Liskeard, Cornwall, in 1876, and sat continuously for that district until 1900. Courtney belonged to the Radical school of Chamberlain and Dilke. He held under-secretaryships in the Gladstone Government of 1880, but resigned in 1884 because the new Franchise bill did not include provision for proportional representation, of which principle he was a lifelong advocate. Courtney separated from Gladstone on the introduction of the Home Rule bill in 1886, but as time went on he found himself less and less in sympathy with his Unionist colleagues on other than Irish questions. On Gladstone's nomination he had become chairman of committee and deputy-speaker of the House of Commons in 1886. He retired in 1892, and his opposition to the Boer War led to his defeat at Liskeard in 1900. On the Liberal victory in 1906 Courtney was made a peer. In the House of Lords he sat on the Liberal benches, and frequently spoke on imperial and foreign questions. He distrusted the foreign policy of Sir Edward Grey, and during the progress of the World War continually urged the search for any avenue of peace. He died on May 11, 1918, six months before the Armistice, and up to the time of his death pleaded for a peace of reconciliation. Courtney married in 1883 Miss Catherine Potter, who, like her husband, was a prominent member of the peace movement. Much of his best work was given to the periodical press; among his separate publications may be mentioned *The Working Constitution of the United Kingdom* (1901).

See G. P. Gooch, *Life of Lord Courtney* (1920).

COURTNEY, WILLIAM LEONARD (1850–1928), British journalist, was born at Poona on Jan. 5, 1850, and was educated at Bath and at University college, Oxford. He was elected fellow of Merton college in 1872 and of New college in 1876. In 1890 he left Oxford and joined the editorial staff of *The Daily Telegraph*, London, where he spent many years as literary editor and dramatic critic, retiring in 1924. He edited *Murray's Magazine* for a short time in 1890–91 and became editor of *The Fortnightly Review* in 1894. He died in London, Nov. 1, 1928.

Courtney's numerous works include *Studies on Philosophy* (1882); *Life of John Stuart Mill* (1889); *Kit Marlowe* (a drama in blank verse produced at the St. James's Theatre, London, in 1893); *The Passing Hour* (1925).

COURTOIS, JACQUES (1621–1676) and **GUILLAUME** (1628–1679). The two French painters who bore these names are also called by the Italian equivalents Giacomo (or Jacopo) Cortese and Guglielmo Cortese. Each of the brothers is likewise named, from his native province, Le Bourguignon, or Il Borgognone.

Jacques Courtois was born at St. Hippolyte, near Besançon, in 1621. His father, whose pupil he became, was a painter. Towards 1640 he went to Bologna, and studied under Guido; thence he proceeded to Rome, where he entered upon his own characteristic style of art, that of battle-painting, in which he has been accounted to excel all other old masters. Prince Matthias of Tuscany employed Courtois on some striking works in his villa, Lappeggio, representing with much historical accuracy the prince's military exploits. In Venice the artist executed for the senator Sagredo some remarkable battle-pieces. In Florence he entered the Society of Jesus, taking the habit in Rome in 1655. As a Jesuit, Courtois painted many works in churches and monasteries of the society. He lived piously in Rome, and died there on May 20, 1676 (some accounts say 1670 or 1671).

Guillaume Courtois, born likewise at St. Hippolyte, came to Italy with his brother. He went at once to Rome, and entered the school of Pietro da Cortona. He studied also the Bolognese painters and Giovanni Barbieri. He painted the "Battle of Joshua" in the Quirinal gallery and the "Crucifixion of St. Andrew" in the church of that saint on Monte Cavallo; he also executed some etchings. Guillaume Courtois died on June 15, 1679.

COURTRAI, an important and once famous town (Flemish, *Kortrijk*) of west Flanders, Belgium, situated on the Lys. Pop. (est. 1939) 41,320. It is best known for its fine linen, which is retted in the Lys, "the golden river," whose waters possess chemical properties which artificial processes have not yet satisfactorily copied. The lace factories are also important. The prosperity of modern Courtrai cannot compare with what it was in the middle ages, when the population numbered 200,000.

Courtrai, the *Cortracum* of the Romans, ranked as a town from the 7th century onwards. It was destroyed by the Normans, but was rebuilt in the 10th century by Baldwin III. of Flanders, who endowed it with market rights and laid the foundation of its industrial importance by inviting the settlement of foreign weavers.

The Broelbrug, with its towers at either end of the bridge, is a characteristic monument of ancient Flanders. The 16th century town hall, restored in 1846, contains two elaborately carved chimney-pieces. The church of St. Martin (15th century) was practically rebuilt after a fire in 1862. The most important building at Courtrai is the church of Our Lady, which was begun by Count Baldwin IX. in 1191 and finished in 1211. In the chapel behind the choir, which is an 18th century reconstruction, is one of Van Dyck's masterpieces, "The Erection of the Cross." Attached to the church is the chapel of the counts (1373) which contains mural paintings (restored) of the counts and countesses of Flanders.

Battle of Courtrai.—In mediaeval and military history Courtrai is famous for the battle of July 11, 1302, and because of the defeat there inflicted by the despised Flemish burghers upon the chivalry of France. Earlier than the earliest of the victories of the Swiss pikemen, earlier than the triumph of the Scottish pikemen at Bannockburn, still earlier than the successes of English bowmen over French knights in the Hundred Years' War, the experience of Courtrai was so novel and startling as to send a quiver of shocked surprise through the knightly ranks of western Europe. The battle bears a striking resemblance to Bannockburn (*q.v.*). It came about through the French king's action in imprisoning and confiscating the estates of Guy, count of Flanders. The latter's Flemish subjects rose in revolt, but as their levy had only a slight leaven of knights it appeared an easy target for the powerful army which Robert of Artois brought to crush the revolt. On his approach the Flemish army took up a position to cover their siege of Courtrai. This position, as at Bannockburn, was aptly chosen, for the Groeninghebeke covered the front, the Lys guarded the left flank and marshy ground lay on the right. On the other hand, with Courtrai lying on the rear, it gave the Flemings no hope of retreat in case of defeat.

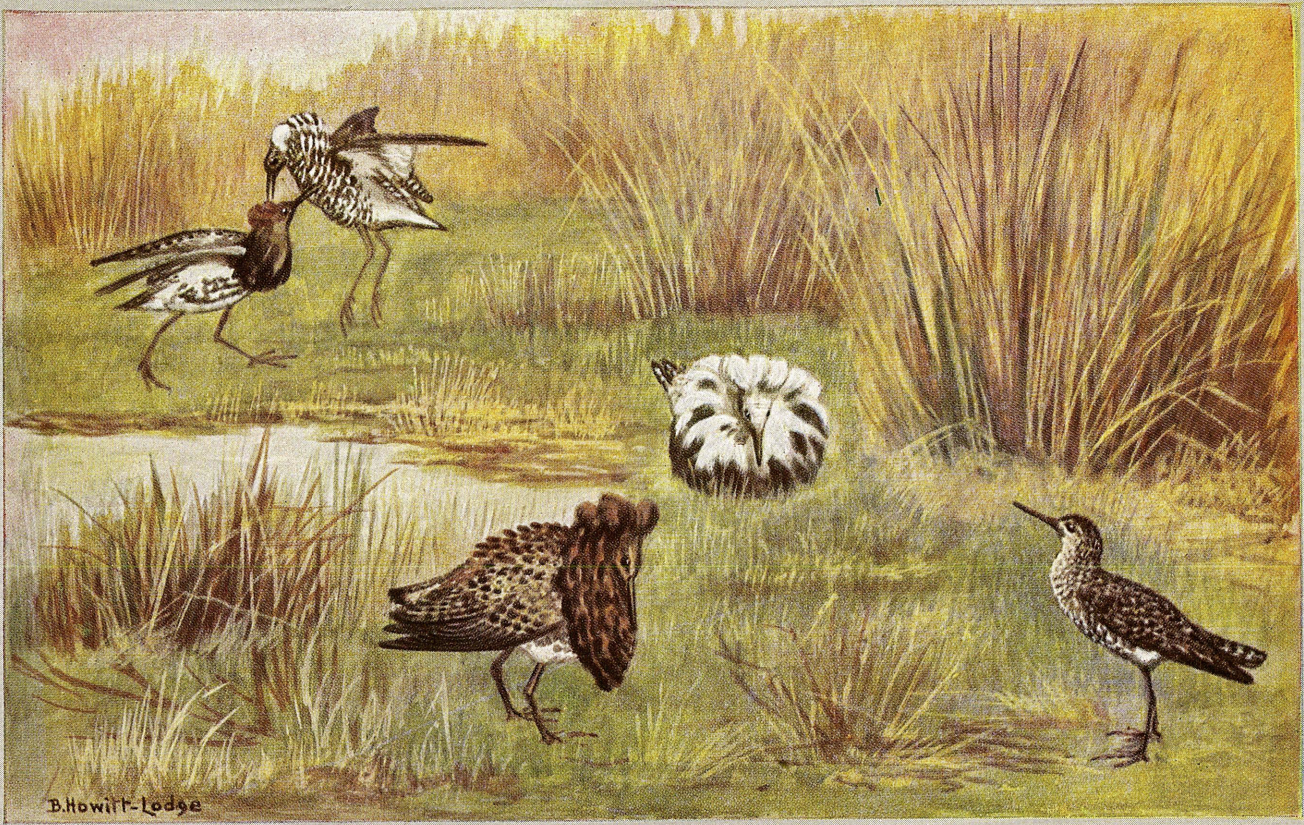
After a preliminary duel across the stream by the rival cross-bowmen, the French vaward, or first line, of cavalry was launched to a frontal attack. The passage through their own cross-bowmen, through the stream and then up the slope beyond disordered the ranks of the men-at-arms. Before they could either reach their enemy or reknit their ranks, the heavy mass of Flemish pikemen was launched forward against them and rolled them backwards. Robert of Artois strove to stop the ebb by infusing his second line. But this also lost impetus and order during its advance and, in the mêlée, suffered such a disadvantage that the horsemen, unseated or with their horses disembowelled, fell easy victims. The Flemings gave no quarter to any knight, and Robert of Artois was himself among the slain, with 63 nobles and 700 knights. When the wreckage was hurled back into the brook, the intact third line and the French foot retired from the field. Legends of all varieties were propagated to explain this defeat of mail-clad knights by mere burghers, but by obscuring the truth of their stupid storm tactics against an enemy who ably used ground, these legends helped to pave the way for the greater disaster of Crécy (*q.v.*).

After the battle as many as 700 pairs of golden spurs were collected on the field from the bodies of French knights and hung up as an offering in an abbey church—which has long disappeared—of the town.

COURTSHIP OF ANIMALS. When we see a peacock spreading his beautiful train to the full, and, occasionally vibrating the quills to produce a rustling sound, turning from side to side before his mate, or a barn-door cock with drooped wing and special call circling close round a hen, we are witnessing familiar examples of animal courtship.

Courtship may be defined to include all forms of action executed by members of one sex to stimulate members of the other sex to sexual activity. Such actions include the display of bright colours, or adornments such as crests; special tactile contacts; dances or other antics; pursuit; music, vocal or instrumental; the discharge of scents and perfumes; and the presentation of prey or of inedible but otherwise stimulating objects.

It is unfortunate that "courtship" is the only term available to denote these activities, since in our own species courtship is usually taken to mean only such as occur before marriage, in

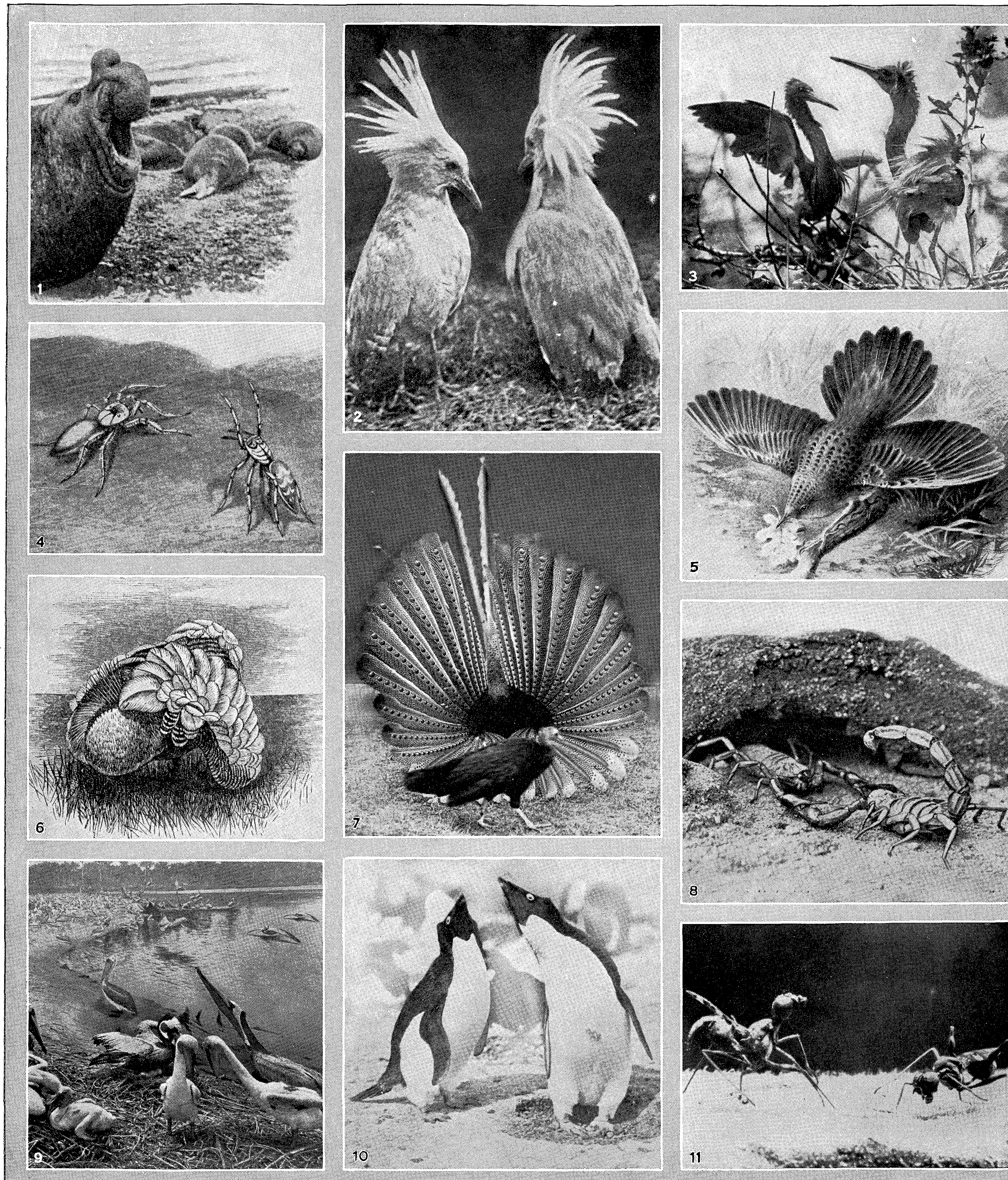


PAINTED FOR THE ENCYCLOPÆDIA BRITANNICA BY B. HOWITT-LODGE

COURTSHIP OF RARE WADING BIRDS

1. The ruff, *Philomachus pugnax*, the only wading bird that is polygamous. In spring the males assume their nuptial dress, the chief feature of which is the ruff

2. Nest relief ceremony of the snowy egret, *Leucophoyx candidissima*. This occurs when one parent is relieved from nest duty by the other



BY COURTESY OF (1) THE COUNCIL OF THE ZOOLOGICAL SOCIETY, LONDON, (9) THE AMERICAN MUSEUM OF NATURAL HISTORY, (11) DR. WHEELER, FROM PHOTOGRAPH BY DR. FAIRCHILD IN "JOURNAL OF HEREDITY"; FROM (4) "MARVELS OF THE UNIVERSE," (HUTCHINSON'S PERIODICAL COMPANY), (5) H. E. HOWARD, "THE BRITISH WARBLERS," (6) W. P. PYCRAFT, "HISTORY OF BIRDS," (METHUEN AND COMPANY), (8) W. P. PYCRAFT "COURTSHIP OF ANIMALS"; PHOTOGRAPHS, (2, 7) D. SETH SMITH, (10) DR. G. MURRAY LEVICK

COURTSHIP DISPLAYS OF VARIOUS ANIMALS

1. Elephant seal and females in the breeding season. In the foreground the male is roaring, with proboscis inflated. 2. Mutual display of kagu. Both sexes are alike and display by drooping the wings and raising the crest. 3. Louisiana heron relieving its mate on the nest. 4. Courtship in Spider Astia. The brightly coloured male is posturing on the right before the less brilliant female. 5. Male grasshopper warbler, without brilliant colour for display, bringing an oak-leaf for nest material to the female. 6. Display of male great bustard (*Otis tarda*). The neck is inflated and the white wing-feathers are fully spread. 7. Argus pheasant making display. He spreads his wings and throws them upward and forward to show eye spots and wing quills. 8. Courtship of scorpions. The male and female dance around, holding each other by the claws. After mating, the female usually devours her mate. 9. Nest relief of the brown pelican. The incoming bird is advancing, waving uplifted bill. The bird on the nest points bill downward, flits the wings slowly and utters a low grunting note. 10. Mutual display of adelie penguin. The female stands in a nest. Both drop their flippers and point the head upwards. 11. Courtship in the calobatas fly. While the male (on right) swings his abdomen to one side, the female throws back her head, waiting to be fed

PAINTED FOR THE ENCYCLOPÆDIA BRITANNICA BY B. HOWITT-LODGE

PHASES OF COURTSHIP BEHAVIOUR OF THE GREAT CRESTED GREBE

Two of the characteristic manifestations of the elaborate courtship of the crested grebe, *Podiceps cristatus*, are shown in the foreground of the illustration. The pair of birds on the right are performing the headshaking ceremony, while those on the left are indulging in the "penguin dance," which is not frequently seen. The behaviour of the birds in the background is normal and is observed at all seasons where the species is found

other words those which conduce to the finding of a more or less permanent mate. In most animals, however, marriage (in the sense of the living together of one or more males with one or more females in sexual association for considerable periods of time) does not exist, and in many birds "courtship" displays do not begin until after the selection of mates has taken place. Courtship, in the biological sense, primarily leads up to the act of pairing; where some form of marriage exists, courtship may also, or even primarily, be connected with the choice of mates.

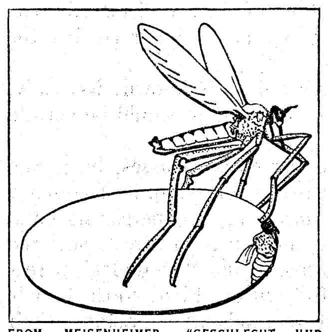
By no means all organisms show even the most primitive form of courtship. It is not present in plants, or in any of the lower groups of animals. A few instances of rudimentary courtship occur in annelid worms, but otherwise it is confined to the vertebrates, the molluscs, and the Arthropods. Even here it is absent from many of the lower sub-divisions of these groups. This becomes intelligible when the function of courtship is more closely looked into. No organism without a nervous system and sense-organs can be expected to show courtship. In other forms, the union of the sexual cells is either entirely a matter of chance; or of simultaneous ripening and discharge (as when all sea-urchins over a wide area discharge eggs and sperm at one time); or of passive transference, as in flower pollination; or of purely reflex reactions. Courtship will only be needed where the active co-operation of the sexes is needed for fertilization to be effected; and this will only be the case where the eggs and sperms are not blindly discharged, but are economized, either by means of internal fertilization or by being discharged in close proximity. Further, courtship will not be required where the nervous organization is so simple that pairing is a simple reflex action; but only when the reflex machinery of pairing is under the control of higher centres in the brain, and the nerve-processes of these centres and their emotional accompaniments need to be stimulated in a particular way before pairing can occur.

Courtship of Invertebrates.—The most primitive type of action which can be called courtship is found in certain marine annelids (bristle-worms) related to the common sandworm *Nereis.* At the breeding season these gather together and the males indulge in extraordinary contortions. These actions, whether by sight, touch, or smell, appear to stimulate the females to shed their eggs, upon which the males discharge their sperm. Certain land snails are among the few molluscs which show courtship; and this in spite of the fact that they are hermaphrodite. They possess a structure called the dart, or *spiculum amoris,* secreted by a special sac. This is discharged with some violence during the preliminaries of mating, and appears to stimulate the other animal, whose skin it may pierce. It might be expected that the highly organized Cephalopods (*q.v.*) would have a striking courtship, but in spite of their peculiar method of fertilization, the meagre reports available do not bear this out.

Although almost all Crustacea have well-developed special sense-organs and internal fertilization, pursuit and forcible capture is usually the only preliminary to mating. In the semi-terrestrial fiddler crabs, however, the males have one enormously enlarged claw, often brilliantly coloured, and this is employed—not as at first surmised, in fights between rival males, or forcibly carrying off females, but in a primitive form of courtship. In the breeding season, if a mature female passes near a sexually eager male, he stands on tiptoe and brandishes his claw in the air. As Pearse says, "the males appear to be proclaiming their maleness." The fiddler crab reacts to three main types of situation—feeding, danger, and reproduction. The brandishing of the male's claw is to the female the visible symbol of the reproductive situation.

A similar proclamation of a "sexual situation" appears also to be the main function of the courtship of male spiders. This, in certain of the hunting spiders (*e.g., Lycosidae, Attidae*), which possess good vision, consists in dances or contortions in which brightly coloured parts are prominently displayed. Web-spinning spiders, however, have poor vision; accordingly in some of them the courting male vibrates a strand of the web in a peculiar way. The importance to the males and to the race of inducing a sexual reaction in the female is here very great, since the female's normal reaction to any small animal would be to attack and devour it. The female does actually sometimes attempt to seize the male as prey, but gradually desists as the courtship proceeds. The male in spiders is occasionally devoured after fertilization. This appears to be the rule in scorpions, in which courtship takes the form of a dance with inter-locked claws.

Insects.—In insects, courtship is not infrequent. In many flies (*e.g., Drosophila, q.v.*) the male vibrates his wings in a special way. Some male butterflies, including the Blues (*Lycaenidae*), have scent-scales on their wings. The most remarkable of scent-producing courtships is that of *Hepialus.* Here the last pair of legs are transformed into organs rather like a powder-puff, normally kept inserted in a pair of pouches lined with scent-producing glands. In courtship the "powder-puffs" are used to throw scent towards the female. The sound-producing organs of grasshoppers and crickets (interesting because they probably produced the first not merely accidental and functionless sounds in the history of life) serve mainly to bring the sexes together; but they doubtless also help to generate a sexual situation. The male of the tree-cricket *Oecanthus* has a unique structure on his back, consisting of a gland capable of secreting a sweet liquid; during courtship he offers this secretion to the female.



FROM MEISENHEIMER, "GESCHLECHT UND GESCHLECHTER IM TIERREICHE" (FISCHER)

COURTSHIP FLIGHT OF EMPIS

In courtship, the males of these small flies present the females with animal prey embedded in a "balloon" of glistening bubbles

Special food of a protein nature is needed by many female insects if their eggs are to undergo their final ripening. Accordingly we find that a number of male insects present animal prey to the females as a part of courtship. In this way, two birds are killed with one biological stone. In some species of little flies of the family *Empidae,* the proffered prey is embedded in a "balloon" of glistening bubbles secreted by the male, and usually larger than himself, which renders him and his gift very conspicuous. In other species a strange modification of this habit has taken place. The balloon is still made and carried, but in place of the prey, bright objects such as flower-petals are placed in it, and the flies will avail themselves of coloured paper if this is provided. This utilization of foreign objects in courtship is only paralleled elsewhere by the bower-birds and man.

Courtship of Vertebrates.—In vertebrates, no courtship appears to exist in Cyclostomes, nor in the majority of fishes. Definite courtship, with striking adornments displayed by the males, is only found in a few fish species with internal fertilization or with peculiar breeding habits. In the Cyprinodonts fertilization is internal; and here the males are often brightly coloured and armed with special prolongations of ventral fin or tail; *e.g.,* in the swordtail (*Xiphophorus*) the handsome breeding males swim excitedly round the females, occasionally giving them a dig with their long tail.

In the sticklebacks there are violent combats between males for the possession of nesting territory, but it is not certain whether display of the bright colours assumed by breeding males has any sexually stimulating effect on the females.

In amphibia the most specialized group (frogs and toads) have no display-courtship, since the males' habit of embracing the females and waiting thus until the eggs are shed, when they discharge their sperm, renders it unnecessary. However, the meeting of the sexes is facilitated by the croaking of the males, which is often very loud owing to the development of huge vocal sacs. Here again possibly, though by no means certainly, the croaking has also a sexually stimulating function. If the chirping of male grasshopper-like insects was the first deliberate sound produced by life, the croaking of male frog-like amphibia was almost certainly life's first vocal music. In the Urodeles, or tailed amphibia, fertilization is internal, and here courtship is not infrequent. It usually consists in the male's rubbing himself against the female, at the same time discharging the secretion of special scent-glands.

It reaches its highest pitch in the European newts—*Molge* (*Triton*) and related genera—where the breeding males are usually brightly coloured, and dance round the females in striking postures while fanning scent from special glands upon them with their tails. The sexually stimulating function of this performance is here very definite. The males of these genera deposit their sperm in a packet or spermatophore, and this must be actually picked up by the female for fertilization to occur. It has been shown that females are quite irresponsive to the presence of isolated spermatophores, but will pick them up when stimulated by the male's performance.

Of reptilian courtship comparatively little is known; its study, especially in the more active lizards and snakes, would be certain to yield many interesting facts.

Mammals.—The two remaining vertebrate classes, birds and mammals, differ considerably in regard to courtship, its frequency and intensity being much greater among birds, whereas its complete or almost complete absence, not infrequently associated with male combat, is commoner in mammals. The biological reasons for this appear to be the following: First, most female mammals, owing to their special method of nourishing their embryonic young, have their reproductive activity very strictly controlled by means of hormones. At certain definite periods the uterus is ready for the embryo's implantation and one or more ova are shed from the ovary; simultaneously, the sexual instincts are strongly stimulated, and the female will readily mate with almost any male, at the same time becoming an object of the males' strong sexual desire owing to an odour specially produced at this period. In other words, the sexual attractiveness of the female and still more her readiness to mate are in the main chemically controlled, the intensity of sexual emotion during the period of "heat" or oestrus being in general very high. In birds, on the other hand, although the sex hormones produced in the breeding female predispose her to sexual emotion, their activity is neither so limited in time nor so intense, while in addition the males are more helpless than in most groups to enforce their desires on an unwilling female. (*See* REPRODUCTION, PHYSIOLOGY OF.)

In most mammals, the cyclical production of female sex hormones thus automatically ensures mating. As a result, both definite courtship and secondary sexual adornments are rare. Since female preference counts for so little, the winning of females by battle will secure them as mates, and consequently size and strength, as of the elephant seal, offensive weapons like stags' antlers or stallions' canines, and defensive weapons like the lion's mane or the baboon's "cape" of long hair are the chief secondary male characters.

In monkeys and apes there appears the tendency, which reaches its climax in civilized man, of emancipating the female's sexual emotions from the strict cyclical control of hormones, and allowing them free play at other times than at oestrus. The mating season is extended over more of the year, and the animals become ready to pair at other periods of the menstrual cycle than oestrus. In such circumstances it would be expected that stimulation by courtship and display would once more become of biological importance, and in point of fact primates do show a number of striking sexual adornments, such as beards, moustaches, or whiskers; bright coloured hair on the face; or brilliantly coloured patches of bare skin on the face and buttocks. Detailed studies of simian courtship would be of great interest. In man, of course, courtship is highly developed, and obviously plays an important biological role; but it cannot be discussed in a purely zoological article.

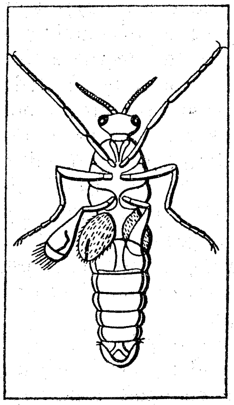
The Courtship of Birds.—It is in birds that courtship is most universal and striking, and its details and its biological significance have been here most thoroughly investigated. Consequently, we can lay down certain general rules as regards the form which courtship takes in birds of different modes of life and reproduction.

(1) The racial function of the male bird may be confined to fertilization (ruff, black grouse); or he may also mount guard during the female's incubation (most ducks); or may also share in feeding the young (most passerines and hawks); or also in incubation (grebes, herons, etc.) The more duties he executes for the good of the offspring, the greater is what may be called his racial value. To kill a male ruff immediately after fertilization has no deleterious effects on the next generation, whereas the death of a male grebe or heron at the same period seriously imperils the chances of the eggs and young.

(2) The "marriage systems" of birds vary from permanent monogamy (parrots, ravens), through monogamy for one season (most monogamous birds) or one brood (some wrens), to polygamy of the "small harem" type (jungle fowl, many pheasants), or of the promiscuous type (ruff, blackcock, probably some birds of paradise).

(3) The need for protection by means of protective coloration and inconspicuous habits varies considerably. Birds which nest gregariously in general need less protection at the nest-site than do birds nesting solitarily.

(4) The need for a continuous supply of food to the naked young of most passerine birds has resulted in the adoption by species of the system of "food-territory" in which the male and later the pair defend from intruders an area of some extent round their nest. (*See* BIRDS: *Reproductive Habits.*)



FROM MEISENHEIMER, "GESCHLECHT UND GESCHLECHTER IM TIERREICHE" (GUSTAV FISCHER)

MALE HISPIALUS HECTUS FROM BELOW

Courtship is modified in various ways with reference to these facts. In general, the less the share of the male in the care of eggs and young, the greater the difference between the sexes in plumage, and the more striking the (exclusively male) courtship behaviour. This is owing to the greater need for sober colouring and inconspicuous behaviour in the female, on whom the whole fate of the brood depends, and the lesser need in the male.

The greater the degree of polygamy, the greater in general the intensity of courtship and the exaggeration of display characters. This is due to the fact that with polygamy the successful males transmit their characters to many offsprings, while the less successful do not transmit their characters at all. Thus the premium on success in mating is greater.

Per contra, where the male plays a part closely similar to that of the female in incubation and care of the young, both sexes tend to be similar in plumage, and often both develop display-characters (crest of crested grebe, plumes of herons), and for the exclusively male courtship to give place to what may be called mutual courtship, in which both sexes take part.

Mutual courtship is often prolonged until the young are no longer under parental care (divers, egrets, grebes, albatrosses). In such cases it is probable that courtship, in addition to its function in raising the level of sexual emotion, has a secondary function as an emotional bond which helps to keep the pair together for the sake of the young.

Then, the greater the need for protection, the less will be the development of bright colours and display-characters. In extreme cases, as in European warblers, the sexes are practically identical in coloration, although the male alone displays in courtship.

In solitary birds with concealed nests, it is rare for courtship to take place near the nest, for fear of revealing its site. When this danger is not of importance, courtship may occur at the nest (*e.g.*, in the rook). It is especially noticeable in gregarious birds with mutual courtship (*e.g.*, pelicans, herons) when a joint ceremony is often performed when one bird relieves its mate on the nest.

Finally, where food-territory exists, many sexual activities are related with the territorial system, and not, as was originally thought, with true courtship. For instance, the song of all our common singing birds is mainly an advertisement to females of the presence of a male in possession of territory, and a warning notice to other males to keep out.

There is often a recrudescence of courtship in a mild form in early autumn when the birds are released from family cares and are still warm and well fed. In some gregarious forms this appears to blend with the remarkable social performances of this season (*e.g.,* stone-curlew). In the oyster-catcher, the same performance is employed both in courtship and to demonstrate sexual or territorial jealousy. When these two motives reinforce each other, this performance may be joined in by a number of birds and assumes in a rudimentary way a social character, as of a human dance.

In courtship, grebes and divers present weeds to their mates, penguins stones, herons sticks, warblers twigs or leaves. In all such cases the objects presented constitute nesting material; it appears that some association occurs between the two pleasurable breeding activities of nest-building and courtship.

Occasionally non-sexual actions are incorporated in courtship. Grebes often give a useless (one might say "ritual") imitation of preening their wings during courtship, and swans behave somewhat similarly. The psychological explanation of this is not easy.

An interesting psychological transference has been noted in the Adelie penguin. The males may present nesting material (stones) not only, as is normal, to the females as part of courtship, but to other organisms which interest them, such as explorers and dogs.

Another type of transference has been observed in a captive male Argus pheasant. The courtship of this species is given to a stationary female. The female with which this male was confined belonged to another species, and would not stand still. The male, after repeated attempts to display before the female, gave up and proceeded to display before his water-trough!

Almost as a matter of course, the mode of life is reflected in courtship. As part of courtship, the males of the fast-flying falcons fly straight at their mates; the golden-eye drake raises a jet of water with his feet; grebes, divers, and various diving ducks use their diving powers to appear from below the surface in striking display-poses close to their mates and so forth.

Bower-Birds.—In some ways the most remarkable courtship known is that of the bower-birds (*q.v.*). These birds clear playgrounds, in which special bowers (quite unlike nests) are constructed by some species. In the playground (if a bower is made opposite its entrance) is deposited a collection of bright objects. The objects differ with the species; they may include silvery leaves, flowers, shells, berries, bones, etc. When the female visits the playground, the male pursues her amorously round it (through the bower, when present). Here it appears that the bright objects collected serve instead of the brilliant plumage of other male birds to stimulate the female.

The details of courtship vary enormously from species to species; a number of special types are figured in the plates. They all have in common two facts. First, the display presents the bird in an unusual aspect; and presumably stimulates by its very unusualness. Secondly, when bright colours or special plumage exists only in one sex, or only during the breeding season, these are in the great majority of cases made specially conspicuous in courtship. Often such characteristics are normally concealed, but made visible only by display.

A great deal still remains to be discovered about courtship, and amateur naturalists can render considerable service to biology by recording the results of intensive observation of the whole courtship period even of quite common species. (*See* SELECTION: *Sexual Selection;* BIRDS; PSYCHOLOGY, COMPARATIVE.)

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COUSIN, JEAN (1500–1590), French painter, was born at Soucy, near Sens, and began as a glass-painter, his windows in the Sainte Chapelle at Vincennes being considered the finest in France. As a painter of subject pictures he is ranked as the founder of the French school, as having first departed from the practice of portraits. His "Last Judgment," influenced by Parmigiano, is in the Louvre, and a "Descent from the Cross" (1523) in the museum at Mainz is attributed to him. He was known also as a sculptor and an engraver, both in etching and on wood, his woodcuts for Jean le Clerc's Bible (1596) and other books being his best known work. He also wrote a *Livre de perspective* (1560), and a *Livre de portraiture* (1571).

See Ambroise Firmin-Didot, *Étude sur J. Cousin* (1872), and *Recueil des oeuvres choisies de J. Cousin* (1873).

COUSIN, VICTOR (1792–1867), French philosopher, was born in Paris, in the Quartier St. Antoine, on Nov. 28, 1792. He was educated at the Lycée Charlemagne, and at the age of 18 passed to the Normal School, where he later lectured on Philosophy. In 1815–16 he was assistant to Royer-Collard in the chair of history of modern philosophy. In these early years the influences to which he owed most were those of Laromiguière, who taught the philosophy of Locke and Condillac, Royer-Collard, who introduced him to the Scottish philosophy, and Maine de Biran, on the psychological side. He then began to study German philosophy, especially that of Schelling, whose influence can also be traced in his work. In 1817 he met Hegel at Heidelberg, and in 1818, going to Munich, he met Schelling and Jacobi.

Political changes deprived him of his offices in 1821–22, and he went again to Germany; in Berlin in 1824 he was imprisoned, on some political charge, for six months, and continued under suspicion for three years. During this period of enforced abandonment of teaching his philosophy took definite shape, and in 1826 he published the *Fragmens Philosophiques,* which contains most that is distinctive in his thought. To this period also belong his edition of Proclus (1820–27), and of Descartes (11 vols. 1826), and the beginning of the translation of Plato (13 vols.), which occupied him from 1825–40. In 1828 Cousin and Guizot were recalled to the university, and the three years that followed were the period of his greatest triumph as a lecturer. The hall of the Sorbonne was crowded, and a taste for history revived in France to an extent unknown since the 17th century. Guizot's ministry then made him a member of the Council of Public Instruction, and in 1832 he ceased to lecture. In 1840 he became minister of public instruction under Thiers, remaining at the same time director of the normal school and virtual head of the university.

The most important work he accomplished at this time was the organization of primary education. Owing to his efforts, France followed in this matter the example of Prussia, which he regarded as affording the best example of organized national education. In 1831 he visited Germany to study the system, and his results were published as "Rapport sur l'état de l'instruction publique . . . en Prusse." Then followed the law of primary instruction, which, in the words of the *Edinburgh Review* (July 1833) "marks an epoch in the progress of national education." During this period he also published revised editions of his lectures and studies of various periods in the history of philosophy. In 1854 he published *Du vrai, du beau, et du bien.* At the close of the reign of Louis Philippe he retired from public life. He occupied a suite of rooms in the Sorbonne, and died at Cannes on Jan. 13, 1867.

The three distinctive points in Cousin's philosophy are method, the results of the method, and its application to the history of philosophy. The method is that of observation, analysis and deduction, applied to the facts of consciousness, supplemented by inferences about the nature of reality necessitated by the data of consciousness; this gives us psychology as the basis of metaphysics or ontology. The results to which this method leads are sensibility, activity or liberty and reason. His doctrine of liberty contains a distinction between the spontaneous and reflective activity of the will, while the distinctive point of his theory of reason is the doctrine of the impersonality of reason, which he thought Kant missed by putting necessity as the criterion of the principles of knowledge, and thus making them relative to the human intelligence, and therefore incapable of revealing substantial reality. The primary principles of reason are cause and substance, and by means of these we pass from psychology to ontology, the knowledge of objective reality. From the reciprocally limitative ideas of the *me* and the *not-me* we reach that of the absolute, which is the cause of both.

Finally, he applies the three stages he has discovered, the spontaneous, the reflective and the recognition of the relation of the finite and infinite to the history of philosophy.

Cousin's gifts lay in the direction of observation and generalization rather than analysis or original speculation. He left no distinctive permanent principle of philosophy. But his eclecticism, proceeding as it did from an appreciation of nearly every system of philosophy ancient and modern, was a valuable influence in the direction of toleration and width of view.

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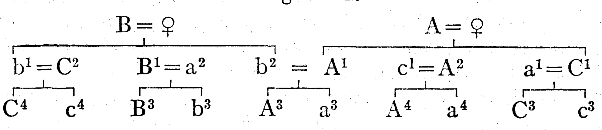
COUSIN, a term of relationship (Late Lat. *cosinus*, perhaps an abbreviation of the classic Latin *consobrinus*). Children of brothers and sisters are to each other first cousins, or cousins-german; the children of first cousins are to each other second cousins; the child of a first cousin is to the first cousin of his father or mother a first cousin once removed.

The word cousin has also, since the 16th century, been used by sovereigns as an honorific style in addressing persons of exalted, but not equal, sovereign rank, the term "brother" being reserved as the style used by one sovereign in addressing another.

COUSIN MARRIAGE. Though among some primitive peoples the marriage of first cousins is strongly deprecated, many consider it the most suitable union and even demand that a man's first wife shall be so related to him. This preference for cousin marriage is found in many parts of Australia, Oceania, Africa and Asia. In North America it is not enjoined, but is freely permitted. There is no conclusive evidence that such peoples suffer in any way from this inbreeding or are inferior physically to those who regard the marriage of first or even more distant cousins as injurious, though the latter aver that such unions result in sterility or the production of weakly children. This disapprobation may even extend to classificatory cousins, as in parts of East Africa, where a man may not take as wife any woman of his mother's clan.

Cross-cousin Marriage.—In European societies all first cousins are regarded as being equally close relatives. Primitive peoples commonly distinguish the offspring of two brothers or two sisters from the offspring of a brother and a sister respectively. The former are technically called parallel or ortho-cousins, the latter cross-cousins. A few tribes do not differentiate between these two for purposes of marriage, but generally, where cousin marriage is enjoined, this refers to *cross-cousins* while *ortho-cousins* are strictly forbidden to mate. In a society based upon the clan organization (*see* RELATIONSHIP TERMS) such a prohibition on one set of ortho-cousins is intelligible for they would belong to the same clan. But this does not explain the *tabu* on both sets, which though not very widespread is found. It may be due to the clan of mother and father being equally important, due possibly to a change in the mode of reckoning descent; or to survival of a time when society contained only two exogamous groups. (*See* diagram I. and art. DUAL ORGANIZATION.)

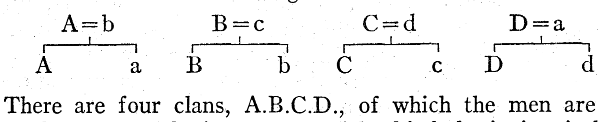
Diagram I.



There are three clans A.B.C. of which the men are represented by A1; A2; . . . the women by a1; a2. . . . Descent is patrilineal. If we take the brother and sister A3, a3, their *cross-cousins* are B3, b3 and C3, c3; while their *ortho-cousins* are A4, a4 and C4, c4. But were there only two clans instead of three their mother's sister, b1 must have married a man of clan A, and her children also would then have belonged to the same clan as A3, a3.

A further distinction is often made between the two types of cross-cousin, the daughters of the father's sister and those of the maternal uncle. Not uncommonly, though marriage with one of these is compulsory, marriage with the other is forbidden. Of the two, it is more usual for the paternal aunt's daughter to be prohibited, though in parts of India, she is the orthodox wife. Owing to the wide expansion of relationship prevalent among those who have the clan organization (*see* RELATIONSHIP TERMS) it is often not clear whether, where cousin-marriage is encouraged, the real or classificatory cousin is usually selected. In the majority of cases a first cousin by genealogical reckoning is preferred, though, failing such an one, a second or a classificatory cousin would be allowed. Thus in a society composed only of three clans, all are directly related; if there are more than three they will still be all linked together though the connection will be indirect. (*See* diagram II.) Cross-cousin marriage is often associated with the Dual Organization of Society (*q.v.*), but it can never bring it about. Cross-cousin marriage which is also associated with marriage by exchange, however, does tend to unite pairs of clans within the community. (*See* EXCHANGE MARRIAGE.)

Diagram II.



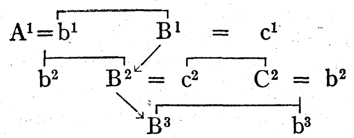
There are four clans, A.B.C.D., of which the men are A.B. . . . the women a. b. A can marry *either* his father's sister's daughter d., *or* his maternal uncle's daughter, b. Similarly B can marry a. *or* c., etc. But A can never take a wife from Clan C nor B one from clan D etc. Where only one cross-cousin is permitted the women of clan A will marry into one clan, *e.g.* D.; the men into the other *e.g.* B.

These inter-clan alliances function clearly in economic and ceremonial life. For instance, in a tribe in Assam which enjoins marriage with the maternal uncle's daughter and prohibits it with the father's sister's daughter, during the death ceremonies the clan of the deceased, that of his wife and that of his sister's husband, each has its appointed part to perform. In Australia marriage is almost entirely conditioned by relationship, not on clan membership, a man's wife being either his mother's brother's daughter or the daughter's daughter of his mother's maternal uncle (real or fictive), which enjoined marriages appear in some tribes to have divided society into four and eight sections respectively.

Though cross-cousin marriage, wherever enjoined, links together both groups and individuals, it cannot be regarded as a single sociological phenomenon. Among some peoples it is an institution for the benefit of the man; in others it safeguards the position of the woman; while in others again it is a duty which both owe for the sake of their respective groups. Where marriageable women are scarce, due to polygyny or female infanticide, or where heavy gifts have to be made for a bride, the difficulty of obtaining a wife is relieved if it is a recognized custom for a man to have preferential right to one of his cousins; and in many parts of the world, especially among patrilineal peoples a father may claim one of his sister's daughters for his son. This does not always imply that the young man can get a wife without giving any bride-price for her, though this happens sometimes, but usually less will be demanded of him, and he may have the power to veto his cousin's marriage to any other man. Elsewhere the institution may chiefly benefit the woman by ensuring her a husband to father her children, and provide her with protection and economic support. In many places however, cross-cousin marriage is enforced for the benefit of the group rather than the individual, for it strengthens the ties between related families or clans, and also prevents the weakening of a group through the loss of its members.

Its most important effect is on the transmission of property. Amongst a matrilineal people a man's heirs are his sister's sons. His own children can receive nothing, however much he may wish them to do so. A partial solution of this conflict between paternal inclination and social duty is obtained by the marriage of his heir with his daughter, which, since he is legal guardian to the former, is generally possible. In this way his daughter will benefit from his wealth. If his son marries his sister's daughter, then his own grandchildren will eventually inherit it. (*See* diagram III.)

Diagram III.



The property passes from B^1 to his sister's son B^2; and if his own son C^2 marries B^2's sister, b^2, it will revert on B^2's death to B^1's grandson B^3.

In parts of the west Pacific where cross-cousin marriage is favoured this desire on the part of a man to provide for his children is given by the natives themselves as the reason for the practice. Similarly, where property is held by the clan constant intermarriage between two or three clans prevents their wealth from being dispersed. The advantages resulting from the customary marriage of cross-cousins, both to the individuals and to society as a whole might have given rise to it in different parts of the world. The least satisfactory theory derives it from a society in which there are two exogamous groups. Where this is found all the women available to a man as a wife belong to the group which contains his cross-cousins and, if matrilineal, his father's sister, or if patrilineal, his mother, and all those who, according to the classificatory system of nomenclature, are included with them. It has been argued that, since a man will tend to choose some one of his own generation, cross-cousin marriage will result. This is purely hypothetical, since a woman of his generation may be many years his senior or his junior, while a woman of the generation above or below may be his contemporary. In a patrilineal community the former might be denied him because classed with his mother, but this would not hold in a matrilineal one. But the strongest argument against this theory is that while it might explain marriage with a classificatory cross-cousin, it does not explain why almost always it is the first cousin who is the prescribed mate. To account for the custom in the west Pacific Dr. Rivers believed that in former times the old men were in the habit of appropriating the young girls as wives for themselves. To provide a mate for his sister's son a man gave him one of his own wives, and later substituted his daughter. This again is hypothetical, though there is some evidence for the practice of marriage with the maternal uncle's wife or widow in this area.

Sir James Frazer argues that a common method of acquiring a wife is for two men to exchange sisters. The children of these two unions would then be cross-cousins. When the boys of the second generation sought for mates, a second exchange of sisters would be effected, thus bringing about a marriage between people who were doubly cross-cousins. (*See* EXCHANGE MARRIAGE.) This cannot be proved, but it affords an explanation of the conditions in many parts of Australia. Nevertheless there are many tribes, such as those of Torres straits and part of New Guinea who practise marriage by exchange, but prohibit the marriage of first cousins.

Ortho-cousin Marriage.—The marriage of ortho-cousins is incompatible with the clan organization, but is enjoined among certain patrilineal peoples who are not so organized, particularly in the form of marriage with the father's brother's daughter. (There is no record of any people who enjoin marriage with the daughter of the maternal aunt.) It is most prominent among the Arabs and is approved by Mohammedans generally, and has been recorded from the Basuto of South Africa. Among the Arabian Bedouins a man has a right to his paternal uncle's daughter. The bride-price he pays for her is less than would be demanded of another man and her father cannot bestow her hand elsewhere without his nephew's consent. It also seems that according to Mohammedan law this type of marriage is something of a duty, to perform which confers religious merit. Two main reasons are put forward for encouraging ortho-cousins to marry. One is a desire to "keep the blood pure" and this is considered especially important among the better class families. The other reason is to prevent property from leaving the family; bride-price and dowry may change hands but the wealth remains within the group of bride and bride-groom. This is probably the reason for the prescribed marriage with the father's brother's daughter in Madagascar, where, though descent is matrilineal and marriage with the mother's sister's daughter therefore incestuous, inheritance is patrilineal. The Arabs maintain that this form of marriage makes for domestic happiness, since the character of the girl is known beforehand, and further, if she should prove refractory her husband will have the support of her father and brothers in quelling her. These reasons are, however, probably rationalizations rather than originators of the custom. For the latter we must look to considerations of family pride and economics.

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COUSINS, SAMUEL (1801–1887), English mezzotint engraver, was born at Exeter, May 9, 1801. He was pre-eminently the interpreter of Sir Thomas Lawrence. During his apprenticeship to S. W. Reynolds he engraved many of the best amongst the 360 little mezzotints illustrating the works of Sir Joshua Reynolds. In the finest of his numerous transcripts of Lawrence, such as "Lady Acland and her Sons," "Pope Pius VII." and "Master Lambton," the distinguishing characteristics of the engraver's work, brilliancy and force of effect in a high key, corresponded exactly with similar qualities in the painter. After the introduction of steel for engraving purposes about the year 1823, Cousins and his contemporaries were compelled to work on it, because the soft copper previously used for mezzotint plates did not yield a sufficient number of fine impressions to enable the method to compete commercially against line engraving. The painter-like quality which distinguished the 18th century mezzotints on copper was wanting in his later works, because the hardness of the steel on which they were engraved impaired freedom of execution and richness of tone, and so enhanced the labour of scraping that he accelerated the work by stipple, etching the details instead of scraping them out of the "ground" in the manner of his predecessors. To this "mixed style," previously used by Richard Earlom on copper, Cousins added heavy roulette and rocking-tool textures, tending to fortify the darks, when he found that the "burr" even on steel failed to yield enough fine impressions to meet the demand. The effect of his prints in this method after Reynolds and Millais was mechanical and out of harmony with the picturesque technique of these painters, but the phenomenal popularity which Cousins gained for his works at least kept alive and in favour a form of mezzotint engraving during a critical phase of its history. He died in London, unmarried, on May 7, 1887.

See Algernon Graves, *Catalogue of the Works of Samuel Cousins, R.A.,* (1888); George Pycroft, M.R.C.S.E., *Memoir of Samuel Cousins, R.A., Member of the Legion of Honour* (1899); and Alfred Whitman, *Samuel Cousins* (1904), which contains a catalogue, good illustrations, and much detail useful to the collector and dealer.

COUSTOU, the name of a famous family of French sculptors.

NICOLAS COUSTOU (1658–1733) was the son of a wood-carver at Lyons, where he was born. At 18 he removed to Paris, to study under C. A. Coysevox, his mother's brother, president of the recently established Academy of Painting and Sculpture; and at 23 he gained the Colbert prize, which entitled him to four years' education at the French academy at Rome. He afterwards became rector and chancellor of the Academy of Painting and Sculpture. From 1700 he was an active collaborator with Coysevox at the palaces of Marly and Versailles. His most famous works are "La Seine et la Marne," "La Saône," the "Berger Chasseur" in the Tuileries gardens, the bas-relief "Le Passage du Rhin" in the Louvre, and the "Descent from the Cross" placed behind the choir altar of Notre Dame at Paris.

His younger brother, GUILLAUME COUSTOU (1677–1746), also gained the Colbert prize; but refusing to submit to the rules of the academy, he wandered homeless, through the streets of Rome. At length he was befriended by the sculptor Legros, under whom he studied. Returning to Paris, he was in 1704 admitted into the Academy of Painting and Sculpture, of which he afterwards became director; and, like his brother, he was employed by Louis XIV. His finest works are the famous group of the "Horse Tamers," originally at Marly, now in the Champs Elysées at Paris, the colossal group "The Ocean and the Mediterranean" at Marly, the bronze "Rhône," which formed part of the statue of Louis XIV. at Lyons, and the sculptures at the entrance of the Hôtel des Invalides partly destroyed during the Revolution and subsequently restored.

Another GUILLAUME COUSTOU (1716–1777), the son of Nicolas, was also a sculptor.

See Louis Gougenot, *Éloge de M. Coustou le jeune* (1903); Arsène Houssaye, *Histoire de l'art français au XVIIIe siècle* (1860); Lady Dilke, *Gazette des beaux-arts*, vol. xxv. (1901).

COUTANCES, WALTER OF (d. 1207), bishop of Lincoln and archbishop of Rouen, commenced his career in the chancery of Henry II., was elected bishop of Lincoln in 1182, and in 1184 obtained, with the king's help, the see of Rouen. Throughout his career he was much employed in diplomatic and administrative duties. He started with Richard I. for the Third Crusade, but was sent back from Messina to investigate the charges which the barons and the official class had brought against the chancellor, William Longchamp. The archbishop of Rouen sided with the barons and John, and sanctioned Longchamp's deposition. The Great Council now recognized the archbishop as chief justiciar, and he remained at the head of the government till 1193, when he was replaced by Hubert Walter. The archbishop did good service in the negotiations for Richard's release, but subsequently quarrelled with his master and laid Normandy under an interdict, because the border stronghold of Château Gaillard in the Vexin had been built on his land without his consent. After Richard's death the archbishop accepted John as the lawful heir of Normandy and consecrated him as duke. The archbishop accepted the French conquest of Normandy with equanimity (1204), although he kept to his old allegiance while the issue of the struggle was in doubt.

See W. Stubbs's editions in Rolls Series of *Benedictus Abbas*, No. 49 (1867); *Hoveden*, No. 51 (1868–71); *Diceto*, No. 68 (1876). R. Howlett's edition of "William of Newburgh" and "Richard of Devizes" in *Chronicles, etc., of the Reigns of Stephen, Henry II., and Richard I.*, Rolls Ser., No. 82 (1884–89). *See* also the preface to vol. 3 of Stubbs's *Hoveden*, pp. lix.–xcviii.; J. H. Round, *Commune of London* (1899), and the French poem on *Guillaume le Maréchal* ed. P. Meyer (Soc. de l'Histoire de France, 1891–1901).

COUTANCES, a town of north-western France, capital of an arrondissement of the department of Manche, 7 mi. E. of the English Channel and 58 mi. S. of Cherbourg on the Western railway. Pop. (1936) 6,465. It is beautifully situated on the right bank of the Soulle on a protruding core of granite crowned by the celebrated cathedral of Notre Dame with its three conspicuous towers. The cathedral of Notre Dame is mainly 13th century Gothic, retaining only some pier-bases of the first church consecrated on the site *c.* 1090. The slender turrets massed round the western towers and the octagonal central tower, which forms a lantern within, are conspicuous features. In the interior, which comprises the nave with aisles, transept and choir with ambulatory and side chapels, there are fine rose-windows with stained glass of the 14th century. The church of St. Pierre, rebuilt in the Renaissance, has a graceful dome and an octagonal tower. There is an aqueduct of the 14th century to the west of the town.

Coutances, the ancient Cosedia, was one of the chief pre-Roman towns in the country of the Unelli. In the 3rd century its name was changed to *Constantia,* in honour of the emperor *Constantius Chlorus* by whom it was fortified. It became the capital of the *pagus Constantinus* (*Cotentin*), and in the middle ages was the seat of a viscount, with a long list of sieges from the time of the Conqueror onwards. It has been an episcopal see since the 5th century. In the 17th century it was the centre of the revolt of the *Nu-pieds,* caused by the imposition of the salt-tax (*gabelle*). Coutances is a quiet town with winding streets and pleasant boulevards bordering it on the east. The town is the seat of a bishop, a court of assizes and a sub-prefect, and has tribunals of first instance and of commerce. Leather-dressing and wool-spinning are carried on and there is trade in live-stock and agricultural produce.

COUTHON, GEORGES (1755–1794), French revolutionist, was born in Orcet, Puy-de-Dôme, and was admitted advocate at Clermont in 1785. On the outbreak of the Revolution, Couthon, who was then a member of the municipality of Clermont-Ferrand, published his *L'Aristocrate converti,* advocating constitutional monarchy. He became president of the tribunal of the town of Clermont in 1791, and in September of the same year was elected deputy to the legislative assembly. In Sept. 1792 Couthon was elected member of the national convention, and at the trial of the king voted for the sentence of death without appeal. After some hesitation he joined Robespierre, and became his staunch friend and adherent. He was the first to demand the arrest of the proscribed Girondists. On May 30, 1793, he became a member of the committee of public safety, and in August was sent as one of the commissioners of the convention attached to the army before Lyons. Impatient at the slow progress made by the besieging force, he decreed a *levée en masse* in the department of Puy-de-Dôme, collected an army of 60,000 men, and himself led them to Lyons. When the city was taken, Oct. 9, 1793, although the convention ordered its destruction, Couthon did not carry out the decree, and showed a certain moderation which led to his recall on Oct. 29. The wholesale massacre in the city began only after the arrival on Nov. 3, 1793, of Collot d'Herbois. Couthon returned to Paris and on Dec. 21 was elected president of the convention. He shared in the prosecution of the Hébertists, and promoted the law of the 22nd Prairial, which in the case of trials before the revolutionary tribunal deprived the accused of the aid of counsel or of witnesses for their defence. During the crisis preceding the 9th Thermidor, Couthon remained in Paris, in order, as he wrote, that he might either die or triumph with Robespierre and liberty. Arrested with Robespierre and Saint-Just, his colleagues in the triumvirate of the Terror, he was taken to the scaffold on the same cart with Robespierre on July 28, 1794 (10th Thermidor).

See Fr. Mège, *Correspondance de Couthon . . . suivie de "l'Aristocrate converti," comédie en deux actes de Couthon* (1872), and *Nouveaux Documents sur Georges Couthon* (Clermont-Ferrand, 1890); also F. A. Aulard, *Les Orateurs de la Législative et de la Convention,* ii. 425–443 (1885–86).

COUTTS, THOMAS (1735–1822), English banker and founder of the banking house of Coutts & Co., was born on Sept. 7, 1735. He was the fourth son of John Coutts (1699–1751), lord provost of Edinburgh in 1742, who carried on a business in corn and negotiated bills of exchange. Soon after the death of John Coutts the business was divided into two branches, one carried on in Edinburgh, the other in London. The banking business in London was in the hands of James and Thomas Coutts, sons of John Coutts. From the death of his brother in 1778, Thomas, as surviving partner, became sole head of the firm; and under his direction the banking house was firmly established. He died in London on Feb. 24, 1822.

See C. Rogers, *Genealogical Memoirs of the Families of Colt and Coutts* (1879); and R. Richardson, *Coutts & Co.* (1900).

COUTURE, THOMAS (1815–1879), French historical and *genre* painter, was born at Senlis (Oise), and studied under Baron A. J. Gros and Paul Delaroche, winning a Prix de Rome in 1837. His masterpieces were his "Romans in the Decadence of the Empire" (1847), now in the Luxembourg, and his "Love of Money" (1844), at Toulouse.

COUVADE, a custom so called in Béarn (literally a "brooding," from Fr. *couver,* to hatch), requiring that the father, at and sometimes before the birth of his child, shall retire to bed and fast or abstain from certain kinds of food, receiving the attentions generally shown to women at their confinements. The existence of the custom in ancient classical times is testified to by Apollonius Rhodius, Diodorus (who found it among the Corsicans), and Strabo (who noticed it among the Spanish Basques, by whom, as well as by the Gascons, it has been said to be observed, though the most recent researches entirely discredit this). Marco Polo relates its observance in Chinese Turkistan. It is found in China, India, Assam, Borneo, Siam, Africa and the Americas. In certain of the Baltic provinces of Russia the husband, on the lying-in of the wife, takes to his bed and groans in mock pain. In East Anglia, a curiously obstinate belief survives (the prevalence of which in earlier times is proved by references to it in Elizabethan drama) that the pregnancy of the woman affects the man, and the young husband who complains of a toothache is assailed by pleasantries as to his wife's condition.

In explanation of the custom, E. B. Tylor traced in it the transition from the matriarchal to the patriarchal system of tribe-organization. Thus, the couvade arose in the father's desire to emphasize the bond of blood between himself and his child. In some countries the father has to purchase the child from its mother; and in the Roman ceremony of the husband raising the baby from the floor we may trace the savage idea that the male parent must formally proclaim his acceptance of and responsibility for the offspring. The explanation of the American Indians, as indeed of many peoples who practise it, is that if the father engaged in any hard or hazardous work, *e.g.* hunting, or was careless in his diet, the child would suffer and inherit the physical faults and peculiarities of the animals eaten. Obviously as Professor Westermarck shows there is the idea "that there is an intimate relationship" between father and child such that the activities of the father affect the child. Tabus of this nature are found both in matrilineal and in patrilineal groups.

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COVE. A small inlet or sheltered bay in a coast-line. In English dialect a cave or recess in a mountain-side. The use of the word was first confined to a small chamber or inner recess in a room or building. Hence the particular application in architecture (*q.v.*) to any kind of concave moulding. The term "coving" is given in half-timbered work to the curved soffit under a projecting window, or carrying the gutter of a house. The slang use of "cove" for any male person, like a "fellow," "chap," is found in the form "cofe" in T. Harman's *Caveat for Cursetors* (1587) and other early quotations, *cf.* the Scots word "cofe," a pedlar, hawker.

COVED, an architectural term applied to the concave curved juncture of two surfaces: thus a coved ceiling is one which is flat or nearly flat in the centre, but joins the walls by means of a concave sweep. A coved moulding, or cove, is any small moulding with a concave profile, particularly when the profile approximates a quarter circle.

COVELLITE, a mineral species consisting of cupric sulphide, CuS, crystallizing in the hexagonal system. It is of less frequent occurrence in nature than chalcocite, the orthorhombic cuprous sulphide. Crystals are rare, the mineral being usually found as compact and earthy masses or as a blue coating on other copper sulphides. The dark indigo-blue colour is a characteristic feature, and the mineral was early known as indigo-copper (Ger. *Kupferindig*). The name covellite is taken from N. Covelli, who in 1839 observed crystals of cupric sulphide encrusting Vesuvian lava, the mineral having been formed here by the interaction of hydrogen sulphide and cupric chloride, both of which are volatile volcanic products. Covellite is, however, more commonly found in copper-bearing veins, where it has resulted by the alteration of other copper sulphides, especially chalcopyrite. It is found in many copper mines. (L. J. S.)

COVENANT, a mutual agreement of two or more parties, or an undertaking made by one of the parties. In Old Testament theology the word connotes a strongly-binding agreement, *e.g.*, the covenant between Abimelech and Isaac; even more particularly a covenant between God and man (Gen. xv. 17).

The word is used by Johannes Cocceius (*q.v.*) to describe his "covenant" or "federal" theology, based on the two covenants of works or life made by God with Adam, on condition of obedience, and of grace or redemption, made with Christ. In Scottish ecclesiastical history, covenant appears in the two agreements signed by the members of the Scottish Church in defence of their religious and ecclesiastical systems (*see* COVENANTERS).

The Ulster Covenant was a solemn pledge undertaken throughout the province of Ulster in Ireland on Sept. 27, 1912, by the followers of Sir Edward (Lord) Carson (*q.v.*) in his opposition to Home Rule (*see* IRELAND: *History*).

Covenant is also in English law a word which has been used in a variety of senses. In its strict sense, covenant means an agreement *under seal,* that something has or has not already been done, or shall or shall not be done hereafter (Shep. *Touchstone,* 160, 162). The person who makes, and is bound to perform, the promise or stipulation is the covenantor: the person in whose favour it is made is the covenantee.

A covenant is said to be *express* when it is created by the express words of the parties to the deed declaratory of their intention. It is not indispensable that the word "covenant" should be used. Any word which clearly indicates the intention of the parties to covenant will suffice. An *implied* covenant, or *covenant in law,* "depends for its existence on the intendment and construction of law. There are some words which of themselves do not import an express covenant, yet, being made use of in certain contracts, have a similar operation and are called covenants in law; and they are as effectually binding on the parties as if expressed in the most unequivocal terms" (Platt on *Covenants,* p. 40). The Conveyancing Act 1881 (now ss. 76 and 77 of the Law of Property Act 1925) provides that in conveyances for valuable consideration, certain covenants are to be implied, although not specified in the instrument. All these statutory implied covenants "run with the land" (*see* LANDLORD AND TENANT). The distinction between *real* and *personal* covenants is that the former do, while the latter do not, run with the land. When a covenant relates to an act already done, it is usually termed a covenant *executed;* where the performance is future, the covenant is termed *executory.* The *covenant for seisin* was an assurance to the grantee that the grantor had the estate which he purported to convey. In England it is now included in the covenant for right to convey; but it is still in separate use in several States in the United States. The *covenant to stand seised to uses* was an assurance by means of which, under the Statute of Uses [1536], a conveyance of an estate might be effected. It is now obsolete, the Statute of Uses having been repealed by the Law of Property Act 1925.

The term "covenant" is unknown to Scots law. But its place is filled to some extent by the doctrine of "warrandice." Many of the British colonies have legislated, as to the implication of covenants for title, on the lines of the English Conveyancing Act 1881. *See* Burgés, *Colonial and Foreign Laws,* 2nd ed., vol. ii. pl. ii.

As to covenants in restraint of trade *see* RESTRAINT.

In the United States, some of the states have abolished the distinction between sealed and unsealed instruments, and where such has been done, an action of covenant may be brought upon any writing operating as a deed, or where debt or assumption might have been maintained before the abolition of such distinction. Statutory modifications have been made in many of the states as to the method of bringing the action. (*See* further LEAGUE OF NATIONS.)

COVENANTERS. Covenants or bands of a secular character, binding the subscribers to common action, were a feature of Scottish history previous to the Reformation. The first religious covenant dates from Dec. 1557, when the leading adherents of the Reformation bound themselves to maintain the evangelical movement in Scotland. A quarter of a century later (1581) another, drawn up by John Craig and largely signed, was the outcome of a widespread fear of a Romanist reaction. Its renewal in 1638, under the name of the National Covenant, was occasioned by the determination of Charles I. in the previous year to impose a new liturgy on the Church of Scotland without asking the consent of the Scottish parliament or the General Assembly. His action aroused a storm of opposition and Johnston of Warriston suggested the revival of the Covenant of 1581 with additions to meet the special situation. As thus expanded it condemned all recent and previous ecclesiastical innovations as subversive of the Reformation and the laws and liberties of the kingdom, and bound its subscribers to forbear the practice of, and resist them until they had been considered in a free parliament and assembly.

The consequence was the abolition of episcopacy by the General Assembly, which met at Glasgow in November in spite of the prohibition and withdrawal of the royal commissioner, the marquess of Hamilton. In the face of this drastic defiance of the royal authority, Charles determined to repress the movement by force, but his attempt to overawe the army of the Covenanters miscarried and he was fain to negotiate and agree to withdraw the service book and ratify whatever a new General Assembly should decree (June 18, 1639). The Assembly renewed the abolition of episcopacy and the Parliament, under the leadership of the earl of Argyll, not only abetted its action, but passed measures materially limiting the royal authority. An invasion of England in the summer of 1640 to enforce acceptance compelled Charles to summon the Long Parliament, and thus the Covenanters, by their resolute action against his arbitrary rule in Scotland, contributed to initiate the great struggle against this rule in England. In this struggle they ultimately intervened on the side of the parliament on the basis of the Solemn League and Covenant, which stipulated that the constitution of the Anglican Church should be reformed according to the Word of God and the example of the best Reformed Churches (Sept. 1643).

On this condition the covenanting army took an active part in the great civil war which resulted in the surrender of Charles to it in May 1646. On his refusal to accept the Solemn League and Covenant the Scots handed him over to the commissioners of the English parliament. Ultimately he went the length of agreeing in the "Engagement" to the provisional establishment of Presbyterianism in England as the price of securing their intervention in his favour, but the concession was nullified by Cromwell's defeat of the Scottish army at Preston in 1648. After his execution in 1649 the Covenanters transferred their allegiance to Charles II. on condition of his subscribing the Solemn League and Covenant. But Cromwell's conquest of Scotland put an end to his kingship for the time being and greatly weakened the covenanting régime.

The Restoration of 1660 was followed by the abrogation of all the acts in favour of Presbyterianism, the restoration of episcopacy, and the execution of its most obnoxious opponents. Thereafter came 25 years of brutal repression, during which the more extreme Covenanters several times rose in rebellion and ultimately in a couple of declarations renounced allegiance to a tyrannic king. So embittered and fanatic did a section of them become that they refused to recognize the ecclesiastical settlement of the revolution of 1689, which re-established the Presbyterian Church government but did not renew the Covenants. Though narrow and doctrinaire in the maintenance of their religious convictions, they deserve the credit of defending civil liberty throughout those years of arbitrary and despotic government.

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COVENT GARDEN, a site north of the Strand, London, England, occupied by the principal flower, fruit and vegetable market in the metropolis. This was originally the so-called "convent garden" belonging to the abbey of St. Peter, Westminster. In the first half of the 17th century the garden was laid out as a square by Inigo Jones, with a piazza on two sides; this garden is mentioned in Restoration plays as a fashionable resort. The first stalls and sheds were set up there about 1656. Covent Garden Theatre (1858) is the chief seat of grand opera in London. The site has carried a theatre since 1733, but earlier buildings were burnt in 1809 and 1856.

COVENTRY, SIR JOHN (d. 1682), grandson of Thomas, Lord Keeper Coventry, was returned to the Long Parliament in 1640 as member for Evesham. During the Civil War he served for the king, and at the Restoration was knighted. In 1667, and in the following parliaments of 1678, 1679 and 1681, he was elected for Weymouth, and opposed the government. On Dec. 21, 1670, owing to his jest in the House of Commons on the subject of the king's amours, Sir Thomas Sandys and others, by the order of Monmouth, and (it was said) with the approval of the king himself, waylaid him as he was returning home and slit his nose to the bone. The outrage led to the passing of the "Coventry Act" declaring assaults accompanied by personal mutilation a felony without benefit of clergy.

COVENTRY, THOMAS COVENTRY, 1ST BARON (1578–1640), lord keeper of England, entered Balliol college, Oxford, in 1592, and was admitted at the Inner Temple in 1594. He became recorder of London in 1616. Returned to parliament for Droitwich in 1621, he became attorney-general, and in 1625 lord keeper of the great seal. It thus fell to him to deliver to the Commons the famous reprimand of March 29, 1626, in which the king declared that parliament had "liberty of counsel" but not "liberty of control." Coventry was raised to the peerage in 1628. At the opening of parliament in that year he threatened the use of the royal prerogative if the Commons withheld supplies. On the whole, however, he showed moderation in presenting the king's policy; but he was better as a judge than as a statesman, and in the Star Chamber he prevented many illegal and tyrannical practices. He must be remembered, for instance, for having prevented the hanging of men for resistance to the pressgangs, pointing out that the men were not under martial law until they were actually enlisted. Coventry died on Jan. 14, 1640.

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COVENTRY, SIR WILLIAM (*c.* 1628–1686), British statesman and son of Thomas, Lord Coventry, entered Queen's college, Oxford, but during the Civil War went to France where he vainly attempted to secure foreign assistance for the royalists. In 1660 he was appointed secretary to James, duke of York, lord high admiral of England, and headed the royal procession when Charles entered London in triumph. He was returned to the parliament of 1661 for Great Yarmouth, became commissioner for the navy in 1662 and in 1663 was made D.C.L. of Oxford. While his ability and energy did little to avert the naval collapse, which was due chiefly to mismanagement and ill-advised appointments, Coventry repudiated the charges of corruption and of responsibility for the Dutch War of 1665 made by the old chancellor Clarendon, and Pepys in his diary supports this repudiation. In 1665 Coventry was knighted and made a privy councillor, and was subsequently admitted to the committee on foreign affairs. His speeches in the House of Commons led to Clarendon's resignation on Aug. 31, 1667, but two days later, he himself left the duke's service and terminated his connection with the navy. Clarendon was succeeded by the brilliant but unscrupulous and incapable duke of Buckingham, who soon brought about the exclusion of Coventry from the cabinet council, and in 1669, his expulsion from the privy council and the Treasury. The real cause of his dismissal was clearly the final adoption by Charles of the policy of subservience to France and desertion of Dutch and Protestant interests. However, Coventry still retained his ascendancy in the Commons. He retired in 1679 and died unmarried on June 23, 1686.

Coventry's writings include *England's Appeal from the Private Cabal at Whitehall to the Great Council of the Nation . . .* published anonymously in 1673 and reflecting his opinion on the French entanglement; *A Letter to Dr. Burnet giving an Account of Cardinal Pool's Secret Powers . . .* (1685); and a number of papers now among the Ashburnham mss. and the Longleat mss.

See A. C. Foxcroft: *Life of Geo. Saville, Marquis of Halifax* (1898); *Hist. mss. Comm. Rep.* iv., v., vi.; Clarendon's *Life and Continuation* (Oxford, 1857); *Calendar of Clarendon Papers;* Wood's *Athenae;* and Pepys's *Diary* and *Pepysiana* (ed. Wheatley, 1903).

COVENTRY, a city, county and parliamentary borough of Warwickshire, England; 94 mi. N.W. of London, on L.M.S.R. Pop. (1938) 213,000. Area 30 sq.mi. Coventry stands on a small hill with higher ground to the west, at the confluence of the Sherbourne and the Radford brook, tributaries of the Avon. Of its ancient fortifications two gates and some portions of the wall are still extant. The German air raids of November 1940 and April 1941 caused vast destruction in Coventry. The centre of the town was laid waste, and about 70,000 houses were damaged. St. Michael's, the cathedral church, a fine Perpendicular building, was ruined except for the 303 ft. steeple. Likewise, all that remained of modern Christ church was the ancient spire of Grey Friars church, to which it was attached. The early 16th century, half-timbered Ford hospital was also seriously damaged. Buildings left standing were Holy Trinity church, a Perpendicular cruciform structure with a lofty steeple; St. John's or Bablake church, which is nearly a parallelogram on the ground plan, but is cruciform in the clerestory, with a central tower; and St. Mary's hall, which was erected by the united guilds in the early 15th century. The principal chamber, above a fine crypt, has a carved oak roof.

Coventry (*Coventreu, Coventre*) owed its existence to the foundation of a Benedictine monastery by Earl Leofric and his wife Godgyfu (Lady Godiva [*q.v.*]), in 1043. The manor, which in 1066 belonged to the latter, descended to the earls of Chester and to Robert de Montalt, and from him passed to Isabella, queen of Edward II, and the crown.

Ranulf, earl of Chester, granted the earliest extant charter to the town in 1153. This, with further privileges, was confirmed by Henry II in 1177, and by nearly every succeeding sovereign until the 17th century. In 1345, Edward III gave Coventry a corporation. It first sent two representatives to parliament in 1295. The prior's market on Fridays was probably of Saxon origin; a second market was granted in 1348, while fairs were obtained in 1217, 1348 and in 1442. As early as 1216 Coventry was important for its trade in wool, cloth and caps, its guilds later being particularly numerous and wealthy.

In 1568 Flemish weavers introduced new methods, but the trade was destroyed in the wars of the 17th century. The arrival of the Flemish weavers, who often had strong religious views, helped to make Coventry in the subsequent centuries a stronghold of Puritanism.

The popular phrase "to send to Coventry" (*i.e.,* to refuse to associate with a person) is of uncertain derivation. Clarendon (*History of the Great Rebellion,* 1647) states that the citizens of Birmingham rose against certain small parties of the king's supporters, and sent the prisoners they captured to Coventry. Coventry acquired such a reputation for its dyeing that the expression "as true as Coventry blue" became proverbial. Existing industries are the making of motor cars, cycles and their accessories, for which Coventry is one of the chief centres in Great Britain; ribbons, watches, cotton, elastic web, trimmings and alpaca and coach laces are also important. There are extensive iron foundries and brickworks.

After 1910 a great manufactory of artificial silk and electrical apparatus grew up. During World Wars I and II the making of munitions and war material took precedence over other manufactures.

The free grammar school, now a secondary school, founded in the reign of Elizabeth, is in modern buildings (1885). There are a technical school, a school of art, endowed charity schools and many charitable foundations. Swanswell and Spencer parks were opened in 1883, and a recreation ground in 1880. The boundaries of Coventry were considerably extended in 1932. Many street improvements were carried out, a new by-pass road being opened in 1939, while a city airport was established in 1936. A county of itself from 1452 to 1842, the town became a county borough in 1888. The parliamentary borough returns one member. In 1894 a suffragan bishopric of Coventry was established under the see of Worcester, but was for a time discontinued until Coventry was created a separate diocese in 1918.

See *Victoria County History, Warwick;* William Dugdale, *The Antiquities of Coventre, illustrated from records* (Coventry, 1765).

COVENTRY, a town of Kent county (R.I.), U.S.A., 15 mi. S.W. of Providence, on Flat river, and served by the New York, New Haven and Hartford railroad. The population in 1940 (federal census) was 6,998. Cotton and woollen goods are manufactured. Coventry was settled about 1700, and was set off from the town of Warwick in 1742.

COVER. In speculative stock and share transactions, a term employed to signify a "deposit made with a broker to secure him from being out of pocket in the event of the stocks falling against his client and the client not paying the difference" (*In re* Cronmire, 1898, 2 Q.B. 383). It is a mode of speculation engaged in almost entirely by persons who wish to limit their risk to a small amount, and, generally, the transactions are carried out in England with "outside" brokers, *i.e.* those dealers in securities who are not members of the Stock Exchange. The deposit is so much per cent. or per share; in the United States it is referred to as the margin. Cover is not money deposited to abide the event of a wager, but as security against a debt which may arise from a gaming contract, and it may be recovered if unappropriated. (*See* BUCKET-SHOP.)

Cover, in military language, is any means, natural or artificial, of concealment from view or protection from fire. For covered way *see* FORTIFICATION AND SIEGECRAFT.

COVERDALE, MILES (1488?–1569), English translator of the Bible and bishop of Exeter, was born of Yorkshire parents about 1488, studied philosophy and theology at Cambridge, was ordained priest at Norwich in 1514, and then entered the convent of Austin friars at Cambridge. Here he came under the influence of the prior, Robert Barnes, made the acquaintance of Sir Thomas More and of Thomas Cromwell, and began a thorough study of the Scriptures. He was one of those who met at the White Horse tavern to discuss theological questions, and when Barnes was arrested on a charge of heresy, Coverdale went up to London to assist him in drawing up his defence. Soon afterwards he left the convent, assumed the habit of a secular priest, and began to preach against confession and the veneration of images. In 1531 he graduated bachelor of canon law at Cambridge, but from 1528 to 1534 he prudently spent most of his time abroad. No corroboration has, however, been found for Foxe's statement that in 1529 he was at Hamburg assisting Tyndale in his translation of the Pentateuch. In 1534 he published two translations of his own, the first Dulichius's *Vom alten und newen Gott,* and the second a *Paraphrase upon the Psalms,* and in 1535 he completed his translation of the Bible. The venture seems to have been projected by Jacob van Meteren, who apparently employed Coverdale to do the translation, and Froschover of Zürich to do the printing. No perfect copy is known to exist, and the five or six which alone have title-pages give no name of publisher or place of publication. The volume is dedicated to the king of England, where Convocation at Cranmer's instance had, in Dec. 1534, petitioned for an authorized English version of the Scriptures. As a work of scholarship it does not rank particularly high. Some of the title-pages state that it had been translated out of "Douche" (*i.e.,* German) and "Latyn": and Coverdale mentions that he used five interpreters, which are supposed to have been the Vulgate, the Latin version of Pagninus, Luther's translation, the Zürich version, and Tyndale's Pentateuch and New Testament. There is no definite mention of the original Greek and Hebrew texts; but it has considerable literary merit, many of Coverdale's phrases are retained in the authorized version, and it was the first complete Bible to be printed in English. Two fresh editions were issued in 1537, but none of them received official sanction. Coverdale was, however, employed by Cromwell to assist in the production of the Great Bible of 1539, which was ordered to be placed in all English churches. The work was done at Paris until the French Government stopped it, when Coverdale and his colleagues returned to England early in 1539 to complete it. He was also employed in the same year in assisting at the suppression of superstitious usages, but the reaction of 1540 drove him once more abroad. His Bible was prohibited by proclamation in 1542, while Coverdale himself defied the Six Articles by marrying Elizabeth Macheson, sister-in-law to Dr. John MacAlpine.

For a time Coverdale lived at Tübingen, where he was created D.D. In 1545 he was pastor and schoolmaster at Bergzabern in the duchy of Pfalz-Zweibrücken. In March, 1548 he was at Frankfurt, when the new English Order of Communion reached him; he at once translated it into German and Latin and sent a copy to Calvin, whose wife had befriended Coverdale at Strassburg. Calvin, however, does not seem to have approved of it so highly as Coverdale.

Coverdale was already on his way back to England, and in Oct. 1548 he was staying at Windsor Castle, where Cranmer and some other divines, inaccurately called the Windsor Commission, were preparing the First Book of Common Prayer. His first appointment had been as almoner to Queen Catherine Parr, then wife of Lord Seymour; and he preached her funeral sermon in Sept. 1548. He was also chaplain to the young king and took an active part in the reforming measures of his reign. He was one of the most effective preachers of the time. A sermon by him at St. Paul's on the second Sunday in Lent, 1549, was immediately followed by the pulling down of "the sacrament at the high altar." A few weeks later he preached at the penance of some Anabaptists, and in Jan. 1550 he was put on a commission to prosecute Anabaptists and all who infringed the Book of Common Prayer. In 1549 he wrote a dedication to Edward for a translation of the second volume of Erasmus's *Paraphrases;* and in 1550 he translated Otto Wermueller's *Precious Pearl,* for which Protector Somerset, who had derived spiritual comfort from the book while in the Tower, wrote a preface.

Perhaps it was his gift of oratory which suggested his appointment as bishop of the refractory men of Devon and Cornwall. He had already, in Aug. 1549, at some risk, gone down with Lord Russell to turn the hearts of the rebels by preaching and persuasion, and two years later he was appointed bishop of Exeter by letters patent, on the compulsory retirement of his predecessor, Veysey, who had reached an almost mythical age. He was an active prelate, and perhaps the vigorous Protestantism of the West in Elizabeth's reign was partly due to his persuasive powers. He sat on the commission for the reform of the canon law, and was in constant attendance during the parliaments of 1552 and 1553. On Mary's accession he was at once deprived on the score of his marriage, and Veysey in spite of his age was restored. Coverdale was called before the privy council on Sept. 1, and required to find sureties; but he was not further molested, and when Christian III. of Denmark at the instance of Coverdale's brother-in-law, MacAlpine, interceded in his favour, he was in Feb. 1555, permitted to leave for Denmark with two servants, and his baggage unsearched; one of these "servants" is said to have been his wife. He declined Christian's offer of a living in Denmark, and preferred to preach at Wesel to the numerous English refugees there, until he was invited by Duke Wolfgang to resume his labours at Bergzabern. He was at Geneva in Dec. 1558, and is said to have participated in the preparation of the Geneva version of the Bible.

In 1559 Coverdale returned to England and resumed his preaching at St. Paul's and elsewhere. Clothed in a plain black gown, he assisted at Parker's consecration, in spite of the facts that he had himself been deprived, and did not resume his bishopric, and that his original appointment had been by the uncanonical method of letters patent. Conscientious objections were probably responsible for his non-restoration to the see of Exeter, and his refusal of that of Llandaff in 1563. He objected to vestments, and at his living of St. Magnus close to London Bridge, which he received in 1563, he took other liberties with the Act of Uniformity. His bishop, Grindal, was his friend, and his vagaries were overlooked until 1566, when he resigned his living rather than conform. He still preached occasionally, and always drew large audiences. He died in Feb. 1568, and was buried on the 19th in St. Bartholomew's behind the Exchange. When this church was pulled down in 1840 to make room for the new Exchange, his remains were removed to St. Magnus.

Coverdale's works, most of them translations, number twenty-six in all; nearly all, with his letters, were published in a collected edition by the Parker Soc. (1846). An excellent account is given in the *Dict. Nat. Biog.* of his life, with authorities, to which may be added R. W. Dixon's *Church History,* Bishop and Gasquet's *Edward VI. and the Book of Common Prayer;* Acts of the Privy Council; Letters and Papers of Henry VIII.; *Lit. Rem. of Edward VI.* (Roxburghe Club); Whittingham's *Brief Discourse of Troubles at Frankfurt;* Pocock's *Troubles connected with the Prayer-Book* (Camden Soc.).

(A. F. Po.)

COVERING FIRE, a military term to express small arm or artillery fire by one unit of troops or arm (*q.v.*) to distract the enemy's attention, and, if possible, subdue his fire, in order that another unit or arm may advance or retire with minimized loss.

COVERLEY, SIR ROGER DE, a name taken by Steele (*q.v.*) from the north country tune "Roger of Coverley" and applied to the country member of the club where his Spectator studied human nature. In the second number of the *Spectator* he is introduced as "a gentleman of Worcestershire of ancient descent. His great-grandfather was the inventor of that famous country dance which is named after him. He is now in his 56th year, cheerful, gay and hearty, rather beloved than esteemed." But Addison soon took the character into his own hands and developed it with subtler observation and humour than Steele ever had at command. The knight became less hearty and, if equally beloved, more estimable. Of the 30 papers in which his character and surroundings are pictured 20 are by Addison, eight by Steele, two by Budgell. In his courtesy and simplicity he shows some kinship with Don Quixote (*q.v.*) but his politics and churchmanship, like his paternal activity as master, landlord and magistrate are native. The creation of Sir Roger marks and probably assisted the evolution of the boorish, hard-living Stuart squire into the benevolent, well-mannered and cultivated country gentleman which was the 18th century ideal. In *Tom Jones* and again in *Rob Roy* the two types are shown in sharp contrast, and the great popularity of Addison as a moralist may have contributed to the victory of the humaner and more civilized way of life.

COVERTURE, a term in English law applied to the condition of a woman during marriage, when she is supposed to be under the cover, influence and protection of her husband. (*See* further HUSBAND AND WIFE.)

COVILHÃ, a town of Portugal on the eastern slope of the Serra da Estrella, and on the Abrantes-Guarda railway. Pop. (1940) 19,213. Covilhã, which has been often compared with a collection of swallows' nests clinging to the rugged granitic mountain side, is shaped like an amphitheatre of closely crowded houses, overlooking the river Zezere and its wild valley from a height of 2,180ft. Over 4,000 operatives are employed in the manufacture of *saragoça,* a coarse brown cloth worn by the peasantry throughout Portugal.

COVILHAM (COVILHÃO, COVILHÃ), **PERO** or **PEDRO DE,** Portuguese explorer and diplomatist (*fl.* 1487–1525), was a native of Covilhã in Beira. In early life he had gone to Castile and entered the service of Alphonso, duke of Seville; later, when war broke out between Castile and Portugal, he returned to his own country and attached himself to King Alphonso V. and his successor John II. On May 7, 1487, he was despatched, in company with Affonso de Payva, on a mission of exploration in the Levant and adjoining regions of Asia and Africa, with the special object of learning where "cinnamon and other spices could be found," as well as of discovering the land of Prester John, by "overland" routes. Bartholomeu Diaz (*q.v.*) at this time was seeking the same country by sea (*see* GEOGRAPHY). The explorers started from Santarem and travelled by the way of Barcelona to Naples; thence they went to Rhodes, and so to Alexandria and Cairo, where they posed as merchants. In company with certain Moors from Fez and Tlemçen they went by way of Tor to Suakin and Aden, where they parted, Covilham proceeding to India and Payva to Ethiopia—agreeing to meet again in Cairo. Covilham thus arrived at Cannanore and Calicut, whence he retraced his course to Goa and Ormuz, the Red Sea and Cairo, making an excursion on his way down the East African coast to Sofala, which he was probably the first European to visit. At Cairo he heard of Payva's death, and met Rabbi Abraham of Beja and Joseph, a shoemaker of Lamego, who had been sent by King John with letters for Covilham and Payva. By Joseph of Lamego, Covilham replied with an account of his Indian and African journeys, and of the observations on the cinnamon, pepper and clove trade at Calicut, together with advice as to the ocean way to India. This he truly represented as quite practicable. The first objective in the eastern ocean, he added, was Sofala or the Island of the Moon, our Madagascar—"from each of these lands one can fetch the coast of Calicut." With this information Joseph returned to Portugal, while Covilham, with Abraham of Beja, again visited Aden and Ormuz. At the latter he left the rabbi, and himself came back to Jidda, the port of the Arabian holy land, and penetrated even to Mecca and Medina. Finally, by Mt. Sinai, Tor and the Red Sea he reached Zeila, whence he struck inland to the court of Prester John (*i.e.*, Abyssinia). Here he was honourably received but he was not permitted to leave. When the Portuguese embassy under Rodrigo de Lima, including Father Francisco Alvarez, entered Abyssinia in 1520, Covilham wept with joy at the sight of his fellow-countrymen. It was then 40 years since he had left Portugal, and over 30 since he had been a prisoner of state in "Ethiopia." Alvarez praises his power of vivid description "as if things were present before him," and his extraordinary knowledge of "all spoken languages of Christians, Moors and Gentiles." His services as an interpreter were valuable to Rodrigo de Lima's embassy; but he never succeeded in escaping from Abyssinia.

See Francisco Alvarez, *Verdadera Informaçam das terras do Preste Joam.* esp. chs. 73, 89, 98, 102, 103, 105 (pp. 177, 224, 254, 264, 265–270, 275, of the Hakluyt Society's English edition, *The Portuguese Embassy to Abyssinia . . . 1520–1727,* 1881); an abstract of this, with some inaccuracies, is given in Major's *Prince Henry the Navigator,* pp. 339–340 (1868).

COVIN, a term used in English law for a secret agreement between persons to cheat and defraud. The word has been superseded by "collusion" or "conspiracy to cheat and defraud."

COVINGTON, the second largest city of Kentucky, U.S.A., on the Ohio river at the mouth of the Licking, opposite Cincinnati; one of the county seats of Kenton county. It is on federal highways 25 and 42, is served by the Chesapeake and Ohio and the Louisville and Nashville railways, and by river steamers. The population was 65,252 in 1930 (native white population 59,870) and was 62,018 by federal census, 1940. The city is built on a plain, partly surrounded by hills, and has many fine residences and spots of scenic beauty. It is the seat of a Roman Catholic bishopric; the cathedral (St. Mary's) contains one of the largest stained-glass windows in the world. Beautiful Devou park extends over 550 ac. The suspension bridge across the Ohio, built between 1856 and 1866, is 2,252 ft. long. Across the Licking river is Newport (*q.v.*). Covington is the trade centre of an extensive district engaged in agriculture, the chief crops being tobacco, corn, wheat and alfalfa, and stock-raising (including thoroughbred horses).

It has substantial manufactures, notably of X-ray machinery, cigars and tobacco, cigar boxes, textiles, cordage, architectural iron, steel, iron fence, boilers, safes and locks, machinery, furniture, Christmas tree ornaments and paper products. It has several breweries, and wines are produced.

Covington is under the commission form of government. A settlement was made there in 1812, and in 1815 a town was laid out, and named after Gen. Leonard Covington (1768–1813) who was mortally wounded at Chrystler's field during the War of 1812. The city was chartered in 1834.

COVINGTON, a town in the western part of Virginia, U.S.A., is the county seat of Alleghany county. It is on federal highways 60 and 220, and the Chesapeake and Ohio railway. Pop. (1920) 5,623 (1,136 Negroes); (1930) 6,538; (1940) 6,300 not including suburbs, which would raise the total population to 12,000. It has a pulp and paper plant employing 1,750 men, a rayon plant employing 1,200, a weaving mill and other industries. The town was settled about 1822 and was incorporated in 1842. It has a city-manager form of government.

COWANS, SIR JOHN STEVEN (1862–1921), British general, was born on March 11, 1862, at Carlisle, passed through Sandhurst and the Staff college, and held many important staff positions in England and India. In 1912 he became quartermaster-general, and in 1913 was created K.C.B. The outbreak of the World War thus found Cowans in charge of the provision of food, housing, transport and equipment of troops. This task assumed gigantic dimensions as the war went on and the armies grew. He continued to direct the department until March 1919. In that year he was promoted general, and received the G.C.M.G. and G.C.B. He died at Mentone on April 16, 1921.

See O. Rutter, *General Sir John Cowans* (1924).

COWARD, NOEL (1899–), English playwright and actor, was born at Teddington on Dec. 16, 1899, and was educated privately. He made his stage debut as a child, and developed into a competent actor. As a playwright his skilful management of dialogue and his frank avowal of certain modern tendencies quickly won him recognition as one of the most brilliant of the younger dramatists.

Among Coward's most successful plays have been *Fallen Angels* and *Hay Fever* (1925); *Easy Virtue* (1926); *Private Lives* (1930); *Design for Living* (1933).

Cavalcade (1932), a historical play, differs from most of his other work, and proved, perhaps, his greatest success. Coward's extraordinary versatility is further evidenced by a number of musical plays and revues, for some of which he composed the music. Such productions include *This Year of Grace* (1928), *Bitter Sweet* (1929), and *Words and Music* (1932). His autobiography, *Present Indicative,* appeared in 1937.

COWBANE: *see* Water Hemlock.

COWBIRD, applied to the species of the genus *Molothrus* and especially to the migratory N. American *M. ater.* They belong to the passerine family Icteridae and, like the old world cuckoos, are parasitic and lay their eggs in the nests of other birds. From southern Texas to southern California there is a smaller subspecies, the dwarf cowbird (*M. a. obscurus*) while northward to Manitoba and British Columbia ranges the Nevada cowbird (*M. a. artemisiae*). The bronzed cowbird (*Tangavius aeneus*) is found in Arizona and Mexico; its subspecies, the red-eyed cowbird (*T. a. involucratus*), glossy black with brassy reflections, is abundant from southern Texas to Panamá. The bay-winged cowbird (*M. badius*) of Argentina builds a nest of its own.

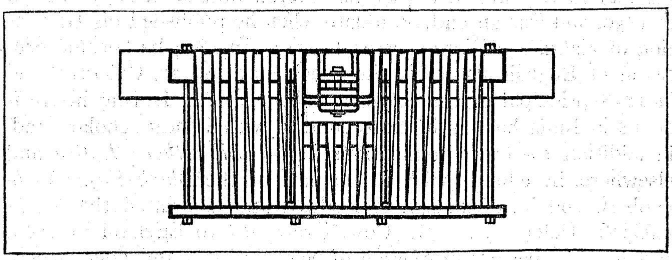
COWBRIDGE, a market town and municipal borough of Glamorganshire, Wales, with a station on the G.W.R. branch from Llantrisant to Aberthaw, 12 mi. W. of Cardiff and 7 mi. S.E. of Bridgend; pop. (est. 1938) 1,036. Area, .1 sq.mi. The town lies in a wide valley at a bridging of the Thaw, probably on the Roman road from Cardiff westwards.

After the Norman conquest Cowbridge grew up as an appanage of the castle of St. Quentin, half a mile S.W. It was walled round before the 13th century, and the south wall and gateway still remain.

During the Tudor and Stuart periods Cowbridge was almost the chief town of Glamorgan. A borough by prescription until 1682, the town was then incorporated by Charles II. The corporation was dissolved in 1883, but a new charter was granted in 1887. From 1536 to 1832 it was a contributory parliamentary borough, and from 1832 to 1918 returned a member contributorily with Cardiff and Llantrisant.

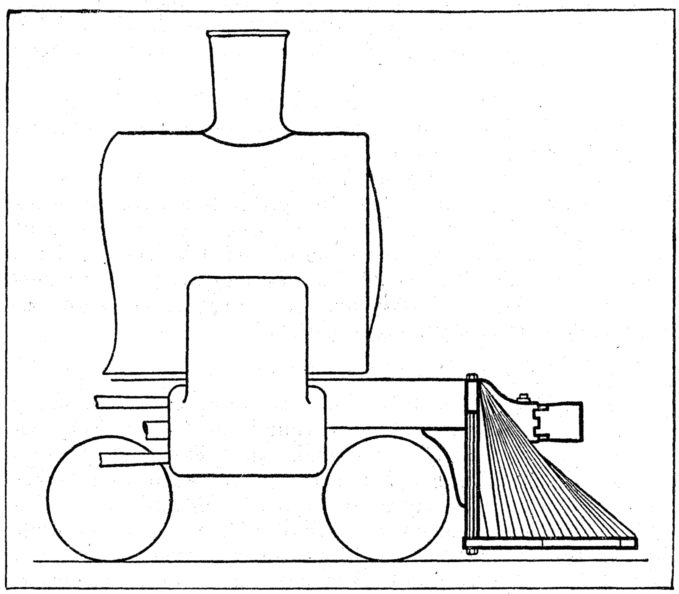
Since 1918 it has been included in the Pontypridd parliamentary area. The buildings of the grammar school, re-founded in 1685, were erected in 1847 by Jesus college, Oxford, by which body the school is administered. St. Mary's church, of early English style, has a fine embattled tower. The town is now wholly agricultural, and has good markets and cattle fairs.

COWCATCHER, also termed a cattle-guard or pilot, a steel framework which is V-shaped in plan and attached to the



Detail of a cowcatcher from the front

front beam of a locomotive or rail-coach. It is necessary in countries where the lines are unfenced or unprotected. The diagram shows the construction, with a central coupling. Tramcars are also fitted thus in some countries, and the idea has been adopted to a slight extent for motor-vehicles. The ordinary guard in European designed locomotives is just two steel bars hanging down from the framing to within a couple of inches or so of the line; in the case of bogies the guards, of course, are attached to their frames. American locomotives which are not stream-lined ordinarily have V-shaped extensions from the drop frame.



SIDE ELEVATION SHOWING COWCATCHER ON FRONT OF ENGINE

COWDENBEATH, a small burgh, Fifeshire, Scotland, $5\frac{3}{4}$ mi. N.E. of Dunfermline by the L.N.E.R. Pop. (est. 1938) 12,440. The principal industry is coal mining, with which its prosperity has been linked. Meetings in connection with the adoption and promulgation of the Covenant were held in the old parish church of Beath. It is included with Dunfermline, Inverkeithing and Lochgelly in the Dunfermline group of burghs, returning one member to parliament.

COWDRAY, WEETMAN DICKINSON PEARSON, 1st VISCOUNT (1856–1927), was born at Shelley Woodhouse (Yorks.), July 15, 1856, and educated privately at Harrogate. He entered the family firm of S. Pearson & Co., contractors, ultimately becoming its head. Under him the firm greatly extended, undertaking many important contracts and acquiring large interests in Mexico and South America. In 1895 he was elected Liberal member for Colchester, holding his seat until 1910. In 1894 he was created a baronet, and in 1910 was raised to the peerage. He was in 1917 made president of the Air Board, and the same year was created a viscount. He was elected lord rector of Aberdeen university in 1918. He died on May 1, 1927.

COWELL, EDWARD BYLES (1826–1903), English Sanskrit scholar, was born at Ipswich on Jan. 23, 1826. He entered the business of his father, who was a merchant and maltster, employing his leisure in oriental and other studies. He was a friend and correspondent at this period of Edward Fitzgerald (*q.v.*). He was already married when he entered Magdalen hall, Oxford, in 1850, and was an undergraduate when he published his translation of Kālidāsa's *Vikramorvasī* (1851). In 1854 he became professor of English history in the Presidency college, Calcutta, and in 1858 principal of the Sanskrit college there. During his residence in India he was in close contact with Hindu scholars and, in addition to many publications in the *Bibliotheca Indica* and elsewhere, he edited (with Roer) part of the *Black Yajur Veda* (vols. i. and ii., 1858–64), and edited and translated the *Kusumāñjali* (Calcutta, 1864). Cowell returned to England in 1864, and in 1867 became professor of Sanskrit at Cambridge, where he lived until his death (Feb. 9, 1903).

Among Cowell's works are: A translation, with A. E. Gough, of the *Sarva-Darśana-Saṃgraha* (1882); an edition, with R. A. Neil, of the *Aśvaghosha* (1893, trans. 1894); a translation, with F. W. Thomas, of the *Harṣacarita of Bāna* (1897).

See G. Cowell, *Life and Letters of Edward Byles Cowell* (1904), where a full bibliography of his works is given; and a notice by F. W. Thomas in the *Dict. Nat. Biog.* (*Supplement* for 1901–11).

COWELL, JOHN (1554–1611), English jurist, was born at Ernsborough, Devonshire. He was educated at Eton, and King's College, Cambridge, ultimately becoming professor of civil law and master of Trinity Hall. In 1607 he compiled a law dictionary, *The Interpreter,* in which he exalted the king's prerogative so much that he was prosecuted before the House of Commons by Sir Edward Coke, and saved from imprisonment only by the interposition of James I. His book was burnt by order of the House of Commons. Dr. Cowell also wrote *Institutiones Iuris Anglicani.* He died at Oxford on Oct. 11, 1611.

COWEN, SIR FREDERIC HYMEN (1852–1935), composer, was born at Kingston, Jamaica, on Jan. 29, 1852. At the age of four he was brought to England, where his father became treasurer to the opera at Her Majesty's theatre and private secretary to the earl of Dudley. His first teacher was Henry Russell, and his first published composition appeared when he was but six years old. He studied the piano with Benedict, and composition with Goss; in 1865 he was at Leipzig under Hauptmann, Moscheles, Reinecke and Plaidy. Returning home on the outbreak of the Austro-Prussian War, he had an overture played at the Promenade Concerts at Covent Garden in September 1866. In the following autumn he went to Berlin, where he was under Kiel, at Stern's conservatorium. A symphony and a piano concerto were given in St. James's Hall in 1869, and thenceforward his claims as a composer were generally recognized. His cantata, *The Rose Maiden,* which enjoyed great popularity in its day, was given in London in 1870, his second symphony by the Liverpool Philharmonic Society in 1872, and his first festival work, *The Corsair,* in 1876 at Birmingham. In that year his opera, *Pauline,* was given by the Carl Rosa Company, but with only moderate success. In 1884 he conducted five concerts of the Philharmonic Society, and in 1888, on the resignation of Arthur Sullivan, he became, till 1892, the regular conductor of the society, this being one of many posts which he subsequently occupied. He received a knighthood in 1911.

Cowen's works include:—Operettas: *Garibaldi* (1860) and *One Too Many* (1874); operas: *Pauline* (1876), *Thorgrim* (1890), *Signa* (Milan, 1893), and *Harold* (1895); oratorios: *The Deluge* (1878), *St. Ursula* (1881), *Ruth* (1887), *Song of Thanksgiving* (1888), *The Transfiguration* (1895); choral works: *The Rose Maiden* (1870), *The Corsair* (1876), *The Sleeping Beauty* (1885), *St. John's Eve* (1889), *The Water Lily* (1893), *Ode to the Passions* (1898), *The Veil* (1910), besides short cantatas for female voices; a large number of songs, ranging from the popular "ballad" to more artistic lyrics, anthems, part-songs, duets, etc.; six symphonies, among which No. 3, the "Scandinavian," has had the greatest success; four overtures; suites, *The Language of Flowers* (1880), *In the Olden Times* (1883), *In Fairyland* (1896); four English dances (1896); a concerto for piano and orchestra, and a fantasia for the same played by M. Paderewski (1900); a quartet in C minor, and a trio in A minor, both early works; pianoforte pieces, etc.

COWEN, JOSEPH (1831–1900), English orator, politician and journalist, son of a Northumberland mine-owner, Sir Joseph Cowen, was educated at Edinburgh university. From an early age he showed rare gifts of eloquence and enthusiasm on behalf of advanced democracy at home and liberty abroad. He sympathized with the Chartists and his close friendship after 1848, "the year of revolutions," with Kossuth, Mazzini, Garibaldi, Herzen, with the Polish exiles and the Irish Nationalists, was the chief influence on his life. He made generous and sometimes daring efforts to help what he thought the righteous conspiracies in Europe and revolts against oppression. Accordingly he was intensely anti-tsarist and his subsequent course was, in him, consistent. He entered the House of Commons in 1874 for Newcastle-on-Tyne. His eloquence was impassioned and vivid if too ornate, but his independence soon became disturbing. He caused consternation amongst the Liberals by championing, against Gladstone, Disraeli's policy towards Russia in the Eastern crisis. His differences with the Liberal Party extended to other questions and became irreconcilable. Though he always called himself a radical he was a strong individualist. He was both an ardent pioneer of Imperial Federation and an advocate of Home Rule for Ireland long before the same position was taken up by Cecil Rhodes. After the Home Rule split in the Liberal Party he retired from parliament, but continued to play an important part in politics through his newspaper, *The Newcastle Daily Chronicle,* which he made famous among provincial journals, and by his strong personal influence in northern England. His non-party orations in this period were his best, and as a journalist his style, unlike his earlier elaborate speaking, was as remarkable for simplicity as for force and phrase. He died on Feb. 18, 1900.

See E. R. Jones, *Life and Speeches of J. Cowen* (1885); W. Duncan, *Joseph Cowen* (1904); *Joseph Cowen's Speeches* ed. by his daughter (1909).

COWES, a seaport and watering place in the Isle of Wight, England, 11 mi. S.S.E. of Southampton. West Cowes is separated from East Cowes by the picturesque estuary of the river Medina, the two towns (which were combined as an urban district in 1933) lying on opposite sides of its mouth at the apex of the northern coast of the island. Pop. (1938) 15,440. Area 8.7 sq.mi. The port between them is the chief on the island, and is the headquarters of the Royal Yacht squadron (founded in 1812); it is in regular steamship communication with Southampton and Portsmouth and Ryde. West Cowes is served by the S.R. A steam ferry across the Medina, here 600 yards broad, unites the towns. Higher up the river is a floating bridge. The towns owe their origin to two forts built on each side of the mouth of the Medina by Henry VIII. in 1540 for coast defense. There are shipbuilding yards and engineering works. On the opposite side of the Medina is East Cowes castle, an 18th century mansion, and beyond it Osborne House, built in 1845 by Queen Victoria.

COWL (O.E. *cufle,* Med. Lat. *cucullа,* from Lat. *cucullus,* a hood; Dutch *keuvel*), a mantle with a hood, worn by monks; hence the phrase "to take the cowl," signifying entry upon the religious life. The word is also used for the hood alone, which in some orders is detached from the cloak. The early Egyptian anchorites wore a cowl covering only head and neck; but the two cowls (thick in winter and thin in summer) which St. Benedict prescribed for his monks (*c.* 530) were hooded cloaks, the length of which was restricted by St. Benedict of Aniane (d. 821) to two cubits. The council of Vienne (1311) defined the cowl (*cuculla*) as "a habit long and full without sleeves," as distinct from the wide-sleeved frock (*floccus*).

The word "cowl" is also applied to a hood-shaped covering to a chimney or ventilating shaft (*see* VENTILATION).

COWLES, HENRY CHANDLER (1869–1939), American botanist, was born in Kensington, Conn., on Feb. 27, 1869. He graduated at Oberlin college in 1893 and pursued further study at the University of Chicago, from which in 1898 he received the degree of doctor of philosophy. He was instructor in botany from 1902 to 1907, assistant professor from 1907 to 1911, and associate professor from 1911 to 1915, when he was made professor, at the University of Chicago, in which in 1925 he became chairman of the department of botany. He was one of the foremost pioneer investigators in plant ecology in America, and made valuable researches in physiographic and comparative ecology, especially the ecological relations of dune vegetation. He also made important contributions on the floristics of the Chicago region and on trees as indicators of past topographic conditions. His writings include *Vegetation of Sand Dunes of Lake Michigan* (1899); *Plant Societies of Chicago* (1901); *Textbook of Plant Ecology* (1911); *Plant Societies of Chicago and Vicinity* (1913). He was editor of *Botanical Gazette* 1925–34.

COWLEY, ABRAHAM (1618–1667), English poet, was born in the City of London, the son of a stationer. While he was still at Westminster school, his poetical *Blossoms,* containing some remarkable work, appeared. He went up to Trinity College, Cambridge, and in his first year there produced a Latin comedy. On March 12, 1641, his comedy *The Guardian,* recast and printed in 1663 as *The Cutter of Colman Street,* was acted at Trinity before Prince Charles, afterwards Charles II. About this time he wrote his *Davideis* (printed in 1656), an epic in rhymed heroic verse.

Cowley became a fellow of Trinity College, Cambridge, but was ejected by the Parliamentarians in 1643. He made his way to Oxford, where he enjoyed the friendship of Lord Falkland, and obtained the personal confidence of the royal family. After the battle of Marston Moor he followed the queen to Paris, and the exile so commenced lasted 12 years. On behalf of the Stuarts he performed several dangerous journeys into Jersey, Scotland, Flanders and Holland. He ciphered and deciphered with his own hand the greater part of all the letters that passed between Henrietta Maria and Charles I. In 1647 a collection of his love verses, entitled *The Mistress,* was published, and in the next year a spurious volume of satires, *The Four Ages of England,* was brought out under his name. On his return to England in 1656, he published a volume of his collected poetical works, which included the *Pindarique Odes,* the *Davideis, The Mistress,* and some *Miscellanies.* Among the latter are to be found Cowley's most vital pieces. This section of his work opens with the famous aspiration:

> What shall I do to be for ever known,
> And make the coming age my own?

It contains elegies on Wotton, Vandyck, Falkland, William Hervey and Crashaw, the last two being among Cowley's finest poems; the amusing ballad of *The Chronicle,* giving a fictitious catalogue of his supposed amours; various gnomic pieces; and some charming paraphrases from Anacreon. The *Pindarique Odes* contain weighty lines and passages. The long cadences of the Alexandrines with which most of the strophes close, continued to echo in English poetry from Dryden down to Gray, but the *Odes* themselves, which were found to be obscure by the poet's contemporaries, immediately fell into disesteem. *The Mistress* was the most popular poetic reading of the age, and is now the least read of all Cowley's works. It was the last and most violent expression of the amatory affectation of the 17th century.

Soon after his return to England he was seized in mistake for another person, and only obtained his liberty on a bail of £1,000. Late in 1658 Cowley took advantage of the confusion after the death of Cromwell to escape to Paris, where he remained until the Restoration brought him back in Charles's train. He published in 1663 *Verses upon several occasions,* in which *The Complaint* is included.

Through his friend, Lord St. Albans, Cowley obtained a property near Chertsey, and here, devoting himself to the study of botany, and buried in his books, he lived in comparative solitude until his death. He took a great and practical interest in experimental science, and his pamphlet on *The Advancement of Experimental Philosophy* (1661) advocated the foundation of the Royal Society, to which body Cowley, in March 1667, at the suggestion of Evelyn, addressed an ode which is the latest and one of the strongest of his poems. He died in the Porch House, in Chertsey, on July 28, 1667, and was buried in Westminster Abbey. His *Poëmata Latina,* including six books "Plantarum," were printed in 1668.

As a prose writer, and especially as an essayist, he holds, and will not lose, a high position in literature; as a poet Johnson justly said of him that "if he left versification yet improveable, he left likewise from time to time such specimens of excellence as enabled succeeding poets to improve it."

BIBLIOGRAPHY.—The works of Cowley were collected in 1668, when Thomas Sprat, afterwards bishop of Rochester, brought out a splendid edition in folio, to which he prefixed a life of the poet. A *Second Part* containing the early works was added in 1681. There were many reprints of this collection, which formed the standard edition till 1881, when A. B. Grosart edited Cowley's works in two volumes, for the Chertsey Worthies library. Cowley's *Poems* and *Essays* were edited by A. R. Waller (1905 and 1906); other partial editions are: A. B. Gough, *Essays and other prose writings* (1915); *Essays,* ed. J. Rawson Lumby, revised by A. Tilley (1923); *The Mistress, with other select poems,* ed. J. Sparrow (1926); *Anacreon done into English, by A. Cowley and S.B.* (1923).

COWLEY, HANNAH (1743–1809), English dramatist, and poet, daughter of Philip Parkhouse, a bookseller at Tiverton, Devonshire, was born in 1743 and died at Tiverton, March 11, 1809. She married a captain in the East India Dock Company's service, who died in 1797. Between 1776 and 1795 she wrote 13 plays, of which *The Belle's Stratagem* (1782) for many years kept the stage.

COWLEY, HENRY WELLESLEY, 1st Earl (1804–1884), British diplomatist, eldest son of the 1st Baron Cowley and nephew of the duke of Wellington, was born on June 17, 1804. After holding various diplomatic posts he succeeded the 1st marquess of Normandy as ambassador in Paris in 1852. This post he held for 15 years. He conducted the negotiations on the Eastern question which preceded and followed the Crimean War, and assisted Cobden in the negotiation of the commercial treaty of 1860 between France and England. He received an earldom in 1857, and died on July 15, 1884.

COWLEY FATHERS, the name commonly given to the members of the Society of Mission Priests of St. John the Evangelist, an Anglican religious community, the headquarters of which are in England, at Cowley St. John, close to Oxford. The society was founded in 1865 by the Rev. R. M. Benson "for the cultivation of a life dedicated to God according to the principles of poverty, chastity and obedience."

COWPENS, a town of Spartanburg county, S.C., U.S.A., in the N. part of the state. Pop. (1930) 1,115; (1940) 1,343. It is served by the Southern railway. In colonial days cattle were rounded up and branded here—whence the name. Seven miles N. of the town is the field of the battle of Cowpens, fought on Jan. 17, 1781, during the Revolutionary war, between the Americans under Gen. Daniel Morgan and the British under Col. (later Gen. Sir) Banastre Tarleton, the British being defeated. A monument was erected on the battlefield in 1859, but was defaced during the Civil War. A second, larger monument was erected in June 1932. The town was founded in 1876, and incorporated in 1880.

COWPER, WILLIAM (1731–1800), English poet, was born in the rectory (now rebuilt) of Great Berkhamsted, Herts., on Nov. 26 (O.S. 15), 1731. His father, the Rev. John Cowper, was rector of the parish as well as a chaplain to George II., and his mother, Ann Donne, belonged to the same family as John Donne, the poet. His grandfather was that Spencer Cowper who, after being tried for his life on a charge of murder, lived to be a judge of the court of common pleas, and whose elder brother became lord chancellor and Earl Cowper, a title which became extinct in 1905.[1]

On his mother's death, when he was six, William Cowper was sent to boarding-school, to a Dr. Pitman at Markyate, a neighbouring village. From 1738 to 1741 he was placed in the care of an oculist, as he suffered from inflammation of the eyes. In the latter year he was sent to Westminster school. Among his most intimate friends seems to have been Sir William Russell. To one of his masters, Vincent Bourne, he was much attached. Later, he translated Bourne's Latin verses into English. It was at the Markyate school that he suffered the tyranny that he commemorated in *Tirocinium.* His days at Westminster, Southey thinks, were "probably the happiest in his life." Much of his time was spent in reading Homer, Milton, and Cowley. He left Westminster in 1748, and in 1749 entered a solicitor's office in Ely place, Holborn. Here he had Thurlow, the future lord chancellor, as a fellow-clerk. The years in Ely place were rendered happy by frequent visits to his uncle Ashley's house in Southampton row, where he fell deeply in love with his cousin Theodora Cowper. At 21 he took chambers in the Middle Temple, where we first hear of the melancholies that accompanied him periodically through manhood. He was called to the bar in 1754. In 1759 he removed to the Inner Temple and was made a commissioner of bankrupts. His attachment to his cousin Theodora ended unhappily. Her father, possibly influenced by Cowper's melancholy tendencies, perhaps possessed by prejudices against the marriage of cousins, interposed, and the lovers were separated —as it turned out for ever. During three years he was a member of the Nonsense Club with his two schoolfellows from Westminster, Charles Churchill and Robert Lloyd, and wrote sundry verses and made a translation (no longer extant) of two books of Voltaire's *Henriade.* A crisis occurred in Cowper's life when his cousin Major Cowper nominated him to a clerkship in the House of Lords. It involved a preliminary appearance at the bar of the house. The prospect drove him insane; he attempted suicide and all but succeeded. His friends were informed, and he was sent to a private lunatic asylum at St. Albans, where he remained for 18 months under the charge of Dr. Nathaniel Cotton, the author of *Visions.* Upon his recovery he removed to Huntingdon (June 1765) in order to be near his brother John, who was a fellow of St. Benet's college, Cambridge. His illness had cut him off from all his old friends save only his cousin Lady Hesketh, Theodora's sister; but new acquaintances were made, the Unwins being the most valued. This family consisted of Morley Unwin (a clergyman), his wife Mary, and his son (William) and daughter (Susannah). The son struck up a warm friendship, which his family shared. Cowper entered the circle as a boarder in November (1765). All went serenely until in July 1767 Morley Unwin was thrown from his horse and killed. A short time before this event the Unwins had received a visit from the Rev. John Newton, the evangelical curate of Olney in Buckinghamshire, with whom they became friends. Newton suggested that the widow and her children with Cowper should take up their abode in Olney. This was achieved in the closing months of 1767. Here Cowper lived for 19 years. His residence in the market place was converted into a Cowper museum 100 years after his death, in 1900. Here his life went on its placid course, interrupted only by the death of his brother in 1770, until 1773, when he again became deranged. This second attack interrupted the contemplated marriage of Cowper with Mary Unwin, whose daughter had married a Mr. Powley. The fact of the engagement was kept secret in later years in order to spare the feelings of Theodora Cowper, who thought that her cousin had remained as faithful as she had done to their early love.

On this second attack of melancholy Cowper was moved to the vicarage, and again treated by Dr. Cotton. As soon as he recovered he returned to his home at Orchard Side, and in 1776 was perfectly normal, recommencing his correspondence with his friends. In 1779 appeared the *Olney Hymns,* written in conjunction with Newton, Cowper's verses being indicated by a "C." Newton had left Olney in 1780. He had exercised a profound influence on Cowper, who had helped him in visiting the sick and in parish work, which was undoubtedly a strain on the poet's nerves. It was only after Newton's removal that he turned to secular poetry, at the suggestion of Mrs. Unwin. It is evident that the release from the religiosity of the Newton circle had improved his mental health. In 1782, when he was 51 years old, there appeared *Poems of William Cowper of the Inner Temple, Esq.; London, Printed for J. Johnson, No. 72 St. Paul's Churchyard.* The volume contained "Table Talk," "The Progress of Error," "Truth," "Expostulation," and much else that survives to be read in our day by virtue of the poet's finer work. This finer work was partly the outcome of his friendship with Lady Austen, a widow who, on a visit to her sister, the wife of the vicar of the neighbouring village of Clifton, made the acquaintance of Cowper and Mrs. Unwin. The three became great friends. Lady Austen determined to give up her house in London and to settle in Olney. She suggested *The Task* and inspired *John Gilpin* and *The Royal George.* But in 1784 the friendship was at an end, doubtless through Mrs. Unwin's jealousy of Lady Austen. Cowper's second volume appeared in 1785: *The Task: A Poem in Six Books. By William Cowper of the Inner Temple, Esq.; To which are added by the same author An Epistle to Joseph Hill, Esq., Tirocinium or a Review of Schools, and the History of John Gilpin: London, Printed for J. Johnson, No. 72 St. Paul's Churchyard; 1785.* His first book had been a failure, one critic even declaring that "Mr. Cowper was certainly a good, pious man, but without one spark of poetic fire." This second book was an instantaneous success, and indeed marks an epoch in literary history. But before its publication—in 1784—the poet had commenced the translation of Homer.

In 1786 his life at Olney was cheered by Lady Hesketh taking up a temporary residence at the vicarage there. The cousins met after an interval of 23 years, and Lady Hesketh was to be Cowper's good angel to the end, even though her letters disclose a considerable impatience with Mrs. Unwin. At the end of 1786

[1]An ancestor, John Cooper, an alderman of London (d. 1609) thus spelt his name, and all the family from that day to this, including the poet, have so pronounced it.

a removal was made to Weston Underwood, the neighbouring village which Cowper had frequently visited as the guest of his Roman Catholic friends the Throckmortons. This was to be his home for yet another ten years. Here he completed his translation of Homer, materially assisted by Mr. Throckmorton's chaplain Dr. Gregson. There are six more months of insanity to record in 1787. In 1790, a year before the *Homer* was published, commenced his friendship with his young cousin John Johnson, known to all biographers of the poet as "Johnny of Norfolk." Johnson also aspired to be a poet and visited his cousin armed with a manuscript. Cowper discouraged the poetry but loved the writer, and the two became great friends. New friends were wanted, for in 1792 Mrs. Unwin had a paralytic stroke and henceforth she was a hopeless invalid. A new and valued friend of this period was Hayley, famous in his own day as a poet and in history for his association with Romney and Cowper. He was drawn to Cowper by the fact that both were contemplating an edition of "Milton," Cowper having received a commission to edit, write notes and translate the Latin and Italian poems. The work was never completed. In 1794 Cowper was again insane, and though he recovered, the best of his working life was over. Mainly through Hayley's efforts he received in this year a pension of £300 per annum. In the following year a removal took place into Norfolk under the loving care of John Johnson. Johnson took Cowper and Mary Unwin to North Tuddenham, thence to Mundesley, then to Dunham Lodge, near Swaffham, and finally in Oct. 1796 they moved to East Dereham. In December of that year Mrs. Unwin died. In 1799 Cowper completed the revision of his *Homer*. He died of dropsy on April 25, 1800, and was buried near Mrs. Unwin in East Dereham church.

Cowper brought a new spirit into English verse and redeemed it from the artificiality and the rhetoric of many of his predecessors. With him began the "enthusiasm of humanity" that was afterwards to become so marked in the poetry of Burns and Shelley, Wordsworth and Byron. With him began the renewal of the deep sympathy with nature and love of animal life, which was to characterize the work of the romantic school.

Cowper had what is a rare quality among English poets, the gift of humour, which was very singularly absent from others who possessed many other of the higher qualities of the intellect. Certain of his poems, moreover—for example, "To Mary," "The Receipt of my Mother's Portrait," and the ballad "On the Loss of the Royal George"—will, it may safely be affirmed, continue to be familiar to each successive generation in a way that pertains to few things in literature. He ranks among the half-dozen greatest letter-writers in the English language.

BIBLIOGRAPHY.—The first important life of Cowper was Hayley's *Life and Letters of William Cowper* (1803–06); it was reprinted in 1809 and 1812. It was again printed by the Rev. T. S. Grimshawe with the correspondence in 8 vols. in 1835. Robert Southey's much more valuable *Life and Letters* appeared in 15 vols. in 1834–37; this remains the standard edition. *The Private Correspondence*, edited by John Johnson, appeared in 2 vols. in 1824 and again in 1835. The *Correspondence* (4 vols.) ed. by Thomas Wright, was published in 1904, but more correspondence appeared in *Notes and Queries*, July, Aug., and Sept. 1904, and in *The Poems of William Cowper*, ed. J. C. Bailey (1905). Edward Dowden discovered new correspondence with William Hayley (*The Atlantic Monthly*, 1907). Several short lives of Cowper have appeared, from Thomas Taylor's (1833) to Goldwin Smith's in the "English Men of Letters" series (1880); a brief biography is attached to the Globe edition of Cowper's *Works*. Essays by Leslie Stephen, Stopford Brooke, Whitwell Elwin, George Eliot, and Walter Bagehot deserve attention. A good modern edition of the *Poetical Works* with a bibliography of the early editions, the text collected from the mss. is that by H. S. Milford (1907, 3rd ed. 1926). *See* also Sainte Beuve, *Causeries du Lundi*, vol. xi. (1868); Rev. Josiah Bull, *John Newton* (1868); John Neave, *A Concordance to the Poetic Works of William Cowper* (1887); Caroline Gearey, *Cowper and Mary Unwin* (1900); *Letters of Lady Hesketh to John Johnson* (1901); *Selection from Letters*, ed. E. V. Lucas, notes M. L. Milford (1911); *The Unpublished and Uncollected Letters of W. Cowper*, ed. T. Wright (1925); *Selected Letters*, Everyman Series (1926); and Hugh I'Anson Fausset, *Cowper* (1928).

COWPER, WILLIAM COWPER, 1ST EARL (*c.* 1665–1723), lord chancellor of England, was the son of Sir William Cowper, Bart., of Ratling Court, Kent, a Whig member of parliament of some mark in the two last Stuart reigns. Educated at St. Albans school, Cowper was called to the bar in 1688; having promptly given his allegiance to the prince of Orange on his landing in England, he was made recorder of Colchester in 1694, and at various times represented Hertford and other constituencies in parliament. He enjoyed a large practice at the bar, and had the reputation of being one of the most effective parliamentary orators of his generation. It was in 1705 that he was appointed lord keeper of the great seal, and took his seat on the woolsack without a peerage. In the following year he conducted the negotiations between the English and Scottish commissioners for arranging the union with Scotland. In November of the same year (1706) he succeeded to his father's baronetcy; and on Dec. 14 he was raised to the peerage as Baron Cowper of Wingham, Kent.

When the union with Scotland came into operation in May 1707 the queen in council named Cowper lord high chancellor of Great Britain, he being the first to hold this office. He presided at the trial of Dr. Sacheverell in 1710, but resigned the seal when Harley and Bolingbroke took office in the same year. On the death of Queen Anne, George I. appointed Cowper one of the lords justices for governing the country during the king's absence, and a few weeks later he again became lord chancellor. A paper which he drew up for the guidance of the new king on constitutional matters, entitled *An Impartial History of Parties*, marks the advance of English opinion towards party government in the modern sense. It was published by Lord Campbell in his *Lives of the Lord Chancellors*. Cowper supported the impeachment of Lord Oxford for high treason in 1715, and in 1716 presided as lord high steward at the trials of the peers charged with complicity in the Jacobite rising. He warmly supported the septennial bill in the same year. On March 18, 1718, he was created Viscount Fordwich and Earl Cowper, and a month later he resigned office on the plea of ill-health, but probably in reality because George I. accused him of espousing the prince of Wales's side in his quarrel with the king. He died at Colne Green, built by himself on the site of the present mansion of Panshanger, on Oct. 10, 1723.

Cowper was not a great lawyer, but Burnet says that "he managed the court of chancery with impartial justice and great despatch"; one or two of his judgments settled important points in real property law. He was twice married. His brother, Spencer Cowper (1669–1728), was grandfather of William Cowper, the poet.

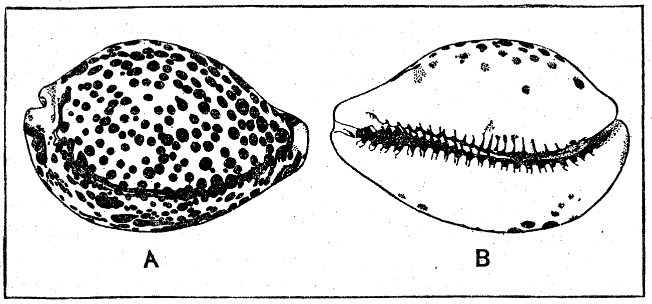
See *Private Diary of Earl Cowper*, edit. E. C. Hawtrey for the Roxburghe club (Eton, 1833); *The Diary of Mary, Countess Cowper*, edit. the Hon. C. Spencer Cowper (1864); John, Lord Campbell, *Lives of the Lord Chancellors and Keepers of the Great Seal* (8 vols. 1845–69); Edward Foss, *The Judges of England* (9 vols. 1848–64); Gilbert Burnet, *History of his Own Time* (6 vols. 1833); T. B. Howell, *State Trials*, vols. xii.–xv. (33 vols. 1809–28).

COWPER STOVE. In blast furnace practice it is economical to heat the air supplied to the furnace. This is effected by causing the furnace to heat its own supply of air, as is now always done save in the case of cold blast furnaces employed to produce certain qualities of iron. The first economical appliance invented to heat the blast was the invention of E. A. Cowper in 1860; hence the name "Cowper stove."

The Cowper stove consists of a large vertical steel shell, containing a combination chamber and a number of narrow vertical flues, built in brickwork, which are heated by the waste furnace gas. When sufficient heat has been absorbed through the flues, the fuel gas is shut off and the air for the blast heated by being driven through the hot flues on its path to the furnace. So the operation proceeds, the Cowper stove being alternately "on gas" and "on wind," first heated, and then cooling as it imparts heat to the blast. (*See* IRON AND STEEL.)

COWRY, the name given to the *Cypraeidae*, a family of marine gastropod molluscs. More than 150 living species are known. They live in shallow water, and are found principally in the Indo-Pacific region. A small cowry, *Trivia europaea*, is found in European waters. They have a striking appearance when seen alive. The edges of the mantle are folded over the shell, covering a large part of its surface, and are provided with branched appendages. A marked difference is found between the shells of young and adult cowries. In the young form the shell is like that of a normally coiled snail, the lip of the aperture being simple and the spire acute and prominent. In the adult the outer lip is very large, the shell is inrolled so that the spire is nearly hidden, and the internal wall between the various whorls is resorbed.

The shells of *Cypraea moneta* are used by certain African tribes as money (*see* SHELL-MONEY) and those of other species are



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TIGER COWRY (CYPRAEA TIGRIS)

(A) Dorsal side, (B) Ventral side

widely employed as ornaments. *Cypraea aurantium* (the orange cowry) is worn as a symbol of rank in the Fiji and the Friendly islands. (G. C. R.)

See G. W. Tryon, *Manual of Conchology,* vol. vii. (1885).

COWSLIP: *see* PRIMROSE; MARSH-MARIGOLD.

COW-TREE or **MILK-TREE,** *Brosimum utile* (family Moraceae), a native of Venezuela. As in other members of the order, the stem contains a milky latex, which flows out in quantities when a notch is cut in it. The "milk" is sweet and pleasant tasting. Another species, *B. Alicastrum,* the bread-nut tree, a native of Central America and Jamaica, bears an edible fruit. The bread-fruit (*Artocarpus*) is an allied genus of the same family. The milk-tree of Brazil, *Mimusops huberi,* produces a latex that "exudes in abundance when the bark is cut; it has about the consistence of thick cream" (A. R. Wallace, *Travels on the Amazon and Rio Negro*) and is used as milk and as glue. The timber of this tree is valuable and the fruit is edible. It belongs to the *sapodilla* family (Sapotaceae).

COX, DAVID (1783–1859), English painter, born April 29, 1783, in Deritend, near Birmingham. Joseph Cox, his father, was both blacksmith and whitesmith, and David was early taken from school and set to the anvil. Later, he became an art teacher, and secured fame in London in 1835–40, years which mark the period of his highest powers. On leaving London, he settled down in his home at Harborne, near his native town, where he died June 7, 1859. The British museum and the Victoria and Albert museum, London, possess a large number of his water-colour drawings. (*See* Hall, *Biography of David Cox* [1881].)

COX, SIR GEORGE WILLIAM (1827-1902), English miscellaneous and historical writer, was born on Jan 10, 1827, at Benares, India, and died at Walmer on Feb. 9, 1902. Educated at Rugby and Trinity college, Oxford, he was ordained in 1850, and succeeded to the baronetcy in 1877. He wrote *Aryan Mythology* (1870), and an *Introduction to the Science of Comparative Mythology* (1881) besides other works.

COX, JACOB DOLSON (1828–1900), American general, political leader and educationalist, was born on Oct. 27, 1828 in Montreal, Canada. He was reared in New York city, and studied in a law office in 1842–44. Working in a broker's office in 1844–46, he came under the influence of Charles G. Finney, whose daughter he afterwards married. In New York city he also prepared himself for the ministry. He graduated at Oberlin college in 1851, having given up his theological studies in rebellion against Finney's dogmatism.

In 1851–53 he was superintendent of schools at Warren (O.); in 1853 was admitted to the Ohio bar, being at that time an anti-slavery Whig; and in 1859 was elected to the State senate. Appointed by Governor Dennison one of three brigadiers general of militia in 1860, he studied tactics, strategy and military history.

He raised troops for the Union service in 1861, enlisted himself in spite of poor health and a family of six children, and was commissioned a brigadier general, U.S. Volunteers. He took part in the West Virginia campaign of 1861, served in the Kanawha region, in supreme command after Rosecrans's relief in the spring, until August 1862, when his troops were ordered to join Burnside's 9th Corps in Virginia. During Antietam, Cox commanded the corps, and at the close of the campaign (Oct. 6, 1862) he was appointed major general, U.S.V., but the appointment was not confirmed. In April-December 1863 he was head of the department of Ohio. In 1864 he took part in the Atlanta campaign, as a corps-commander. He led an expedition following Sherman into the Carolinas and fought two successful actions with Bragg at Kinston (N.C.). As governor of Ohio in 1866-67, he advocated colonization of the freedmen in a restricted area, sympathized with President Johnson's programme of reconstruction and worked for a compromise between Johnson and his opponents. In 1868 he was chairman of the Republican national convention which nominated Grant. He was secretary of the interior in 1869–70; opposed the confirmation of the treaty for the annexation of Santo Domingo; introduced the merit system in his department, and resigned in Oct. 1870 because of political pressure.

He took up legal practice in Cincinnati, became president of the Toledo and Wabash and Western in 1873, and until 1877 was receiver of that company. In 1877–79 he was a representative in Congress. From 1881 to 1897 he was dean of the Cincinnati law school, and from 1885 to 1889 president of the University of Cincinnati. He died at Magnolia (Mass.), on Aug. 4, 1900. A successful lawyer, and in his later years a prominent microscopist, he is best known as one of the great "civilian" generals of the Civil War, and, with the possible exception of J. C. Ropes, one of the outstanding American authorities of his time on military history, particularly the history of the Civil War.

He wrote *Atlanta* (1882) and *The March to the Sea, Franklin and Nashville* (1882), both in the series *Campaigns of the Civil War; The Second Battle of Bull Run, as Connected with the Fitz-John Porter Case* (Cincinnati, 1882); and the valuable *Military Reminiscences of the Civil War* (1900), published posthumously.

See J. R. Ewing, *Public Services of Jacob Dolson Cox* (Washington, 1902), a Johns Hopkins university dissertation; and W. C. Cochran, "Early Life and Military Services of General Jacob Dolson Cox," in *Bibliotheca Sacra,* vol. 58 (Oberlin, O., 1901).

COX, JAMES MIDDLETON (1870–), American politician, was born near Jacksonburg (O.), on March 31, 1870. After being educated in the common schools he worked in a newspaper office, and for a short time was a country school teacher. Later he became a reporter on the Cincinnati *Enquirer.* In 1898 he purchased the Dayton *News* and five years later the Springfield *Press-Republic,* subsequently named the *Daily News.* In 1923 he purchased the Canton *Daily News* and the Miami (Fla.) *Metropolis,* which later became the Miami *Daily News.* From 1909–13 he was a member of Congress for the Dayton district. He was governor of Ohio 1913–15 and 1917–21. His career as governor was notable. Among the reforms introduced under his guidance were a workmen's compensation law; the elimination of the sweatshop; the establishment of a State industrial commission for dealing with questions of labour and capital; the provision of a minimum wage and a nine-hour day for women; mothers' pensions; a blue-sky law (*q.v.*) protecting investors from unscrupulous promoters; the initiative and referendum; the establishment of a State tuberculosis hospital and the extension of safety devices on railways and in mines. He was energetic in suppressing violence in connection with strikes, his general policy being to hold local authorities responsible without recourse to the State militia. He favoured the abolition of the Federal inheritance tax, believing that the State alone should have jurisdiction over inheritances. He was a strong supporter of President Wilson's policies and especially of the League of Nations. He was charged with opposing prohibition, but repeatedly declared that all laws must be enforced. At the Democratic national convention in 1920 he received the presidential nomination, but was overwhelmingly defeated by Harding, the Republican nominee. The electoral vote was 404 for Harding and 127 for Cox. The popular vote was 16,152,200 for Harding and 9,147,353 for Cox

The vote in Ohio, the home State of both candidates, was 1,182,022 for Harding and 780,037 for Cox.

COX, KENYON (1856–1919), American painter, was born at Warren (O.), on Oct. 27, 1856, the son of Gen. Jacob Dolson Cox. He was a pupil of Carolus-Duran and of J. L. Gérôme in Paris from 1877–82, when he returned to New York, subsequently teaching with much success in the Art Students' League. It was in mural decorative work that he achieved prominence. Among the better-known examples of his work are the frieze for the court room of the Appellate Court, New York, and decorations for the Walker Art Gallery, Bowdoin College; for the Capitol at St. Paul (Minn.), and elsewhere. He also wrote with much authority on art topics, and was the author of *Old Masters and New* (1905), *Painters and Sculptors* (1907), *The Classic Point of View* (1912), *Artist and Public* (1914), *Winslow Homer* (1914), and *Concerning Painting* (1917), besides some poems. He became a National Academician in 1903, and in 1910 was awarded the medal of honour for mural painting by the Architectural League. His wife, *née* Louise H. King (1865–1945), whom he married in 1892, also became a figure and portrait-painter of note. Kenyon Cox died in New York on March 17, 1919.

COX, SIR PERCY (1864–1937), British administrator, was born on Nov. 20, 1864, educated at Harrow and Sandhurst, and entered the army in 1884, serving in the 2nd battalion of the Cameronians until 1889. He gained his very great knowledge of and experience in Eastern politics and diplomacy first in the Indian political department, and then in a series of consular appointments in the Persian gulf, where he became political resident in 1909. He was chief political officer to a section of the Indian Expeditionary Force in 1914. He was appointed British ambassador to Tehran from 1918 to 1920, and high commissioner in Mesopotamia in the critical years 1920 to 1923. For the history of his administration *see* 'IRAQ. Sir Percy Cox also represented the British Government in the Mosul boundary negotiations with Turkey. He was the recipient of many honours, including the G.C.M.G. (1922), and was a member of many learned societies.

COX, RICHARD (1500?–1581), dean of Westminster and bishop of Ely, was born at Whaddon, Buckinghamshire, educated at the Benedictine priory of St. Leonard.Snelshall near Whaddon, at Eton, and at King's college, Cambridge, where he graduated in 1524. At Wolsey's invitation he became a member of the cardinal's new foundation at Oxford, was incorporated B.A. in 1525, and created M.A. in 1526. In 1530 he was engaged in persuading the more unruly members of the university to approve of the king's divorce. He was then appointed master of the royal foundation at Eton. In 1533 he appears as author of an ode on the coronation of Anne Boleyn. In 1540 he was one of the 15 divines to whom were referred crucial questions on the sacraments and the seat of authority in the church; his answers (printed in Pocock's *Burnet,* iii. 443–496) indicate a mind tending away from Catholicism, but susceptible to "the king's doctrine"; and, indeed, Cox was one of the divines by whom Henry said the "King's Book" had been drawn up when he wished to impress upon the Regent Arran that it was not exclusively his own doing. Cox subscribed the divorce of Anne of Cleves in 1540, and in that year became archdeacon and prebendary of Ely and canon of Westminster.

After Edward's accession, Cox's opinions took a more Protestant turn, and he became one of the most active agents of the Reformation. He was consulted on the compilation of the Communion office in 1548, and the first and second books of Common Prayer, and sat on the commission for the reform of the canon law. As chancellor of the University of Oxford (1547–52) he promoted foreign divines such as Peter Martyr, and was a moving spirit of the two commissions which sought with some success to eradicate everything savouring of Romanism from the books, mss., ornaments and endowments of the university, and earned Cox the sobriquet of its cancellor rather than its chancellor. He received other preferments, which he lost on Mary's accession, and was for a fortnight in Aug. 1553 confined to the Marshalsea. He remained in obscurity until after the failure of Wyatt's rebellion, and then in May 1554 escaped in the same ship as the future archbishop Sandys, to Antwerp. Thence in March 1555 he made his way to Frankfort, where the English and Scottish exiles had, under the influence of Knox and Whittingham, adopted Calvinistic doctrine and a form of service far more Puritanical than the Prayer Book of 1552. Cox stood up for that service, and the exiles were divided into Knoxians and Coxians. Knox attacked Cox as a pluralist, Cox accused Knox of treason to the emperor Charles V. This proved the more dangerous charge: Knox and his followers were expelled, and the Prayer Book of 1552 was restored.

In 1559 Cox returned to England, and was elected bishop of Norwich, but the queen changed her mind and Cox's destination to Ely, where he remained 21 years. He was an honest, but narrow-minded ecclesiastic, who held what views he did hold intolerantly, and was always wanting more power to constrain those who differed from him (*see* his letter in *Hatfield mss.* i. 308). While he refused to minister in the queen's chapel because of the crucifix and lights there, and was a bitter enemy to the Roman Catholics, he had little more patience with the Puritans. He was grasping, or at least tenacious of his rights in money matters, and was often brought into conflict with courtiers who coveted episcopal lands. The queen herself intervened, when he refused to grant Ely House to her favourite, Sir Christopher Hatton; but the well-known letter beginning "Proud Prelate" and threatening to unfrock him seems to be an impudent forgery which first saw the light in the *Annual Register* for 1761. It hardly, however, misrepresents the queen's meaning, and Cox was forced to give way. These and other trials led him in 1580 to resign his see, which remained vacant 19 years. Cox died on July 22, 1581.

BIBLIOGRAPHY.—Voluminous details about Cox's life are given in T. Strype, *Works,* Parker Soc. Publ., and C. H. and T. Cooper, *Athenae Cantab,* i. 437–445 (1858–1913). *See* also T. Gairdner, *Letters and Papers of Henry VIII.* (1862 etc.); *Acts of the Privy Council* (1542–1890); *Calendar State Dom. Papers* (1856–71); *Cal. Hatfield mss.* (1883 etc.); *Lit. Remains of Edward VI.,* ed. J. G. Nichols (1857); W. Whittingham, *Troubles at Frankfort* (1575, 1907); J. Le Neve, *Fasti* (1716); B. Willis, *Cathedrals* (1718–19); J. Bentham, *Ely* (1771); H. Machyn, *Diary* (1848); G. Burnet's *History of the Reformation,* ed. N. Pocock (1865).

COX, SAMUEL (1826–1893), English Baptist divine, was born in London on April 19, 1826. He worked in the London docks and then entered the Baptist college at Stepney. In 1851 he became pastor of a Baptist church at Southsea, removing in 1855 to Ryde and in 1863 to Nottingham. He was president of the Baptist Association in 1873. Cox was the founder and first editor of *The Expositor* (1875–84). His works include: *Salvator Mundi* (1877), *A Commentary on the Book of Job* (1880), *The Larger Hope* (1883).

COXCIE, MICHAEL (1499–1592), Flemish painter, was born at Malines, and studied under Bernard van Orley. At Rome in 1532 he painted the chapel of Cardinal Enckenvoort in the church of Santa Maria dell' Anima. Coxcie's principal occupation was designing for engravers; and the fable of Psyche in 32 sheets by Agostino Veneziano and the Master of the Die are favourable specimens of his skill. His productions were long concealed under an interlaced monogram M.C.O.K.X.I.N. Coxcie returned in 1539 to Malines, where he matriculated, and painted for the chapel of the gild of St. Luke the wings of an altar-piece (centre by Mabuse) now in Sanct Veit of Prague. There are large and capital works of his (1587–88) in St. Rombaud, Malines, in Ste. Gudule, Brussels, and in the museums of Brussels and Antwerp. He died at Malines on March 5, 1592.

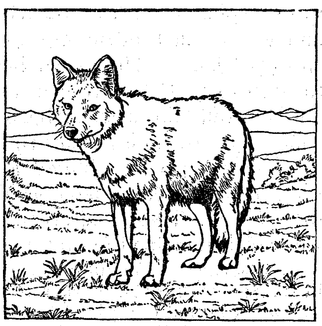
COXE, HENRY OCTAVIUS (1811–81), English librarian and palaeographer, was born at Bucklebury, Berkshire, and educated at Westminster and Worcester college, Oxford. He began work in the manuscript department of the British Museum, became sub-librarian of the Bodleian, at Oxford, in 1838, and was head librarian there, 1860–81. He was sent by the British Government, in 1857, on a tour of inspection of the monastic libraries of the Levant, one of the results being the detection of the forgery attempted by Constantine Simonides.

He published *Rogeri de Wendover Chronica* (1841–44), and *Report on the Greek Manuscripts yet remaining in the Libraries of the Levant* (1858).

COXWELL, HENRY TRACEY (1819–1900), English aeronaut, was born at Wouldham, Kent, on March 2, 1819, the son of a naval officer. In 1848 he became a professional balloonist, making numerous public ascents in the chief continental cities and in London. In 1862 in company with Dr. James Glaisher, he attained the greatest height on record, about 7 miles. His companion became insensible, and he himself, unable to use his frostbitten hands, opened the gas valve with his teeth, and made an extremely rapid but safe descent. The aerial voyages by Coxwell and Glaisher provided important contributions to the science of meteorology. Coxwell was most pertinacious in urging the practical utility of employing balloons in time of war. His last ascent was made in 1885. He died on Jan. 5, 1900.

See his *My Life and Balloon Experiences* (1887).

COYOTE, a North American member of the dog family, also known as the prairie wolf, *Canis latrans*. Ranging from Alaska in the north to Guatemala in the south and frequenting almost every kind of country, especially the plains, the coyote is smaller than the wolf and more jackal-like. The length is about 36 in., the tail being 12 to 15 in.; the general colour grizzled buffy above and whitish below; the legs ochraceous; the tail having a black tip and a dark gland-patch near the root. There is, however, considerable local variation in size and colour.



BY COURTESY OF NEW YORK ZOOLOGICAL SOCIETY

THE COYOTE, A JACKAL-LIKE WOLF COMMON TO THE PRAIRIES OF NORTH AMERICA

Coyotes are slinking and stealthy creatures. They live in burrows in the plains and hunt at night. Hares, chipmunks and mice form a large portion of their food; but also the fawns of deer and prongbuck, sage hens and other game birds. A surprising amount of vegetable food is also taken, fruit of prickly pear cactus, rose hips and juniper berries. They dig burrows for themselves, usually on a slope, or take possession of those already made by badgers and prairie dogs. There, in the spring, the half-dozen or more coyote pups are brought forth.

The yapping cry of the coyote is one of the most characteristic notes of the west. (*See* CARNIVORA.) (J. E. HL.)

COYPEL, the name of a French family of painters. Noel Coypel (1628–1707), also called, from the fact that he was much influenced by Poussin, COYPEL LE POUSSIN, was employed by Charles Errard to paint some pictures required for the Louvre. In 1672 he was appointed director of the French academy at Rome. After four years he returned to France; and not long after he became director of the Academy of Painting. The "Martyrdom of St. James" in Notre Dame is perhaps his finest work.

His son and pupil, ANTOINE COYPEL (1661–1722), was more celebrated than his father, with whom he spent four years at Rome. At the age of 18 he was admitted into the Academy of Painting, of which he became professor and rector in 1707, and director in 1714. In 1716 he was appointed king's painter, and he was ennobled in 1717. He was a clever etcher, and engraved several of his own works. His *Discours prononcés dans les conférences de l'Académie royale de Peinture*, etc., appeared in 1741.

Antoine's half-brother, NOEL NICHOLAS COYPEL (1692–1734), was also an exceedingly popular artist; and his son, CHARLES ANTOINE (1694–1752), was painter to the king and director of the Academy of Painting.

COYPU (*Myocastor coypus*), a large South American aquatic rodent. Its size, aquatic habits, partially webbed hind-toes, and the smooth, broad, orange-coloured incisors, are sufficient to distinguish this rodent from the other members of the family Capromyidae. Coypus are abundant in the fresh waters of South America. Although subsisting largely on aquatic plants, these rodents frequently come ashore to feed, especially in the evening. Several young are produced at a birth. The fur is of some commercial value and is known as nutria; its colour is reddish-brown. (*See* FUR-BEARING ANIMALS (LAND); RODENTIA.)

COYSEVOX, CHARLES ANTOINE (1640–1720), French sculptor, was born at Lyons on Sept. 29, 1640, and died at Paris on Oct. 10, 1720. He belonged to a family which had emigrated from Spain, and he studied under Lerambert. He was employed by Louis XIV in producing much of the decoration and a large number of statues for the palaces at Versailles and Marly (subsequently destroyed in the Revolution), and produced statues of most of the celebrated men of his age, including Louis XIV and Louis XV at Versailles, Colbert (at Saint-Eustache), Mazarin (in the church des Quatre-Nations), Condé the Great (in the Louvre), Bossuet (in the Louvre) and many others. Among the pupils of Coysevox were Nicolas and Guillaume Coustou.

See Henry Jouin, *A. Coysevox, sa vie, son oeuvre* (1883); Jean du Seigneur, *Revue universelle des arts*, vol. i (1855), pp. 32 *et seq.*

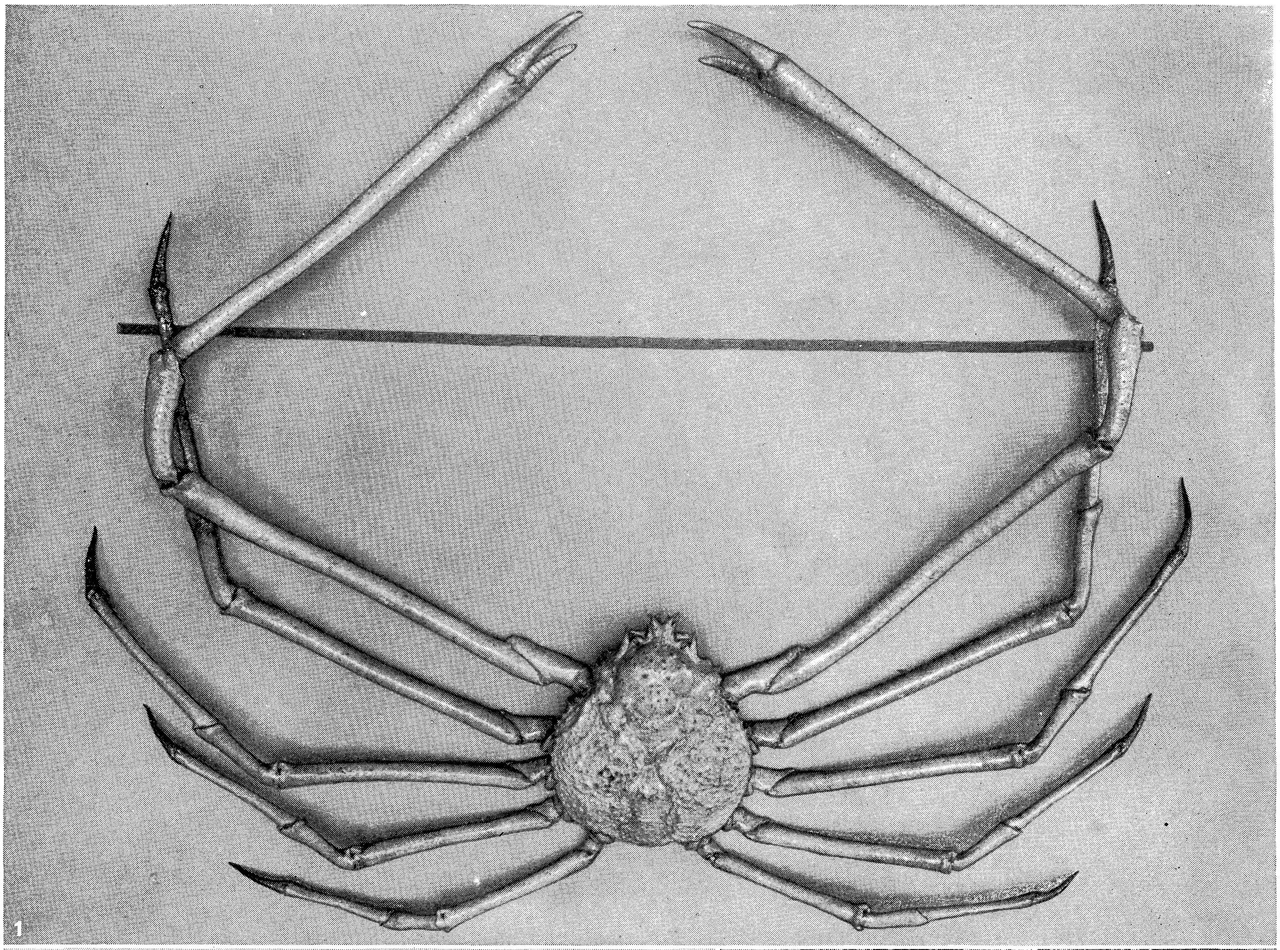
COZENS, JOHN ROBERT (*c.* 1752–1797), English landscape painter in watercolours, born in London. His father, Alexander Cozens, said to have been the natural son of Peter the Great and an Englishwoman from Deptford, after having studied art in Italy, came to England in 1746, was drawing master at Eton from 1763 to 1768 and published several treatises on art. The watercolours of J. R. Cozens are spirited impressionist sketches, rendering fine atmospheric effects by means of a few monochrome tints. They are free from the traditional laws of composition, which governed the art of that time. J. R. Cozens was, therefore, a precursor of Girtin and Turner in the British school of watercolour painting. Turner confessed to have learned more from Cozens' "Landscape with Hannibal in his March over the Alps, showing his Army the Fertile Plains of Italy," exhibited at the Royal Academy in 1776, than from any other picture. Cozens visited Italy twice, in 1776, and again in 1782 with William Beckford. On these trips he executed numerous sketches in pen and monochrome wash. He died in 1797, having spent the last three years of his life in a lunatic asylum. A collection of his watercolours is at the Victoria and Albert Museum; others in private ownership were exhibited at the Grafton Gallery in 1911. The British Museum has 54 drawings by Alexander Cozens, which were lost on his journey from Italy to England, and were recovered by his son in Florence 30 years later.

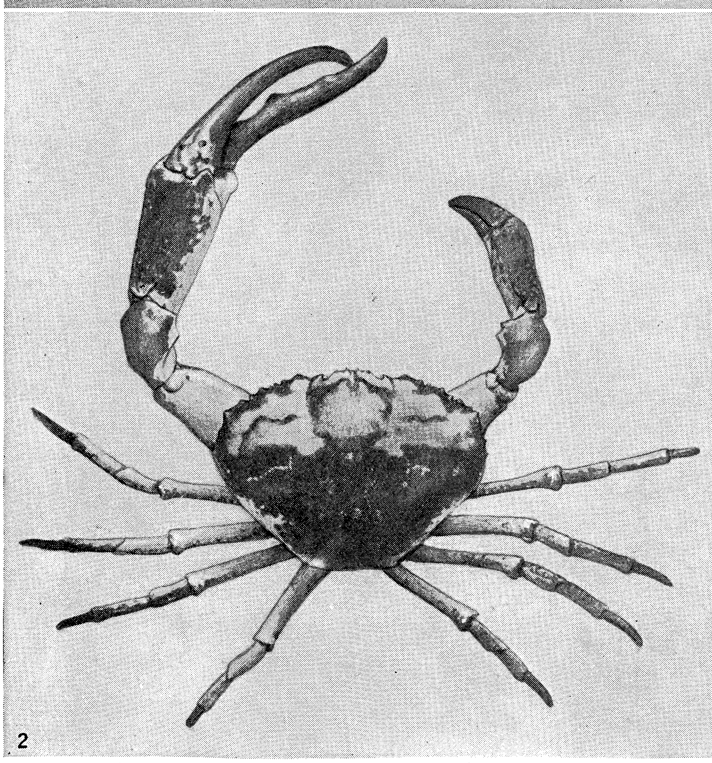
CRAB, a name applied to the Crustacea of the section Brachyura of the order Decapoda, and to other forms, especially of the section Anomura, which may resemble them in appearance and habits.

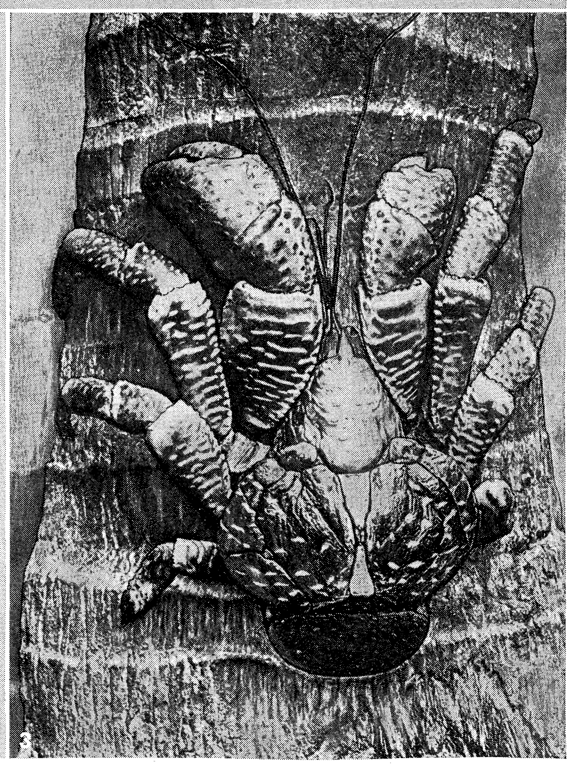
Brachyura, or true crabs, are distinguished from the long-tailed lobsters and shrimps by the small abdomen or tail, folded up under the body. In most the body is transversely oval or triangular in outline and more or less flattened, and is covered by a hard shell, the carapace. There are five pairs of legs. The first pair end in nippers or chelae and are usually much more massive than the others which are used in walking or swimming. The eyes are set on movable stalks and can be withdrawn into sockets in the front part of the carapace. There are six pairs of jaws and foot jaws (maxillipedes) enclosed within a "buccal cavern," the opening of which is covered by the broad and flattened third pair of foot jaws. The abdomen is usually narrow and triangular in the males, but in the females it is broad and rounded and bears appendages to which the eggs are attached after spawning.

As in most Crustacea, the young of nearly all crabs, when newly hatched, are very different from their parents. The first larval stage, known as zoea, is a minute transparent organism, swimming at the surface of the sea. It has a rounded body, armed with long spines, and a long segmented tail. The eyes are not stalked, the legs not yet developed, and the foot jaws form swimming paddles. After casting its skin several times as it grows in size, the young crab passes into a stage known as the Megalopa, in which the body and limbs are more crablike, but the abdomen is large and not folded up. After a further moult the animal assumes a form very similar to that of the adult. There are a few crabs, especially those living in fresh water, which do not pass through a metamorphosis but leave the egg as miniature adults.

Most crabs live in the sea; even the land crabs, which are abundant in tropical countries, visit the sea occasionally and pass through their early stages in it. The river crab of southern Europe







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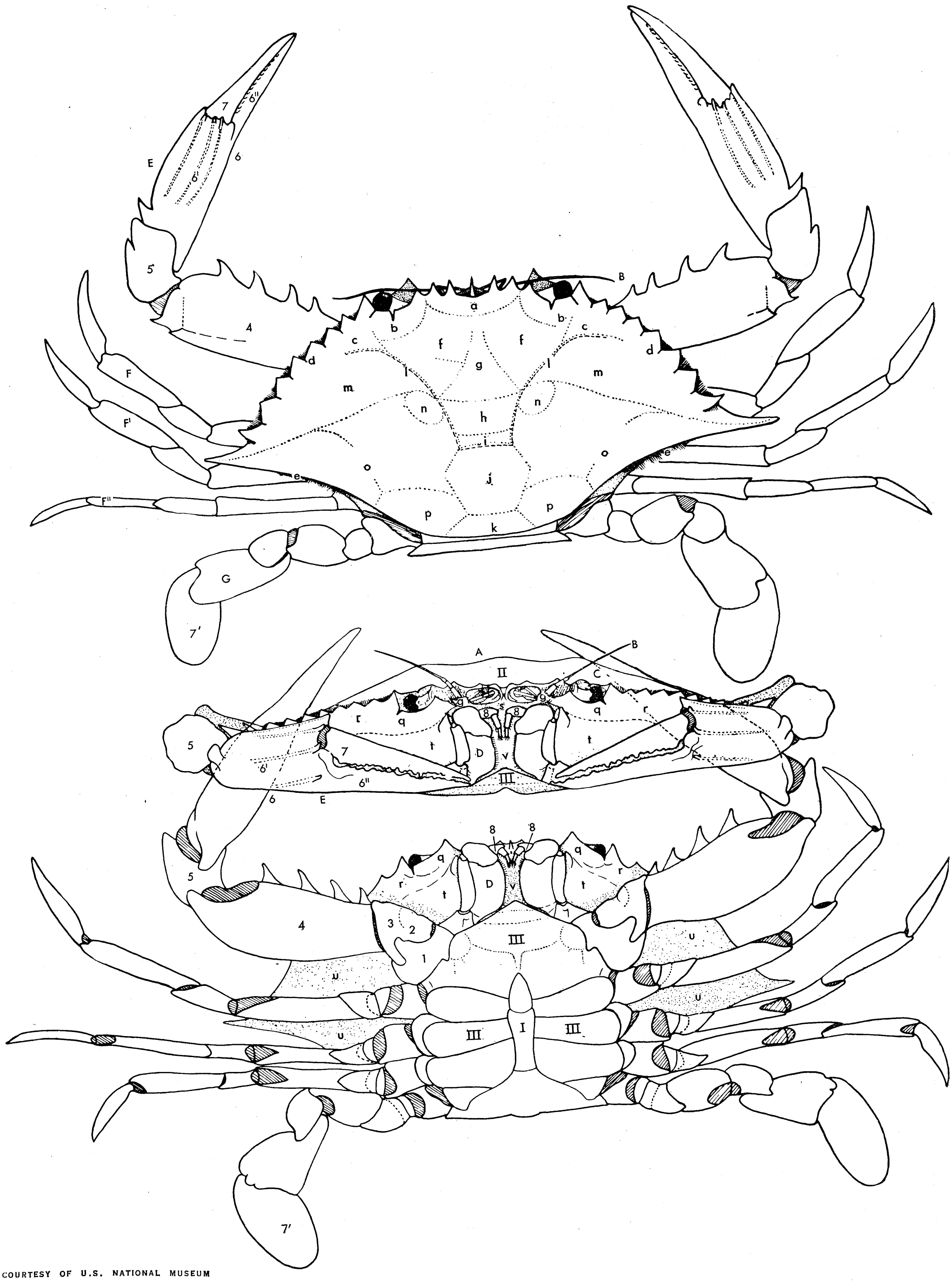
CRABS (Eucarida, Order Decapoda, Reptantia)

1. The giant crab of Japan, *Macrocheira kaempferi* (Section Brachyura), much reduced as can be seen from the 5 ft. rule. Largest specimen of record spans 12½ ft. across the outstretched chelipeds
2. *Pseudocarcinus gigas* (Section Brachyura), giant crab of Tasmania. Found in deep water off the Australian coast. The shell or carapace attains a width of 16 in. Specimens of 30 lb. in weight have been taken
3. The coco-nut or robber crab, *Birgus latro* (Section Anomura), climbing trunk of palm tree. Much reduced in size. Large specimens will grow to be as much as 18 in. in length of body

CRAB



Conventionalized swimming crab, illustrating terms used in description (dorsal, anterior, and ventral views). Body: I, Abdomen; II, Carapace or shell; III, Thoracic sternum. *Regions, areolations, and margins of carapace:* Dorsal view, a, Frontal; b, Orbital; c. Hepatic; d, Antero-lateral; e, Posterolateral; f, Protogastric; g, Mesogastric; h, Metagastric; i, Urogastric; j, Cardiac; k, Intestinal; l, Cervical groove; m, Epibranchial; n, Branchial lobe; o, Mesobranchial; p, Metabranchial. Anterior and ventral views, q, Suborbital; r, Subhepatic; s, Epistome; t, Pterygostomian; u, Subbranchial; v, Buccal cavity. *Appendages:* A, Antennule; B, Antenna; C, Eye on stalk; D, 3rd or outer maxilliped; E, Cheliped or Pincer; F, F′, F″, 1st to 3rd periopods, ambulatory or walking legs; G, Swimming leg. *Parts of Appendages:* 1, Coxa; 2, Basis; 3, Ischium; 4, Merus or arm; 5, Carpus or wrist; 6, Propodus with 6′, manus, hand, or palm, and 6″, fixed or immovable finger; 7, Dactylus or movable finger; 7′, Dactylus or paddle of swimming foot; 8, Palp of maxilliped or Lenten crab (*Potamon edulis,* better known as *Thelphusa fluviatilis*) is an example of the fresh-water crabs which are abundant in most of the warmer regions of the world. As a rule, crabs breathe by gills, which are lodged in a pair of cavities at the sides of the carapace, but in the true land crabs the cavities become enlarged and modified so as to act as lungs for breathing air.

Walking or crawling is the usual mode of locomotion, and the peculiar sidelong gait familiar to most people in the common shore crab, is characteristic of most members of the group. The crabs of the family Portunidae, and some others, swim with great dexterity by means of their flattened paddle-shaped feet.

Like many other Crustacea, crabs are often omnivorous and act as scavengers, but many are predatory in their habits and some are content with a vegetable diet.

Though no crab, perhaps, is truly parasitic, some live in relations of commensalism with other animals. The best known examples of this are the little mussel crabs (Pinnotheridae) which live within the shells of mussels and other bivalve molluscs and share the food of their hosts. Another small but intriguing species is the coral-gall crab (*Hapalocarcinus*), which in some fashion irritates the growing tips of certain corals so that they grow to enclose the female in a stony prison from which there is no escape but which provides an enduring shelter for the mother and successive broods of young. Many of the sluggish spider crabs (Maiidae) have their shells covered by a forest of growing seaweeds, zoophytes and sponges, which are planted there by the crab itself, and which afford it a very effective disguise. The giant crab of Japan (*Macrocheira kaempferi*) and the huge Tasmanian crab (*Pseudocarcinus gigas*) are the largest known Crustacea. The former, over its laterally extended chelipeds, will measure 12½ ft., while specimens of *Pseudocarcinus* of 30 lb. in weight and 16 in. in width have been taken from the deep waters about Australia at 75 to 100 fathoms.

Many crabs are sought as food by man. The most important and valuable are the edible crab of British and European coasts (*Cancer pagurus*), the blue crab (*Callinectes sapidus*) of the Atlantic coast and the Dungeness crab (*Cancer magister*) of the Pacific coast of North America. The latter is fished throughout its productive range from San Francisco to southeastern Alaska. In 1940 nearly 17,000,000 lb. were taken in American waters and 772,000 lb. (1942) on the coast of British Columbia. The blue crab fishery, centering largely in Chesapeake Bay, yielded 72,513,000 lb. of hard and 4,390,000 lb. of soft (recently moulted) crabs (1940). The *Cancer* fishery of Europe ranks next in importance to its lobster industry. The crustacean fisheries of India, for which only partial figures are available, outweigh in quantity and value the yield of all other fisheries of that large and populous country, the crabs being outranked only by the shrimps in importance. The swimming crabs, *Scylla* and *Neptunus,* related to the American blue crab, are among the most important sources of sea food throughout the entire Indo-Pacific region. *Scylla serratus* reaches a large size, 8 to 12 in. in width, exceptionally 18 in. in the brackish waters of Chilka Lake, India.

The commercially valuable Anomura are the lithodid, literally "stone," crabs, of which the so-called king crab of Japan, the Bering Sea, and Alaskan waters (*Paralithodes camtschatica*) is the most important. This species constituted by far the greater part of the 13,507,000 lb. of canned crab meat, valued at $4,582,000, imported into the United States in 1939, chiefly from Japan (78%). A related species (*Lithodes antarctica*), known in Latin America as the "centolla," is the basis of a considerable fishery in southern Chile and the Straits of Magellan.

Better known Anomura are the hermit crabs which live in empty shells of gasteropod molluscs, which they carry about with them as portable dwellings. As the crab grows it changes its abode from time to time, often having to fight with its fellows for the possession of an empty shell. In tropical countries the hermit crabs of the family Coenobitidae live on land, often at considerable distances from the sea to which they must return to hatch out their spawn. The large robber or coconut crab of the Indo-Pacific islands (*Birgus latro*), which belongs to this family, has given up the habit of carrying a portable dwelling, and the upper surface of its abdomen has become covered by shelly plates. It climbs palm trees to get the fruit.

(W. T. C.; W. L. St.)

CRAB-APPLE, the name applied to the fruits or plants of various species of *Malus,* the apple genus; also to certain crosses of such species with improved cultivated types, which give small-size, tart fruits. The genus *Malus,* the apples (included by some botanists in *Pyrus,* the pear genus) includes approximately 25 species indigenous in temperate regions of North America, Europe and Asia. In general, they resemble the cultivated apple in flowers and foliage but have more slender trunks, stiffer and more or less spiny branches, and much smaller, usually very acid fruits. They are extensively used as ornamental shrubs or small trees. The blossoms of many of the crab-apples are extremely showy in the spring and many are characterized by brightly coloured fruit which may hang on well into the winter. Species most widely used as ornamentals include *Malus spectabilis,* the Chinese flowering crab-apple; *M. baccata,* Siberian crab; *M. Sieboldi,* Toringo crab; *M. floribunda,* the Japanese flowering crab-apple; and *M. pumila* var. *niedwetzkyana,* the redvein crab-apple. The American crab-apples include the following: *M. coronaria,* indigenous from western New York and southern Ontario to Wisconsin and southward to North Carolina and Missouri, a beautiful tree when in blossom in April or May and cultivated to some extent as an ornamental. The fruit is delicately scented but very acid, 1 to 1½ in. in diameter. *M. angustifolia,* the southern crab-apple, is native from southern Virginia to southern Illinois and southward to Florida and Louisiana. It produces fruit ¾ to 1 in. in diameter. *M. ioensis,* the prairie crab-apple, is indigenous from Wisconsin and Minnesota southward to Nebraska, Kansas and Missouri. The Oregon crab-apple, *M. fusca,* is found along the Pacific coast from Alaska to California. The fruit is oblong, ½ in. or less in diameter. Fruits of all the crab-apples may be used for jelly and other culinary purposes. The Siberian crab is rather widely grown for fruit, which is used mainly for jelly and for preserving and pickling. Most of the crab-apple species can be crossed with standard apple varieties and many such crosses have been made, particularly in Canada, to secure very hardy, early ripening apples adapted to severe weather conditions. In general, the progeny are intermediate in size and quality between the parents.

In Europe many horticultural varieties producing small, highly-acid fruit are grown primarily for cider making and are commonly referred to as crab-apples or cider apples. Many of these may have originated as crosses between the *Malus* species and cultivated apples. They represent a large proportion of the apple production, particularly of France.

(J. R. Mag.)

CRABBE, GEORGE (1754–1832), English poet, was born at Aldeburgh, Suffolk, the son of a customs officer. His father wanted to make his clever boy a doctor, and Crabbe became an apothecary's assistant at Wickham Brook, near Newmarket, and then a surgeon's assistant at Woodbridge, where he met Sarah Elmy, his future wife and a good friend to him during the hard years ahead. For some time Crabbe worked as a day-labourer at Aldeburgh; he then sought to establish a surgery, which, during his absence for nine months in London for the study of midwifery, was not successful. A period of want followed, but in 1780 a local magnate gave him £5 with which to seek his fortune in London. He had already published at Ipswich his first poem, *Inebriety,* in 1775, and he took with him to London many mss., none of which he was able to place except *The Candidate.* But in March 1781 he was received by Edmund Burke, who read his mss., advised him, and helped him with the publication of *The Library* (1781), and sought the interest of others whereby he could enter the church. Crabbe was ordained in 1781 and became curate at Aldeburgh. The Aldeburgh parishioners were not disposed to respect a curate whom they had known as a day-labourer, and in 1782 Burke persuaded the duke of Rutland to appoint Crabbe as his chaplain at Belvoir castle. The duke gave him two small livings in Dorsetshire. Crabbe then married Sarah Elmy (Dec. 1783). Earlier in the year was published *The Village,* which on Burke's advice had been completed and revised. *The Village* is a poem which has none of the romantic atmosphere of Goldsmith's *Deserted Village* or Gray's *Elegy.* Crabbe had a passion for truth, naked and unashamed. If he laid more stress on the seamy side of village life, it was because that side of it was more familiar to him. His descriptions of nature revealed an intimate and concise knowledge of flora and fauna. The poem, written in heroic couplets, made a deep impression. Scott read it with such attention that ten years later he still knew it by heart.

For 20 years after the publication of *The Village* Crabbe published nothing. He received various preferments, and in 1814, the year after his wife's death, the living of Trowbridge, Wiltshire, where the rest of his life was spent.

Those last years were the most prosperous of his life. He was a frequent visitor to London, and a friend of all the literary celebrities of the time. He proposed marriage to one of his parishioners, Charlotte Ridout, and was accepted in 1814, but broke off the engagement in 1816. He proposed to yet another friend, Elizabeth Charter, somewhat later. In his visits to London Crabbe was the guest of Samuel Rogers, in St. James's place, and was a frequent visitor to Holland House, where he met his brother poets Moore and Campbell. In 1817 his *Tales of the Hall* were completed, and John Murray offered £3,000 for the copyright, Crabbe's previous works, *The Parish Register* (1807), *The Borough* (1810), and *Tales in Verse* (1812) being included. The offer, after much negotiation, was accepted, but Crabbe's popularity was then on the wane.

In 1822 Crabbe went to Edinburgh on a visit to Sir Walter Scott. The adventure, complicated as it was by the visit of George IV. about the same time, is most amusingly described in Lockhart's biography of Scott. Crabbe died at Trowbridge on Feb. 3, 1832, and was buried in Trowbridge church.

Never was any poet so great and continuous a favourite with the critics, and yet so conspicuously ignored by the public. The works of his contemporaries, such as Cowper, Scott, Byron, and Shelley in particular, had been reprinted again and again. With Crabbe it was for long quite otherwise. His works were collected into eight volumes in 1832, the first containing a biography by his son. It was also intended to publish some of his prose writings, but the reception of the eight volumes was not sufficiently encouraging. A reprint, however, in one volume was made in 1847, and it has been reproduced several times since. It was not until the end of the century that sundry volumes of "selections" from his poems appeared; one by Edward FitzGerald (privately printed, 1879), and others by Bernard Holland (1899), C. H. Herford (1902), and Deane (1903). The *Complete Works* were published by the Cambridge University Press in three volumes, edited by A. W. Ward, in 1906.

Crabbe's poems have been praised by many competent critics, by Edward FitzGerald in his *Letters,* by Cardinal Newman in his *Apologia,* and by Sir Leslie Stephen in his *Hours in a Library* most notably. His verses consoled the last hours of Charles James Fox and Sir Walter Scott, while Thomas Hardy has acknowledged their influence on the realism of his novels. But Crabbe's works have ceased to command a wide public interest. He just failed of being the artist in words who is able to make the same appeal in all ages. Yet his poems will well repay perusal. His stories are profoundly poignant and when once read live long in the memory. They reveal him as one of the great realists of English fiction and make fascinating reading. There is true poetry in Crabbe's works although his most distinctively lyric note was attained when he wrote under the influence of opium, to which he became much addicted in his later years.

See *The Life of the Rev. George Crabbe, LL.B., by his son the Rev. George Crabbe, A.M.* (1834); *George Crabbe and His Times, 1754–1832; A Critical and Biographical Study,* by René Huchon, translated from the French by Frederick Clarke (1907); also the brief biographies by T. H. Kebbel ("Great Writers" series) and by Canon Ainger ("English Men of Letters" series).

CRAB GRASS, finger grass, the name for various species of *Digitaria,* especially *D. sanguinalis* and *D. ischaemum,* both natives of Europe widely naturalized as weeds in eastern North America. They are very troublesome in lawns and in late summer in cultivated fields.

BY COURTESY OF THE IOWA EXPERIMENTAL STATION

CRAB GRASS, A WEED, INTRODUCED FROM EUROPE INTO AMERICA

CRACKER, something which "cracks" (Ger. *Krachen*); a firework which explodes with several reports and jumps at each explosion (*see* FIREWORKS); a roll of coloured and ornamented paper containing sweets, etc., together with a strip of card with a fulminant which explodes on being pulled. In America, the general name for a biscuit. In the southern states of America "cracker" is a term of contempt for the "poor" or "mean whites" of Georgia and Florida; the term dates back to the Revolution, and is supposed to be derived from the "cracked corn" which formed the staple food of the class to whom the term refers.

CRACKING PROCESS: *see* PETROLEUM.

CRACOW, a province of Poland, bounded north by the province of Kielce, east by the province of Lwow, west by Polish Silesia and south by Czechoslovakia; occupied by Germany in 1939.

Cracow covers 6,736 square miles. It is drained by the Vistula and its tributaries, the Dunajec and Wisloka. The north region is a fertile plain, but the main portion consists of highlands stretching up to the Carpathian mountains. The mountain chain reaches from the West Beskids to the Low Beskids, but in the valley of the Dunajec the province extends to the lofty Tatry heights (more than 7,900 ft.). Population (1931) 2,296,842, mainly Poles, with 7.8% classed as other than Polish mother tongue.

The Poles speak the same dialect as their neighbours in the provinces of Kielce and Lublin, but the mountain area is inhabited by the Gorale or Highlanders with their picturesque costume and local dialects.

The province is divided into 24 districts, the chief towns being the capital, Cracow (*q.v.*), Tarnów (pop. 1931, 45,235) and Nowy Sacz (pop. 1931, 30,278). Rye, oats, wheat and vegetables are produced.

The peasants, who enjoyed economic liberty after 1848 and political liberty after 1867, are better educated than the peasants of the provinces formerly under Russia, and the peasants' parties originating in this region played an important part in the constitutional life of Poland. Industry, however, suffered from the competition of the factories of Austria and Bohemia.

The salt mines of Bochnia and Wieliczka (*q.v.*) have been famous from the earliest times. The greater part of the province was occupied by Austria at the first partition of Poland, and was known as West Galicia till 1918. The province was overrun by German armies in the first week of World War II.

CRACOW (Krah-kow′, Polish Krah′kuf), the fourth city of Poland, capital of the province of the same name, an industrial centre 212 mi. W. by N. of Lemberg (Lwow) by rail; it was occupied by Germany in 1939. Polish name Kraków. Pop. (1931) 221,260, of whom 172,866 were Poles; (est. 1939) 259,000. No other Polish town contains so many historic buildings and national relics. It is the intellectual centre of Poland.

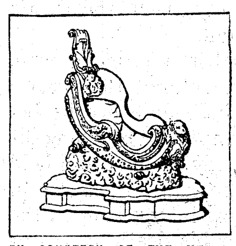
Cracow is in a fertile plain on the left bank of the Vistula (which becomes navigable here) and occupies a position of great strategical importance. It consists of the old inner town and seven suburbs. The only relics of the fortifications of the old town, now replaced by shady promenades, are the Florian's Gate and the Rondel, a circular structure, built in 1498. Cracow has 39 churches—about half the number it formerly had—and 25 convents for monks and nuns. Of these the most important is the Stanislaw cathedral, in Gothic style, consecrated in 1359, and built on the Wawel, the rocky eminence to the south-west of the old town. Here the kings of Poland were crowned, and this church is also the Pantheon of Poland, the burial place of its kings, of John Sobieski, Thaddaeus Kosciuszko, Joseph Poniatovski, Adam Mickiewicz and Joseph Pilsudski. Here also are conserved the remains of St. Stanislaw, the patron saint of the Poles, who, as bishop of Cracow, was slain before the altar by King Boleslaw in 1079. The cathedral is adorned with many valuable objects of art, paintings and sculptures, by such artists as Veit Stoss, Guido Reni, Peter Vischer, Thorwaldsen, etc. Part of the ancient Polish regalia is also kept there. The Gothic church of St. Mary, founded in 1223, rebuilt in the 14th century, with several chapels added in the 15th and 16th centuries, was restored in 1889–1893, and decorated with paintings from the designs by Matejko. It contains a huge high altar, executed 1477–89, the masterpiece of Veit Stoss, who was a native of Cracow; a colossal stone crucifix of the end of the 15th century, and several sumptuous tombs from the 16th and 17th centuries. The royal castle (*Zamek Królewski*), a huge building, begun in the 13th century, and successively enlarged by Casimir the Great and by Zygmunt I. Jagiello (1510–1533), is situated on the Wawel, and was until 1610 the residence of the Polish kings. It suffered much from fires and other disasters, and from 1846 onward was used as a barracks and a military hospital; it has now, however, been cleared out and restored. The Jagellonian university, housed in a Gothic building of 1881–1887, is the second oldest university in central Europe—the oldest being that of Prague—and was famous during the 15th and 16th centuries. It was founded by Casimir the Great in 1364, and completed by Wladislaw Jagiello in 1400. Its rich library is housed in the old 15th century university buildings, in the beautiful Gothic court of which a bronze statue of Copernicus was placed in 1900. The Polish academy of science, founded in 1872, was housed in the new university buildings. In the Ring-Platz, or the principal square, opposite the church of St. Mary, is the cloth-hall (Pol. *Sukiennice*), a building erected in 1257, several times renovated and enlarged, most recently in 1879, which contains the Polish national museum of art. Behind it is a Gothic tower, the only relic of the old town hall, demolished in 1820. The Czartoryski museum contains a rich library and a precious collection of manuscripts, relating to the history of Poland.

Among the manufactures of the town are machinery, agricultural implements, chemicals, soap, tobacco, etc. But Cracow is more important as a trading than as an industrial centre. Its position on the Vistula and at the junction of several railways makes it the natural mart for the exchange of the products of the adjacent territories. Cracow's trade in timber, salt, textiles, cattle, wine and agricultural produce of all kinds is very considerable. In the neighbourhood of Cracow there are mines of coal and zinc, and, not far away lies the village of Krzeszowice with sulphur baths. About $2\frac{1}{2}$ mi. N.W. lies the Kosciuszko hill, a mound of earth 100 ft. high, thrown up in 1820–23 on the Borislava hill (1,093 ft.), in honour of Thaddaeus Kosciuszko, the hero of Poland. On the opposite bank of the Vistula, united to Cracow by a bridge, lies the town of Podgorze (pop. 18,142); near it is the Krakus hill, smaller than the Kosciuszko hill, and a thousand years older than it, erected in honour of Krakus, the founder of Cracow. About 8 mi. S.E. of Cracow is situated Wieliczka (*q.v.*), with its famous salt mines.

History.—Tradition assigns the foundation of Cracow to the mythical Krak, a Polish prince who is said to have built a stronghold there about A.D. 700. In the latter part of the 10th century it was annexed to the Bohemian principality, but was recaptured by Boleslaus Chrobry, who made it the seat of a bishopric, and it became the capital of one of the most important of the principalities into which Poland was divided from the 12th century onwards. The city was practically ruined during the first Tatar invasion in 1241, but the introduction of German colonists restored its prosperity, and in 1257 it received "Magdeburg rights," *i.e.*, a civic constitution modelled on that of Magdeburg. The town passed through many vicissitudes until, in 1305, the Polish king, Ladislaus Lokietek, made it his capital, and from that time until 1764 it remained the coronation and burial place of the Polish kings. In 1795 Austria took possession of Cracow; but in 1809 Napoleon incorporated it with the duchy of Warsaw. In the campaign of 1812 the emperor Alexander made himself master of this and the other territory which formed the duchy of Warsaw. At the general settlement of Europe in 1815 Cracow and the adjoining territory were formed into a free state. In Feb. 1846, an insurrection broke out in Cracow, apparently a ramification of a widely spread conspiracy throughout Poland. The senate and the other authorities of Cracow were unable to subdue the rebels or to maintain order, and, at their request, the city was occupied by a corps of Austrian troops. Russia, Austria and Prussia made this a pretext for extinguishing this independent state; and, as the outcome of a conference at Vienna (Nov. 1846), the three courts, contrary to the assurance previously given and in opposition to the British and French governments, decided to incorporate Cracow with the dominions of Austria. At the conclusion of World War I, Cracow was included in the Polish republic. In World War II it fell to Germany Sept. 6, 1939.

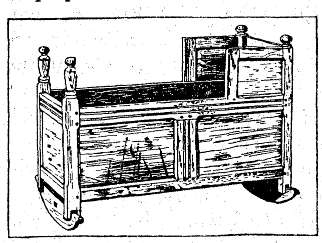
CRADDOCK, CHARLES EGBERT (1850–1922), the pen-name of MARY NOAILLES MURFREE, American author, who was born near Murfreesboro, Tenn., Jan. 24 1850. She was crippled in childhood by paralysis, but attended school in Nashville and Philadelphia. During her summers in the mountains of eastern Tennessee, she came to know the primitive people there whom her writings portray. She contributed to *Appleton's Journal*, and, first in 1878, to the *Atlantic Monthly*. No one, apparently, suspected that the author of these tales was a woman, and her identity was not disclosed until after the publication of her first volume of short stories, *In the Tennessee Mountains* (1884). She deals mainly with the narrow, stern life of the mountaineers, who, left behind in the advance of civilization, live amid traditions and customs and speak a dialect peculiarly their own. Her work abounds in effective descriptions of scenery. Among her other books are: *Where the Battle Was Fought* (1884), a novel dealing with the old aristocratic southern life; *Down the Ravine* (1885) and *The Story of Keedon Bluffs* (1887) for young people; *The Prophet of the Great Smoky Mountains* (1885); *In the Clouds* (1886); *The Despot of Broomsedge Cove* (1888); and *His Vanished Star* (1894), novels; *The Mystery of Witch Face Mountain* (1895); *The Phantoms of the Footbridge* (1895); *The Young Mountaineers* (1897); *The Bush Whackers* (1899), short stories. Her later books, *The Fair Mississippian* (1908) or *The Story of Dulciehurst* (1914) are inferior to those written when the local colour movement was at its height. She died at Murfreesboro (Tenn.), July 31 1922.

CRADLE, a child's bed of wood, wicker or iron, with enclosed sides, slung upon pivots or mounted on rockers (of uncertain etymology, possibly connected with "crate" and "creel," *i.e.*, basket). It is a very ancient piece of furniture, but the date when it first assumed its characteristic swinging or rocking form is by no means clear. A miniature in an illuminated *Histoire de la belle Hélaine* in the Bibliothèque Nationale in Paris (end of the 14th or beginning of the 15th century) shows an infant sleeping in a tiny four-post bed slung upon rockers. In its oldest forms the cradle is an oblong oak box without a lid—originally the rockers appear to have been detachable—but, like all other household appliances, it has been subject to changes of fashion alike in shape and adornment. It has been panelled and carved, supported on Renaissance pillars, inlaid with marqueterie or mounted in gilded bronze. The original simple shape persisted for two or three centuries—even the hood made its appearance very early. In the 18th century, however, cradles were often very elaborate—indeed in France they had begun to be so much earlier, but the richly carved and upholstered examples were used chiefly for purposes of State, being in fact miniature *lits de parade*. In modern times they have become lighter and simpler, the old hood being very often replaced by a draped curtain hanging from a carved or shaped upright. By analogy, the word "cradle" is also applied to various sorts of framework in engineering, and to a rocking-tool used in engraving.



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

CARVED ITALIAN CRADLE OF THE XVIIITH CENTURY



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

EARLY AMERICAN CHEST CRADLE DESIGNED BETWEEN 1625 AND 1675

CRADOCK, a town in South Africa, 32° 10′ S., 25° 37′ E. Altitude 2,856 ft. Pop. (1936) 9,260: Europeans 3,690; natives 3,569; coloured 1,951; Asiatics 50. It is in the upper valley of the Great Fish river, 183 mi. from Port Elizabeth. A large trade is done in wool and mohair. In the surrounding district 30,000 ac. are irrigated from the Great Fish and Paul's rivers. and lucerne and fruit are grown. The district has an area of 3,048 sq.mi. The town has a reputation as a health resort. The air is dry and bracing, especially in winter; the rainfall is 14.5 inches. Three miles to the north are hot sulphur baths, which are used for the treatment of rheumatism. The town dates from the beginning of the 19th century, and is named after Sir John Cradock, governor of the Cape 1811–13. In the neighbourhood some zebra still survive, protected by the game laws.

CRAFT, a word confined in English to intellectual power, and used as a synonym of "art" (Ger. *Kraft,* strength, power). It also means skill or ingenuity, especially in the manual arts, hence its use in the expression "Arts and Crafts" (*q.v.*); it is thus applied to an association of workmen of a particular trade, a trade gild, and in particular to Freemasons. The word appears also in words such as "handicraft" or "craftsman." Skill applied to outwit or deceive gives the common sense of cunning or trickery, and it is this meaning which is implied in such combined words as "priestcraft," "witchcraft" and the like. A more particular use of the word is in the nautical sense of vessels of transport by water; this is probably a colloquially shortened form either of "vessels of a fisherman's, lighterman's craft," etc., or of "vessels of a heavier or lighter craft."

CRAFTON, a borough of Allegheny county (Pa.), U.S.A. 6 mi. W. of Pittsburgh, on the Pennsylvania railroad. The population in 1930 was 7,004; in 1940, 7,163 by federal census.

CRAG, a steep rock. The word (of Celtic origin, *cf.* Gael. *creag,* Manx *creg,* and Welsh and Modern Scots *craig*) appears in many place-names in north Britain, and is probably connected with "carrick," of similar meaning, which also occurs in place-names. In geology, the term is applied to strata in which a shelly sand deposit is found, and, in the expression "crag and tail," to a glaciated land form in which one side of a hill is precipitous and lofty and the other slopes or "tails" gradually away, as in the Castle Rock on which Old Town Edinburgh was built.

CRAGGS, JAMES (1657–1721), English politician, who, after following various callings in London, entered the service of the duchess of Marlborough, through whose influence he became in 1702 member of parliament for Grampound, retaining his seat until 1713. He was in business as an army clothier and held several official positions, becoming joint postmaster-general in 1715. Craggs also increased his enormous wealth by mixing in the affairs of the South Sea Company, but after his death an act of parliament confiscated all the property which he had acquired since Dec. 1719. He died on March 16, 1721.

His son, James Craggs the younger (1686–1721), was born on April 9, 1686. In 1713 he became member of parliament for Tregoney, in 1717 secretary for war, and in 1718 one of the principal secretaries of state. Craggs was implicated in the South Sea Bubble, but not so deeply as his father, whom he predeceased on Feb. 16, 1721.

CRAIG, EDWARD GORDON (1872–), English stage-designer and writer on the art of the theatre, was born on Jan. 16, 1872. He began life as an actor, appearing first in 1889 at the Lyceum theatre, London, under the direction of Sir Henry Irving. As a young man he designed several stage productions in which he approached the problem of stage scenery from a point of view entirely different from that current at the time. Among these productions were Purcell's opera, *Dido and Aeneas; Bethlehem,* a nativity play by Laurence Housman; *The Vikings,* by Ibsen; and *Much Ado About Nothing,* in which his mother, Ellen Terry, appeared.

Feeling that the contemporary London theatre gave no opportunity for that creative experiment which he felt necessary, Craig founded his school for the Art of the Theatre in Florence in 1913. He had already published his famous book *On the Art of the Theatre* (1911), and commenced issue (1908) of *The Mask,* a journal in which appeared a large number of essays and illustrations revealing his philosophy of theatre art and the practical applications thereof so far as they could be expressed through drawing and letterpress. These and later publications had wide influence in Europe, and the effect of Craig's teaching and example is to be seen, implicit or explicit, in the work of most of the best modern schools of stage design in Europe. The school in Florence did not fulfil Craig's hopes. His most important productions out of England are:—*Rosmersholm,* designed for Eleonora Duse in Florence in 1906; *Hamlet,* for Stanislavsky at the Moscow Art Theatre (1908 or 09); and *The Pretenders,* at the Theatre Royal, Copenhagen. It has been suggested that Craig's practical example has been a far-reaching influence, but it may be that he has most affected posterity by the large body of his writings which provide an effective theory of stage art. Among his later works are *Books and Theatres* (1925), *Henry Irving* (1930), *Fourteen Notes* (1931) and *Ellen Terry and Her Secret Self* (1931).

His sister, Edith Craig (1869–), studied music in London and Berlin, and has been mainly occupied in stage-management and production.

CRAIG, JOHN (1512?–1600), Scottish reformer, the son of Craig of Craigston, Aberdeenshire, was educated at St. Andrews and became a Dominican. He came under suspicion of heresy, and made his way in 1536 to England and then to Italy, where by the influence of Cardinal Pole, he became master of the novices in the Dominican convent at Bologna. His heretical tendencies were revived by the reading of Calvin's *Institutes.* He was condemned to be burnt, but escaped during the riot which broke out on the death of Paul IV. (Aug. 18, 1559), when the prison of the Inquisition was burst open. Returning to Scotland in 1560 he was ordained (1561) minister of Holyrood, and in 1562 became Knox's colleague in the High Church. At first he refused to publish the banns of marriage between Mary and Bothwell, but yielded in the end. He helped to draw up the National Covenant in 1580 and prepared (1581) the "King's Confession" which became the basis of the Covenant of 1638. He died on Dec. 12, 1600.

See T. G. Law, Preface to *John Craig's Catechism* (1885); Hew Scott, *Fasti Ecclesiae Scoticanae* (1915, ed. J. Warwick, 1921).

CRAIG, SIR THOMAS (*c.* 1538–1608), Scottish jurist and poet, was born about 1538, a member of the Craigfintray family. He was educated at St. Andrews, where he took the B.A. degree in 1555. From St. Andrews he went to France, to study the canon and the civil law. He returned to Scotland about 1561, and was admitted advocate in Feb. 1563. In 1564 he was appointed justice-depute by the justice-general, Archibald, earl of Argyll; in 1573 he was appointed sheriff-depute of Edinburgh, and in 1606 procurator for the church. In 1604 he came to London on the commission regarding the union of the two kingdoms. It is said that he wished to refuse the knighthood the king desired to give him, but he has always been styled and reputed a knight. His eldest son, Sir Lewis Craig (1569–1622), was raised to the bench in 1604. Sir Thomas died on Feb. 26, 1608.

Except his poems, the only one of Craig's works which appeared during his lifetime was his *Ius feudale* (1603; ed. R. Burnet, 1655; Leipzig, 1716; ed. J. Baillie 1732). The object of this treatise was to assimilate the laws of England and Scotland, but, instead of this, it was an important factor in building up the law of Scotland into a separate system. Other works were *De unione regnorum Britanniae tractatus, De iure successionis regni Angliae* and *De hominio disputatio.* Translations of the last two have been published, and in 1910 an edition of the *De Unione* appeared, with translation and notes by C. S. Terry. Craig's first poem, an *Epithalamium* in honour of the marriage of Mary, queen of Scots, and Darnley, appeared in 1565. Most of his poems have been reprinted in the *Delitiae poëtarum Scotorum.*

See P. F. Tytler, *Life of Craig* (1823); Life prefixed to Baillie's edition of the *Jus feudale.*

CRAIGAVON, JAMES CRAIG, 1st Viscount (1871–1940), the first prime minister of Northern Ireland, was born Jan. 8, 1871, a son of James Craig of Craigavon, Co. Down. He was educated at Merchiston school, Edinburgh, and served in the South African War of 1899–1902 in the Royal Irish Rifles

He won back for the Unionist party one of the seats in his native county of Down in 1906. In and out of parliament he was in the confidence of Sir Edward Carson, and when, in 1914, it was decided to offer armed resistance to what Ulster Unionists regarded as the threatened destruction of their rights of citizenship in Great Britain, he shouldered a prominent share of the work and the risk (*see* CARSON, EDWARD HENRY CARSON).

During World War I Colonel Craig recruited and organized the 36th (Ulster) Division. In the Coalition Government of 1916, he was treasurer of the household. In 1919 he was parliamentary secretary to the Ministry of Pensions, and in 1920 financial secretary to the Admiralty. When the Government of Ireland Act, 1920, came into force, he resigned and became prime minister of Northern Ireland. In 1918 he was created a baronet, and in 1927 a viscount, taking the title of Viscount Craigavon of Stormont. He continued as prime minister until his death Nov. 24, 1940. (*See* IRELAND, NORTHERN.)

CRAIGIE, PEARL MARY TERESA (1867–1906), Anglo-American novelist and dramatist, who wrote under the pen-name of "JOHN OLIVER HOBBES," was born at Boston, U.S.A., on Nov. 3, 1867, and died in London on Aug. 13, 1906. She was the elder daughter of John Morgan Richards, and in 1887 married Reginald Walpole Craigie, by whom she had one son, John Churchill Craigie; but the marriage proved an unhappy one, and was dissolved on her petition in July 1895. She was brought up as a Nonconformist, but in 1892 was received into the Roman Catholic Church.

Her first little book, the brilliant and epigrammatic *Some Emotions and a Moral,* was published in 1891 in Mr. Fisher Unwin's "Pseudonym Library," and was followed by *The Sinner's Comedy* (1892), *A Study in Temptations* (1893), *A Bundle of Life* (1894), *The Gods, Some Mortals, and Lord Wickenham. The Herb Moon* (1896), a country love story, was followed by *The School for Saints* (1897), with a sequel, *Robert Orange* (1900). Mrs. Craigie had already written short pieces, when her successful play, *The Ambassador,* was produced at the St. James's theatre in 1898. She was part author of *The Bishop's Move* (Garrick theatre, 1902). Among her later works were *The Vineyard* (1904), and *The Dream and the Business* (1906).

CRAIK, DINAH MARIA (1826–1887), author of *John Halifax, Gentleman,* was the daughter of Thomas Mulock, an eccentric religious enthusiast of Irish extraction, and was born on April 20, 1826 at Stoke-upon-Trent, Staffordshire. *John Halifax, Gentleman* (1857), placed her in the front rank of the women novelists of her day. *A Life for a Life* (1859), though inferior, maintained a high position, but she afterwards wrote little of importance except some very charming tales for children. She married Mr. G. L. Craik, a partner in the house of Macmillan and Company, in 1864, and died at Shortlands, near Bromley, Kent, on Oct. 12, 1887.

CRAIK, GEORGE LILLIE (1798–1866), British man of letters, the son of a schoolmaster, was born at Kennoway, Fifeshire. He studied at the university of St. Andrews with the intention of entering the church, but became the editor of a local newspaper, and went to London in 1824 to devote himself to literature. In 1844 he published his *History of Literature and Learning in England from the Norman Conquest to the Present Time,* illustrated by extracts. Craik is best known for his abridged version of this work, *The History of English Literature and the English Language* (1861), which passed through several editions and for his *Spenser and his Poetry* (1845). In 1849 he obtained the chair of history and English literature at Queen's College, Belfast, a position which he held till his death.

CRAIL (formerly *Karel*), a royal and small burgh, Fifeshire, Scotland, 2 mi. from Fifeness, the most easterly point of the county, and 11 mi. S.E. of St. Andrews by the L.N.E.R. Pop. (est. 1938), 1,025. It is said to have been a town of some note as early as the 9th century; its castle, of which there are hardly any remains, was the residence of David I. and other Scottish kings. It was constituted a royal burgh by a charter of Robert Bruce in 1306, and had its privileges confirmed by Robert II. in 1371, by Mary in 1553, and by Charles I. in 1635. Of its priory, dedicated to St. Rufus, a few ruins exist. The ancient church is dedicated to Maelrubha, the patron saint of Crail. Many of the houses are massive and picturesque. The public buildings include an unusual town hall with a Dutch tower. The chief industry is fishing, especially for crabs. Crail is in favour as a summer resort.

Balcomie castle, about 2 m. to the north-east, dates from the 14th century. Here Mary of Guise landed in 1538, a few days before her marriage to James V. in St. Andrews cathedral. The East Neuk is a term applied particularly to the country round Fifeness, and more generally to all of the peninsula east of an imaginary line drawn from St. Andrews to Elie.

CRAILSHEIM, a town of Germany, in the *Land* of Württemberg, on a tributary of the Neckar. Population, 6,391.

It was incorporated as a town in 1338, passed later into the possession of the burgraves of Nürnberg, and came in 1791 to Prussia, in 1806 to Bavaria and in 1810 to Württemberg. There are tanneries and machine workshops, and trade is in wine.

CRAIOVA, the capital of the department of Dolj, in Rumania, situated near the left bank of the river Jiu, and on the main railway from Verciorova to Bucharest. Pop. (1939) 55,444. A branch railway runs to Calafat. Craiova is the chief commercial town west of Bucharest; the surrounding uplands are very rich in grain, pasturage and vegetable products, and contain extensive forests. The town has rope and carriage factories, and manufactories of belting, candles, leather, soap and terra-cotta, and grain and flour mills. Close by is a large tannery worked by convict labour and supplying the army. The principal trade is in cattle, cereals, fish, linen, pottery, glue and leather. In the town, which is the headquarters of the I. Army Corps, there are military and commercial academies, an appeal court and a chamber of commerce, besides many churches.

Craiova, which occupied the site of the Roman Castra Nova, was formerly the capital of Little Walachia. Its ancient *bans* or military governors were, next to the princes, the chief dignitaries of Walachia, and the district is still styled the banat of Craiova. Among the holders of this office were Michael the Brave (1593–1601), and several members of the celebrated Bassarab family (*q.v.*). The bans had the right of coining money stamped with their own effigies, and hence arose the name of *bani* (centimes). The Rumanian franc, or *leu* ("lion"), so called from the image it bore, likewise came from Craiova.

CRAM, RALPH ADAMS (1863–1942), American architect, was born at Hampton Falls (N.H.), on Dec. 16, 1863. He was educated at the Westford (Mass.) academy and the Exeter (N.H.) high school. He studied architecture, and in 1889 opened an architect's office in Boston. Recognized as an authority on mediaeval architecture and an able advocate of the Gothic style, he was appointed architect for the Cathedral of St. John the Divine, New York, in 1911, and consulting architect for the Washington and San Francisco cathedrals. He was professor of architecture at the Massachusetts Institute of Technology, 1914–1921, and was the first chairman of the Boston city planning board, 1915–22. Cram died Sept. 22, 1942.

BIBLIOGRAPHY.—His numerous writings include *Church Building* (1901); *The Ruined Abbeys of Great Britain* (1905); *Impressions of Japanese Architecture and The Allied Arts* (1905); *The Gothic Quest* (1907); *The Ministry of Art* (1914); *Heart of Europe* (1915); *The Substance of Gothic* (1916, Lowell lectures); *The Nemesis of Mediocrity* (1918); *The Great Thousand Years* (1918); *The Sins of the Fathers* (1919); *Walled Towns* (1919); *Gold, Frankincense and Myrrh* (1919); *My Life in Architecture* (1936); *The End of Democracy* (1937).

CRAMBO, an old rhyming game which, according to Strutt (*Sports and Pastimes*), was played as early as the 14th century under the name of the *ABC of Aristotle.* Crambo, or capping the rhyme, is played by one player thinking of a word and telling the others what it rhymes with, the others not naming the actual word they guess but its meaning. Thus one says "I know a word that rhymes with *bird.*" A second asks "Is it ridiculous?" "No, it is not absurd." "Is it a part of speech?" "No, it is not a word." This proceeds until the right word is guessed.

In *Dumb Crambo* the guessers, instead of naming the word, express its meaning by dumb show, a rhyme being given them as a clue.

CRAMER, JOHANN BAPTIST (1771–1858), naturalized English musician, of German extraction, was born in Mannheim. Son of Wilhelm Cramer (1743–1799), a famous London violinist and musical conductor, one of a numerous family who were identified with the progress of music during the 18th and 19th centuries, he was brought to London as a child, and it was in London that the greater part of his musical career was passed. From 1782 to 1784 he studied the pianoforte under Muzio Clementi, and soon became known as a professional pianist both in London and on the continent; he enjoyed a world-wide reputation, and was particularly esteemed by Beethoven. He died in London. Cramer's compositions were numerous, mostly for the piano, but all have been long since forgotten with the exception of his splendid *Études* for the training of pianists, which rank still among the finest works of their class ever produced. His name is also still preserved as one of the principal founders of the London music publishing house of Cramer & Co.

CRAMP, CHARLES HENRY (1828–1913), American shipbuilder, was born in Philadelphia, May 9, 1828, the eldest of eleven children of William Cramp (1807–1869), who in 1830 established shipyards on the Delaware river, near Philadelphia. He became his father's partner in 1849. His inventive capacity and resourcefulness soon gave him high rank as an authority on shipbuilding, and made his influence in that industry widely felt. During the Civil War he designed and built several ironclads for the United States navy, notably the "New Ironsides" in 1862, and the light-draught monitors used in the Carolina sounds; and after 1887 constructed wholly or in part from his own designs many of the most powerful ships in the "new" navy. In the transformation from sail to steam, and from wood to iron and steel, Cramp had a prominent part. He built warships for several foreign navies, among others the "Retvizan" and the "Variag" for the Russian Government. He died in Philadelphia June 6, 1913.

See A. C. Buel, *Memoirs of C. H. Cramp* (Philadelphia, 1906).

CRAMP, a painful spasmodic contraction of muscles, commonest in the limbs, but also affecting certain internal organs. This disorder is probably of reflex nervous origin. Cramp in the limbs comes on suddenly, often during sleep, the patient being roused by agonizing pain in the calf of the leg or back of the thigh. During the paroxysm the muscular fibres affected form a hard knot. The attack in general lasts but a few seconds, and suddenly departs, but relief may come more gradually during a period of minutes or even hours. A liability to cramp is often associated with a rheumatic or gouty tendency. Exposure to cold will also bring it on and to this is probably to be ascribed its occurrence in swimmers. Cramp of the extremities is one of the most distressing accompaniments of cholera, and is common in parturition, just before delivery.

Writer's Cramp, or *Scrivener's Palsy,* is a special example of functional spasm affecting certain muscles when engaged in the performance of acts, the result of education and long usage, but not occurring when the same muscles are employed in acts of a different kind.

The symptoms are in the first instance a gradually increasing difficulty in making the movements required for the work in hand. Taking, for example, the case of writers, the pen cannot be moved with freedom. At an early stage of the disease the difficulty may largely be overcome by persevering efforts, but ultimately, the muscles of the fingers, and even those of the forearm, are seized with cramp, and writing is impossible. Sometimes the fingers, instead of being cramped, move in a disorderly manner and the pen cannot be grasped, while in other rare instances a kind of paralysis affects the muscles of the fingers, and they are powerless to make the movements necessary for holding the pen. It is only in the act of writing that these phenomena present themselves; for all other movements the fingers and arms possess their natural power. The same symptoms are observed and the same remarks apply *mutatis mutandis* in the case of musicians, artists, compositors, seamstresses, tailors and many mechanics in whom this affection may occur. Indeed, although actually a rare disease, no muscle or group of muscles in the body which is specially called into action in any particular occupation is exempt from liability to this functional spasm.

The pathology of writer's cramp is unknown, but it is believed that the disease is not a local one of muscles or nerves, but is an affection of the central nervous system. It never occurs under thirty years of age, and is more frequent in males than females. In its treatment the first requisite is absolute cessation from the employment which caused it.

CRAMP-RINGS, rings anciently worn as a cure for cramp and "falling-sickness," or epilepsy. The legend is that the first one was presented to Edward the Confessor by a pilgrim on his return from Jerusalem, its miraculous properties being explained to the king. At his death it passed into the keeping of the abbot of Westminster, by whom it was used medically and was known as St. Edward's Ring. The belief grew that the successors of Edward inherited his powers, and that the rings blessed by them worked cures. Hence arose the custom for the successive sovereigns of England each year on Good Friday to bless a number of cramp-rings. The ceremony survived to the reign of Queen Mary, but the belief in the curative powers of similar circlets of sacred metal has lingered on even to the present day.

See F. G. Waldron, *The Literary Museum* (1792); *see* also *Notes and Queries*, vol. vii., 1853; vol. ix., 1878.

CRANACH, LUCAS (1472–1553), German painter, was born at Cronach, in upper Franconia, and learnt the art of drawing from his father. He attracted the attention of the elector of Saxony, who gave him a position in his court in 1504. The only clue to Cranach's settlement previous to his Wittenberg appointment is afforded by the knowledge that he owned a house at Gotha, and that Barbara Brengbier, his wife, was the daughter of a burgher of that city.

Of his skill as an artist we have sufficient evidence in a picture dated 1504. After that date we find him active in several branches of his profession, producing portraits and altar-pieces, designing on wood, engraving copperplates, and acting as draughtsman for the dies of the electoral mint. Before 1508 he had painted several altar-pieces for the Schlosskirche at Wittenberg in competition with Dürer, Burgkmair, and others; the duke and his brother John were portrayed in various attitudes, and a number of the best woodcuts and copperplates were published. Great honour accrued to Cranach when he went in 1509 to the Netherlands and took sittings from the emperor Maximilian and the boy who afterwards became Charles V. Till 1508 Cranach signed his works with the initials of his name. In that year the elector gave him the winged snake as a motto, and this motto or *Kleinod* (jewel), as it was called, superseded the initials on all his pictures after that date. Cranach was at an early period with the reformers. The first engraved portrait of Luther by Cranach represents an Augustinian friar, and is dated 1520. Five years later the friar dropped the cowl, and Cranach was present as "one of the council" at the betrothal festival of Luther and Catherine Bora. Cranach died on Oct. 16, 1553, at Weimar, where the house in which he lived still stands in the market-place.

The oldest extant picture by Cranach, the "Rest of the Virgin during the Flight into Egypt," marked with the initials L. C., and the date of 1504, is one of the most graceful creations of his pencil. His copperplates and woodcuts furnish splendid examples of his art; and the earlier they are in date the more conspicuous is their power. Striking evidence of this is the "St. Christopher" of 1506, or the plate of "Elector Frederick praying before the Madonna" (1509). His first woodcut (1505) represents the Virgin and three saints in prayer before a crucifix. Later on he composes the marriage of St. Catherine, a series of martyrdoms, and scenes from the Passion. After 1517 he illustrates occasionally the old gospel themes, but he also gives expression to some of the thoughts of the reformers. In a picture of 1518 at Leipzig, where a dying man offers "his soul to God, his body to earth, and his wordly goods to his relations," the soul rises to meet the Trinity in heaven, and salvation is clearly shown to depend on faith and not on good works. Again sin and grace become a familiar subject of delineation as in the two examples in the galleries of Gotha and Prague, both of them dated 1529. One of the latest pictures with which the name of Cranach is connected is the altar-piece which Cranach's son completed in 1555, and which is now in the *Stadtkirche* (city church) at Weimar. Cranach sometimes composed gospel subjects with feeling and dignity. "The Woman taken in Adultery" at Munich is a favourable specimen of his skill. But he was not exclusively a religious painter. He was equally successful, and often comically naïve, in mythological scenes, as where Cupid, who has stolen a honeycomb, complains to Venus that he has been stung by a bee (Weimar, 1530; Berlin, 1534), or where Hercules sits at the spinning wheel mocked by Omphale and her maids. Humour and pathos are combined at times with strong effect in pictures such as the "Jealousy" (Augsburg, 1527; Vienna, 1530). In a lost canvas of 1545 he depicted hares catching and roasting sportsmen. In 1546, possibly under Italian influence, Cranach composed the "Fons Juventutis" of the Berlin gallery, executed by his son.

Cranach's chief occupation was that of portrait painting, and we are indebted to him chiefly for the preservation of the features of all the German reformers and their princely adherents. But he sometimes condescended to depict such noted followers of the papacy as Albert of Brandenburg, archbishop elector of Mainz, Anthony Granvelle, and the duke of Alva. A dozen likenesses of Frederick III and his brother John are found to bear the date of 1532. It is characteristic of Cranach's readiness, and a proof that he possessed ample material for mechanical reproduction, that he received payment at Wittenberg in 1533 for "sixty pairs of portraits of the elector and his brother" in one day. Among existing likenesses we should notice as the best that of Albert, elector of Mainz, in the Berlin museum, and that of John, elector of Saxony, at Dresden.

Cranach had three sons, all artists—JOHN LUCAS, who died at Bologna in 1586; HANS CRANACH, whose life is obscure; and LUCAS CRANACH (1515–1586) "the younger." He was born at Wittenberg on Oct. 4, 1515, and died at Weimar on Jan. 25, 1586. He studied under his father and worked with him on many of his pictures. In 1565 he was burgomaster of Wittenberg.

See Heller, *Leben und Werke Lukas Cranachs,* 2nd ed. (Bamberg, 1844); Chr. Schuchard, *Lukas Cranachs des älteren Leben und Werke* (Leipzig, 1851–71); Warnecke, *Cranach der ältere* (Görlitz, 1879); Lippmann, *Lukas Cranach, Sammlung, etc.* (1895), reproductions of his most notable woodcuts and engravings; Woermann, *Verzeichnis der Dresdener Cranach-Ausstellung von 1899* (Dresden, 1899); Flechsig, *Tafebilder Cranach's des ältern und seiner Werkstatt* (Leipzig, 1900); Muther, *Lukas Cranach* (1902); Michaelson, *L. Cranach der ältere* (Leipzig, 1902).

CRANBERRY, the fruit of several small plants the more important of which are allied to the blueberries.

The northern cranberry (*Vaccinium oxycoccos*) is found in marshy land in northern Asia, northern and central Europe and northern North America. Its stems are wiry and creeping; the leaves are evergreen, ovate or elliptical in shape and less than half an inch long; the flowers, which appear in June, are small and have a four-lobed, rose-tinted corolla; the berries ripen in September, are mostly round, about the size of currants, crimson in colour and often spotted, with an acid taste.

The American cranberry (*V. macrocarpon*) is found wild from Newfoundland to the Carolinas and westward to Minnesota and Arkansas. It is much like *V. oxycoccos,* but is coarser and bears bigger and finer berries, which are round, oblong or pear-shaped, and vary from pink to very dark red or may be mottled red and white. It is cultivated on acid soils of peat or vegetable mould, free from loam and clay, cleared of turf and with a surface layer of sand. It is grown extensively in Massachusetts, New Jersey and Wisconsin and near the coast of Washington and Oregon. Early Black and Howes are the main varieties in the east, McFarlin and Searls in Wisconsin, and McFarlin in the far west. False blossom is a very harmful, though easily controlled, virus disease. The vines are protected from winter injury and from frost by flooding. The picking of the berries begins early in September and continues till late October. Over 2,000,000 bu. are often produced annually. They are much used in pies, as a sauce-relish for meats, and in making a beverage and are consumed mostly in the United States and Canada. Over one-third of the crop of the country is now canned or dried commercially.

The cowberry or foxberry (*Vaccinium vitis-idaea*), called mountain or rock cranberry in the eastern United States, is used extensively in northern Europe and by Scandinavians in U.S. cities. The southern cranberry (*V. erythrocarpum*) is indigenous in the mountains from Virginia to Georgia and is remarkable for the fine flavour of its dark red berry. The fruit of the cranberry tree or highbush cranberry (*Viburnum americanum*) is sometimes used as a substitute for true cranberries in Canada and the northern United States. The Tasmanian and the Australian cranberries are the produce respectively of *Astroloma humifusum* and *Lissanthe sapida,* plants of the family Epacridaceae.

See *Bulletins* 332 (1936) and 371 (1940) of the Mass. Agricultural Experiment Station. (H. J. FN.)

CRANBROOK, GATHORNE GATHORNE-HARDY, 1ST EARL OF (1814–1906), British statesman, was born at Bradford on Oct. 1, 1814. After graduating at Oxford he was called to the bar. In 1856 he was returned for Leominster, and in 1865 defeated Mr. Gladstone at Oxford. In 1866 he became president of the Poor Law board in Lord Derby's new administration. When in 1867 Walpole resigned, from dissatisfaction with Disraeli's Reform bill, Hardy succeeded him at the Home office. In 1874 he was secretary for war and four years later succeeded Lord Salisbury at the India office, being raised to the peerage as Viscount Cranbrook. At the same time he had assumed the additional family surname of Gathorne, which had been that of his mother.

In Lord Salisbury's administrations of 1885 and 1886 Lord Cranbrook was president of the council, and upon his retirement from public life concurrently with the resignation of the cabinet in 1892 he was raised to an earldom. He died on Oct. 30, 1906.

See *Gathorne-Hardy, 1st earl of Cranbrook, a memoir with extracts from his correspondence,* edited by the Hon. A. E. Gathorne-Hardy (1910).

CRANBROOK, a small town, south Kent, England, 40 mi. S.E. of London on a branch of the Southern railway. Pop. of rural district (1938) 13,250. Cranbrook lies on the Crane brook, a feeder of the river Beult, in a hilly and wooded district. The church (mainly Perpendicular) is dedicated to St. Dunstan, and has some ancient stained glass.

As the agricultural centre of the Kentish Weald, it trades in malt, hops and general goods; but from the 14th to the 17th century, it was one of the principal seats of broadcloth manufacture.

Cranbrook public school was founded in 1520.

CRANBROOK, a town of British Columbia in the Kootenay valley between the Selkirk range and the Rocky Mountains. Population (1941) 2,568.

The town is a divisional point on the C.P.R. (Crow's Nest branch). The district is the seat of fruit farming, lumbering and mining operations.

CRANDALL, PRUDENCE (1803–1890), American schoolteacher of Quaker parentage, was born at Hopkinton, R.I., Sept. 3, 1803. She was educated in the Friends' school at Providence, taught at Plainfield, Conn., and in 1831 established a private academy for girls at Canterbury, Conn. Although the school was recognized as one of the best in the state, by admitting a Negro girl she lost her white patrons, and in March 1833, on the advice of William Lloyd Garrison and Samuel J. May, she opened a school for "young ladies and little misses of colour." For this she was persecuted, boycotted and socially ostracized; measures were taken in the Canterbury town meeting to break up the school, and finally in May 1833 the state legislature passed the notorious Connecticut "Black law," prohibiting the establishment of schools for nonresident Negroes in any city or township of Connecticut without the consent of the local authorities. Miss Crandall, refusing to submit, was arrested, tried and convicted in the lower courts, whose verdict, however, was reversed on a technicality by the court of appeals in July 1834. Thereupon the local opposition to her redoubled, and she was finally in Sept. 1834 forced to close her school. She married the Rev. Calvin Philleo. She died at Elk Falls, Kan., on Jan. 28, 1890.

See J. C. Kimball's *Connecticut Canterbury Tale* (Hartford, Conn., 1889) and S. J. May's *Recollections of Our Anti-Slavery Conflict* (Boston, 1869).

CRANE, STEPHEN (1871–1900), American author, the 14th child of Jonathan Crane, Methodist pastor, was born in Newark (N.J.), on Nov. 1, 1871. Crane attended Lafayette and Syracuse universities but took no degree. He began newspaper work at an early age. He published his first book, *Maggie: A Girl of the Streets,* under a pseudonym at his own expense. This novel attracted no attention but Crane's next work, *The Red Badge of Courage* (1895), a remarkable study of the psychology of courage, laid in the American Civil War, immediately made him famous and has been widely imitated. Ambrose Bierce said of it: "This young man has the power to feel. He knows nothing of war, yet he is drenched in blood. Most beginners who deal with this subject spatter themselves with ink." When Crane published this story he had never witnessed a battle, but his pictures of soldiers were so veracious and convincing that he was at once engaged as a war correspondent by various American and later by English periodicals. He served with a Cuban filibustering expedition, in the Graeco-Turkish War and in the Spanish-American War. On the filibustering expedition the vessel that carried Crane was shipwrecked, and he suffered great hardships on his way back to Florida. His privations undermined his health and led to his early death, but they furnished the material for *The Open Boat,* an account of his experiences that H. G. Wells called "the finest short story in the English language."

For several years Crane lived in England, at Brede in Sussex, and became a friend of Joseph Conrad. He was preparing to visit St. Helena as a special writer for the London *Morning Post* when he was seized with his fatal illness. He died of consumption in Baden, on June 5, 1900, and was buried in the cemetery of Elizabeth, New Jersey. His birthplace in Newark, acquired as a memorial by the Stephen Crane Association, is marked with a tablet. Crane was described as "typically American, long and spare, with very straight hair and features, and long, quiet hands and hollow eyes, moving slowly, smiling and speaking slowly."

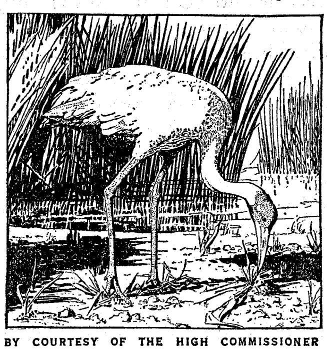
His work falls into three groups—novels, short stories and sketches, and verse. In his fiction he was one of the earliest of American realists. Among his short stories *The Blue Hotel* and a series of tales of American boys, the *Whilomville Stories,* are particularly memorable. Crane was a pioneer in writing free verse, and his epigrammatic tang in *Black Riders* and *War Is Kind* has rarely been equalled. Of his work as a whole Arnold Bennett has said, "In my opinion Crane must rank with the best writers that America has produced, and as one of the finest descriptive experts of modern times." Some of his other books are: *George's Mother* (1896); *The Little Regiment* (1896); *The Open Boat and Other Tales of Adventure* (1898); *The Monster* (1899).

See Vincent Starrett, *Bibliography of Stephen Crane* (Philadelphia, 1923); Thomas Beer, *Stephen Crane* (1923); *Complete Works,* 12 vols. edit. Wilson Fottett (1925–26); also biographical introduction to the new edition of *The Red Badge of Courage* (1925). (M. J. H.)

CRANE, WALTER (1845–1915), English artist, second son of Thomas Crane (1808–1859), portrait painter and miniaturist, was born in Liverpool on Aug. 15, 1845. The family soon removed to Torquay (where the boy gained his early artistic impressions), and, when he was 12 years old, to London. He early came under the influence of the Pre-Raphaelites, and was a diligent student of Ruskin. He was apprenticed for three years (1859–1862) to William James Linton, the wood-engraver. As a wood-engraver he had abundant opportunity for the minute study of the contemporary artists whose work passed through his hands, of Rossetti, Millais, Tenniel and F. Sandys, and of the masters of the Italian Renaissance; he was also greatly influenced by the Elgin Marbles in the British Museum. A further and important element in the development of his talent, was the study of Japanese colour-prints, the methods of which he imitated in a series of toy-books, which started a new fashion. In 1862 his picture, "The Lady of Shalott," was exhibited at the Royal Academy, but the Academy steadily refused his maturer work; and after the opening of the Grosvenor gallery in 1877 he ceased to send pictures to Burlington house. In 1864 he began to illustrate for Mr. Edmund Evans, the colour printer, a series of sixpenny tóy-books of nursery rhymes, displaying admirable fancy and beauty of design, though he was limited to the use of three colours. He was allowed more freedom in a delightful series begun in 1873 *The Frog Prince,* etc., which showed markedly the influence of Japanese art, and of a long visit to Italy following on his marriage in 1871. *The Baby's Opera* was a book of English nursery songs planned in 1877 with Mr. Evans, and a third series of children's books with the collective title *A Romance of the Three R's,* provided a regular course of instruction in art for the nursery. In his *Lady of Shalott* the artist had shown his preoccupation with unity of design in book illustration by printing the words of the poem himself, as he considered that this union of the calligrapher's and the decorator's art was one secret of the beauty of the old illuminated books. He followed the same course in *The First of May: A Fairy Masque* by John R. Wise, text and decoration being in this case reproduced by photogravure. The "Goose Girl" illustration taken from his *Household Stories from Grimm* (1882) was reproduced in tapestry by William Morris, and is now in the South Kensington museum. *Flora's Feast: A Masque of Flowers* had lithographic reproductions of Crane's line drawings washed in with water-colour; he also decorated in colour *The Wonder Book* of Nathaniel Hawthorne, and Margaret Deland's *Old Garden;* in 1894 he collaborated with William Morris in the page decoration of *The Story of the Glittering Plain,* published at the Kelmscott press, which was executed in the style of 16th century Italian and German woodcuts; but in purely decorative interest the finest of his works in book illustration is Spenser's *Faerie Queene* (1894–96) and the *Shepheard's Calendar.* The poems which form the text of *Queen Summer* (1891), *Renascence* (1891), and *The Sirens Three* (1886) are by the artist himself.

In the early '80s under Morris's influence he was closely associated with the socialist movement. He did as much as Morris himself to bring art into the daily life of all classes. With this object in view he devoted much attention to designs for textile stuffs, for wall-papers, and to house decoration; but he also used his art for the direct advancement of the socialist cause. For a long time he provided the weekly cartoons for the socialist organs *Justice* and *The Commonweal.* Many of these were collected as *Cartoons for the Cause* (1896). He devoted much time and energy to the work of the Art Workers' Guild, and to the Arts and Crafts Exhibition Society, founded by him 1888.

A portrait of Walter Crane by G. F. Watts is in the National Portrait Gallery. There is a comprehensive and sumptuously illustrated book on *The Art of Walter Crane* (1902) by P. G. Konody; a monograph (1902) by Otto von Schleinitz in the *Künstler Monographien* series (Bielefeld and Leipzig); and an account of himself *An Artist's Reminiscences* (1901).



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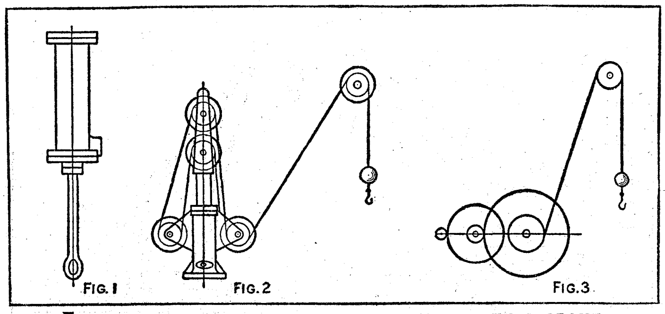
THE NATIVE COMPANION CRANE, DISTRIBUTED OVER THE GREATER PART OF AUSTRALIA

CRANE, a large wading bird. Formerly inhabiting England, the crane (*Megalornis grus*) breeds in the marshes of Spain, Turkey, Russia, N. Germany and Scandinavia, migrating in large flocks in autumn to Africa and India. The nest is formed on the ground and the same spot is utilized year after year. The eggs are brown with dark spots and two in number. The young, which are able to run soon after they are hatched, are clothed in tawny down. The adult plumage is grey, with black, white and red (the last due to bare skin) on the head and neck. The crane has a loud trumpeting call, correlated with the formation of the trachea, which is received into a hollow space formed by the walls of the keel of the sternum, where it makes three turns before running upwards and backwards to the lungs. The crane and its allies form the family *Gruidae,* whose nearest allies are probably the bustards (*q.v.*); they are an ancient group, species of the *Grus* occurring in the Miocene of France and Greece. At the present time, cranes inhabit all the great zoo-geographical regions except the Neotropical. The demoiselle crane (*Anthropoides virgo*), distinguished by its white ear-tufts, inhabits S. Europe, Asia and Africa and allied species occur in other parts of Asia and Africa. In Australia there is *G. australis*, the "native companion," and four species are found in N. America, of which the little brown crane (*G. canadensis*) and the sandhill crane (*G. mexicana*) are widely distributed. The whooping crane (*G. americana*) is on the verge of extinction. The African crowned cranes (*Balearica*) have a tuft of slender yellow feathers on the head. The food of the cranes consists of small animals of all kinds.

CRANES, machines by means of which heavy bodies may be lifted, and also displaced horizontally, within certain defined limits (so called from the resemblance to the long neck of the bird, *cf*. Gr. γέρανος, Fr. *grue*). Strictly speaking, the name alludes to the arm or jib from which the load to be moved is suspended, but it is now used in a wider sense to include the whole mechanism by which a load is raised vertically and moved horizontally. Machines used for lifting only are not called cranes, but winches, lifts or hoists, while the term elevator or conveyor is commonly given to appliances which continuously, not in separate loads, move materials like grain or coal in a vertical, horizontal or diagonal direction. (*See* CONVEYORS.) The use of cranes is of great antiquity, but it is only since the great industrial development of the 19th century, and the introduction of other motive powers than hand labour, that the crane has acquired the important and indispensable position it now occupies. In all places where finished goods are handled, or manufactured goods are made, cranes of various forms are in universal use.

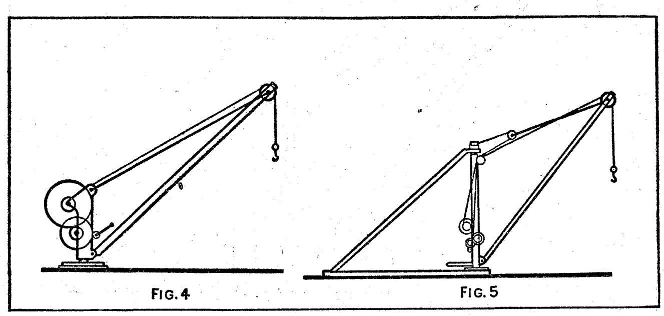
Classification of Motive Power.—Cranes may be divided into two main classes—revolving and non-revolving. In the first the load can be lifted vertically, and then moved round a central pivot, so as to be deposited at any convenient point within the range. The type of this class is the ordinary jib crane. In the second class there are, in addition to the lifting motion, two horizontal movements at right angles to one another. The type of this class is the overhead traveller. The two classes represent respectively systems of polar and rectangular co-ordinates. Jib cranes can be subdivided into fixed cranes and portable cranes; in the former the central post or pivot is firmly fixed in a permanent position, while in the latter the whole crane is mounted on wheels, so that it may be transported from place to place.

The different kinds of motive power used to actuate cranes—manual, steam, hydraulic, electric—give a further classification. Hand cranes are extremely useful where the load is not excessive and the quantities to be dealt with are not great, also where speed is not important and first cost is an essential consideration. The net effective work of lifting that can be performed by a man turning a handle may be taken, for intermittent work, as being on an average about 5,000 ft.-lb. per minute; this is equivalent to one ton lifted about $2\frac{1}{4}$ft. per minute, so that four men can by a crane raise one ton 9ft. in a minute or nine tons 1ft. per minute. It is at once evident that hand power is only suitable for cranes of moderate power, or in cases where heavy loads have to be lifted only very occasionally. This point is dwelt upon because the speed limitations of the hand-crane are often overlooked by engineers. Steam is an extremely useful motive power for all cranes that are not worked off a central power station. The steam crane has the immense advantage of being completely self-contained. It can be moved (by its own locomotive power if desired) long distances without requiring any complicated means of conveying power to it; and it is rapid in work, fairly economical and can be adapted to the most varying circumstances. Where, however, there are a number of cranes all belonging to the same installation, and these are placed so as to be conveniently worked from a central power station, and where the work is rapid, heavy and continuous, as is the case at large ports, docks and railway or other warehouses, experience has shown that it is best to produce the power in a generating station and distribute it to the cranes. Down to the closing decades of the 19th century hydraulic power was practically the only system available for working cranes from a power station. The hydraulic crane is rapid in action, very smooth and silent in working, easy to handle and not excessive in cost or upkeep—advantages which have secured its adoption in every part of the world. Electricity as a motive power for cranes is of more recent introduction. The electric transmission of energy can be performed with an efficiency not reached by any other method, and the electric motor readily adapts itself to cranes. When they are worked from a power station the great advantage is gained that the same plant which drives them can be used for many other purposes, such as working machine tools and supplying current for lighting. For dock-side jib cranes the use of electric power is making rapid strides. For overhead travellers in workshops, and for most of the cranes which fall into our second class, electricity as a motive power has already displaced nearly every other method. Cranes driven by shafting, or by mechanical power, have been largely superseded by electric cranes, principally on account of the much greater economy of transmission. For many years the best workshop travellers were those driven by quick running ropes; these performed admirable service, but they have given place to the more modern electric traveller.



FIGS. 1 TO 3.—THREE METHODS OF LIFTING WITH A CRANE
1.—Direct pull by a piston-rod under power, giving short range of lift only
2.—Indirect pull from piston through pulley system, used in hydraulic cranes
3.—Indirect pull through winding rope on rotating barrel

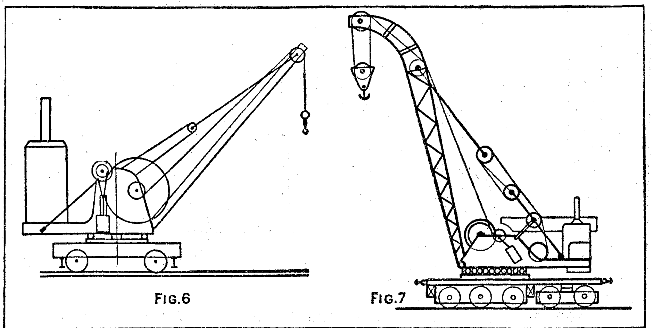
Lifting mechanisms.—The principal motion in a crane is naturally the hoisting or lifting motion. This is effected by slinging the load to an eye or hook, and elevating the hook vertically. There are three typical methods: (1) A direct pull may be applied to the hook, either by screws, or by a cylinder fitted with piston and rod and actuated by direct hydraulic or other pressure, as shown diagrammatically (fig. 1). These methods are used in exceptional cases, but present the obvious difficulty of giving a very short range of lift. (2) The hook may be attached to a rope or chain and the pulling cylinder connected with a system of pulleys around which the rope is led; by these means the lift can be very largely increased. Various arrangements are adopted; the one indicated (fig. 2) gives a lift of load four times the stroke of the cylinder. This second method forms the basis of the lifting gear in all hydraulic cranes. (3) The lifting rope or chain is led over pulley to a lifting barrel, upon which it is coiled as the barrel is rotated by the source of power (fig. 3). Sometimes, especially in the case of overhead travelling cranes for very heavy loads, the chain is a special pitch chain, formed of flat links pinned together, and the barrel is reduced to a wheel provided with teeth, or "sprockets," which engage in the links. In this case the chain is not coiled, but simply passes over the lifting wheel,



FIGS. 4 AND 5.—TYPES OF HAND CRANES USED BY RAILROAD COMPANIES
4.—The weight of the jib is carried by the central steel post, the load weight being taken by the rollers
5.—The superstructure is pivoted at the base, and the head by means of diagonal supporting legs

the free end hanging loose. All the methods in this third category require a rotating lifting or barrel shaft, and this is the important difference between them and the hydraulic cranes mentioned above. Cranes fitted with rotating hydraulic engines may be considered as coming under the third category.

When the loads are heavy the above mechanisms are supplemented by systems of purchase blocks suspended from the jib



FIGS. 6 AND 7.—TWO TYPES OF STEAM CRANE IN WHICH THE BOILER HELPS TO SERVE AS COUNTERWEIGHT, AND THE LOAD IS LIFTED BY MEANS OF A STEEL WIRE ROPE COILED ON A BARREL
6.—A portable steam crane of the type n general use
7.—A railway breakdown crane

or the traveller crab; and in barrel cranes trains of rotating gearing are interposed between the motor, or manual bar, and the barrel (fig. 3).

Hand Cranes.—Typical examples are illustrated in figs. 4 and 5. A large number are still used for places where the work is only occasional. Both these types are largely used by railway companies and small ports. In fig. 4 the weight of the revolving part or superstructure is carried on the top of a forged steel or cast iron post, the overturning moment of the load being taken on rollers carried at the bottom of the superstructure, which roll round the part of the post immediately above the bed of the crane. In fig. 5 the superstructure is carried on rollers which revolve on a turned path on the bed or truck. Sufficient ballast is carried in the tail of the superstructure to keep the centre of gravity of the revolving portion inside this roller path.

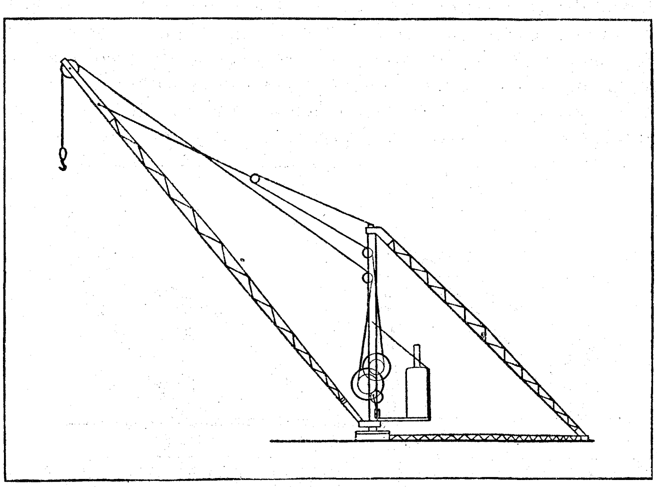


FIG. 8.—THE SCOTCH DERRICK, A STATIONARY STEAM (OR ELECTRIC) CRANE, WITH LIMITED ROTATING MOVEMENT, MUCH USED IN BUILDING CONSTRUCTION

Steam Cranes.—Two well-known types are shown in figs. 6 and 7. The former is the standard type of portable steam crane which can be constructed to run on any gauge or on road wheels or on a caterpillar track. Fig. 7 shows a railway breakdown crane. This is fitted with a large number of axles in order to reduce the axle loads for running on the main line, and has one bogey to enable it to negotiate the curves. It is fitted with standard railway buffers and draw gear and vacuum brakes.

In both of these types the motions provided for are those of hoisting the load, slewing or revolving the superstructure about a perpendicular axis through the centre of the truck, travelling the crane along the line, and lifting and lowering the jib. This latter motion is known as derricking or luffing. The boiler is mounted on the tail girders at the back of the revolving superstructure. In this position it acts as a counterweight, which, together with cast-iron ballast underneath, serves to balance off the forward moment of the load and jib. Two cylinders are mounted one on either side of the crane. These may be either vertical, horizontal or inclined. They drive direct on to a transverse horizontal shaft from which the various motions are taken. The lifting mechanism is of the type illustrated (fig. 3), and is operated by a pinion which slides on its shaft so that the load can be lowered, under control of a band brake on the barrel, without revolving the engine shaft. The crane revolves on rollers carried on pins fixed to the bed of the revolving superstructure. A circular path for these rollers is fixed to the top of the truck. For large cranes a live ring of rollers is often used. This consists of a number of rollers the pins of which are all carried by either one or two rings. Thus the live ring revolves on the truck at half the rate of revolution of the superstructure. The live ring is thus a large roller thrust bearing and makes the slewing very free besides giving a good distribution of load. A circular steel curb ring fitted with teeth is mounted on the top of the truck, the teeth of which engage with a vertical pinion mounted on a shaft which is carried by the superstructure. This shaft is revolved through a train of spur gearing by friction cones which are keyed to the engine shaft and drive down through bevel gears. The motions of travelling and derricking are also taken from the engine shaft, the former being operated by a vertical shaft which passes down into the truck through the middle of the centre post or pin about which the crane revolves. From there the motion is taken on to the axles through bevel gear and longitudinal shafts. The jib is supported by a rope or ropes which pass over sheaves at the top of the superstructure, and are coiled on the derricking barrel. The latter is driven from the engine shaft, usually through a worm and wheel which are made so that the motion will not reverse under the weight of the jib and load. This is done for safety so that the derricking clutch can be withdrawn without allowing the jib to run out.

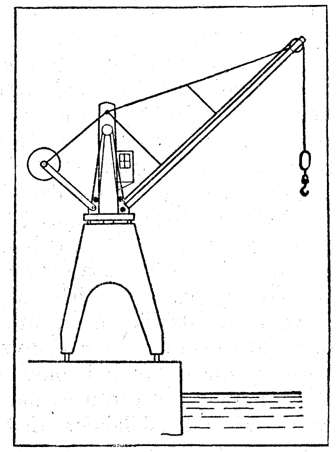


FIG. 9.—HYDRAULIC CRANE
The load is lifted by a ram, and the crane can be slewed by chains wrapped round the revolving central mast

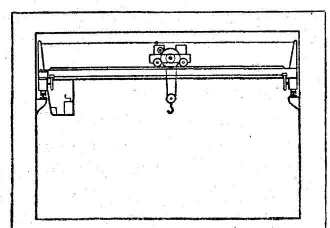


FIG. 10.—ELECTRIC OVERHEAD TRAVELLING CRANE

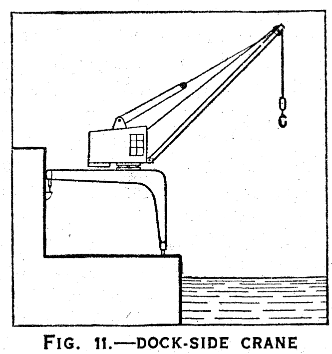


FIG. 11.—DOCK-SIDE CRANE
This type is generally mounted on a gantry, which travels along the quay

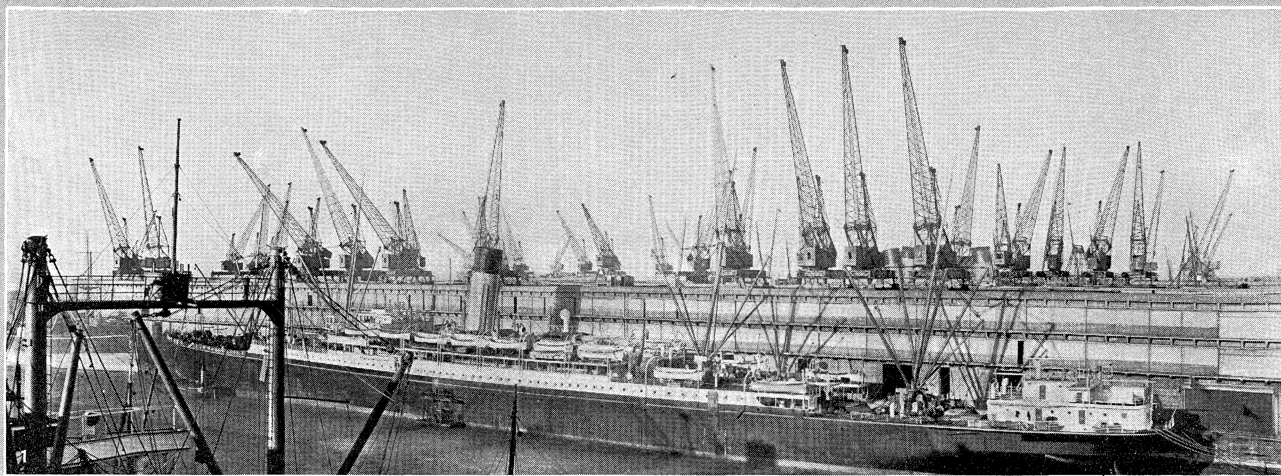
Another familiar form of steam crane, and one much used for building construction, is the Scotch derrick (fig. 8). It operates much as described above, except that it does not travel, and can only slew through part of a circle. It is often mounted on steel framed towers so as to get extra height of lift. Scotch derricks are also often operated by electric motors.

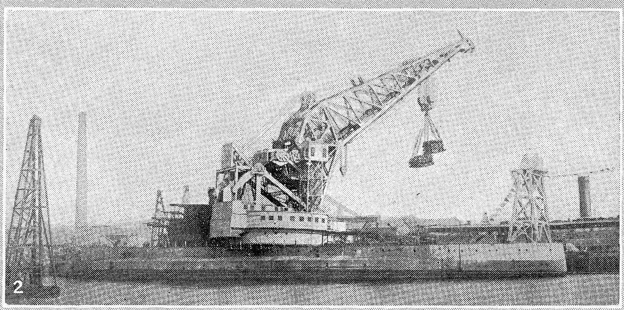
Hydraulic Cranes.—A common type of hydraulic crane is illustrated in fig. 9. The load is lifted by means of a ram (fig. 2). Similar rams are mounted horizontally at the top of the gantry,

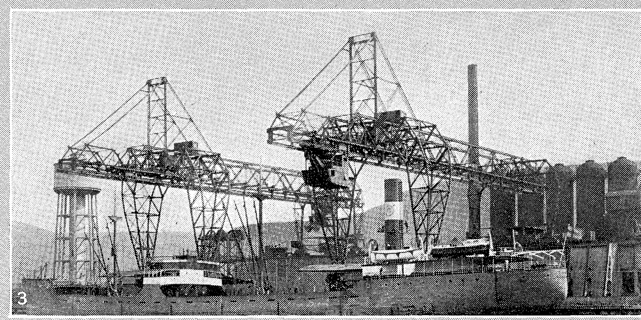
BY COURTESY OF THE CLEVELAND CRANE & ENGINEERING CO.

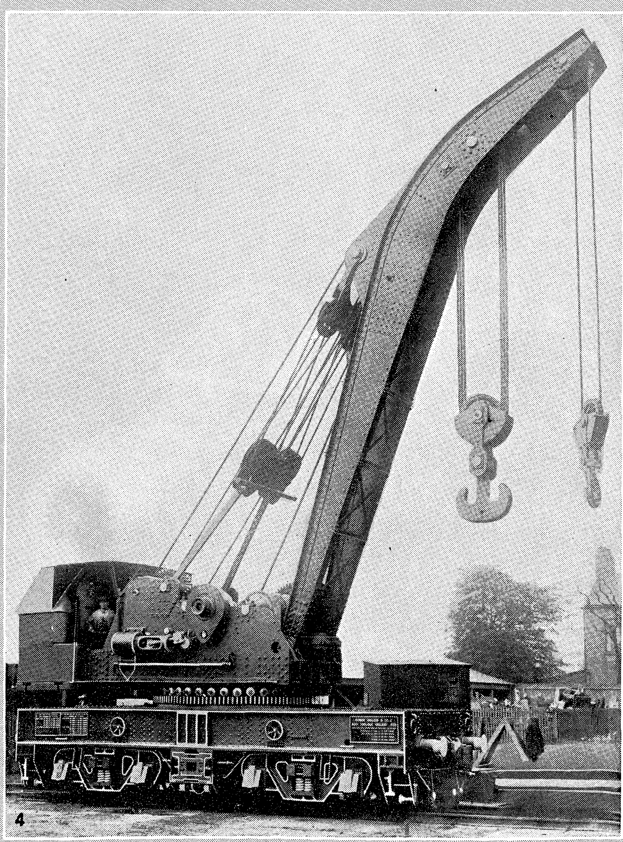
OVERHEAD CRANES IN INDUSTRIAL PLANTS

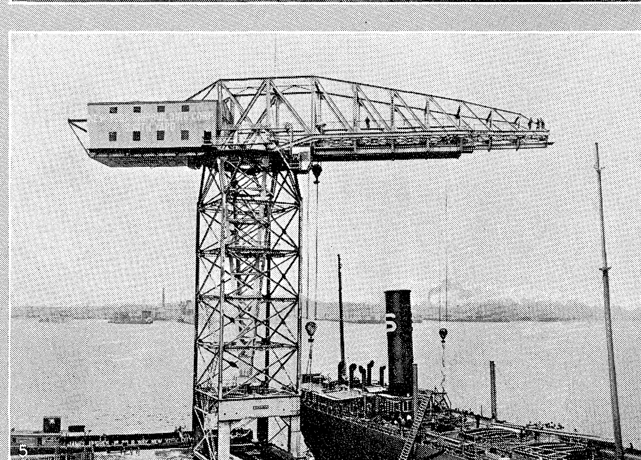
1. All-welded powerhouse crane with 105-ft. span, used to transport heavy electrical equipment. The two overhead girders are more than 8 ft. deep in the middle and weigh 45 tons each. The entire crane weighs 178 tons
2. Ten-ton, all-welded magnet handling crane in a large steel mill. In the background is a 15-ton crane
3. Small motor-driven tram-rail gantry crane, controlled from a push-button station attached to a rigid arm. This type is often employed under a large overhead crane to relieve the latter of lighter, time-consuming work
4. Hand-propelled tram-rail crane with electric hoist

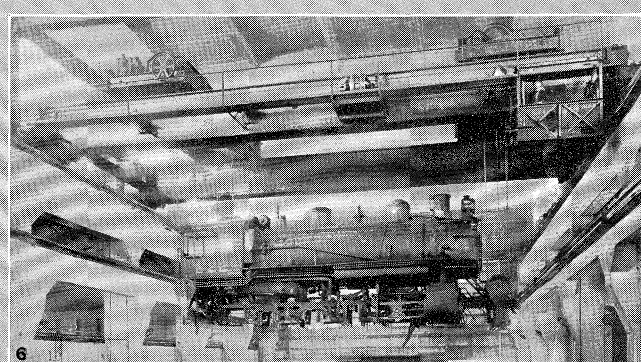












BY COURTESY OF (2, 5) THE WELLMAN-SEAVER-MORGAN COMPANY, (6) THE NILES CRANE CORPORATION AND THE SOUTHERN PACIFIC RAILROAD

MODERN STEEL POWER CRANES FOR INDUSTRIAL USES

1. Modern installation of dockside cranes for transferring cargoes to and from ocean vessels. Cranes reach warerooms and holds of vessels. **2.** Kearsarge type crane in U.S. navy yard. Mounted on battleship hull, this crane can be towed to sea for use in raising or rescuing vessels. **3.** Transporter travelling cranes, 12-ton capacity, unloading ore from steamer to blast furnaces; used in handling coal, ore and raw materials. **4.** Steam breakdown crane, 120-ton capacity, for railroad use. Mounted on special trucks, has self-contained power plant, geared for propulsion. **5.** Hammerhead crane, 200-ton capacity. Horizontal "head" turns in a circle on vertical base. Power plant is located in housing at left. **6.** Locomotive lifting crane, 200-ton capacity, in railroad shops. Four hoists and framework are controlled by operator in car at right or non-revolving portion of the crane. These rams pull on chains which are wrapped round the revolving mast and give the crane the motion of slewing. A further ram is mounted on the back of the superstructure and is used to luff the jib in and out. Hydraulic cranes are usually travelled by hand power, but sometimes revolving hydraulic engines are fitted for this purpose.

Electric Cranes.—The two types of electric cranes most generally used are those shown in figs. 10 and 11. The former shows the common type of overhead traveller. It consists of two main or bridge girders the ends of which are attached to end carriages which travel on the longitudinal gantry girders or runway. The main girders may be of the single joist construction for small cranes, or lattice or plate girders for large cranes. The hoisting winch is carried on a frame mounted on wheels called the crab or jenny. This crab moves on either the top or bottom booms of the main girders and carries a separate motor for this motion of "cross traversing." The controllers for all these motions are in the driver's cage at one or other end of the main girders. Sometimes a revolving jib crane is mounted on the jenny (fig. 12). Such a type is useful where it is required to pick up loads outside the shop runway rails, but it has the disadvantage of taking up valuable headroom. Allowance must be made in designing the gantry girders for the eccentric load.

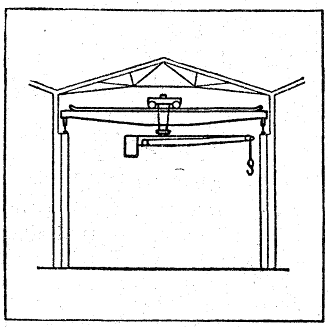


FIG. 12.—OVERHEAD TRAVELLING CRANE WITH JIB, USEFUL FOR PICKING UP LOADS OUTSIDE THE AREA ENCLOSED BY RUNWAYS

Dockside cranes (fig. 11) are a very important class. They are usually of the revolving type, and are either mounted on the roof of the warehouse or on a gantry on the quay. This latter may be of the half portal type as illustrated, or the full portal type where both crane rails are on the quay. They have four motions, that of lifting the load, slewing, luffing or derricking the jib, and travelling along the quay or roof. They vary in capacity from $1\frac{1}{2}$ to 5 tons, which are handled at a radius of from 25 to 90ft.

Special Purpose Cranes.—The cranes described so far have been roughly classified according to the motive power which operates them, but it is obviously not possible always to follow this plan, as a crane can be designed for any special duty and worked by the motive power which is most conveniently available at site. Figs. 13 to 22 show a number of these.

Fig. 13 shows a useful type of steam crane for reclaiming coal from a store at a power station. It is mounted on a caterpillar truck, and operates a grab. The latter picks up $2\frac{3}{4}$ tons of coal per lift and weighs, empty, $2\frac{1}{4}$ tons. The boiler has a steaming capacity of 1,400lb. per hour, and the crane will handle coal at the rate of 600 tons per hour without losing steam. For this purpose a steam crane has the advantage of mobility, but is handicapped by its output being limited by its boiler capacity. The whole crane with ballast and load weighs 59 tons, and has a maximum track pressure of 2·3 tons per square foot with the jib across the corner of one track.

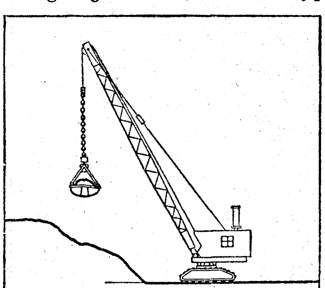


FIG. 13.—MOVING STEAM CRANE FOR USE IN CLEARING DUMPS

Fig. 14 shows an electric crane for discharging coal from ships by means of a grab. The coal is deposited into a hopper in front of the gantry, from whence it passes through a weighing machine and on to a belt conveyor. The latter discharges the coal through the rear of the gantry on to another conveyor, not shown in the fig., into the boiler house bunkers. It will be noted that the motions most used are those of lifting and luffing.

Fig. 15 shows another method of carrying out a similar duty by means of an electric transporter crane. Here the front apron girder or boom is hinged at the rear end to allow ships to be brought in. The boom is thus lowered out over the hatch, and the trolley moves backwards and forwards on it. The trolley carries the lifting and cross traversing machinery and the driver's cabin. The lifting machinery revolves on a large ball race, and carries a jib from the end of which the grab is suspended. This machine

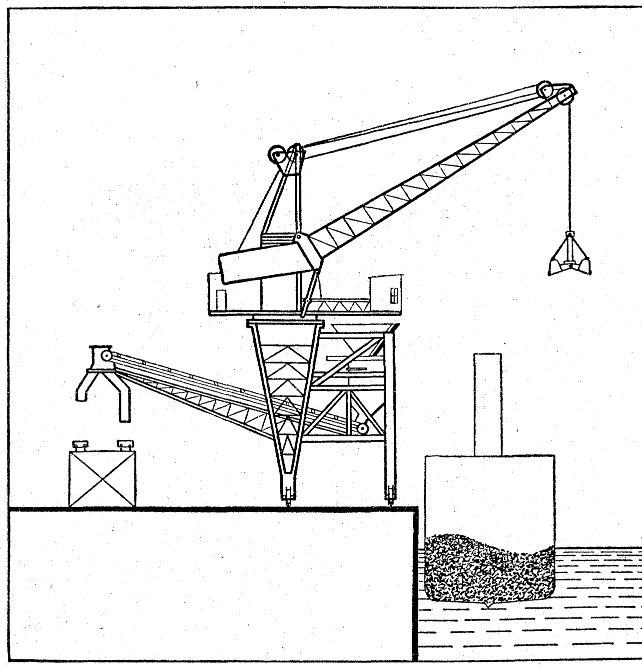


FIG. 14.—ELECTRIC CRANE DISCHARGING COAL FROM A SHIP
The coal is discharged into a hopper, from which it passes through a weighing machine, and thence by means of conveyors to the boiler-house bunkers

was designed to give a rate of discharge of 150 tons per hour through the ship. It is important in unloading bulk cargo to make sufficient allowance for the time lost in cleaning up nearly empty hatches and in shifting to new hatches. In this transporter the

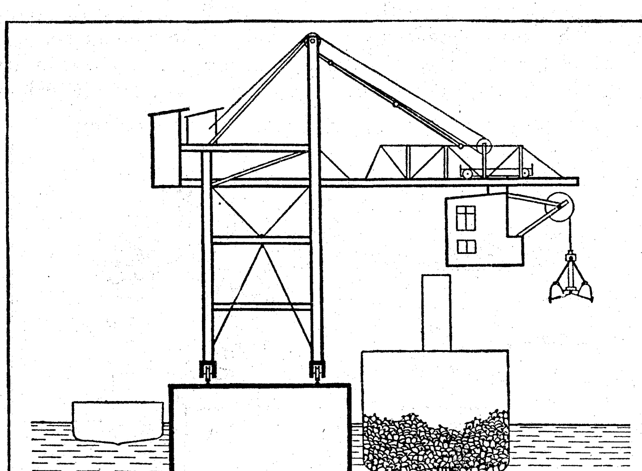


FIG. 15.—ELECTRIC TRANSPORTER CRANE FOR DISCHARGING COAL
In this type the front boom is first raised to permit the entry of the ship; the trolley and control cabin then move out till over the ship's hatch

rate of discharge with a fairly full hatch was 230 tons per hour, but the average rate throughout a ship holding 2,700 tons of coal was 160 tons per hour.

Fig. 16 shows a similar machine for unloading iron ore. It has a capacity of 300 tons per hour without making the allowances mentioned above. The gross weight of grab and contents is 18 to 19 tons, according to the class of ore handled. There are two hoisting motors and two winches, one for closing the grab or digging, and the other for holding the head of the grab while discharging. Each motor has a capacity of 155 b.h.p. on a one-hour rating, and 200 b.h.p. on a half-hour rating. After the grab has been filled both winches lift together. The crane can also be used for handling loaded 20-ton wagons. The whole of the hoisting gear revolves on a circular roller path, and the ropes are led direct from the barrels to the grab, no jib being used as in fig. 15. This arrangement allows the grab to be turned by means of slewing gear in the crab, so as to pick up the ore at the most suitable angle. The speed of lifting is 220ft. per minute,

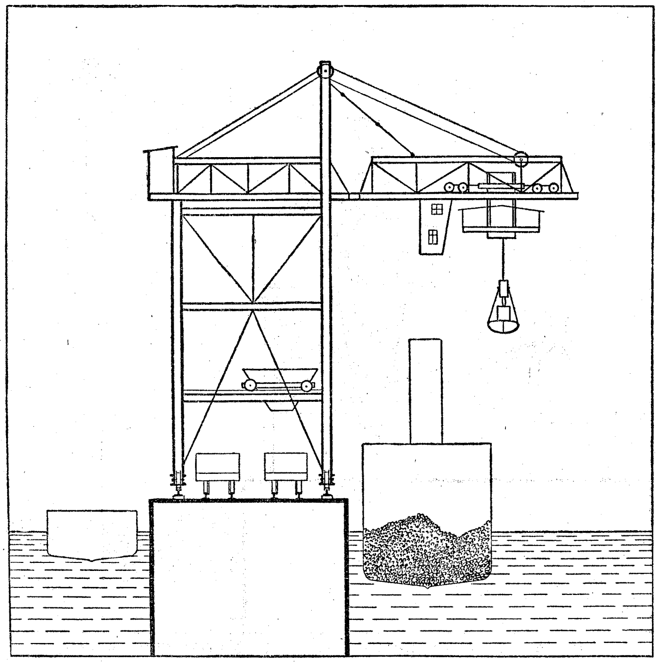


FIG. 16.—DIAGRAM OF TRANSPORTER CRANE FOR UNLOADING IRON ORE
This type can lift 19 tons; no jib is fitted, and gear is employed to slew the grab to a convenient position for picking up the ore

cross traverse of crab 300ft. per minute with two 40 h.p.motors, slewing three revolutions per minute with one 12 h.p. motor, travelling along the quay 40ft. per minute with a 40 h.p. motor. The overall dimensions of the grab are 7ft. 6in. long by 14ft. 6in. wide when open. These figures are given in some detail because they show that the rate of discharge is limited, and cannot be increased very much unless the sizes of hatches are increased so

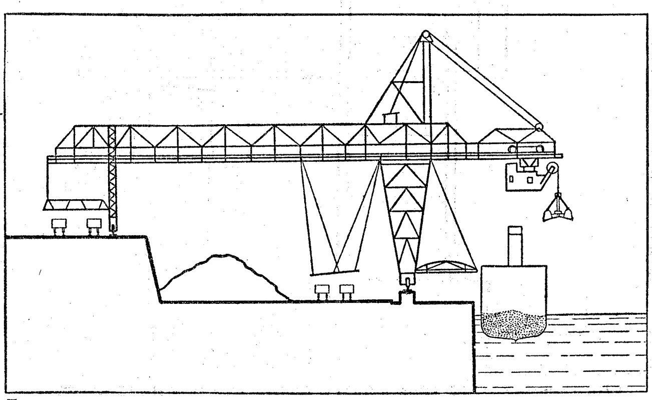


FIG. 17.—LONG TRANSPORTER CRANE WITH A GRAB OF 5 TONS' CAPACITY. IT CAN TRAVEL 260 FT. AT 800 FT. A MINUTE

as to allow of the use of larger grabs. For the heaviest duties a transporter has some advantage over a crane, as higher speeds can be used for the cross traverse than are possible with the slewing or luffing motions of a crane, owing to the fact that the length of rope above the load is not so great and consequently the inertia of stopping and starting does not produce such a swing on the grab. It must always be remembered that control of the load is as important for quick working as the actual speed of any particular motion, and future development of this class of machinery will probably be more with the object of getting better control than of increasing either the load or the speeds. Fig. 17 shows a similar machine for unloading iron ore. The grab has a capacity of five tons, and discharges either on to the quay or into a bunker at the rear end. The crab travels a distance of 260ft. at a speed of 800ft. per minute.

Fig. 18 shows the "hammer-headed" crane which is used for loads up to 250 tons. It is used for lifting heavy machinery, either for construction or repair, into and out of ships. The general arrangements are similar to those described above, but all the motions are much slower. The heavy lifting machinery is fixed at the tail of the crane, as is also the racking machinery. The jenny is pulled in and out by ropes, and only carries the sheaves over which the hoist ropes pass. Fig. 19 shows a very usual form of graving dock crane having a capacity of 30 tons at 85ft. radius. It is used for ship repair work. The superstructure revolves on a live ring of rollers, and the arrangement of machinery is similar though much larger than that of the dockside cranes described above.

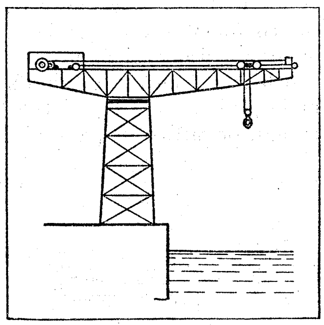


FIG. 18.—HAMMER-HEADED CRANE

Where a graving dock is not available, and for general work in a harbour where large lifts are required at different places, it is usual to mount a crane on a large pontoon (fig. 20). This floating crane revolves on a base fixed to the deck, and the jib is supported by screws, which enables the jib to be luffed in and out. Another type of floating crane is shown (fig. 21). Three such cranes, operated by steam, are commonly mounted on a hopper barge, one being at the bow and two at the stern. They are used for dredging, each crane having a capacity up to about 200 tons of silt per hour.

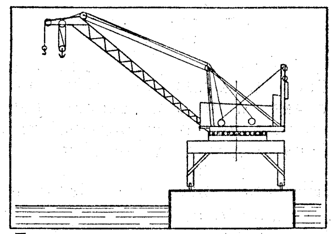


FIG. 19.—GRAVING DOCK CRANE USED FOR SHIP REPAIR WORK

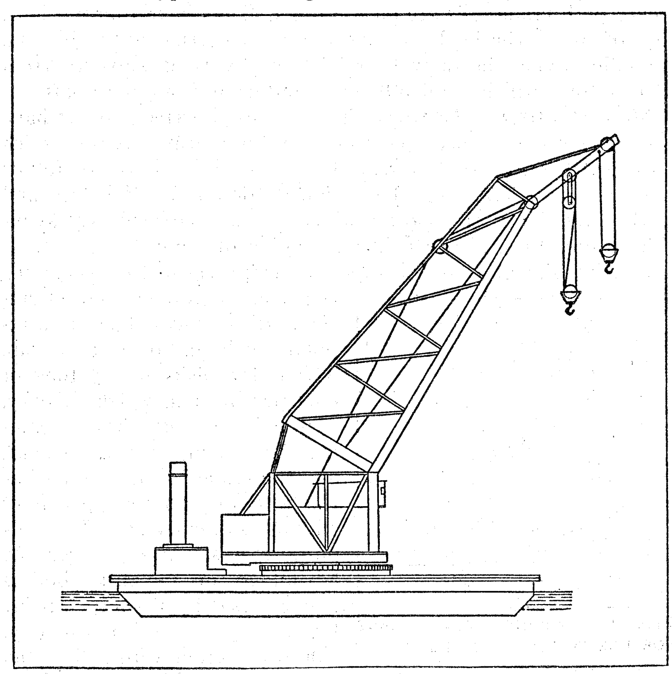


FIG. 20.—FLOATING CRANE FOR GENERAL HARBOUR WORK, MOUNTED ON A PONTOON

A special form of jib crane, designed to meet a particular purpose, is the Titan (fig. 22), largely used in the construction of piers and breakwaters. It contains all the essential elements of the hammer-head crane, of which it may be considered to be the parent; in fact, the only essential difference is that the Titan is portable, and the hammer-head crane fixed. The Titan was the first type of large portable crane in which full use was made of a truly horizontal movement of the load; for the purpose for which the type is designed, viz., setting concrete blocks in courses, the motion is almost a necessity. A simple form of crane for lifting heavy loads is shown in fig. 23. This shows the shear legs.

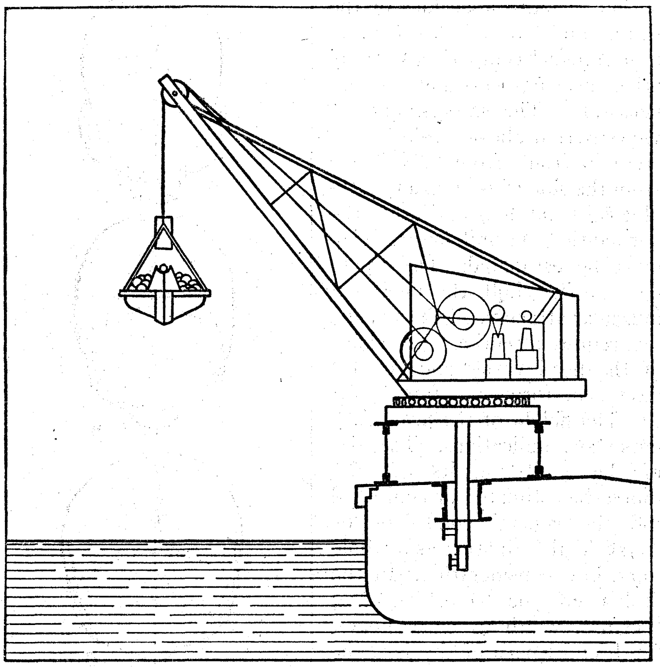


FIG. 21.—STEAM CRANE MOUNTED ON A BARGE, USED FOR DREDGING. IT HAS A CAPACITY OF 200 TONS PER HOUR

Here the place of the jib is taken by two inclined legs joined together at the top and pivoted at the bottom; a third back leg is connected at the top to the other two, and the bottom leg is coupled to a nut which runs along a long horizontal screw. This movement allows the front legs to fold back over the quay so that a load can be taken out of a vessel and deposited on the quay wall.

Methods of Control.—The importance of methods of control in the handling of bulk cargo in grabs has already been mentioned. Speed of working is, however, equally important in handling mixed cargo so that the ship can be turned round in the least possible time. The growth in the size of ships has necessitated much longer radius cranes than were formerly used, *i.e.*, up to about 90ft. radius instead of about 50 feet. It has been found that not much, if any, time is saved by increasing the speeds of the various motions beyond about 250ft. p.m. for lifting, 400ft. p.m. for lowering, 600ft. p.m. for slewing and 180ft. p.m. for luffing. These speeds are higher than those commonly used. They have, however, been exceeded. That rate at which a ship can be loaded or discharged can be increased by improvements in two directions; firstly, by better arrangements of the positions of the sheds and cranes relative to the quays, so that more cranes can work at one hatch at the same time without getting in each other's way, and, secondly, by improving the electrical controls so that high speeds can be utilized where a clear run for the load occurs, at the same time enabling the driver to slow down, and to creep where necessary to avoid swinging the load into the sides of hatches and other obstructions. The former is the direction in which most improvement is taking place. It may be said that the arrangement of a number of cranes situated on the roof of a quay enables several cranes to work in the same hatch. In this case the cranes work almost entirely by lifting and luffing, instead of by lifting and slewing, the cargo being worked from, or to, either the quay itself or platforms projecting from the various floors. With regard to electrical control it may be said that much has been done recently, but that the problem has by no means been solved. It is complicated by the introduction of alternating current in place of direct.

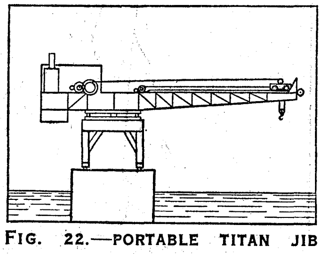


FIG. 22.—PORTABLE TITAN JIB CRANE EMPLOYED IN PIER CONSTRUCTION

Brakes.—When a load is lowered the work which it does in falling has to be absorbed, and the dissipation is effected partly by the friction of the gear and moving parts, but mostly either by the heat produced through the mechanical brakes, or by the current generated when the lifting motor is driven by the load and acts as a dynamo. Friction accounts for only about 15–20%, so that a considerable amount of energy is absorbed by the brake or the dynamotor. One of the simplest forms of braking is to disengage the barrel from the motor and gearing by means of a coil clutch, and control the load entirely on foot brake. This system has the great advantage of enabling the driver to control the speed of lowering within any limits he desires, and for dockside cranes up to about five tons lifting capacity is used fairly extensively. Many engineers, however, prefer a system which does not allow the load to run away if the driver makes a mistake, and to meet this many systems of electrical braking have been devised, by which the regenerated current is used to control the speed of lowering through the controller. In addition to one or other of the above methods it is usual to fit a holding brake on the motor armature shaft which is held in by a weight and released by a solenoid. A hand release can be fitted to this brake so that the load can be eased down gently on to the ground for the last few inches.

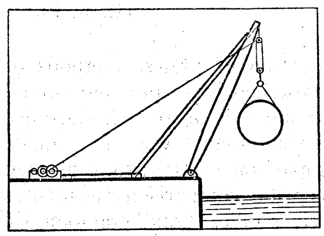
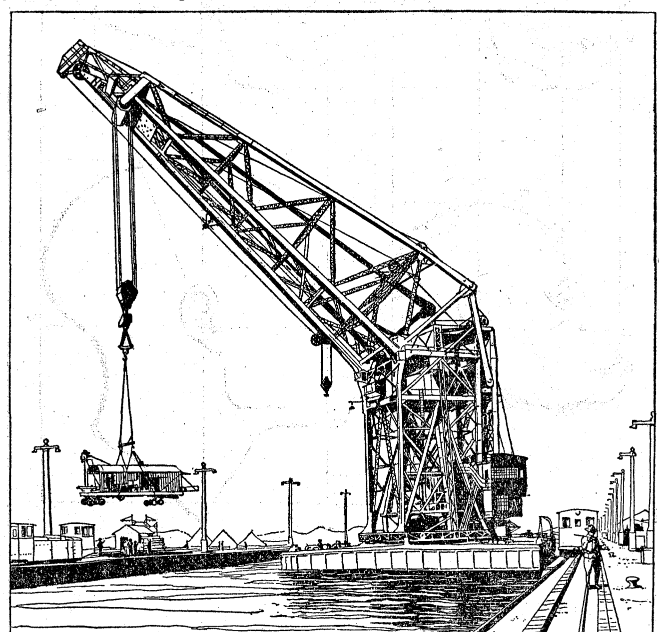


FIG. 23.—SIMPLE CRANE FOR LIFTING HEAVY LOADS



BY COURTESY OF THE WASHINGTON OFFICE OF THE PANAMA CANAL

FIG. 24.—THE FLOATING CRANE "HERCULES" TRANSFERRING EQUIPMENT ACROSS THE GATUN LOCKS, PANAMA CANAL

Luffing Gear.—We have spoken of the growing importance of luffing, and it is largely owing to the improvements in this gear and consequent increased speed of luffing that this motion is so much more used than formerly. This has been brought about by the introduction of various arrangements by which the load is neither lifted nor lowered during the process of luffing the jib in and out. There are many ways of providing for this which are covered by patents. They are too numerous to describe here but have been summarized in an article in *The Engineer* dated Aug. 26 and Sept. 2, 1927. With any of these systems it will be seen that the power taken for luffing is only that necessary to overcome friction or to lift the weight of the jib itself. The latter can be avoided by balancing off the jib either by means of a counterweight supported by ropes or ties, or by projecting the jib backwards and fixing the counterweight direct on to its rear end.

Bibliography.—A. Ernst, *Die Hebezeuge* (1903); A. Böttcher, *Cranes* (1908); C. W. Hill, *Electric Crane Construction* (1911); H. H. Broughton, *Electrical Handling of Materials* (1921–23); H. Davies, *Elevating and Conveying Machinery* (1922–23); F. E. Chilton, *Electric Cranes and Hauling Machines* (1923); H. Wilda, *The Design of Cranes and Hoists* (1925). (R. B. Pi.)

CRANESBILL: *see* Geranium.

CRANIOMETRY. The application of precise methods of measurement in craniometry, a comprehensive expression for all methods of measuring the skull (cranium) is of great importance in anthropological studies. The measurements were first made with a view to elucidating the comparison of the skulls of men with those of other animals. This wide comparison constitutes the first subdivision of craniometric studies. And craniometric methods have rendered the results of comparison clear and comprehensible. Among the first measurements employed angular determinations occur, and the "facial angle" invented by Camper

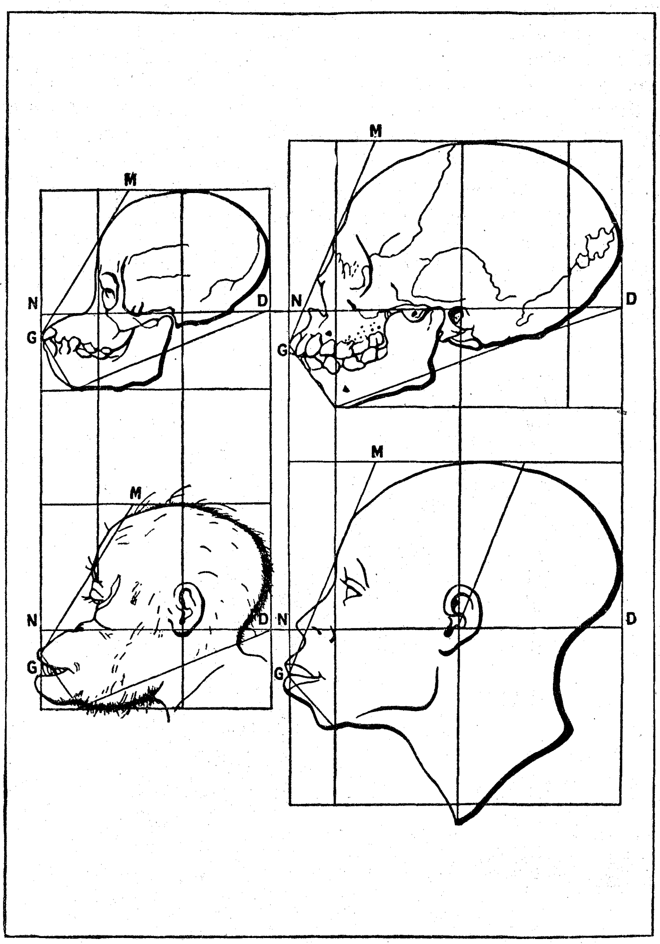
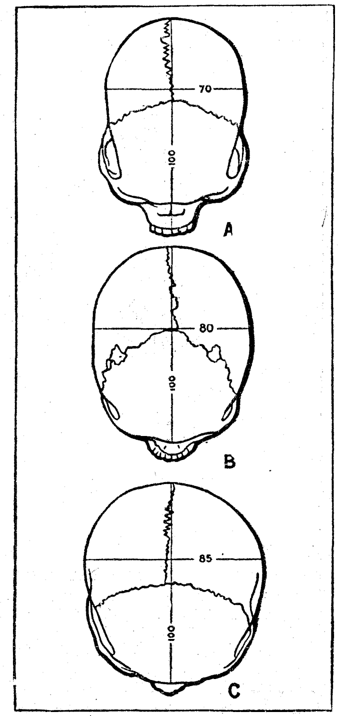


FIG. 1.—LEFT, SKULL AND HEAD OF YOUNG ORANG-UTAN, SHOWING THE FACIAL ANGLE FORMED BY LINES MG-ND TO BE LESS THAN 70°, AND ON RIGHT, SKULL AND HEAD OF NEGRO, SHOWING THE SAME ANGLE TO BE 70°

(fig. 1), was employed for comparative purposes, as will appear from the following extract from the translation of the original work: "The two extremities of the facial line are from 70 to 80° from the negro to the Grecian antique: make it under 70, and you describe an ourang or an ape: lessen it still more, and you have the head of a dog. Increase the minimum, and you form a fowl, a snipe for example, the facial line of which is nearly parallel with the horizon." (Camper's Works, p. 42, translated by Cogan, 1821.) The International Anthropological Association at its meeting in 1882 established a plane now known as the Frankfort plane or horizontal, and in general use, despite serious defects when dealing with imperfect skulls.

The second division of craniometric studies includes those in which the skulls of the races of mankind are compared and classified. And in this domain, the advent of accurate numerical methods of recording observations brought about great advances, completed by a system of comparing various dimensions of the skull, and of a classification based on such comparisons. Many other measurements and data are necessary. The skull should be viewed from above, from below, from in front, from behind and from the side (figs. 2, 3, 4). Pathological conditions and other abnormalities, natural or artificial, must be estimated. The thickness of the skull, the points of muscular attachment, the age and sex, require attention. The shape of the head varies and six distinct type-forms are found (fig. 5). The height of the head gives important indications. The size of the skull and its capacity should be estimated or computed and the general conditions of the skeletal formation as a whole come into consideration. In the skull itself, the eye-orbits, nasal aperture, width of cheek-bones, depth and length of the jaw, the proportions of its attachment, the relative position and size and proportions of the elements of the bony structure of the skull are capable of measurement and therefore are valuable for the purpose of classification by advanced mathematical and statistical processes. (*See* Anthropometry.)

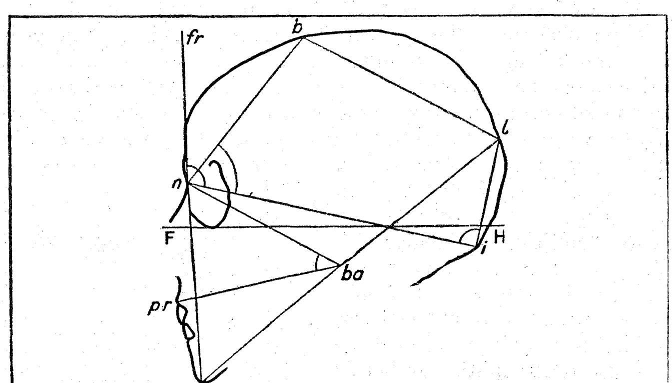


FROM TYLOR, "ANTHROPOLOGY" (MACMILLAN)

FIG. 2.—SKULLS, FROM ABOVE

Measured by the cephalic index, the greatest width compared with greatest breadth is; A. Negro, index 70, dolichocephalic; B. European index 80, mesaticephalic; C. Samoyed, index 85, brachycephalic

Endocranial casts afford precious indications of the conformation of the brain itself. No one feature, no single index, can be held sufficient by itself for definitive classification. Many of the data yielded by craniometry can be contrasted usefully with analogous measurements on living subjects which allow information yielding further criteria (*see* Races of Mankind). The contours and angles of the elements of the skull may be recorded and



FROM WILDER, "LABORATORY MANUAL OF ANTHROPOMETRY" (BLAKISTON'S SON & CO.)

FIG. 3.—PRINCIPAL POINTS OF FRANKFORT PLANE

FH.-Frankfort horizontal or plane; fr.-tangent to FH through n, the nasion, or upper end of the nasal suture; b.-Bregma, where the coronal and sagittal sutures meet; l.-Lambda, where the sagittal and lambdoidal meet; i.-inion, the occipital protuberance; fr.-n-i.-Frontal angle; b-n-i.-Frontal inclination angle; l-i-n.-Occipital inclination angle; n-ba-pr.-Superior facial length angle; ba.-The middle point (basion) of the anterior margin of the occipital foramen pr.-The lowest point of the intermaxillary suture measured by the diagraph and goniometer.

The third subdivision of craniometric researches is one in which the field of comparison is still further narrowed. For herein the various sub-racial types such as the dark and fair Europeans are brought together for the purposes of comparison or contrast. But although the range of research is thus narrowed and restricted, the guiding principles and the methods remain unchanged. By the method of expressing as a formula two cranial dimensions which have been measured are compared, one skull may be so proportioned that its greatest width measures 75% of its greatest length (*i.e.*, its width is to its length as three to four).

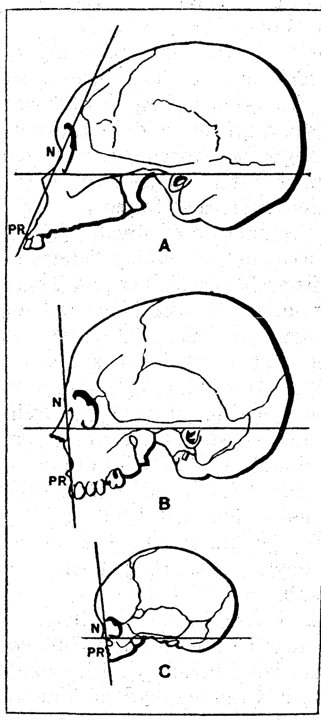


FIG. 4.—THE FACIAL ANGLE OF THE FRANKFORT AGREEMENT IS SHOWN IN THE CRANIA OF: A. A NEW GUINEA NATIVE (MALE) 75°; B. A EUROPEAN (WOMAN) 93°; C. A NEW BORN INFANT 93°

This ratio (of 75%) is termed the cephalic or breadth-index. A skull providing a breadth-index of 75 possesses different proportions from one with an index of 85.

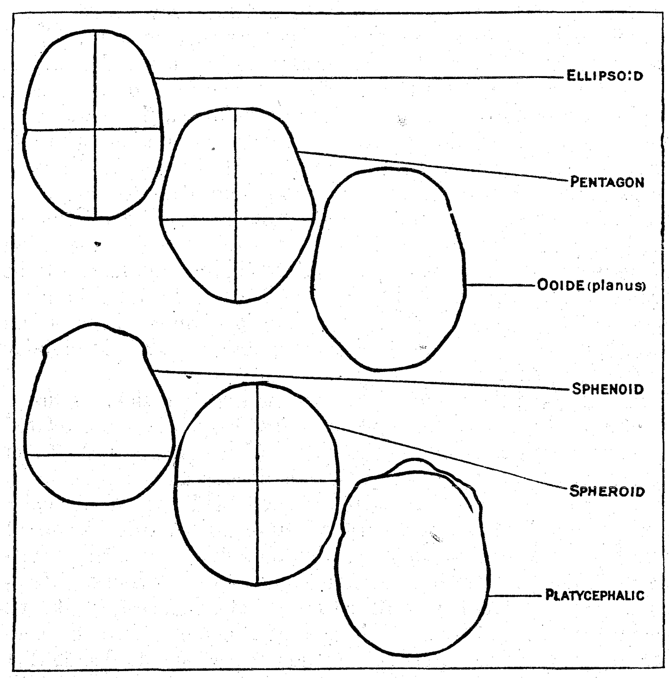
The fourth subdivision of craniometry deals with the comparison of the prehistoric and the recent types of mankind. The methods resemble those employed in the comparison of living races; but in some particular instances where the prehistoric individual is represented only by a comparatively minute portion of the skull, special modifications of the usual procedures are needed.

The complexity of craniometric studies has inevitably increased. International agreements for the unification of the various measurements have been established, and the application of the methods of statistical science in dealing with large numbers of craniometric data has been greatly developed. (*See* ANTHROPOMETRY.) These systems of measurement, and the methods of dealing with them on statistical principles have been extended to the study of large numbers of the skulls of domestic and feral animals, such as white rats or the varieties of the horse. In 1927 an international committee of anatomists was organized to collect accurate information about the variations of human structure and the different races of mankind. These investigations will surely yield material of the highest value.

BIBLIOGRAPHY.—W. L. H. Duckworth, *International Agreements for the Unification (a) of Craniometric and cephalometric measurements (b) of Anthropometric measurements to be made on the living subject* (1913); H. H. Wilder, *A Laboratory Manual of Anthropometry* (1921); and *Pedigree of the Human Race,* n.d.; Sir Arthur Keith, *The Antiquity of Man* (1925).

CRANK. In mechanics, a crank is a device by which reciprocating motion is converted into circular motion or vice versa, consisting of a crank-arm, one end of which is fastened rigidly at right angles to the rotating shaft or axis, while the other end bears a crank-pin projecting from it at right angles and parallel to the shaft. When the reciprocating part of a machine, as the piston and piston-rod of a steam engine, is linked to this crank by a crank-rod or connecting rod, one end of which works on the crank-pin and the other on a pin in the end of the reciprocating part, the to-and-fro motion of the latter imparts a circular motion to the shaft and vice versa. The crank, instead of being made up as described above, may be formed by bending the shaft to the required shape, as sometimes in the handle of a winch. A bell-crank, so called because of its original use in bell-hanging to change the direction of motion of the wires from horizontal to vertical or vice versa, consists of two arms rigidly connected at an angle, say of 90°, to each other and pivoted on a pin placed at the point of junction.

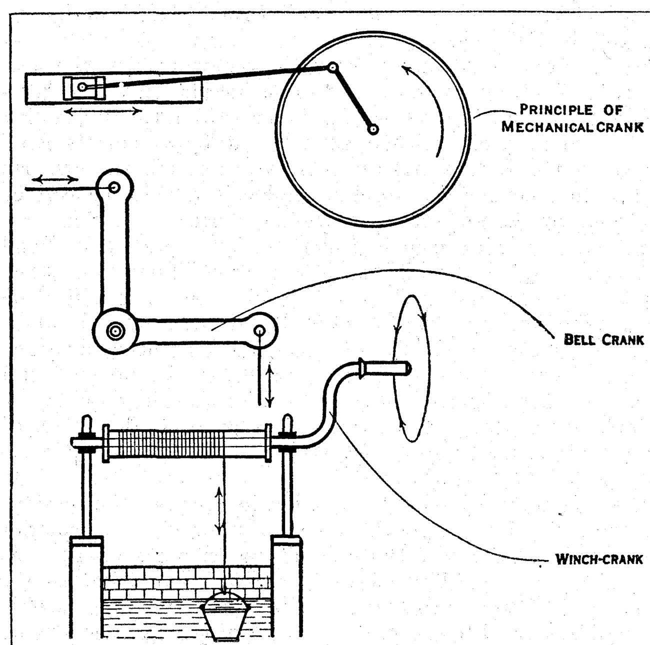
Crank is also the name given to a labour machine once used in prison as a means of punishment (*see* TREADMILL). Other uses



FROM SERGI, "THE VARIETIES OF THE HUMAN SPECIES" (SMITHSONIAN INSTITUTION)

FIG. 5.—SKULLS ARE ACCURATELY CLASSIFIED BY A SCIENTIFIC COMPARISON OF CERTAIN DIMENSIONS OF THE CRANIUM, AND SIX DISTINCT TYPE FORMS, AS SHOWN ABOVE, ARE FOUND

of the word, connected with the primary meaning, are for a crooked path, a crevice or chink, and a freakish turn of thought or speech, as in Milton's phrase "quips and cranks." It is also used



MECHANICAL, BELL AND WINCH CRANKS SHOWING HOW CHANGE OF APPLIED FORCE IS EFFECTED. AS IN THE MECHANICAL CRANK, HORIZONTAL MOVEMENT IS CONVERTED INTO CIRCULAR; IN THE BELL CRANK, VERTICAL BECOMES HORIZONTAL, AND IN THE WINCH CRANK, CIRCULAR MOVEMENT IS CHANGED INTO VERTICAL

as a slang expression, American in origin, for a harmless lunatic, or a faddist, whose enthusiasm for some one idea or hobby becomes a monomania. "Crank" or "crank-sided" is a nautical term used of a ship which by reason of her build or from want of balance is liable to overturn.

CRANMER, THOMAS (1489–1556), archbishop of Canterbury, born at Aslacton or Aslockton in Nottinghamshire on July 2, 1489, was the second son of Thomas Cranmer and of his wife Anne Hatfield. He received his early education, according to Morise his secretary, from "a marvellous severe and cruel schoolmaster." The same authority tells us that he was initiated by his father in those field sports, such as hunting and hawking, which formed one of his recreations in after life. To early training he also owed the skilful horsemanship for which he was conspicuous. At the age of 14 he was sent by his mother, who had in 1501 become a widow, to Cambridge. He became a fellow of Jesus college in 1510 or 1511, but had soon after to vacate his fellowship, owing to his marriage to "Black Joan," a relative of the landlady of the Dolphin inn. He was reinstated on the death of his wife, which occurred in childbirth before the lapse of the year of grace allowed by the statutes. He was ordained in 1523, and soon after took his doctor's degree in divinity; he was lecturer in divinity at his own college and public examiner in divinity to the university.

In Aug. 1529 the plague known as the sweating sickness drove Cranmer with two of his pupils named Cressy, who were related to him through their mother, to their father's house at Waltham in Essex. The king (Henry VIII.) happened at the time to be visiting in the immediate neighbourhood, and two of his chief counsellors, Gardiner, secretary of State, afterwards bishop of Winchester, and Edward Fox, the lord high almoner, afterwards bishop of Hereford, were lodged at Cressy's house. Meeting with Cranmer, they were naturally led to discuss the king's meditated divorce from Catherine of Aragon. Cranmer suggested that if the canonists and the universities should decide that marriage with a deceased brother's widow was illegal, and if it were proved that Catherine had been married to Prince Arthur, her marriage to Henry could be declared null and void by the ordinary ecclesiastical courts. The necessity of an appeal to Rome was thus dispensed with, and this point was at once seen by the king, who, when Cranmer's opinion was reported to him, is said to have ordered him to be summoned in these terms: "I will speak to him. Let him be sent for out of hand. This man, I trow, has got the right sow by the ear."

At their first interview Cranmer was commanded by the king to lay aside all other pursuits and to devote himself to the question of the divorce. He was to draw up a written treatise, stating the course he proposed, and defending it by arguments from Scripture, the Fathers and the decrees of general councils. He was further commended to Anne Boleyn's father, the earl of Wiltshire, in whose house at Durham Place he resided for some time; the king appointed him archdeacon of Taunton and one of his chaplains; and he also held a parochial benefice. When the treatise was finished Cranmer was called upon to defend its argument before the universities of Oxford and Cambridge, which he visited, accompanied by Fox and Gardiner. Immediately afterwards he was sent to plead the cause before a more powerful if not a higher tribunal. An embassy, with the earl of Wiltshire at its head, was despatched to Rome in 1530, that "the matter of the divorce should be disputed and ventilated," and Cranmer was an important member of it.

Cranmer returned in Sept. 1530, but in Jan. 1531 he received a second commission from the king appointing him "Conciliarius Regius et ad Caesarem Orator." In the summer of 1531 he accordingly proceeded to Germany as sole ambassador to the emperor. He was also to sound the Lutheran princes with a view to an alliance, and to obtain the removal of some restrictions on English trade. At Nuremberg he became acquainted with Osiander, whose somewhat isolated theological position he probably found to be in many points analogous to his own. Both were convinced that the old order must change; neither saw clearly what the new order should be to which it was to give place. They had frequent interviews, which had doubtless an important influence on Cranmer's opinions. In 1532 Cranmer married Osiander's niece, Margaret. Hook finds in the fact of the marriage corroboration of Cranmer's statement that he never expected or desired the primacy; and it seems probable enough that, if he had foreseen how soon the primacy was to be forced upon him, he would have avoided a disqualification which it was difficult to conceal and dangerous to disclose.

Expected or not, the primacy was forced upon him within a very few months of his marriage. In Aug. 1532 Archbishop Warham died, and the king almost immediately afterwards intimated to Cranmer, who had accompanied the emperor in his campaign against the Turks, his nomination to the vacant see. Cranmer's conduct was certainly consistent with his profession that he did not desire, as he had not expected, the dangerous promotion. The papal bulls of confirmation were dated Feb. and Mar. 1533, and the consecration took place on Mar. 30.

In the last as in the first step of Cranmer's promotion Henry had been actuated by one and the same motive. The business of the divorce—or rather, of the legitimation of Anne Boleyn's expected issue—had now become very urgent, and in the new archbishop he had an agent who might be expected to forward it with the needful haste. Cranmer after securing decisions favourable to the king in Convocation wrote a letter to the king, praying to be allowed to remove the anxiety of loyal subjects as to a possible case of disputed succession, by finally determining the validity of the marriage in his archiepiscopal court. There is evidence that the request was prompted by the king, and his consent was given as a matter of course. Queen Catherine was residing at Ampthill in Bedfordshire, and to suit her convenience the court was held at the priory of Dunstable. Declining to appear, she was declared contumacious, and on May 23, the archbishop gave judgment declaring the marriage null and void from the first. The Act of Appeals had already prohibited any appeal from the archbishop's court. Five days later he pronounced the marriage between Henry and Anne—which had been secretly celebrated about Jan. 25, 1533—to be valid. On June 1 he crowned Anne as queen, and on Sept. 10 stood godfather to her child, the future Queen Elizabeth.

In 1536 Cranmer was required to revise his own sentence in favour of the validity of Henry's marriage with Anne Boleyn, and on May 17, the marriage was declared invalid. With Anne's condemnation by the House of Lords Cranmer had nothing to do. He interceded for her in vain with the king, as he had done in the cases of Fisher, More and the monks of Christchurch. His share in the divorce of Anne of Cleves was less prominent than that of Gardiner, though he did preside over the Convocation in which nearly all the dignitaries of the church signified their approval of that measure.

Meanwhile Cranmer was actively carrying out the policy which has associated his name more closely, perhaps, than that of any other ecclesiastic with the Reformation in England. Its most important feature on the theological as distinct from the political side was the endeavour to promote the circulation of the Bible in the vernacular, by encouraging translation and procuring an order in 1538 that a copy of the Bible in English should be set up in every church in a convenient place for reading. Only second in importance to this was the readjustment of the creed and liturgy of the church, which formed Cranmer's principal work during the latter half of his life. Both in parliament and in the convocation he opposed the Six Articles of 1539, but he stood almost alone. During the period between 1540 and 1543 the archbishop was engaged at the head of a commission in the revision of the "Bishop's Book" (1537) or *Institutions of a Christian Man*, and the preparation of the *Necessary Erudition* (1543) known as the "King's Book," which was a modification of the former work in the direction of Roman Catholic doctrine. In June 1545 was issued his Litany, which was substantially the same as that now in use, and shows his mastery of a rhythmical English style.

Cranmer was present with Henry VIII. when he died (1547). By the will of the king he was nominated one of a council of regency composed of 16 persons, but he acquiesced in the arrangement by which Somerset became lord protector. He officiated at the coronation of the boy king Edward VI., and is supposed to have instituted a sinister change in the order of the ceremony, by which the right of the monarch to reign was made to appear to depend upon inheritance alone, without the concurrent consent of the people. But Edward's title had been expressly sanctioned by act of parliament, so that there was no more room for election in his case than in that of George I., and the real motive of the changes was to shorten the weary ceremony for the frail child.

During this reign Cranmer was enabled without let or hindrance to complete the preparation of the church formularies, on which he had been for some time engaged. In 1547 appeared the *Homilies* prepared under his direction. Four of them are attributed to the archbishop himself—those on salvation, faith, good works and the reading of scripture. His translation of the German catechism of Justus Jonas, known as Cranmer's catechism, appeared in the following year. Important, as showing his views on a cardinal doctrine, was the *Defence of the True and Catholic Doctrine of the Sacrament,* which he published in 1550. The first prayer book of Edward VI. was finished in November 1548, and received legal sanction in March 1549; the second was completed and sanctioned in April 1552. The archbishop did much of the work of compilation personally. The 42 articles of Edward VI. published in 1553 owe their form and style almost entirely to the hand of Cranmer. The last great undertaking in which he was employed was the revision of his codification of the canon law, which had been all but completed before the death of Henry. The task was one eminently well suited to his powers, and the execution of it was marked by great skill in definition and arrangement. It never received any authoritative sanction, Edward VI. dying before the proclamation establishing it could be made, and it remained unpublished until 1571, when a Latin translation by Dr. Walter Haddon and Sir John Cheke appeared under the title *Reformatio legum ecclesiasticarum.* It laid down the lawfulness and necessity of persecution to the death for heresy in the most absolute terms; and Cranmer himself condemned Joan Bocher to the flames. But he naturally loathed persecution, and was as tolerant as any in that age.

Cranmer stood by the dying bed of Edward as he had stood by that of his father, and he there suffered himself to be persuaded to take a step against his own convictions. He had pledged himself to respect the testamentary disposition of Henry VIII. by which the succession devolved upon Mary, and now he violated his oath by signing Edward's "device" of the crown to Lady Jane Grey. On grounds of policy and morality alike the act was quite indefensible; but it is perhaps some palliation of his perjury that it was committed to satisfy the last urgent wish of a dying man, and that he alone remained true to the nine days' queen when the others who had with him signed Edward's device deserted her.

On the accession of Mary he was summoned to the council—most of whom had signed the same device—reprimanded for his conduct, and ordered to confine himself to his palace at Lambeth until the queen's pleasure was known. He refused to follow the advice of his friends and avoid the fate that was clearly impending over him by flight to the continent. Any chance of safety that lay in the friendliness of a strong party in the council was more than nullified by the bitter personal enmity of the queen, who could not forgive his share in her mother's divorce and her own disgrace. On Sept. 14, 1553, he was sent to the Tower where Ridley and Latimer were also confined. The immediate occasion of his imprisonment was a strongly worded declaration he had written a few days previously against the mass, the celebration of which, he heard, had been re-established at Canterbury. In Nov. with Lady Jane Grey, her husband, and two other Dudleys, Cranmer was condemned for treason. Renard thought he would be executed, but so true a Romanist as Mary could scarcely have an ecclesiastic put to death in consequence of a sentence by a secular court, and Cranmer was reserved for treatment as a heretic by the highest of clerical tribunals, which could not act until parliament had restored the papal jurisdiction. Accordingly in March 1554 he and his two illustrious fellow-prisoners, Ridley and Latimer, were removed to Oxford, where they were confined in the bocardo or common prison. Ridley and Latimer were unflinching, and suffered bravely at the stake on Oct. 16, 1555. Cranmer had been tried by a papal commission, over which Bishop Brooks of Gloucester presided in Sept. 1555. Brooks had no power to give sentence, but reported to Rome, where Cranmer was summoned, but not permitted, to attend. On Nov. 25, he was pronounced contumacious by the pope and excommunicated, and a commission was sent to England to degrade him from his office of archbishop. This was done with the usual humiliating ceremonies in Christ church, Oxford, on Feb. 14, 1556, and he was then handed over to the secular power. About the same time Cranmer subscribed the first two of his "recantations." His difficulty consisted in the fact that, like all Anglicans of the 16th century, he recognized no right of private judgment, but believed that the State, as represented by monarchy, parliament and Convocation, had an absolute right to determine the national faith and to impose it on every Englishman. All these authorities had now legally established Roman Catholicism as the national faith, and Cranmer had no logical ground on which to resist. His early "recantations" are merely recognitions of his lifelong conviction of this right of the State. But his dilemma on this point led him into further doubts, and he was eventually induced to revile his whole career and the Reformation. This is what the government wanted. Northumberland's recantation had done much to discredit the Reformation, Cranmer's, it was hoped, would complete the work. Hence the enormous effect of Cranmer's recovery at the final scene. On Mar. 21 he was taken to St. Mary's church, and asked to repeat his recantation in the hearing of the people as he had promised. To the surprise of all he declared with dignity and emphasis that what he had recently done troubled him more than anything he ever did or said in his whole life; that he renounced and refused all his recantations as things written with his hand, contrary to the truth which he thought in his heart; and that as his hand had offended, his hand should be first burned when he came to the fire. As he had said, his right hand was steadfastly exposed to the flames. The calm cheerfulness and resolution with which he met his fate show that he felt that he had cleared his conscience, and that his recantation of his recantations was a repentance that needed not to be repented of.

It was a noble end to what, in spite of its besetting sin of infirmity of moral purpose, was a not ignoble life. The key to his character is well given in what Hooper said of him in a letter to Bullinger, that he was "too fearful about what might happen to him." This weakness was the worst blot on Cranmer's character. As a theologian it is somewhat difficult to class him. As early as 1538 he had repudiated the doctrine of transubstantiation; by 1550 he had rejected also the real presence (Pref. to his *Answer to Dr. Richard Smith*). But here he used the term "real" somewhat unguardedly, for in his *Defence* he asserts a real presence, but defines it as exclusively a spiritual presence; and he repudiates the idea that the bread and wine were "bare tokens." His views on church polity were dominated by his implicit belief in the divine right of kings (not of course the divine *hereditary* right of kings) which the Anglicans felt it necessary to set up against the divine right of popes. He set practically no limits to the ecclesiastical authority of kings; they were as fully the representatives of the church as the State, and Cranmer hardly distinguished between the two. Church and State to him were one.

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CRANNOG, the term applied in Scotland and Ireland to the stockaded islands so numerous in ancient times in the lochs of both countries.

They have little in common, structurally, with the Swiss lake-dwellings, except that they are placed in lakes. Few examples are known in England or Wales, although over 150 have been examined in Ireland, and more than half that number in Scotland.

As a rule they have been constructed on islets or shallows in the lochs, which have been adapted for occupation, and fortified by single or double lines of stockaded defences drawn round the margin.

From their common feature of a substructure of brushwood and logs built up from the bottom, the crannogs have been classed as fascine-dwellings, to distinguish them from the typical pile-dwellings of the earlier periods in Switzerland, whose platforms are supported by piles driven into the bed of the lake. Among the few remains of lacustrine settlements in England and Wales, some are suggestive of the typical crannog structure. The most important of these is the Glastonbury lake village excavated by A. Bulleid and H. St. George Gray, and discovered by the first named antiquary in 1892. It consists of some 70 or more separate dwellings, grouped within a triangular palisaded defence, 3½ acres in extent, and built in the midst of a Somerset marsh now reclaimed. The substructure was formed of logs and brushwood, helped by masses of bracken, rush, peat and stone, covered with layers of clay. The dwellings were circular, 18 to 35ft. in diameter, the walls 6 to 7ft. in height made of wattle and daub, with supporting uprights arranged 12 to 18in. apart. The floors were of clay, with a raised circular area near the centre, sometimes paved for a hearth. Both floors and hearths were renewed from time to time on account of subsidence. As many as 13 superimposed hearths have been discovered in a single dwelling. In many huts the stump of the central post remained which had supported the roof, and in others the doorstep or entrance pavement. The occupation must be dated within the Iron Age, and is likely pre-Roman, as little evidence of contact with Roman civilization has been discovered. Besides the implements and weapons of iron there are finger rings, fibulae and brooches of bronze, weaving combs and spindle-whorls, a bronze mirror and tweezers, quantities of pottery chiefly hand-made ornamented with late Celtic patterns, a bowl of thin bronze decorated with bosses, portions of the nave of a wooden wheel with holes for 12 spokes and a dug-out canoe. In 1895 another lake village of similar date and construction was discovered near Meare, some three miles north-west of Glastonbury; the site is undergoing examination by the Somerset Archaeological Society and the relics discovered are exhibited at Taunton museum. The implements and weapons found in the Scottish and Irish crannogs are usually of iron, or, if objects of bronze and stone are found, they are commonly such as were in use in the Iron Age. Crannogs are frequently referred to in the Irish annals. In the register of the privy council of Scotland, April 14, 1608, it is ordered that "the haill houssis of defence, strongholds, and *crannokis* in the Yllis (the western isles) pertaining to Angus M'Conneill of Dunnyvaig and Hector M'Cloyne of Dowart sal be delyverit to His Majestie." Judging from the historical evidence of their late continuance, and from the character of the relics found in them, the crannogs may be included among the latest prehistoric strongholds, reaching their greatest development in early historic times, and surviving through the middle ages.

Little lake dwelling research has taken place in Ireland or Scotland since 1910. The excavation of Lochpaire Crannog near Tuam, Ireland (1914), and the investigation of the artificial island in Loch Kinellan, Strathpeffer, Scotland (1916), have been the chief explorations. (*See* LAKE DWELLINGS.)

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CRANSTON, a city of Providence county, Rhode Island, U.S.A., adjoining the city of Providence on the south; served by the New York, New Haven and Hartford railroad. The population in 1920 was 29,407, of whom 7,516 were foreign-born white (2,641 from Italy); and in 1940 federal census 47,085. Within its land area of 28.7 sq.mi. are a water front on Narragansett bay; farms, nurseries and market gardens; and several villages with important manufactures, including cotton print goods, winding machinery and automatic fire extinguishers. The total assessed valuation for 1940 was $76,175,800. In the southern part of the city is a state farm of 667 ac. (P.O. Howard), on which are several state institutions for the dependent and the delinquent and also the county jail.

Cranston was settled as a part of Providence about 1640 by associates of Roger Williams. It was incorporated as a separate town in 1754. In 1868, 1873 and 1892 portions of it were re-annexed to Providence. In 1910 it was chartered as a city. It was named after Samuel Cranston, governor of Rhode Island 1698–1727.

CRANTOR, a Greek philosopher of the Old Academy, was born, probably about the middle of the 4th century B.C., at Soli in Cilicia. He was the first commentator on Plato. He is said to have written some poems which he sealed up and deposited in the temple of Athens at Soli (Diog. Laërtius, iv. 5. 25). Of his celebrated work *On Grief* (Περὶ πένθους), a letter of condolence to his friend Hippocles on the death of his children, numerous extracts have been preserved in Plutarch's *Consolatio ad Apollonium* and in the *De consolatione* of Cicero, who speaks of it (*Acad.,* ii. 44. 135) in the highest terms. Crantor's ethical theory arranged "good" things in the following order—virtue, health, pleasure, riches.

See F. Kayser, *De Crantore Academico* (1841); M. H. E. Meier, *Opuscula academica,* ii. (1863); F. Susemihl, *Geschichte der griechischen Literatur in der Alexandrinerzeit,* i., p. 118 (1891).

CRANWORTH, ROBERT MONSEY ROLFE, BARON (1790–1868), lord chancellor of England, elder son of the Rev. E. Rolfe, was born at Cranworth, Norfolk, on Dec. 18, 1790. Educated at Bury St. Edmund's, Winchester, and Trinity College, Cambridge, he was called to the bar at Lincoln's Inn in 1816, and attached himself to the chancery courts. He represented Penryn and Falmouth in parliament from 1832 till his promotion to the bench as baron of the exchequer in 1839. In 1850 he was appointed a vice-chancellor and created Baron Cranworth, and in 1852 he became lord chancellor in Aberdeen's ministry. He continued to hold the chancellorship in the administration of Palmerston until the latter's resignation in 1857. He was not reappointed when Palmerston returned to office in 1859, but on the retirement of Lord Westbury in 1865 he accepted the great seal for a second time, and held it till the fall of the Russell administration in 1866. Cranworth died in London on July 26, 1868. His name is associated in the statute book with a measure of conveyancing. He left no issue and the barony became extinct on his death.

See E. Foss, *The Judges of England* (1848–64); *The Times* (July 27, 1868); E. Manson, *The Builders of our Law* (1904); J. B. Atlay, *Lives of the Chancellors,* vol. ii. (1908).

CRAPE, a silk fabric of a gauzy texture, having a peculiar crisp or crimpy appearance. It is woven of hard spun silk yarn "in the gum" or natural condition. There are two distinct varieties of the textile—soft, Canton or oriental, crape, and hard or crisped crape. The wavy appearance of Canton crape results from the peculiar manner in which the weft is prepared, the yarn from two bobbins being twisted together in the reverse way. The fabric when woven is smooth and even, having no *crêpé* appearance, but when the gum is subsequently extracted by boiling it at once becomes soft, and the weft, losing its twist, gives the fabric the waved structure which constitutes its distinguishing feature. Canton crapes are used, either white or coloured, for ladies' scarves and shawls, bonnet trimmings, etc. The Chinese and Japanese excel in the manufacture of soft crapes.

The crisp and elastic structure of hard crape is not produced either in the spinning or in the weaving, but is due to processes through which the gauze passes after it is woven. What the details of these processes are is known to only a few manufacturers, who so jealously guard their secret that, in some cases, the different stages in the manufacture are conducted in towns far removed from each other. Commercially they are distinguished as single, double, three-ply and four-ply crapes, according to the nature of the yarn used in their manufacture. They are almost exclusively dyed black and used in mourning dress, and among Roman Catholic communities for nuns' veils, etc. In Great Britain hard crapes are made at Braintree in Essex, Norwich, Yarmouth, Manchester and Glasgow. The crape formerly made at Norwich was made with a silk warp and worsted weft, and is said to have afterwards degenerated into bombazine. A very successful imitation of real crape is made in Manchester of cotton yarn.

CRASH. A technical textile term applied to a species of narrow towels, from 14 to 20in. wide. The name is probably of Russian origin, the simplest and coarsest type of the cloth being known as "Russian crash." The latter is made from grey flax or tow yarns, and sometimes from boiled yarns. The simple term "crash" is given to all these narrow cloths, but the above distinction is very convenient, as also are the following: grey, boiled, bleached, plain, twilled and fancy crash. A large variety obtains with and without fancy borders, while of late years cotton has been introduced as warp, as well as mixed and jute yarns for weft. After the cloth has passed through all the finishing operations, it is cut up into lengths of about three yds., the ends are sewn together and it is then ready to be placed over a suspended roller; for this reason it is often termed "roller towelling."

CRASHAW, RICHARD (1613?–1649), English poet, styled "the divine," was born in London about 1613. He was the son of a strongly anti-papistical divine, Dr. William Crashaw (1572–1626). Richard Crashaw was educated at Charterhouse, and at Pembroke college, Cambridge, where he took the degree of B.A. in 1634. The publication of Herbert's *Temple* in 1633 seems to have finally determined the bias of his genius in favour of religious poetry, and next year he published his first book, *Epigrammatum sacrorum liber,* a volume of Latin verses. In 1636 he removed to Peterhouse, was made a fellow of that college in 1637, and proceeded M.A. in 1638. About this time began his lasting friendship with Abraham Cowley. He was also on terms of intimacy with the Anglican monk Nicholas Ferrar, and frequently visited him at Little Gidding. In 1641 he is said to have gone to Oxford, but only for a short time; for when in 1643 Cowley left Cambridge to seek a refuge at Oxford, Crashaw remained behind, and was forcibly ejected from his fellowship in 1644. In the confusion of the civil wars he escaped to France, where he finally embraced the Catholic religion.

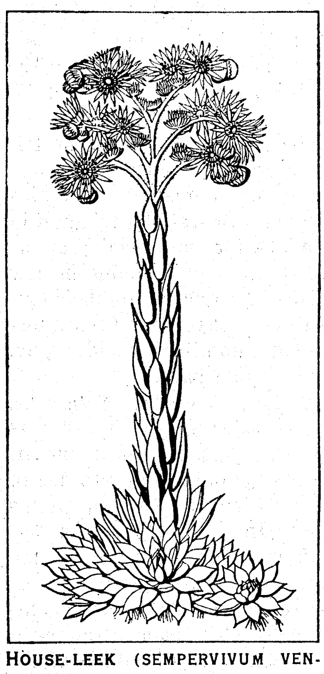
During his exile his religious and secular poems were collected by an anonymous friend, and published under the title of *Steps to the Temple* and *The Delights of the Muses,* in one volume, in 1646. The first part includes the hymn to St. Teresa and the version of Marini's *Sospetto d'Herode.* This same year Cowley found him in great destitution at Paris, and induced Queen Henrietta Maria to give him introductions in Rome, where he became attendant to Cardinal Palotta. In 1648 he published two Latin hymns at Paris. He remained until 1649 in the service of the cardinal, to whom he had a great personal attachment; but his retinue contained persons whose violent and licentious behaviour was a source of ceaseless vexation to the sensitive English mystic. He was sent by the cardinal in 1649 to Loretto, where he was made a canon of the Holy House. In less than three weeks, however, he sickened of fever, and died on Aug. 25, not without grave suspicion of having being poisoned. He was buried in the Lady chapel at Loretto. A collection of his religious poems, entitled *Carmen Deo nostro,* was brought out in Paris in 1652, dedicated to the countess of Denbigh. The book is illustrated by 13 engravings after Crashaw's own designs.

Crashaw excelled in all manner of graceful accomplishments; besides being an excellent Latinist and Hellenist, he had an intimate knowledge of Italian and Spanish; and his skill in music, painting and engraving was no less admired in his lifetime than his skill in poetry. Cowley embalmed his memory in a very fine elegy.

Crashaw's verse is studded with fiery beauties and sudden felicities of language, unsurpassed by any lyrist between his own time and Shelley's. There is no religious poetry in English so full at once of gross and awkward images and imaginative touches of the most ethereal beauty, and these peculiarities can be studied nowhere to more advantage than in the *Hymn to Saint Teresa.* Among the secular poems of Crashaw the best are *Music's Duel,* which deals with strife between the musician and the nightingale, and *Wishes to his supposed Mistress.* In his latest sacred poems, included in the *Carmen Deo nostro,* the mysticism has become more pronounced, and the ecclesiastical mannerism more harsh and repellent.

Crashaw's works were first collected, in one volume, in 1858, by W. B. Turnbull. In 1872 an edition, in 2 volumes, was printed for private subscription by the Rev. A. B. Grosart. A complete edition was edited (1904) for the Cambridge University Press by Mr. A. R. Waller. *See* also L. C Martin, *The Poems, English, Latin and Greek, of Richard Crashaw* (1927).

CRASSULACEAE, in botany, a family of dicotyledons, containing 33 genera and 1,400 species; of cosmopolitan distribution, but most developed in South Africa. The plants are herbs or small shrubs, generally with thick fleshy stems and leaves, adapted for life in dry, especially rocky places. The fleshy leaves are often reduced to a more or less cylindrical structure, as in the stonecrops (*Sedum*), or form closely crowded rosettes as in the houseleek (*Sempervivum*). Correlated with their life in dry situations, the bulk of the tissue is succulent, forming a water-store, which is protected from loss by evaporation by a thickly cuticularized epidermis covered with a waxy secretion which gives a glaucous appearance to the plant. The flowers are generally arranged in terminal or axillary clusters, and are markedly regular with the same number of parts in each series. This number is, however, very variable, and often not constant in one and the same species. The sepals and petals are free or more or less united, the stamens as many or twice as many as the petals; the carpels, usually free, are equal to the petals in number, and form in the fruit follicles with two or more seeds. The means of vegetative propagation are general. Many species spread by means of a creeping much-branched rootstock or, as in house-leek, by runners that perish after producing a terminal leaf-rosette. In other cases small portions of the stem or leaves give rise to new plants by budding, as in *Bryophyllum,* where buds develop at the edges of the leaf and form new plants.



HOUSE-LEEK (SEMPERVIVUM VENUSTUM), SHOWING BASAL ROSETTE OF SUCCULENT LEAVES; NATIVE TO SOUTH AFRICA AND CULTIVATED FOR ITS SHOWY FLOWERS

The family is almost absent from Australia and Polynesia, and has but few representatives in South America; it is otherwise generally distributed. The largest genus, *Sedum,* contains about 200 species in the temperate and colder parts of the northern hemisphere; nine occur wild in Britain, including *S. Telephium* (orpine) and *S. acre* (common stonecrop). The species are very easily cultivated and will thrive in almost any soil. *Crassula* has about 150 species, chiefly at the Cape. *Cotyledon,* a widely distributed genus with about 100 species, is represented in the British Isles by *C. umbilicus,* pennywort, or navelwort, which takes its name from the succulent peltate leaves. It grows profusely on dry rocks and walls, especially on the western coasts, and bears a spike of drooping greenish cup-shaped flowers. The *Echeveria* of gardens is included in this genus. *Sempervivum* has about 50 species in the mountains of central and southern Europe, in the Himalayas, Abyssinia and the Canaries and Madeira; *S. tectorum,* common house-leek, is seen often growing on tops of walls and house-roofs. The hardy species will grow well in dry sandy soil, and are suitable for rockeries, old walls or edgings.

In North America some 40 representatives of the family are found, most numerous from the Rocky Mountains westward, 20 occurring in California, mostly species of *Sedum* and *Cotyledon*.

The family is closely allied to Saxifragaceae, from which it is distinguished by its fleshy habit and the larger number of carpels.

See A. Berger, *Crassulaceae;* Engler and Prantl, *Die Natürlichen Pflanzenfamilien* 18a:352–483, fig. 183–212 (1930).

CRASSUS (literally "dense," "thick," "fat"), a family name in the Roman gens Licinia (plebeian).

1. Publius Licinius Crassus, surnamed *Dives Mucianus,* Roman statesman, orator and jurist, consul, 131 B.C. A friend of Tiberius Gracchus, he was chosen after his death to take his place on the agrarian commission (*see* Gracchus, Tiberius Sempronius [163–133 B.C.]). In 131 when Crassus was consul with L. Valerius Flaccus, Aristonicus, a pretender, laid claim to Pergamum, which had been bequeathed by Attalus III to Rome. Both consuls were anxious to obtain the command against him; Crassus secured it, despite the rule which forbade him, as pontifex maximus, to leave Italy. Nothing is known of his military operations. But in the following year, when he was preparing to return, he was surprised near Leucae, and taken prisoner by a Thracian band and put to death.

See Cicero, *De oratore,* i. 50; *Philippics,* xi. 8; Plutarch, *Tib. Gracchus,* 21; Livy, *Epit.* 59; Val. Max. iii. 2. 12, viii. 7. 6; Vell. Pat. ii. 4; Justin xxxvi. 4; Orosius v. 10.

2. Lucius Licinius Crassus (140–91 B.C.), the orator, of unknown parentage. At the age of 19 (or 21) he made his reputation by a speech against G. Papirius Carbo, the friend of the Gracchi. The law passed by him and his colleague Q. Mucius Scaevola, during their consulship (95), to prevent those passing as Roman citizens who had no right to the title, was one of the prime causes of the Social War (Cicero, *Pro Balbo,* xxi., *De Officiis,* iii. 11). During his censorship Crassus suppressed the newly founded schools of Latin rhetoricians (Aulus Gellius xv. 11). Crassus is one of the chief speakers in the *De Oratore* of Cicero, who has also preserved a few fragments of his speeches.

3. Publius Licinius Crassus, called Dives, father of the triumvir. During his consulship (97) the practice of magic arts was condemned by a decree of the senate, and human sacrifice was abolished. He was governor of Spain and celebrated a triumph in 93 for successes over the Lusitanians. After the Social War, as censor with L. Julius Caesar, he had the task of enrolling in new tribes certain of the Latins and Italians as a reward for their loyalty to the Romans, but the proceedings seem to have been interrupted by certain irregularities. Crassus committed suicide in 87, to avoid falling into the hands of the Marian party.

See Plutarch, *Crassus,* 4; Aulus Gellius ii. 24; Macrobius, *Saturnalia,* ii. 13; Livy, *Epit.* 80; Pliny, *Nat. Hist.* xxx. 3; Appian, *Bell. Civ. i.* 72

4. Marcus Licinius Crassus (*c.* 115–53 B.C.), the triumvir, Roman financier. Cinna's proscription (87) obliged him to flee to Spain, but he returned to Italy with Sulla, and was one of his officers during the campaign of 83–82. In the proscriptions that followed he laid the foundation of his immense wealth by buying at nominal prices the confiscated estates of the proscribed. This fortune he increased by traffic in slaves, usury and other means, until he became the richest man in Rome. The power of the purse made him a force to be reckoned with in the corrupt politics of the day. In 71, when praetor, he was given the command against Spartacus, and succeeded in crushing the revolt which had kept Italy in terror for three years. Pompey, wishing to coerce the senate, now made a pact with Crassus, and the two, by exerting their influence with knights and people, were elected consuls for 70. But their relations soon became strained, and in 67, when Pompey left Rome, a pact was made between Crassus and Caesar, the object of which was to counteract the influence of Pompey. It is likely that they were behind the conspiracy of Autronius (66–65), and the early plans of Catiline (*q.v.*), whose candidature they supported in 64. In 65 Crassus was censor, but resigned owing to quarrels with his colleague. In 60, the refusal of the senate to ratify Pompey's Eastern settlement brought about the coalition between Caesar, Pompey and Crassus known as the First Triumvirate. After Caesar's departure for Gaul, Crassus remained in Rome, and the jealousy between him and Pompey seems to have broken out afresh. But at the conference of Luca (56) Caesar managed to compose their differences; and in 55 Pompey and Crassus became consuls once more, and a law was passed assigning them the provinces of Spain and Syria respectively for five years. In November, Crassus, greedy of wealth, and jealous of Pompey's military renown, set out for the East, determined to make war on the Parthians, although they had given Rome no provocation. He spent the summer of 54 in ravaging Mesopotamia; next year, after wintering in Syria, and plundering the temple at Jerusalem, he invaded Parthia once more; his army was destroyed at Carrhae and Crassus himself captured and put to death. The defeat of Crassus, in a war which he had provoked, forced upon Rome the Parthian question which was to trouble her for many years to come; his death left his two colleagues face to face, and hastened the inevitable conflict for the mastery of the empire.

See Plutarch, *Crassus;* also Caesar, Gaius Julius; Pompey; Rome, *Ancient History.*

CRATER, the cavity at the mouth of a volcanic duct, usually funnel-shaped or presenting the form of a bowl, whence the name, from the Gr. κρατήρ, a bowl. (*See* Volcano.) Also the cavity in the carbon (or electrode) of an arc light. When an alternating current is employed, a crater is formed in both electrodes.

CRATER MOUND (long known as Coon Butte), perhaps the most mysterious geological feature in western United States, is located about 10m. S. of Sunshine, Arizona. Viewed from a distance, the mound appears as a low ridge, but on near approach this ridge is found to be circular and to enclose a great hole 4,000ft. in diameter and 600ft. deep. The encircling ridge is from 100 to 150ft. high, and consists of loose fragments of rock and sand, evidently blown out of the hole. The cause of this great hole has not been satisfactorily determined. Several geologists believe that it was made by a great meteor, but no evidences were revealed by the tests made. Others suggest that it is due to an explosion of steam from volcanic sources below. The latter theory would account for the somewhat upturned and broken strata of the rim.

CRATERS OF THE MOON NATIONAL MONUMENT, a tract of about 39 sq.m. in south-central Idaho, U.S.A., set apart in 1924 as a Government reservation. It is a region of cones and craters formed by volcanoes which have probably been extinct for only a few centuries, and the name of the reservation was suggested by its resemblance to the surface of the moon. While the black lava and cinders allow only the scantiest flora and quickly absorb the very light rainfall, water is to be found in tunnels which were formed by eruptions through a partly formed crust. Lava stalactites and stalagmites in red and blue are striking features of these tunnels.

CRATES, Athenian actor and author of comedies, flourished about 470 B.C. He was regarded as the founder of Greek comedy proper, since he abandoned political lampoons on individuals and introduced more general subjects and a well-developed plot (Aristotle, *Poëtica,* 5). He is stated to have been the first to represent the drunkard on the stage (Aristophanes, *Knights,* 37 ff.).

Fragments in Meineke, *Poëtarum Comicorum Graecorum fragmenta,* i.

CRATES, the name of two Greek philosophers.

1. Crates, of Athens, successor of Polemo as leader of the Old Academy.

2. Crates, of Thebes, a Cynic philosopher of the latter half of the 4th century B.C. He was the pupil of Diogenes, and the last great representative of cynicism. He gave up his fortune in accordance with Cynic principles, and devoted his life to the attainment of virtue and the teaching of self-control. He married Hipparchia, of a wealthy Thracian family, against her father's wishes. He seems to have lived into the third century. According to Diogenes Laërtius, he was the author of a number of letters on philosophical subjects; but those extant under the name of Crates (R. Hercher, *Epistolographi Graeci,* 1873) are spurious. Diogenes Laërtius credits him with a short poem, Παίγνια, and several

philosophic tragedies. Plutarch's life of Crates is lost. The great importance of Crates' work is that he formed the link between Cynicism and the Stoics, Zeno of Citium being his pupil.

See N. Postumus, *De Cratete Cynico* (1823); F. Mullach, *Frag. Philosophorum Graecorum,* ii. (1867); E. Wellmann in Ersch and Gruber's *Allgemeine Encyklopädie;* Diog. Laërt. vi. 85–93, 96–98.

CRATES, of Mallus in Cilicia, a Greek grammarian and Stoic philosopher of the 2nd century B.C., leader of the literary school and head of the library of Pergamum. He was the chief representative of the allegorical theory of exegesis, and maintained that Homer intended to express scientific or philosophical truths in the form of poetry. About 170 B.C., he visited Rome as ambassador of Attalus II., king of Pergamum, where he delivered lectures which gave the first impulse to the study of grammar and criticism among the Romans (Suetonius, *De grammaticis,* 2). His chief work was a critical and exegetical commentary on Homer.

See C. Wachsmuth, *De Cratete Mallota* (1860), containing an account of the life, pupils and writings of Crates; J. E. Sandys, *Hist. of Class. Schol.* i. 156 (1906).

CRATINUS (Gr. *kră-tē-nŏs*) (*c.* 520–423 B.C.), Athenian dramatist, chief representative of the old comedy. Hardly anything is known of his life, and only fragments of his works have been preserved. But a good idea of their character can be gained from the opinions of his contemporaries, especially Aristophanes. His comedies were notable for their vigorous political satire, a marked exception being the burlesque Ὀδυσσεῖς, probably written while a law was in force forbidding all political references on the stage. Persius calls the author "the bold," as in the *Nemesis* and *Archilochi,* he attacks Pericles, then at the height of his power. The *Panoptae* was a satire on the sophists and speculative philosophers of the day. Of his last comedy the plot has come down to us. Aristophanes and others taunted him with being a doting drunkard. Cratinus was roused to put forth all his strength, and in 423 B.C. produced the Πυτίνη, or *Bottle,* which defeated the *Clouds* of Aristophanes. In this comedy, Cratinus represents the comic muse as the faithful wife of his youth. His guilty fondness for a rival—the bottle—has aroused her jealousy. She demands a divorce from the archon; but her husband returns penitent to her side. In Grenfell and Hunt's *Oxyrhynchus Papyri,* iv. (1904), containing a further instalment of their edition of the Behnesa papyri discovered by them in 1896–97, is the argument of a play by Cratinus—the *Dionysalexandros* (*i.e.,* Dionysus in the part of Paris), aimed against Pericles. The style of Cratinus has been likened to that of Aeschylus; and Aristophanes, in the *Knights,* compares him to a rushing torrent. According to the statement of a doubtful authority, which is not borne out by Aristotle, Cratinus increased the number of actors in comedy to three. He wrote 21 comedies and gained the prize nine times.

BIBLIOGRAPHY.—Fragments in Meineke, *Fragmenta Comicorum Graecorum,* or Kock, *Comicorum Atticorum fragmenta.* A younger Cratinus flourished in the time of Alexander the Great. It is considered that some of the comedies ascribed to the elder Cratinus were really the work of the younger. *See* G. Thieme, *Quaestionum Comicarum ad Periclem pertinentium, Capita Tria* (1908).

CRATIPPUS (fl. *c.* 375 B.C.), Greek historian. There are only three or four references to him in ancient literature, but he has been identified by several scholars (*e.g.* Blass) with the author of the historical fragment discovered by Grenfell and Hunt, and published by them in *Oxyrhynchus Papyri,* vol. v. It may be regarded as a fairly certain inference from a passage in Plutarch (*De Gloria Atheniensium,* p. 345 E, ed. Bernardakis, ii. p. 455) that he was an Athenian writer, intermediate in date between Thucydides and Xenophon, and that his work continued the narrative of Thucydides, from the point at which the latter historian stopped (410 B.C.) down to the battle of Cnidus (394 B.C.).

The fragments are published in C. Müller's *Fragmenta Historicorum Graecorum.* For authorities *see* under THEOPOMPUS.

CRATIPPUS, of Mitylene (1st century B.C.), Peripatetic philosopher, contemporary with Cicero, whose son he taught at Athens, and by whom he is praised in the *De officiis* as the greatest of his school. He shared Pompey's flight after Pharsalia. Brutus, while at Athens, after the assassination of Caesar, attended his lectures. The freedom of Rome was conferred upon him by Caesar, at the request of Cicero. In 44 B.C. the Areopagus invited him to succeed Andronicus of Rhodes as scholarch. He seems to have held that, while motion, sense and appetite cannot exist apart from the body, thought reaches its greatest power when most free from bodily influence, and that divination is due to the direct action of the divine mind on that faculty of the human soul which is not dependent on the body. A work on divination is attributed to him.

Cicero, *De divinatione,* i. 3, 32, 50, ii. 48, 52; *De officiis,* i. 1, iii. 2; Plutarch, *Cicero,* 24.

CRAU, a region of southern France, in the department of Bouches-du-Rhône, lying east of the eastern arm of the Rhône between the chain of the Alpines and the Mediterranean, west and northwest of the Étang de Berre. It is a low-lying plain, about 80 sq.mi. in area, practically desert. Its surface is formed of pebbles (whence the name, from a Celtic root meaning "stone") of all sizes; these, mixed with a proportion of fine soil, overlie a subsoil of stones cemented into a hard mass by deposits of calcareous mud, beneath which lie loose stones, once the sea bed. Naturally sterile, the Crau is adapted for agriculture by the process of warping, carried out by means of the Canal de Craponne, which dates from the 16th century; about one-quarter of the region in the north and east has thus been covered by the rich deposits of the waters of the Durance, to which the Crau is said to owe its natural surface. Land which before supplied only rough pasture for sheep has thus been made to grow the vine and olive; where irrigation is practicable, water meadows have been formed. In the uncultivated parts the mirage is said to occur.

CRAUCK, GUSTAVE (1827–1905), French sculptor, was born and died at Valenciennes, where a special museum for his works was erected in his honour. At Paris his "Coligny" monument is in the rue de Rivoli, his "Victory" in the Place des Arts et Métiers, and "Twilight" in the Avenue de l'Observatoire. Among his finest works is his "Combat du Centaure," on which he was engaged for 30 years, the figure of the Lapith having been modelled after the athlete, Eugene Sandow.

CRAUFURD, QUINTIN (1743–1819), British author, was born at Kilwinning and entered the service of the East India Company. Returning to Europe before the age of 40, he settled in Paris, where he formed a good library and collection of paintings, coins, and other objects of antiquarian interest. Craufurd was on intimate terms with the French court, especially with Marie Antoinette, and was one of those who arranged the flight to Varennes. He escaped to Brussels, but in 1792 he returned to Paris in the hope of rescuing the royal prisoners. He lived among the French *émigrés* until the peace of Amiens made it possible to return to Paris. Through Talleyrand's influence he was able to remain in Paris after the war was renewed, and he died there on Nov. 23 1819.

BIBLIOGRAPHY.—Among his works are *The History, Religion, Learning, and Manners of the Hindus* (1790), *History of the Bastille* (1798), *Secret History of the King of France and his Escape from Paris* (first published in 1885), *Notice sur Marie Antoinette* (1809).

CRAUFURD, ROBERT (1764–1812), British major-general, one of the quickest and most brilliant of Wellington's lieutenants in the Peninsular War, was born at Newark, Ayrshire, on May 5, 1764, and entered the 25th Foot in 1779. He saw service in the campaigns against Tippoo Sahib (1790–92); with the Austrian armies in 1793; in 1797 with Lake in the suppression of the Irish rising of that year; as British commissioner at Russian headquarters in Suvórov's Swiss campaign 1799; and in the Buenos Aires expedition of 1807. Craufurd held a brigade command in the Corunna campaign of 1808, and next year was sent to Spain in command of the brigade (43rd, 52nd and 95th battalions), soon to be famous throughout Europe as the "Light Brigade." Craufurd found himself three marches in the rear of Wellesley's army when the news that a battle was in progress at Talavera reached him. He reached the front on the day after the battle, the brigade having covered 62 miles in 26 hours. Starting with this record, Craufurd's brigade covered itself with glory at Busaco, at Fuentes d'Onoro, and at the storming of Ciudad

Rodrigo, where their commander was mortally wounded (Jan. 19, 1812) while directing the attack. He died on the 24th and was buried in the breach his men had made.

Craufurd's elder brother, Lieut.-Gen. SIR CHARLES CRAUFURD (1761–1821), was British commissioner at the Austrian army headquarters in Flanders in the campaign of 1793, and in western Germany in 1795–96. He was severely wounded at Amberg and invalided home. He was promoted lieutenant-general in 1810, and received the G.C.B. in 1821. He died on March 26, 1821. Craufurd published nothing except a translation of Tielke's book on the Seven Years War, but he was an acute observer, and his papers on the campaigns in which he shared, preserved in the Record Office, London, form invaluable material for the military historian.

CRAVAT, the name given by the French in the reign of Louis XIV. to the scarf worn by the Croatian soldiers enlisted in the royal Croatian regiment (Fr. *cravate,* a corruption of "Croat"). Made of linen or muslin with broad edges of lace, it became fashionable, and the name was applied both in England and France to various forms of neckerchief, from the loosely tied lace cravat with long flowing ends, called a "Steinkirk" after the battle of 1692, to the elaborately folded and lightly starched linen or cambric neckcloth worn in the late 18th and early 19th centuries. The modern cravat is a necktie.

CRAVEN, PAULINE (1808–1891), French author, was born in London on April 12, 1808, daughter of the comte Auguste de la Ferronaye, diplomatist, and for a short time foreign minister under Charles X. She married in 1834 Augustus Craven, who was at that time an attaché in the British embassy at Naples. Her most famous work, *Récit d'une soeur* (1866, Eng. trans. 1868), crowned by the Académie Française, was drawn from her own family history. Other novels followed, and in 1888 *Lady Georgiana Fullerton, sa vie et ses oeuvres.* She died in Paris on April 1, 1891. Her husband (d. 1884), translated the correspondence of Lord Palmerston and of the Prince Consort into French.

See *Memoir of Mrs. Augustus Craven* (1894), by her friend Mrs. Mary Catherine Bishop; also *Paolina Craven,* by T. F. Ravaschieri Fieschi (1892). There is a biography of Mrs. Craven's father, "En Émigration," in Étienne Lamy's *Témoins des jours passés* (1907).

CRAVEN, WILLIAM CRAVEN, EARL OF (1608–1697), eldest son of Sir William Craven, lord mayor of London, matriculated at Trinity college, Oxford, in 1623, and joined the Middle Temple in 1624. He served under the princes of Orange, and then in 1632 joined Frederick, the exiled king of Bohemia, in an attempt to recover the Palatinate. In a second expedition (1637) he was taken prisoner, but was ransomed in 1639. He joined Elizabeth, queen of Bohemia (*q.v.*), in her exile in Holland. He also gave large financial assistance to Charles I. and to Charles II., whom he accompanied on his return to England. He received the queen of Bohemia at his house in Drury lane, London, in 1661. In 1664 he was created viscount and earl of Craven, and held many offices under Charles II. and James II. Craven was a patron of letters and a member of the Royal Society. He died unmarried on April 9, 1697, when the earldom became extinct, the barony passing by special remainder to his cousin William, 2nd Baron Craven; the present earl of Craven (the earldom being revived in 1801) is descended from John, a younger brother of the latter. The first Lord Craven's brother John, who was created Baron Craven of Ryton, Shropshire, and died in 1648, was the founder of the Craven scholarships at Oxford and Cambridge, of which the first was awarded in 1649.

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CRAWFORD, EARLS OF. The house of Lindsay, of which the earl of Crawford is the head, traces its descent to the barons of Crawford who flourished in the 12th century. Sir James Lindsay (d. 1396), 9th lord of Crawford, in Lanarkshire, was descended from Sir Alexander Lindsay of Luffness (d. 1309), who obtained Crawford and other estates in 1297 and who was high chamberlain of Scotland. Froissart tells of the wanderings of the 9th lord after the battle of Otterburn. His cousin and successor, Sir David Lindsay (*c.* 1360–1407), who married a daughter of Robert II., was made earl of Crawford. The 4th earl of Crawford (d. 1454), one of the most powerful of the Scottish nobles, took arms against King James II., but submitted in 1452. His son David the 5th earl (*c.* 1440–95) was lord high admiral and lord chamberlain; he went as ambassador to England, and in 1488 was created duke of Montrose, though the title did not descend to his son. Montrose fought for James III. at Sauchieburn, and his son John, the 6th earl (d. 1513), fell at Flodden. David Lindsay, 8th earl (d. 1542), whose son Alexander was sentenced to death for attempting to kill his father, conveyed the earldom to his kinsman, David Lindsay of Edzell, at whose death in 1558 the earldom came back with the consent of the Crown to the elder line of the Lindsays, *i.e.,* to Alexander's son David. The 10th earl, David Lindsay (d. 1574), supported Mary, queen of Scots. His son and successor, David, a grandson of Cardinal Beaton, took part in the risings under James VI., was converted to Roman Catholicism and communicated with Spain about an invasion of England. Ludovic Lindsay, 16th earl (1600–52), took part in the strange plot of 1641 to overthrow Argyll. He joined Charles I. during the Civil War. In 1644 the Scottish parliament declared his earldom forfeited and gave it to John Lindsay, 1st earl of Lindsay. Ludovic was imprisoned, but was released in 1645 by Montrose, under whom he served until the king's surrender. He died without issue, probably in France. The earl of Lindsay (17th earl of Crawford), who thus supplanted his kinsman, belonged to the family of Lindsay of the Byres, a branch descended from Sir David Lindsay of Crawford, grandfather of the 1st earl of Crawford. A leader of the Covenanters, he marched with the Scottish army into England in 1644; in the same year he became lord high treasurer of Scotland, and in 1645 president of the parliament. Later he changed sides and signed the "engagement" for the release of Charles I. in 1647, losing all his offices by the act of classes when his enemy, the marquess of Argyll, obtained the upper hand. In 1661 he was restored to his dignities, but his refusal to abjure the covenant compelled him to resign them in 1663. His son William, 18th earl of Crawford, also an ardent Covenanter, was president of the Convention parliament in 1690. William's grandson, John Lindsay, 20th earl of Crawford and 4th earl of Lindsay (1702–49), served against the Turks in the Russian army, and also under Prince Eugene. He also served at Dettingen and Fontenoy, and against France in the Netherlands.

At the death of George, 22nd earl (1758–1808), without issue, the earldoms of Crawford and Lindsay were separated, George's kinsman, David Lindsay (d. 1809), a descendant of the 4th Lord Lindsay of the Byres, becoming 7th earl of Lindsay. Both he and his successor Patrick (d. 1839) died without sons, and in 1878 the House of Lords decided that Sir John Trotter Bethune, bart. (1827–94), also a descendant of the 4th Lord Lindsay of the Byres, was entitled to the earldom. The earldom of Crawford remained dormant from 1808 until 1848, when the House of Lords adjudged it to James Lindsay, 7th earl of Balcarres. His son, Alexander William Crawford Lindsay, 25th earl of Crawford (1812–80), wrote *Lives of the Lindsays* (3 vols., 1849); *Letters on Egypt, Edom and the Holy Land* (1838); *The Earldom of Mar during 500 years* (1882), and other works.

His only son, James Ludovic Lindsay, 26th earl of Crawford and 9th earl of Balcarres (1847–1913), was an astronomer and orientalist. He was elected president of the Royal Astronomical society in 1882, and at his death he bequeathed to the British museum his great collection of stamps and many valuable mss. to the John Rylands library, Manchester and the free library of Wigan. He was succeeded as 27th earl by his son David (1871–1940), who was a member of Lloyd George's Coalition Cabinet (1916–22). Robert Alexander Lindsay (1900–), succeeded his father as 28th earl of Crawford and 11th earl of Balcarres in 1940.

See Lord Lindsay (25th earl of Crawford), *Lives of the Lindsays*

(1849); A. Jervise, *History and Traditions of the Land of the Lindsays* (1882); H. T. Folkard, *A Lindsay Record* (1899); and Sir J. B. Paul's edition of the *Scots Peerage* of Sir R. Douglas, vol. iii. (1906).

CRAWFORD, FRANCIS MARION (1854–1909), American author, was born at Bagni di Lucca, Italy, Aug. 2, 1854, being the son of the American sculptor, Thomas Crawford (*q.v.*), and the nephew of Julia Ward Howe, the American poet. The cosmopolitanism of his work is foreshadowed by his early training at St. Paul's school, Concord, N.H.; Trinity college, Cambridge; Heidelberg, and Rome. In 1879 he went to India, where he studied Sanskrit and edited the Allahabad *Indian Herald.* Returning to America he continued to study Sanskrit at Harvard university for a year, contributed to various periodicals, and in 1882 produced his first novel, *Mr. Isaacs,* a brilliant sketch of modern Anglo-Indian life mingled with a touch of Oriental mystery. This book had an immediate success, and its author's promise was confirmed by the publication of *Dr. Claudius* (1883). After a brief residence in N.Y. city and Boston and travelling in Turkey and elsewhere, Crawford in 1883 returned to Italy, where he made his permanent home and about which he wrote numerous novels, including the excellent series *Saracinesca* (1887), *Sant' Ilario* (1889) and *Don Orsino* (1892). His interest in his adopted country is also revealed in his historical works, *Ave Roma Immortalis* (1898), *Rulers of the South* (1900)—renamed *Sicily, Calabria and Malta* in 1904—and *Gleanings from Venetian History* (1905), in which his intimate knowledge of local Italian history combines with the romanticist's imaginative faculty to excellent effect. He was exceptionally prolific and treated with vividness and accuracy widely varying periods and countries. Among the most celebrated of his novels are: *A Roman Singer* (1884), *A Tale of a Lonely Parish* (1886), *Paul Patoff* (1887), *The Witch of Prague* (1891), *Via Crucis* (1899), *In the Palace of the King* (1900), and *The White Sister* (1909). In his American novels, such as *An American Politician* (1884), he was probably least successful. Nevertheless, he was always a gifted narrator, and his romances, with their picturesque backgrounds and dramatic characterizations, were very popular. His belief that the novel should be "a pocket-stage" for entertainment only, he set forth in *The Novel—What Is It?* (1893). It was but natural, therefore, that *A Cigarette-Maker's Romance* (1890) should be effective on the stage, and that in 1902 an original play from his pen, *Francesca da Rimini,* should be produced in Paris by Sarah Bernhardt. He died at Sorrento April 9, 1909.

For criticism and bibliography *see* F. J. Cooper, *Some American Story Tellers* (1911).

CRAWFORD, ISABELLA VALANCY (1850–1887), Canadian poetess, the daughter of an Irish physician, was born in Dublin on Dec. 25, 1850, and died in Toronto on Feb. 12, 1887. In 1858 Dr. Crawford and his family emigrated to Canada and settled in Ontario. After her father's death Isabella supported herself and her mother by journalistic writing in Toronto. In 1884 she published a small volume of poems. But recognition of her work was slow, and, worn out by the struggle for a livelihood, she died of heart disease at the age of 36. Her best known poems are *Old Spookeses Pass* and *Malcolm's Katie.*

See K. Hale, *Isabella Valancy Crawford* (1923), which contains a memoir and full bibliography.

CRAWFORD, THOMAS (1814–1857), American sculptor, was born in New York on March 22, 1814. He showed at an early age great taste for art, and learned to draw and carve in wood. In the summer of 1835 he went to Rome and became a pupil of Thorwaldsen. The first work which made him generally known as a man of genius was his group of "Orpheus entering Hades in Search of Eurydice," executed in 1839, followed by the "Babes in the Wood," "Flora," "Hebe and Ganymede," "Sappho," "Vesta," the "Dancers" and the "Hunter." Among his statues and busts are especially noteworthy the bust of Josiah Quincy, in the Boston Athenaeum, the equestrian statue of Washington at Richmond (Va.), the statue of Beethoven in the Boston music hall, statues of Channing and Henry Clay, and the colossal figure of "Armed Liberty" for the Capitol at Washington. For this building he executed also the figures for the pediment and began the bas-reliefs for the bronze doors, which were afterwards completed by W. H. Rinehart. The groups of the pediment symbolize the progress of civilization in America. Crawford's works include a large number of bas-reliefs of Scriptural subjects taken from both the Old and the New Testaments. He made Rome his home, but he visited America several times—first in 1844 (in which year he married Louisa Ward), in 1849 and in 1856. He died in London on October 10, 1857.

See *Das Lincoln Monument, eine Rede des Senator Charles Sumner,* to which are appended the biographies of several sculptors, including that of Thomas Crawford (Frankfurt a. M., 1868); Thomas Hicks, *Eulogy on Thomas Crawford* (1865).

CRAWFORD, WILLIAM HARRIS (1772–1834), American statesman, was born in Amherst county, Va., Feb. 24, 1772. He studied at Carmel academy for two years, was principal of one of the largest schools in Augusta, and in 1798 was admitted to the bar. With Horatio Marbury, he prepared a digest of the laws of Georgia from 1755 to 1800. From 1803 to 1807 he was a member of the State House of Representatives. From 1807 to 1813 he was a member of the U.S. Senate, of which he was president *pro tempore* from March 1812 to March 1813. In 1813 he declined the offer of the post of secretary of war, and until 1815 was minister to the court of France. He was secretary of war in 1815–1816, and secretary of the Treasury from 1816 to 1825. In 1816 in the congressional caucus which nominated James Monroe for the Presidency. Crawford was a strong opposing candidate having, at first a majority, but when the vote was finally cast 65 were for Monroe and 54 for Crawford.

In 1824, when the congressional caucus was fast becoming extinct, Crawford, being prepared to control it, insisted that it be held, but of 216 Republicans only 66 attended; of these, 64 voted for Crawford. Three other candidates, however, Andrew Jackson, John Quincy Adams and Henry Clay, were otherwise put in the field. During the campaign Crawford was stricken with paralysis, and when the electoral vote was cast Jackson received 99, Adams 84, Crawford 41 and Clay 37. Adams became president through Clay's influence in the House of Representatives. Crawford was invited by Adams to continue as secretary of the treasury, but declined. He recovered his health sufficiently to become (in 1827) a circuit judge in his own State, but died while on circuit, in Elberton, Ga., on Sept. 15, 1834.

In his day he was undoubtedly one of the foremost political leaders of the country, but his reputation has not stood the test of time. He was of imposing presence and had great conversational powers; but his inflexible integrity was not sufficiently tempered by tact and civility to make him generally popular. Although a skilful political organizer, he incurred the bitter enmity of other leaders of his time—Jackson, Adams and Calhoun. He won the admiration of Albert Gallatin and others by his powerful support of the movement in 1811 to recharter the Bank of the United States; he earned the condemnation of posterity by his authorship in 1820 of the four-years-term law, which limited the term of service of thousands of public officials to four years, and did much to develop the "spoils system." He was a Liberal Democrat, and advised the calling of a Constitutional Convention as preferable to nullification or secession.

CRAWFORD NOTCH, a deep defile through the White mountains, dividing the great New Hampshire group near its centre. The notch proper, about 3m. in length, is formed by Mts. Willard and Willey on the west and Mts. Webster and Jackson on the east. The pass at its highest point attains an altitude of 1,914ft., and above it the granite walls rise boldly on either side for approximately an equal elevation, the peaks being still higher, but generally not visible from the highway. Fantastic figures carved in the rocky heights, several cascades and the dashing Saco river all lend charm to this naturally beautiful place. The State of New Hampshire has set apart about 6,000ac. of the notch as a State forest.

CRAWFORDSVILLE, a city of Indiana, U.S.A., 40m. N.W. of Indianapolis, on Sugar creek; the county seat of Montgomery county. It is served by the Monon Route, the Big Four, and the Pennsylvania railways. The population in 1930 was 10,355, in 1940 it was 11,089. It is a trading and distributing centre for an important stock-raising region. There are many shippers and breeders of pedigree cattle, pigs, sheep and poultry in the county. Leading manufacturing products are building bricks, nails, wire specialties, sheet metal products, water tanks, poultry houses and brooders, steel culverts, lift trucks and skid platforms, water softener, spark arresters, gray iron castings, caskets, milk processing products, roof tile machines and bottle caps and metal lithographing. There are printing plants and large wholesale houses dealing mostly in field and garden seeds. The municipality owns its electric power and light plant and serves many outlying towns and the surrounding farm area. Montgomery county was the first in the U.S.A. to establish consolidated rural schools, and the first to have free delivery of mail in the rural districts. Wabash college for men, occupying 40 ac. in the heart of the city, was founded here in 1832 by four pioneer Presbyterian missionaries. The enrolment is limited to about 500. The town was laid out in 1822, and was chartered as a city in 1863. It was the home of Gen. Lew Wallace and of Maurice Thompson, and the birthplace of Meredith Nicholson and of Kenyon Nicholson.

CRAYER, GASPARD DE (1582–1669), Flemish painter, was born at Antwerp, Nov. 18, 1582, and was a pupil of Raphael Coxcie. He matriculated in the guild of St. Luke at Brussels in 1607, resided in the capital of Brabant till after 1660, and finally settled at Ghent. Among the numerous pictures which he painted in Ghent, one in the museum represents the martyrdom of St. Blaise, and bears the inscription A° 1668 aet. 86. His pictures abound in the churches and museums of Brussels and Ghent; and there is scarcely a country chapel in Flanders or Brabant that cannot boast of one or more of his works. Some important pictures are to be found at Aix in Provence and at Amberg in the Upper Palatinate. Crayer died at Ghent on Jan. 27, 1669. His best works may be seen in the galleries of Brussels, Ghent, the Louvre, the Munich Pinakothek, and the Belvedere at Vienna. His portrait by Van Dyck was engraved by P. Pontius.

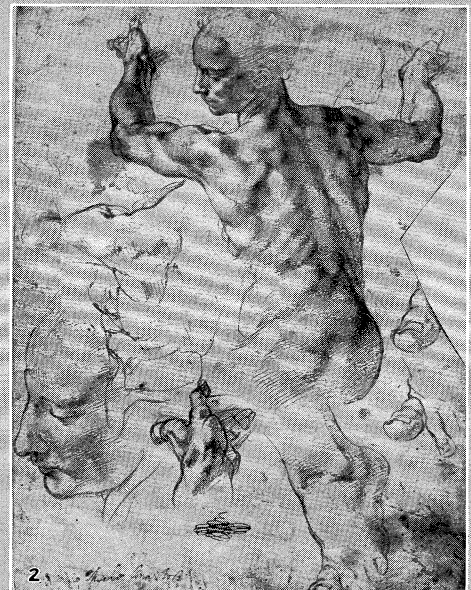
CRAYFISH, or crawfish, are fresh-water crustacea closely allied to and resembling the lobsters and, like them, belonging to the order Decapoda. They range in length from 1 or 2 in. to 16 in. and may attain a weight of 8 lb. (*Astacopsis gouldi* of Tasmania). So-called marine crawfish are more correctly spiny or rock lobsters; large fresh-water shrimp of the genus *Macrobrachium,* with the second pair of legs developed into powerful pincers, are mistakenly called crawfish. Crayfish frequent rivers, streams and other bodies of water, swamps or marshy places, and subterranean watercourses, sheltering under stones or constructing burrows. Wherever they are abundant, crayfish are used as food by man, to a greater extent in the old world than in the new. The "Murray river lobster," a crayfish rivalling the Tasmanian species in size, if not maximum weight, is much esteemed as food.

Crayfish are an important item in the diet of many animals, such as the river otter, water rat, mink, raccoon, opossum, bears, alligators, wading birds, ducks, and fish. They are omnivorous themselves, killing and eating other crustacea, insects, worms, snails, frogs, fish and other animals, devouring any carrion encountered and partaking of vegetable food. One species (*Cambarus hagenianus*) is so destructive to young crops as to interfere with the successful production of cotton and corn over 1,000 sq.mi. of moist lime-soil lands in Mississippi and adjacent Alabama. It lives in deep burrows, never visiting ponds or streams. On rainy spring nights these crayfish, which can go eight to nine months without food, destroy entire fields of corn and cotton. The recommended countermeasure is the application of creosote stock dip to their burrows by means of compressed air sprayers.

The crayfish are classified into three families, the Astacidae inhabiting the northern hemisphere and in the southern hemisphere, the Parastacidae and Austroastacidae, the latter confined to Victoria, Australia. The crayfish of England, Ireland and Europe belong to the genus *Astacus,* ranging as far east as Turkestan. Farther east a gap occurs in the distribution and no crayfish are met with until the basin of the Amur is reached, where a group of species occurs, by some authorities considered a subgenus of *Astacus, Cambaroïdes,* which extends into northern Japan. In North America, west of the Rocky Mountains the genus *Astacus* again appears, but east of the watershed it is replaced by the genus *Cambarus,* which is represented by numerous species ranging from the Great Lakes to Mexico. The American Cambari are divided into six subgenera or full genera, according to the authority consulted. A number of blind species have been described, of which the best known is *Cambarus* (*Orconectes*) *pellucidus,* found in Mammoth Cave, Ky., and the most recently described (1942) is *Troglocambarus maclanei,* from Gum Cave and "Squirrel Chimney," Fla. (*See* CRUSTACEA; LOBSTER; MALACOSTRACA.) (W. L. ST.)

CRAYON, a black or coloured material for drawing, generally in the form of pencils, but sometimes in powdered form. Obtainable, to some extent, from native earthy and other compact and friable mineral substances, crayons are, for the most part, artificially prepared mixtures of a base of pipe or china clay with Prussian blue, chrome yellow, vermilion, ochres, umbers and other pigments cemented together by the introduction of some weak adhesive, usually gum tragacanth. Calcined gypsum, talc and compounds of magnesium, bismuth and lead are occasionally used as bases. The required shades of tints are obtained by adding varying amounts of colouring matter to a given quantity of the base. The use of chalks, especially red earth, is of ancient origin as testified by surviving examples, and Horace's *rubrica picta aut carbone* would show that the conflicts of the famous gladiators were delineated in red chalk as well as charcoal. It is, however, with the use of the medium in more modern ages that we are now mainly concerned, especially when, in the 16th century, the artists used black chalk on white paper, and when, as the century advanced, they began more and more to employ it together with other mediums for the purpose of suggesting colour. First black chalk heightened with white, on a tinted paper, then black and red crayon, heightened with white, on papers of various tonality. With the specific use, however, of red crayon, in *sanguine,* as the French call it, draughtsmanship seemed to extend its scope and capacity, as we see particularly in the exquisite drawings of Watteau, done in infinite numbers, not only as notes and studies for pictures, but for the sheer joy of drawing, with all their inexpressible sense of grace and vitality inherent in the just emphasis of the accents of every figure, and the rhythmic significance of every line, and a general expression of animation. *"C'est de la sanguine qui contient de la pourpre"* wrote Edmond de Goncourt *à propos* the incomparable Watteau, *"c'est du crayon noir qui a un velouté à mul autre pareil; et cela mélangé de craie avec la pratique savante et spirituelle de l'artiste, devient, sur du papier chamois, de la chair blonde et rose."* There is little in the use of crayon that we could not learn from the inimitable drawings of Watteau if only we had the wit to divine the magic of his art. How to commingle the red, black and white strokes with the tone of the paper so as to suggest the illusion of a natural garment of colour, how to rub the vermilion chalk on the black with the finger or a stump or a rag, so that a lovely tone shall evolve, how to draw those expressive lines that positively sparkle with the living accent, how to judge the exact tones of white that shall lighten the contours and the shadows, which the paper always shows between as a half tone; in all these is the secret of Watteau's pre-eminence. This secret was never quite shared, for all their talent and charm, with Boucher, Greuze, Lagonard, Lancret, Baudouin or Chardin, who put their touch in *sanguine* to the test of unconscious rivalry.

Most of the old masters used chalk for their drawings at one time or another, giving it preference in many instances to pencil, or reed, pen and ink, or sepia wash, as for instance in the 15th century Gentile Bellini did a self-portrait in black chalk, and Francesco Morone a "Virgin enthroned with Saints" in red. There were, however, certain outstanding masters whose expressive lines in red and black chalk reflected a clear vision of character inherent in the contours. There were the Clouets, Jean and François, successively court painters to Francis I. whose crayon drawings, almost in outline, were so peculiarly distinguished for their psychological truth, and there was Holbein, whose series of portrait drawings at Windsor, is one of our glorious possessions. To obtain a full effect of colour he would variously tint the



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CRAYONS AND PASTELS, 16TH–19TH CENTURIES

1. Pierre Bouguer, crayon portrait by Jean Baptiste Perronneau (1731–83). The original is in the Louvre
2. Crayon studies for the Libyan Sybil, by Michelangelo (1475–1564), for the ceiling of the Sistine Chapel, in the Vatican, Rome
3. Girl with cherries, pastel by John Russell (1745–1806). The Louvre
4. Crayon studies for a mural, by Pierre C. Puvis de Chavannes (1824–98)
5. Landscape in crayon by Thomas Gainsborough (1727–88)
6. Girl with a monkey, pastel by Rosalba Carriera of Venice (1675–1757)

paper, and rub the tint away where light was wanted, or he would add white, the drawing being done with red or black chalk, the essential character of the face and head being exactly defined, and the chalk then rubbed to soften the tone suggestively, and a supplementary line or so of silver point being introduced for accent. The magnificently rich drawings of Rubens were done with black chalk heightened with white, or with the red crayon, while Van Dyck used chalk on a blue or brown paper, the choice of paper, by the way, influencing very much the effect of the chalks in the drawing. Titian and Tintoretto drew in black and white on blue paper, and Fra Bartolommeo on salmon pink or yellowish paper, while Correggio used red chalk with washes of red bistre heightened with white, Leonardo caressed the toned paper, so to speak, with his exquisite enfolding lines in red, and Piero di Cosimo, among others, reflected his influence. The black or red crayon was used characteristically with individual powers and finesse by Michelangelo, Raphael, Andrea del Sarto, Pontorno, Carpaccio, Lorenzo di Credi, Dürer and Lucas van Leyden, Rembrandt, Ruisdael, Esias van de Velde, Claude Loraine, Callot, Gravelot. Of English artists, Richard Wilson used chalk for classic landscape studies with beautiful effect, but the supreme master of the crayon in English art was Gainsborough, who, with the softening influence of the stump, made nature speak pictorially with grace, beauty and vivacity as well in landscape as in the human figure. A notable series of drawings in red chalk is that by Alfred Stevens, the famous sculptor, but among the moderns Whistler's manner of using coloured chalks was most lovely and distinguished. A new invention of oil colours in crayon form, purporting to be used as a substitute for brush painting, was invented at the beginning of the century by I. F. Raffaelli, the French painter and etcher, who painted many pictures with the new medium. The colours, however, are said to have soon lost their brilliancy. *See* also PASTEL. (M. C. S.)

CREAMERIES are factories where the main concern is the making of butter from cream gathered from a number of farms. In the United States the idea of associated dairying was first applied to cheese making, and for some time it was quite common to have creameries equipped to make both butter and cheese. Although several earlier instances were locally successful, the creamery built by Alanson Slaughter near Wallkill, Orange county, N.Y., in 1861 is usually regarded as the example that others followed. The system spread slowly across New York and westward to the upper Mississippi valley and on to California. Minnesota, Iowa and Wisconsin became the main centre of creamery butter production. In Denmark the depressed condition of agriculture following the loss of Schleswig-Holstein in 1864 and the establishment of direct trade with Great Britain led to attempts to use the creamery system, but it remained for the successful co-operative creamery established at Hjedding in western Jutland in 1882 to pioneer and point the way for the Danish dairy industry. In Ireland Canon Bagot established a joint-stock creamery at Hospital in County Limerick in 1884, but the main development in Ireland came after Sir Horace Plunkett began to organize co-operatives in 1889. The introduction of creameries in Canada parallels that of the United States, but development in New Zealand and Australia was somewhat later.

Several factors influenced the shift from farm butter making to the factory system. Probably the most important was its relatively greater economy in many phases of the work. A second factor was superior efficiency; a creamery could produce a larger volume of butter of more uniform grade, and this possibility became important as soon as the volume of production in a given community increased to the point where it had to look for markets beyond its borders. The factory system also enabled dairymen to specialize in milk production, and to increase it considerably beyond the amount they would have been able to manufacture into butter on farms.

Although the dates and details vary according to community and country, the creamery system can be described in terms of periods of development. At first the farmers delivered whole milk to creameries where it was set over night in shallow vats (the Schwartz system) or in deep cans immersed in cold water (the Cooley system) for creaming by gravity. Then the cream was skimmed from the top of the milk and churned and worked into butter. With bad weather and poor roads, farmers found it difficult to make daily deliveries, and households that produced better than average butter were reluctant to believe that they could not get more for their product by following the old system. At another stage, the farmers used pans or cans on their farms in setting the milk and then delivered the cream or had the creamery send a hauler along a regular route to gather it. The invention of the centrifugal cream separator by Carl Gustaf Patrik de Laval in Sweden in 1878 and its gradual introduction in creameries led to a return to the daily delivery of whole milk to creameries. In 1888 Nicholas Gerber of Switzerland and in 1890 Stephen Moulton Babcock of Wisconsin invented the butterfat testers that came into common use in Europe and the English-speaking countries respectively. Until then, the creameries had no simple but scientific method of determining the exact butterfat content of milk or cream with a view to paying farmers in accordance with quality. The use of testers, together with the introduction of hand separators on farms after 1895, facilitated the return to the practice of gathering cream from the farms. Throughout this early history, the manufacturers of equipment and supplies took a leading part in promoting the organization of creameries. Later the improvement of roads and the increasing use of motor transportation enabled the creameries to draw cream from areas of sparse milk production and thus greatly increased their volume of business. In most communities and countries the first creameries were usually individual enterprises, but often within a decade the more successful were organized and operated as co-operatives. The creameries ultimately found it advantageous to federate for the purchase of supplies and for marketing their products.

Every country with advanced agriculture has creameries, and the requirements and equipment are roughly similar. A considerable volume of cream is necessary if the operating expense per pound of butter is to be kept down. Surveys indicate that a local creamery should have the produce of from 900 to 1,000 cows within a 7-mile radius. It must have efficient business management, a skilled operator, and a well planned building with drainage. About $10,000 is needed for the basic equipment which includes a combined churn and butter worker, a pasteurizing vat, a starter can (except for sweet-cream butter), machinery for washing, sterilizing and drying cans, weighing scales, a butterfat tester, and facilities for refrigeration, either by mechanical means or natural ice.

See U.S. Dept. of Agriculture, *1899 Yearbook*, p. 381–402; and *Miscellaneous Publication 37* (1930); T. R. Pirtle, *History of the Dairy Industry* (1926); Arthur W. Farrall, *Dairy Engineering* (1942). (E. E. Es.)

CREASY, SIR EDWARD SHEPHERD (1812–1878), English historian, was born at Bexley in Kent, and educated at Eton and King's college, Cambridge. He was called to the bar at Lincoln's inn in 1837. In 1840 he was appointed professor of modern and ancient history in the University of London, and in 1860 became chief justice of Ceylon and a knight. He died in London on Jan. 27, 1878. Creasy's most popular work is his *Fifteen Decisive Battles of the World* (Marathon, Syracuse, Arbela or Gaugamela, the Metaurus, the defeat of Varus, Châlons, Tours, Hastings, Joan of Arc's victory at Orleans, the Spanish Armada, Blenheim, Poltava, Saratoga, Valmy and Waterloo), which, first published in 1851, has passed through many editions. He also wrote *History of England* (1869–70); *Rise and Progress of the English Constitution* (1853); etc.

CREATION, EPIC OF. The Babylonian Epic of Creation consisted originally of six books or tablets, the longest being tablet I, 161 lines, and the shortest, tablet II, 129 lines; latterly a hymn on the divine titles of Marduk, the hero of the epic, in 142 or more lines was added as tablet VII. The composition is a product of the priests of Babylon, in which the local god Marduk is glorified as the only deity who was able to defeat Tiamat, dragon of chaos and personification of the primeval salt water seas. The legend states that in the beginning only two entities existed: Apsû, the deity of fresh water, and the female dragon Tiamat, whose waters were mingled in a chaos, but from their union sprang the gods of heaven and earth, who rebelled and sought to create an orderly universe. This version attributed the defeat of the male deity of chaos, Apsû, to the god Nudimmud, or Ea, who then became the deity of fresh water. But in the great conflict with the female dragon, Tiamat, both Anu, the heaven god, and Ea, the water god, fled before her and only Marduk, son of Ea, went forth to battle with Kingu, leader of Tiamat's hosts, and then with Tiamat herself. There is a long description of the birth of Marduk in Book I. The Assyrian version substitutes Ashur for Marduk but this revision is not consistently carried out in the Assyrian copies. In her determination to destroy the gods of light and order Tiamat created 11 monsters, and Kingu, her husband, was their leader. These 11 monsters were identified later with constellations, Hydra, Leo, Scorpio, etc., after they had been bound by Marduk and chained to the stars.

Marduk, who was at first an inferior deity, had to be raised to the rank of a great god in the divine assembly, whereby he acquired the power to decree fates and to work miracles. He then defeated Tiamat and her host and bound Kingu and the 11 monsters. The body of Tiamat he divided and with half of it he made the canopy of heaven, and with the other half the abode of the Apsû. Tablet V. contains an astronomical poem, in which Marduk fixed the movements of the planets in the ecliptic, the motions of the moon, and the positions of the signs of the zodiac. The sixth tablet describes the creation of man by Ea, from the blood of the slain Kingu, the assigning of the various spheres of influence to the gods, the building of Babylon and its temples, and the institution of the Babylonian New Year's festival.

In certain other sources there are references to an older Sumerian legend of the primeval conflict of the dragons of darkness and the gods of light and order, in which not Marduk, but the war god Ninurta was the champion of the gods, and the bird-god, *Zu*, called the "Storm-bird" was the dragon of chaos, who is identified with both Pegasus and Scorpio. There are also obscure references to Kingu and the dragons having been bound and cast into hell fire by Marduk, a legend which has been compared with the burning of the beast in Daniel 7 and in the Apocalypse of John 20. The recitation of the Epic of Creation formed part of the ceremony of the New Year's festival at Babylon. In its present form it cannot antedate the period of the first Babylonian dynasty (2169–1870), when it was probably written. The texts are all from the late Babylonian and Assyrian period. The epic had more influence upon the rituals and theological views of the Semitic races of Western Asia than any other Babylonian literary work.

Bibliography.—S. Langdon, *The Babylonian Epic of Creation* (Oxford, 1923); E. Ebeling, *Das Babylonische Weltschöpfungslied* (1921); and the same scholar gives a new translation in Hugo Gressman's *Altorientalische Texte und Bilder*, 2nd ed. (Tübingen, 1926); *Babylonian Penitential Psalms*, Tablets I. and VI. from Kisk (1927).

(S. L.)

CREATIONISM AND TRADUCIANISM. Traducianism is the doctrine about the origin of the soul which was taught by Tertullian in his *De anima*—that souls are generated from souls in the same way and at the same time as bodies from bodies: creationism is the doctrine that God creates a soul for each body that is generated. The Pelagians taunted the upholders of original sin with holding Tertullian's opinion, and called them Traduciani (from *tradux: vid.* Du Cange *s. vv.*), a name which was perhaps suggested by a metaphor in *De an.* 19, where the soul is described "velut surculus quidam ex matrice Adam in propaginem deducta." Hence we have formed "traducianist," "traducianism," and by analogy "creationist," "creationism." Augustine denied that traducianism was necessarily connected with the doctrine of original sin, and to the end of his life was unable to decide for or against it. His letter to Jerome (*Epist. Clas.* iii. 166) is a most valuable statement of his difficulties. Jerome condemned it, and said that creationism was the opinion of the Church, though he admitted that most of the Western Christians held traducianism. The question has never been authoritatively determined, but creationism, which had always prevailed in the East, became the general opinion of the mediaeval theologians, and Peter Lombard's *creando infundit animas Deus et infundendo creat* was an accepted formula. Luther, like Augustine, was undecided, but Lutherans have as a rule been traducianists. Calvin favoured creationism.

Modern biological and psychological studies have modified the conditions of the problem. By insisting upon the close union between body and soul, and the continuity in the development of both from the parents, they may seem to lend support to traducianism. Yet this need not carry with it any materialistic consequence; for the soul, or psychical element in man's nature, may be as important as the body, or physical element, in the development which takes place; and the evolutionary process itself may be creative.

See, for the history, indices to *Augustine*, vol. xi., and *Jerome*, vol. xi., in Migne's *Patrologia, s.v.* "Anima"; A. Harnack, *History of Dogma* (*see* Index).

CREATIVE EVOLUTION is an expression introduced by H. Bergson (*q.v.*), and intimately connected with his philosophy (*Creative Evolution*, Eng. trans., 1922). It is intended to draw attention to the moment of spontaneous originality in nature, and especially in certain activities and experiences of mankind. The work of a great poet or painter clearly cannot be explained by merely mechanical forces. It cannot even be accounted for by explicitly conscious plans and purposes, for the great artist does not as a rule know in advance what the result will be, but is led to it gradually, step by step. This kind of activity, unfettered by mechanical forces *a tergo* or by explicitly preconceived ends *a fronte*, and yet resulting in something new, is typical of creative evolution. A somewhat similar trend of thought, at all events in respect of its opposition to purely mechanistic accounts of natural phenomena, has been maintained and made familiar in England by C. Lloyd Morgan under the term Emergence (*q.v.*).

CRÉBILLON, PROSPER JOLYOT DE (1674–1762), French tragic poet, was born at Dijon, where his father, Melchior Jolyot, was notary-royal. In 1705 he produced *Idoménée;* in 1707 his *Atrée et Thyeste* was repeatedly acted at court; *Electre* appeared in 1709; and in 1711 he produced his finest play, the *Rhadamiste et Zénobie*, which held the stage for a long period, although the plot is so complicated as to be almost incomprehensible. But his *Xerxes* (1714) was only once played, and his *Sémiramis* (1717) was an absolute failure. In 1707 Crébillon married a girl without fortune, who died leaving him two young children. Oppressed with melancholy, he removed to a garret, where he surrounded himself with a number of dogs, cats and ravens, which he had befriended; he became utterly careless of cleanliness or food, and solaced himself with constant smoking. But in 1731, in spite of his long seclusion, he was elected member of the French Academy; in 1735 he was appointed royal censor; and in 1745 Mme. de Pompadour presented him with a pension of 1,000 francs and a post in the royal library. He returned to the stage in 1726 with a successful play, *Pyrrhus;* in 1748 his *Catilina* was played with great success before the court; and in 1754, when he was 80 years old, appeared his last tragedy, *Le Triumvirat.* The enemies of Voltaire maintained that Crébillon was his superior as a tragic poet, and Voltaire then took subjects of no less than five of Crébillon's tragedies—*Sémiramis, Electre, Catilina, Le Triumvirat, Atrée*—as subjects for tragedies of his own. The so-called *Éloge de Crébillon* (1762), really a depreciation, which appeared in the year of the poet's death, is generally attributed to Voltaire, though he strenuously denied the authorship.

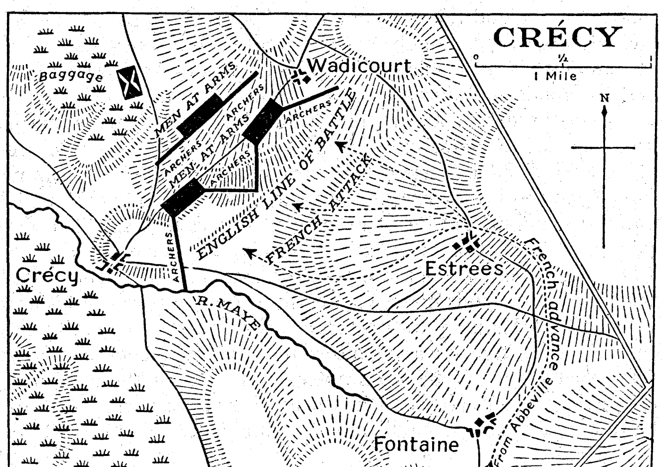
There are numerous editions of Crébillon's works, among which may be noticed: *Oeuvres* (1772) with preface and "éloge" by Joseph de la Porte; *Oeuvres* (1828), containing D'Alembert's *Éloge de Crébillon* (1775); and *Théâtre complet* (1885) with a notice by Auguste Vitu. A complete bibliography is given by Maurice Dutrait, in his *Étude sur la vie et le théâtre de Crébillon* (1895).

His only son, Claude Prosper Jolyot Crébillon (1707–1777), French novelist, was born in Paris, where his life was almost entirely spent, but the publication of *L'Écumoire, ou Tanzaï et Neadarné histoire japonaise* (1734), which contained veiled attacks on the bull *Unigenitus*, the cardinal de Rohan and the duchesse du Maine, led to imprisonment, followed by five years' exile in the provinces. With Alexis Piron and Charles Collé he founded in 1752 the gay society which met regularly to dine at the famous "Caveau," where many good stories were elaborated. From 1759 onwards he was to be found at the Wednesday dinners of the Pelletier, at which Garrick, Sterne and Wilkes were sometimes guests. He married in 1748 an English lady of noble family, Lady Henrietta Maria Stafford, who had been his mistress from 1744. The most celebrated of his numerous novels are: *Les Amours de Zéokinizul, roi des Kofirans* (1740), in which "Zéokinizul" may be translated Louis XIV., and *Le Sopha, conte moral* (1740), where the moral is supplied in the title only.

His *Oeuvres Complètes* were collected and printed in 1772. *See* a notice of Crébillon prefixed to O. Uzanne's edition of his *Contes dialogués* in the series of *Conteurs du XVIII^e^ siècle.*

CRÈCHE: *see* DAY NURSERIES.

CRÉCY (Cressy), a town of France, in the department of Somme, on the Maye, 12 mi. N. by E. of Abbeville by road. Pop. (1936) 1,232. It is famous for the victory gained here on Aug. 26, 1346, by the English under Edward III over the French of King Philip of Valois. After landing near Cherbourg, on July 12, and making a pillaging march through Normandy, Edward decided, in view of reports of the gathering French forces, to retire towards his allies the Flemings. If this merely meant a continuance of his actual direction of march, it also meant that he had to find feasible crossings over the Seine and Somme. For the first he had to go upstream almost to Paris, and the second, after being thwarted four times, he eventually achieved near the rivermouth. His line of retreat at last secure, he decided to halt and face his pursuers on a well-chosen site, to this end encamping, on Aug. 25, at Crécy, the French king in the meantime marching from Abbeville on Braye. Early on the 26th Edward's army took up its position for battle, while the French army continued their pursuit, in a straggling column and in much disorder. The English lay on the forward slope of a hillside, with their right in front of the village of Crécy, their left resting on Wadicourt. Two of the three divisions, or "battles," were in first line, that of the young prince of Wales (the Black Prince) on the right, that of the earls of Northampton and Arundel on the left; the third, under the king's own command, in reserve, and the baggage was packed to the rear. Each battle consisted of a centre of dismounted knights and men-at-arms and two wings of archers. The total force was at most 3,900 men-at-arms, 11,000 English archers, and 5,000 Welsh light troops (Froissart, first edition; the second gives a lower estimate). The French were far stronger, having at least



PLAN OF THE BATTLE OF CRÉCY, AUGUST 26, 1346

12,000 men-at-arms, 6,000 mercenary crossbowmen (Genoese), perhaps 20,000 of the *milice des communes,* besides a certain number of foot of the feudal levy. Along with these served a Luxemburg contingent of horse under John, king of Bohemia, and other feudatories of the Holy Roman Empire.

The day was far advanced when the French came unsuspectingly upon the English position. Philip, near Estrées, decided to halt and bivouac, deferring the battle until the army was better closed up; but the independence and indiscipline of his feudal lords committed him to an immediate action, and he ordered forward the Genoese crossbowmen, while a line of men-at-arms deployed for battle behind them; the rest of the army was still marching in an irregular column of route along the road from Abbeville. A sudden thunderstorm caused a short delay, then the archers and the crossbowmen opened the battle. Here, for the first time in Continental warfare, the English long-bow proved its worth. After a brief contest the crossbowmen, outranged and outmatched, were driven back with enormous loss. Thereupon the first line of French knights behind them charged down upon the "faint-hearted rabble" of their own fugitives, and soon the first two lines of the French were a mere mob of horse and foot struggling with each other. The archers did not neglect the opportunity, and shot coolly and rapidly into the helpless target in front of them. The second attack was made by another large body of knights which had arrived, and served but to increase the number of the casualties though here and there a few charged up to the English line and fell near it, among them the blind king of Bohemia, who with a party of devoted knights penetrated, and was killed amongst, the ranks of the prince of Wales's men-at-arms.

The battle was now one long series of desperate but ill-conducted charges, a fresh onslaught being made as each new corps of troops appeared on the scene. The English archers on the flanks of the two first-line battles had been wheeled up, the centres of dismounted men-at-arms held back, so that the whole line resembled a "herse" or harrow with three points formed by the archers (*see* sketch). Each successive body of the French sought to come to close quarters with the men-at-arms, and exposed themselves therefore at short range to the arrows on either flank. Under these circumstances there could be but one issue of the battle. Though 16 distinct attacks were made, and the fighting lasted until long after dark, no impression was made on the English line. At one moment the prince was so far in danger that his barons sent to the king for aid. Even then Edward was not disquieted and he sent a mere handful of knights to the prince's battle, saying, "Let the boy win his spurs." The left battle of the English, hitherto somewhat to the rear, moved up into line with the prince and the French attack slackened. By midnight the army of France had practically annihilated itself; 1,542 men of gentle blood were left dead on the field and counted by Edward's heralds, the losses of the remainder are unknown. Some 50 of the victors fell in the battle, which established England as a great military power, helped to ring the curfew on the long day of cavalry supremacy, proved the value of fire-power as represented in the long-bow, and revealed the magic defensive properties of a tactical combination of ground, archery-fire and the stability afforded by steady spearmen. As the long-bow had been acquired from the Welsh wars, so the new tactical combination had been learnt from the Scottish wars. But all that the French learnt was to dismount their cavalry when making attacks! The story that the Black Prince adopted from the fallen king of Bohemia the crest and motto now borne by the princes of Wales lacks foundation (*see* JOHN, King of Bohemia). A memorial to the French and their allies was erected, by public subscription in France, Luxemburg, and Bohemia, in 1905.

See H. B. George, *Battles of English History* (1895), and C. W. C. Oman, *A History of the Art of War in the Middle Ages* (1924). *See* also BANNOCKBURN; HALIDON HILL, BATTLE OF.

CREDENCE or **CREDENCE TABLE,** originally a small side-table placed near the high table, in royal or noble houses, for the tasting of food and drink for poisons by an official of the household called the *praegustator* or *credentiarius.* The name (from Med. Lat. *credentia,* Ital. *credenza,* Fr. *crédence*), survived after the disuse of this precautionary ceremony, and the table developed into the buffet (*q.v.*). In the Roman Catholic Church the credence table is a small table of wood or stone, placed near the wall on the south side of the altar, to hold the cruets containing the wine and water, the chalice, acolytes' candlesticks and other objects to be used in the Mass. The use of such a table appears to have arisen after the disuse of personal presentation of oblations at the Mass. In some English churches the old stone credence tables still exist (*e.g.,* at St. Cross near Winchester), most frequently as a stone shelf near the piscina; some carved wooden ones also survive. The use of the credence table has been revived in the English Church, and has been pronounced legal.

CREDENTIALS (*lettres de créance*), a document which ambassadors, ministers plenipotentiary and chargés d'affaires hand to the government to which they are accredited, for the purpose, chiefly, of communicating to the latter the envoy's diplomatic rank. It also contains a request that full credence be accorded to his official statements. Until his credentials have been presented and found in proper order, an envoy receives no official recognition. The credentials of an ambassador or minister plenipotentiary are signed by the chief of the state, those of a chargé d'affaires by the foreign minister.

CREDI, LORENZO DI (1457–1537), Italian artist, whose surname was Barducci, was born at Florence. He was the least gifted of three artists who began life as journeymen with Andrea del Verrocchio. The other two were Leonardo da Vinci and Perugino, of whom he was the companion and friend. Credi had a respectable local practice at Florence. He was consulted on most occasions when the opinion of his profession was required on public grounds, *e.g.* in 1491 as to the fronting, and in 1498 as to the lantern of the Florentine cathedral, in 1504 as to the place due to Michelangelo's "David." At rare intervals he produced large ecclesiastical pictures. The greater part of his time was spent on easel pieces, upon which he expended minute and patient labour. But he worked with such industry that numbers of his Madonnas exist in European galleries. The best of his altar-pieces is that which represents the Virgin and Child with Saints in the cathedral of Pistoia. A fine example of his easel roundels is in the gallery of Mainz. In his old age he withdrew on an annuity into the hospital of Santa Maria Nuova, where he died on Jan. 12, 1537. The National gallery, London, has two pictures of the Virgin and Child, and a portrait of Costanza de' Medici by Credi.

CREDIT. In commerce, the sale of goods or the transfer of property upon promise of deferred payment. Generally, belief or trust (Lat. *credere,* to believe). The term is also commonly used to express the reputation of an individual or institution, as in "a man of credit." In bookkeeping, the side of the account in which payments are entered is termed "credit" or "Cr."; hence, sometimes, the name is applied to the payments themselves. The confidence of traders in each other and in the commercial or monetary system in which they perform their functions has so much to do with profitable work and enterprise that economists have given much attention to the part which credit plays in the production and exchange of wealth. (*See* ECONOMICS.)

In a highly civilized community the use of credit money becomes possible. Paper promises to pay money become currency if backed by gold (*e.g.* a Bank of England note), or by accepted credit (*e.g.* a cheque) and greatly facilitate trading operations. The cheque has become the currency of British and American internal trade and a cheque is a draft on credit backed by commodities. (*See* BANKING AND CREDIT; MONEY.)

CREDIT, INSOLVENCY OR BAD DEBT INSURANCE. It was not until the last decade of the 19th century that attempts were made to provide insurance against bad debts. Since then two British companies have underwritten such risks profitably. In America insurance against bad debts has been provided by the American Foreign Credit Underwriters, Incorporated, which has its headquarters in New York city. Credit policies only indemnify an insured for losses due to the insolvency of his customer. Insolvency is generally defined as "an adjudication of bankruptcy or composition with creditors in legal form, or execution of an assignment for the benefit of creditors, or, in the case of a limited company, an order that the company be liquidated voluntarily, compulsorily or with supervision."

After World War I universal interest was aroused in this subject and schemes were established in Germany as regards exports to Russia; in Italy the government was searching for a satisfactory basis of action; while Austria, Czechoslovakia, Switzerland and Sweden showed signs of activity. Policies are issued to traders either as regards a single transaction, in respect of an open account, or on the basis of annual turnover. Such insurance appeals not only to large traders, who in their normal experience are prepared to risk a certain amount in bad debts and who are now enabled to increase their accounts, but also to the small trader whose capital is insufficient to warrant participating in any transaction involving the slightest element of risk of loss of capital.

Certain fundamental principles apply in common with most other classes of insurance. There must be the utmost good faith (*uberrima fides*) between the parties, and the onus is thrown upon the proposer to disclose all material information to the insurer which may affect his view of the risk as regards acceptance, declinature or rating. The proposer must possess an insurable interest, or in other words must bear some relation to the transaction to be insured, recognized by law, by which he stands to benefit by its completion or to be prejudiced by its non-fulfilment. The principle of indemnity must also be observed and in no circumstances must the insured be able to obtain profit by virtue of the policy. In the event of a loss the insured must, as far as possible, and subject to the limitations of the particular contract, be placed in that position which he would have occupied had the loss not occurred. Fire risks are universally insured, but credit risks are usually insured only when some element of doubt exists in the mind of the proposer as to the stability of his customer. It is therefore an established practice that the insured must bear some proportion of each and every loss himself. If it is worth a trader's while to accept a risk then a credit insurance company will generally undertake a proportion unless the transaction is obviously a gamble. In England an increasing business is written on home and foreign accounts. Domestic business inevitably proves the simpler in operation since debts are more easily collected at home than abroad, and confidential information is more readily obtainable. An increase in the number of companies transacting the business in various countries will make it easier to procure information and foreign guarantees will be granted with greater facility. Proposal forms are required to be completed in every case and full particulars as to the name of the firm to be guaranteed, its standing, the class and extent of the account and terms of payment must be stated. The reason for the guarantee is often sought, particularly when additional security has never been required before.

Policies are issued in respect of individual open accounts and often in respect of all the accounts on a trader's books. The policy provides for the payment of a proportion of the net loss to the insured due to the insolvency of any trader admitted by the policy. In England the percentage paid by the company does not generally exceed 75% of the net loss limited to the sum set against the name in the schedule to the policy. Losses are restricted to those on goods sold during the period of insurance which are delivered to the debtor and invoiced and debited to him in the insured's books. Renewal policies are so endorsed that the insured is not prejudiced in respect of transactions entered into immediately prior to the expiry of the policy. Another form of policy guarantees individual bills of exchange, subject to a specified date upon which the bill must be met or insolvency occur.

The exports credit guarantee scheme established by the British government in 1926 is dissimilar to any form of insurance hitherto devised. The trader is protected against the debtor's failure to meet his obligation on a definite date from whatever cause. In most cases the guarantee does not exceed 75% of the amount of the credit granted, although in certain instances a guarantee for the full amount of the credit may be obtained. (A. G. M. B.)

IN THE UNITED STATES

Credit insurance in the United States was first written by The U.S. Credit System company, organized in 1888 in Newark, N.J.; the first policy issued late in 1889. The premium was divided into expense, guarantee and reserve and the business written on the Tontine plan with 650 policies of $5,000 each making a series, a total of $3,250,000 at risk to a series. Each series paid its own losses, since the funds of one series could not be diverted to another series unless a profit was made, which profit had to apply to the liquidation of any deficit of prior series. This plan proved unsatisfactory and was discontinued by amending the original charter granted by New Jersey, so that all funds were available to pay any losses incurred. Original policies provided for payment of premium and required the insured to sustain agreed percentage of loss on gross annual sales before the company was liable. This percentage, based on applicant's previous credit loss experience, was termed "initial" or "own" loss. The initial loss determined governed the policy's amount and the limit of individual coverage, the policy issued for twice the amount of the largest debtor's limit, in turn double the amount of initial loss. The excess of the amount agreed to be borne by the insured was the policy amount, subject to debtor's limits and the face of the policy, hence the "Excess Bad Debt Insurance." Amounts insured on individual debtors were based on ratings of a mercantile agency selected by the policyholder when the policy was applied for. The meaning of insolvency was confined to that arising from bankruptcies, receiverships, absconding debtors with no assets or a judgment that the debtor was unable to pay in full.

Companies were organized to write this form of insurance only, but their underwriting experience was generally unprofitable, owing to lack of knowledge of carrying costs and of other requirements for safeguarding the company's and the policyholder's interests. After the great financial depression in 1893 the Ocean Accident and Guarantee Corporation, Ltd., took up the business, modernized policy forms, improved underwriting conditions and stabilized the business so as to gain and retain the insuring public's confidence. A number of larger casualty companies followed this pioneer lead. This branch of insurance has since been successfully and increasingly underwritten in the United States. It is now called credit insurance. The fundamental principles of the original idea still operate in broadened scope.

The most modern credit insurance policy covers the policyholder's annual shipments, operates in a dual capacity, provides adequate guarantee against loss due to insolvency of debtors and assists in minimizing the insured hazards. The most comprehensive credit insurance now protects against abnormal or unexpected loss from delinquent, dilatory debtors sold in the ordinary course of business, the policy undertaking to collect from such debtors or pay when "normal loss" is exceeded. In credit granting there is generally some loss during the business year. "Normal loss" is loss understood as inherent to the risk, fixed by class statistics and individual experience. In this essential, credit insurance differs from fire, marine, tornado, burglary and other branches of property indemnity. The coverage in these lines is against a happening considered less certain than credit loss. Overhead can provide for known or normal loss, only insurance for the abnormal or catastrophe loss.

Diverse forms are issued for varying needs but generally "insolvency" includes bankruptcy or insolvency petition, assignment, receivership, compromise, attachment, execution, death or insanity of sole debtor, chattel mortgage, absconding, confession of judgment, transfer or sale of stock in bulk, a debtor's business taken over by a committee. Besides these insolvency definitions collection policy forms provide for assigning accounts as insolvent, after becoming due and payable under original terms of sale. Under this form accounts can be filed as an insolvency when they become past due on original terms of sale or, at the policyholder's option, within an agreed number of days after original due date.

Original underwriting conditions have greatly improved. Original policies limited coverage to $10,000. In 1938, $100,000 could be had on a single account. Principal credit insurance companies pooled loss statistics for a period of years, resulting in experience normal loss tables showing average experience on any given sales basis in over 400 different businesses. The larger proportion of U.S. credit insurance policies cover the policyholder's annual sales volume, but the demand for coverage on individual debtors is met by single credit account policies, though this particular underwriting experience is still developing. Considerable hazard attends credit insurance underwriting, including future business conditions, reasonable expectancy of business depression in cycles, when credit losses reach large proportions, and the especially important factor of moral hazard, the control of the insured hazard being in the policyholder's hands to a greater extent than in other insurances. It therefore demands of underwriters a broad general knowledge of business and of local conditions, acquaintance with different specific hazards and keen judgment of human nature obtained only through wide experience over a number of years.

See J. G. Legg, *Loss of Profits Insurance* (1938).

CREDIT, LETTER OF: *see* LETTER OR BILL OF CREDIT.

CRÉDIT FONCIER DE FRANCE.—The Crédit Foncier de France was originally founded as Banque Foncière de Paris by decree of Louis Napoléon in 1852. It went through a number of reorganizations after its foundation as a mortgage loan bank. Its functions were extended in 1860 and 1862 when it was authorized to lend with or without mortgage to local governments, public and semi-public institutions and institutions of "public interest" such as hospitals or chambers of commerce. At that time it was also authorized to operate in Algeria, in later years in all of French North Africa, until in 1929 it received authority for the entire French empire inclusive of all protectorates and mandates. The charter of the bank was renewed in 1881 for a period of 99 years. In the 1940s it existed as a joint stock company under government control, the governor and the two deputy governors being appointed by decree.

During its evolution the Crédit Foncier expanded its field of activity every few years into new types of lending. Its power, however, declined as time went on, because as its operations became more diffused its monopolistic position decreased, and new competing public and semi-public institutions came into being. The procedures of all loans granted by the Crédit Foncier are carefully prescribed by rules and regulations. It is authorized to grant both long and short term loans, repayable usually by annuity, sometimes drawable by lot. It is, however, also authorized to engage in certain commercial banking operations.

The loans are of two main types: (1) mortgage loans on first mortgages and "maritime" loans on ocean-going vessels; (2) loans to municipalities, *départements,* public or semi-public bodies and non-profit making establishments "of public interest."

The Crédit Foncier has a legal monopoly on mortgage loans. It issues debentures in the open market, but no direct lien connects an individual "obligation foncière" with any particular property. All the mortgages are pooled, and together form the guarantee for each and all individual debentures.

The "obligations communales" which represent the loans to local governments and other approved institutions are also sold in the open market. They are guaranteed by an elaborate system of revenue pledges. Municipal councils have to vote the assignment of specific taxes to be pledged for the fulfilment of the obligation contracted between the municipality and the Crédit Foncier. As in the case of mortgage debentures all pledges are pooled together to guarantee each and all outstanding debentures. There is therefore no direct connection between an individual debenture and the individual pledge as far as the purchaser of the debenture is concerned.

The Crédit Foncier never enjoyed a legal monopoly on local loans in the manner in which it controlled mortgage loans. Up to the 1930s, however, it had a quasi-monopoly because smaller communities rarely issued loans directly in the open market and even large cities were reluctant to do so, and rather used the services of the Crédit Foncier. The local governments' advantage in borrowing from the Crédit Foncier was that large loans could be repaid in small instalments over extended periods of time. The government supported the dominating position of this institution and in the 1920s it actually prohibited for some time another public credit agency (the Caisse des Dépots et Consignations) from granting loans to local governments at rates lower than those charged by the Crédit Foncier. This policy was changed during the 1930s. The central government began to give active support to other institutions engaged in lending to local authorities at reduced rates. The Caisse de Crédit aux Départements et aux Communes was especially founded for that purpose in 1935 and became in the ensuing years a powerful competitor for the Crédit Foncier. It was to become the government lending establishment in charge of regulation and co-ordination of credit granted to local governments.

Traditionally the Crédit Foncier had been considered as an intermediary between the investing public on one hand and the mortgage borrowers, local governments and approved institutions on the other hand. The system had long been used in a number of European countries. With the introduction of modern fiscal planning it might provide the means for the integration of local lending policy with national fiscal policy, and thus give the central government more power in the influencing of monetary developments. It had often been charged in France that the Crédit Foncier exploited its monopolistic position by charging excessive interest rates. To counteract this policy, the French government, on at least one occasion in 1936, advanced money to the institution under the explicit condition that the proceeds be used for the granting of low interest loans to local governments and mortgage borrowers and that the rates charged on outstanding as well as new loans be reduced. (H. S. Bh.)

CREDIT MANAGER, a title used in business organization, especially in the U.S.A., to denote the individual charged with responsibility for determining when and where credit will be extended and with supervision over the collection of outstanding accounts and notes receivable. He is usually responsible to the chief financial executive of the company and works in close cooperation with the sales departments. In large organizations, the credit manager may direct a number of widely scattered credit men. In such cases, he lays down the credit policies and adjusts them to the varying requirements of the territorial subdivisions. He should receive from sales and collection departments detailed data regarding markets, risks and local economic changes affecting the business as a whole. The credit manager also depends to a considerable degree upon the exchange of information with other credit men. In the United States this is done through the National Association of Credit Men, which has for its major purposes the protection of credit, the establishment of a bureau for collection and adjustment and the maintenance of a credit exchange bureau. It furnishes credit information in the United States and foreign countries, and carries on a continuous program of education and research. The organization also conducts courses in credit management and issues news letters and periodicals.

CRÉDIT MOBILIER OF AMERICA, a construction company whose operations in connection with the building of the Union Pacific railroad gave rise to one of the most serious political scandals in the history of the United States congress. The company was originally chartered as the Pennsylvania Fiscal agency in 1859. In March 1864 a controlling interest in the stock was secured by Thomas Durant, vice-president of the Union Pacific Railroad company, and the Pennsylvania legislature authorized the adoption of the name Crédit Mobilier of America. Durant proposed to utilize it as a construction company, pay it an extravagant sum for the work, and thus secure for the stockholders of the Union Pacific, who now controlled the Crédit Mobilier, the bonds loaned by the United States government. The net proceeds from the government and the first mortgage bonds issued to the construction company were $50,863,172.05, slightly more than enough to pay the entire cost of construction. According to the report of the Wilson Congressional committee, the Crédit Mobilier received in addition, in the form of stock, income bonds, and land grant bonds, $23,000,000—a profit of about 48%. The work extended over the years 1865–67. During the winter of 1867–68, when adverse legislation by congress was feared, it is alleged that Oakes Ames (*q.v.*), a representative from Massachusetts and principal promoter of the Crédit Mobilier, distributed a number of shares among congressmen and senators to influence their attitude. As the result of a lawsuit between Ames and H. S. McComb, some private letters were brought out in Sept. 1872, which gave publicity to the entire proceedings. The house appointed two investigating committees, the Poland and the Wilson committees, and on the report of the former (1873) Ames and James Brooks of New York were formally censured by the house. Charges were also made against Schuyler Colfax, then vice-president but speaker of the house at the time of the transaction, and several other members either of the house or of the senate. The senate later appointed a special committee to investigate the charges against its members. This committee, on Feb. 27, 1873, recommended the expulsion from the senate of James W. Patterson, of New Hampshire. The evidence was exaggerated by the Democrats for partisan purposes, but the investigation showed clearly that many of those accused were at least indiscreet if not dishonest.

See J. B. Crawford, *The Crédit Mobilier of America* (Boston, 1880), and R. Hazard, *The Crédit Mobilier of America* (Providence, 1881), both of which defend Ames; also the histories of the Union Pacific Railroad company by J. P. Davis (Chicago, 1894) and H. K. White (Chicago, 1895); and for a succinct and impartial account, James Ford Rhodes, *History of the United States*, vol. vii (1906).

CREDIT NOTE. In commerce, an invoice acknowledging that a sum of money is due from the issuing person or firm as debtor to the receiver as creditor. It is usual to issue a credit note in respect of such matters as overcharges, breakages, goods accepted returnable, allowances for faulty work, etc.; a matter of the kind is thus placed on proper and formal record in account.

CREDITON, market town of Devonshire, England, 7½ mi. N.W. of Exeter by the S.R. Pop. of urban district (1938) 3,719. Area, 1.7 sq.mi. It is situated in the narrow vale of the Creedy near its junction with the Exe, between two steep hills, and is divided into the east or old town and the west or new town.

Crediton (*Credington, Cryditon, Kirton*) is traditionally the birthplace of Boniface, following whom it was for a while a bishop's seat. In 1049 Leofric, bishop of Crediton, requested Leo IX to transfer the see to Exeter, as Crediton was "an open town and much exposed to the incursions of pirates." In 1231 the bishop obtained a fair, still held, on the vigil, feast and morrow of St. Lawrence. This was important as the wool trade was established by 1249 and certainly continued until 1630, when the market for kersies is mentioned in conjunction with a saying "as fine as Kirton spinning." Agricultural trades with the making of cider and some confectionery superseded the former woollen and serge industries. In 1897 Crediton was made the seat of a bishopric suffragan in the diocese of Exeter.

CREE, an Algonkin Indian tribe, or loose aggregation of bands, holding a large territory south of Churchill river and from Hudson bay west into Manitoba and Assiniboia. The name is an abbreviation from Cristineaux or Kinisteneaux. Essentially a forest people, as shown by the resemblance of their dialect to Ojibwa (*q.v.*), part of the Cree became bison hunters and have been known as Plains Cree. When the Assiniboin broke away from the Dakota, they moved into Cree territory, with the result that the two groups became allied against the Dakota and Blackfoot; the latter ancient relatives of the Cree. The culture of the Cree is essentially of eastern woodland type, but lacking the maize agriculture which their habitat forbade. There are some 15,000, including mixed breeds, which was probably about their original number. (A. L. K.)

CREEDS. From the times of the early church till the present day, definitely formulated confessions of faith have played a large part both in the liturgy and in the theology of all Christian denominations. We find them in the early church predominantly as baptismal confessions, *i.e.,* as formulae which are spoken by the candidate at the sacrament of baptism or confirmed by him in response to a question put by the person baptising him (*see* Baptism). Since the Council of Nicaea (325), however, they have served concurrently as formulae for dogmatic decisions of ecclesiastical councils; and in the early middle ages they also began in Spain and Gaul to be recited ceremonially in the Sunday worship, a custom introduced also into the Roman mass by Pope Benedict VIII in about the year 1020 at the wish of the Emperor Henry II. Since that time the Creed has been an established part of the Roman liturgy and has passed thence into the new-formed liturgies of the churches of the Reformation.

The oldest creed of the kind is the confession of the Roman Church which we have in its Greek form in a letter of Bishop Marcellus of Ancyra written in 340 and in Latin in several manuscripts.

It runs:

I believe in God, the Father, the Almighty.

And in Christ Jesus, his only begotten Son, our Lord,
who was born of the Holy Ghost and the Virgin Mary

who was crucified under Pontius Pilate and was buried, on the third day rose from the dead, ascended into heaven, is seated at the right hand of the Father, whence he will come to judge the living and the dead.
And in the Holy Ghost, the holy Church, the forgiveness of sins, the resurrection of the flesh.

A careful examination of the text, yields the result that the Greek form is the original, the Latin the translation: and as Greek was the official ecclesiastical language in the Roman community only till the middle of the third century, we can draw the conclusion that the formulation of this creed must have taken place before 250. The Latin translation, however, will already have been made at a very early date and it spread from Rome throughout the West. All Latin creeds of the West, from Africa, Spain, Gaul, Britain, Germany, are derived from the Latin form of the Roman creed, which they took over as a whole and developed further in its details by minor alterations or additions. For the middle ages and the modern age the so-called *Apostolicum* (or "Apostle's Creed") has attained the greatest importance among these descendants of the old Roman creed. We find it already in the seventh century in Gaul, whence it spread both to Ireland and to Spain and Germany. It is connected in origin with a form of the creed which we find associated with Bishop Niceta of Remesiana (to-day Bela Palanka on the Serbian-Bulgarian frontier) about 400. The official text of the Apostolicum runs:

I believe in God the Father, the Almighty, creator of heaven and earth.
And in Jesus Christ, his only son, our Lord, who was conceived by the Holy Ghost, born of the Virgin Mary, suffered under Pontius Pilate, crucified, dead and buried, descended to hell, the third day rose again from the dead, ascended into heaven, seated at the right hand of God the Father Almighty, whence he will come, to judge the living and the dead.
I believe in the Holy Ghost, a holy catholic Christian Church, communion of saints, forgiveness of sins, resurrection of the flesh, and an everlasting life. Amen.

Whilst, therefore, we can prove the existence in the West since the 4th century of a single form of the creed preserved, although with numerous variations, through the centuries without a break till the present day, for the East a wealth of creed forms is characteristic, differing widely from one another. Of special importance is the creed of the first ecumenical synod of Nicaea (325), which was formulated in defence against Arianism. It runs:

We believe in one God, the Almighty Father, creator of all things visible and invisible.
And in one Lord Jesus Christ, the son of God, who alone was begotten of the Father [that is of the substance of the Father] God of God, Light of Light [very God of very God, begotten, not made, of one substance with the Father], through whom all was made that is in heaven and on earth, who for us men and for our salvation came down and became flesh, became man, suffered and rose on the third day, is ascended to heaven and will come to judge the living and the dead.
And in the Holy Spirit.

In this formula of the synod we have an ancient eastern baptismal confession into which the clauses marked [. . .] have been inserted as dogmatic formulas in defence against Arius. Similar confessions are preserved to us in ever changing forms, from Palestine, Syria and Egypt. With the forms beloved in the Jerusalem district is closely related the creed which in its Latin form is customary in the western liturgy and is used to the present day in the liturgy of the mass. It also is commonly called the Nicene, although it arose later and is officially attributed by the Byzantine Church to the second ecumenical synod of Constantinople (381). Its wording is:

We believe in one God the Father Almighty, maker of heaven and earth, and of all things visible and invisible:
And in one Lord Jesus Christ, the only-begotten Son of God, begotten of his Father before all worlds, God of God, Light of Light, very God of very God, begotten not made, being of one substance with the Father, by whom all things were made: who for us men and for our salvation came down from heaven, and was incarnate by the Holy Spirit of the Virgin Mary, and was made man, and was crucified also for us under Pontius Pilate. He suffered and was buried, and the third day he rose again according to the scriptures, and ascended into heaven, and sitteth on the right hand of the Father. And he shall come again to judge both the living and the dead: whose kingdom shall have no end.
And we believe in the Holy Spirit, the Lord and giver of life, who proceedeth from the Father, and with the Father and the Son together is worshipped and glorified, who spake by the prophets. And we believe one catholic and apostolic Church. We acknowledge one baptism for the remission of sins. And we look for the resurrection of the dead and the life of the world to come.

In these two examples already can be seen the variety of the oriental creeds and their freedom in large and small alterations of the text. We add to them an Egyptian confession, which is attributed to Macarius (about 370):

I believe in one God the Almighty Father.
And in the Logos of one substance with him, through whom he made the world, who at the end of the times took his dwelling in flesh for the destruction of sin, which he prepared for himself out of the Holy Virgin Mary, crucified and dead and buried and risen the third day and seated at the right hand of the Father, and who comes again in the world to come to judge the living and the dead.
And in the Holy Ghost, who is of one substance with the Father and his Logos. We believe also in the resurrection of the soul and of the body, as the apostle says: 'It is sown a natural body, it is raised a spiritual body.'

In spite of all this variability of the creed, due to the liturgical freedom of the East, the attempt can be made to construct a common archetype out of which the eastern confessions grew. It may perhaps have run:

I believe in one God, the Father, the Almighty, the creator of all things visible and invisible.
And in one Lord Jesus Christ, the only begotten Son of God,
who was born of the Father before all aeons, through whom all came into being,
who (for our salvation) became man, suffered and rose the third day and is ascended into the heavens and will come again (in glory), to judge the living and the dead.
And in the Holy Ghost.

From this arises the problem concerning the origin of the creed. Have Rome and the East a common root, or is one of the great centres of Christendom the original home of the creed, and have the others borrowed it from these? And at what time may the oldest formulated creed have arisen? This problem has been discussed with special eagerness in Norway by C. P. Caspari, in Germany by A. v. Harnack and F. Kattenbusch, in England by A. E. Burn; in particular the fundamental work of Kattenbusch has become of determining influence in the method of the enquiry. In numerous ecclesiastical writers of the first centuries occur single clauses or longer discussions which show relationship, both in form and in content, with the clauses of the creed. All these passages have been regarded as allusions to the confession of faith, and the attempt has been made to reconstruct out of them the creed familiar to the writer in question. In this attempt the presupposition is always that the type which finds expression in the Roman and eastern creeds must lie at the basis also of all earlier confessions of faith, and that it is therefore only necessary to piece together according to the known scheme the scattered allusions of the writer examined in order more or less to recover his creed. In this way for instance a creed of Justin Martyr's, who worked in Rome about 150, can be restored:

I believe in the Father of all things and the Lord God.
And in our Lord Jesus Christ, the first-born Son of God, according to the Father's will born through a virgin and become passible man and crucified under Pontius Pilate and dead and risen from the dead and ascended into heaven, and will come again in the glory as judge of all men.
And in the Holy Spirit of prophecy.

We should have here a primitive form of the Roman creed discussed above and should thus be in a position to trace back the history of its origin to the year 150 and establish as highly probable that the very first formulation of the creed is due to Rome, and that from thence it entered upon its victorious progress through the whole of Christendom. Other scholars, above all A. Seeberg and later P. Feine, have even thought it possible by help of the allusions to work back to the New Testament period and to put the date of the origin of the creed back into apostolic times. The numerous accordances in the New Testament with all the clauses of the creed provide rich material for this hypothesis, though indeed always on the presupposition that underlying these separate scattered expressions is the type of a confession composed of three articles with a fuller treatment of the expressions about Christ in the second article. But it is just that which cannot be proved for the New Testament period and the beginning of the second century; hence the justification of this whole construction is open to question. A. v. Harnack already more than once pointed out that, in addition to a three-fold confession of faith in Father, Son and Holy Spirit, there existed a fully developed confession of Christ; and that the form of the creed familiar to us was the outcome of the insertion of that Christological confession into the second article of a trinitarian creed which thus developed into the form of which we have evidence in the old Roman symbol. And in 1922 Reinhold Seeberg proposed the hypothesis that the original form of creed known to us from Rome arose about the year 140 in Jerusalem through the conflation of a christological and a trinitarian formula.

The study of the creeds, which had been undisturbed since the appearance of Kattenbusch's great work (1900), received a new shock from an enquiry which Karl Holl laid before the Berlin Academy in the year 1919. He pointed out that, in the Greek original text of the Roman creed, as in its old Latin translation, the clauses fell clearly into groups (*see* the text as printed above). After the words, "and in Christ Jesus, his only-begotten Son, our Lord" follow two expressions parallel in form, the first of which expounds the title "his only-begotten Son" according to Lk. i. 35 as he who is born of the Holy Spirit and the Virgin Mary, whilst the second describes in the manner of Phil. ii. 5–11 how Jesus obediently enters upon his passion and thereafter is exalted to the right hand of God and confessed as "Lord" by the whole world: so that in this way the second title "our Lord" is explained. A. v. Harnack recognized at once in this observation of Holl's a confirmation of his theory and drew the conclusion that thus the oldest form of the Roman creed did not have those explanatory sections and consisted of three equally-balanced articles, each of which was composed of three elements. H. Lietzmann then pointed out that this ninefold creed suspected by Harnack was actually preserved in the Egyptian Church and that there was evidence for it in not a few passages; and to this he joined a new hypothesis of the origin of the creed. The Egyptian creed runs:

I believe in God, the Father, the Almighty,
And in Christ Jesus, his only-begotten Son, our Lord,
And in the Holy Spirit, the holy Church, the resurrection of the flesh.

Thus it is only necessary to delete in the Roman creed the two expository clauses of the second article to obtain the Egyptian form, which research had hitherto regarded as an abbreviation of the Roman text. Now it became clear that on the contrary the development was from the shorter to the longer form, and new perspectives were thereby opened to research. As soon, namely, as it is inferred that the numerous confessional utterances of early Christian literature should be regarded, not as "allusions" to a creed lying behind them, but as actual confessions, there emerges the conception of a development moving from single utterances and brief forms to the creed formulas we know, and this is in itself inherently probable.

In the early period are to be mentioned first of all the *one-clause* confessions of *Jesus*. Paul says in 1 Cor. xii. 3. "No man can say 'Lord Jesus,' except by the Holy Spirit," and in Rom. x. 9: "if thou shalt confess with thy mouth the "Lord Jesus" and shalt believe in thine heart that God raised him from the dead, thou shalt be saved." Here the confession runs quite simply: "Jesus is the Lord," and in Rom. x. 9 we can already observe the tendency to add the clause that God raised him from the dead. From this kernel was developed the formula, known to us from numerous sources and above all from the symbol of the fish: "Jesus Christ, Son of God, the Saviour." The chance circumstance that the first letters of these five words when read together make the Greek word for fish (*icthys*) made the fish the emblem of the early Christians. In many other passages of New Testament and early Christian literature we meet with confessions of Christ: Rom. i. 3; 2 Tim. ii. 8; 1 Cor. xv. 3–4; 1 Pet. iii. 13–22 and the famous passage Phil. ii. 5–11 which celebrates in hymn-like form the saving work of Christ.

For by confession ought not to be understood only some kind of formula expressing obligation, and not only at baptism does the Christian confess his faith, but early Christian usage speaks of "confessing" wherever the great truths of religion are uttered to the laud and praise of God or proclaimed to the hostile powers for the confusion of the demons. Thus we find, especially in the central prayer of the Eucharist in the oldest form of the western rite, the ceremonial confession of the saving work of Jesus. In the oldest Roman liturgy this prayer runs:

We thank thee God through thy beloved servant Jesus Christ, whom thou hast sent us in the last times as saviour and redeemer and messenger of thy counsel, the Logos proceeding from thee, through whom thou madest all things whom thou wast pleased to send from heaven into the womb of the virgin, and in her body he became flesh and was shown as thy Son, born of the Holy Spirit and the virgin. To fulfil thy will and to prepare a holy people, he stretched out his hands, for he suffered that he might release from evil those who have believed in thee.

And when he delivered himself up to voluntary suffering, to loose death and to break asunder the bands of the devil and to tread down hell and to illuminate the righteous and to set up the boundary stone and to reveal the resurrection, he took a loaf, gave thanks and spake: "Take, eat, this is my body, which is broken for you," etc.

The relationship of this prayer with passages like Phil. ii. 5–11 on the one side and to the second article of the formulated creed on the other side is obvious. And the connection with the creed is no less clear in the early Church forms for exorcising evil spirits, *e.g.*: "I exorcise thee in the name of our Lord Jesus Christ of Nazareth, who became flesh in the virgin Mary, under whom the Father hath set all that is in heaven and on earth."

By the side of this one-clause confession of Christ we find already in the earliest period a two-fold confession of God and Christ. Paul says in 1 Cor. viii. 6:

One God the Father, from whom is all and we are to him.
And one Lord Jesus Christ, through whom is all and we are through him.

And in Tim. vi. 12 we read:

of the good confession before many witnesses,
Before God, who has called all into life
And Christ Jesus, who under Pontius
Pilate witnessed the good confession.

We meet also with such two-fold confessions in early Christian writing again and again. Even so do Syrian martyrs make confession at a later time:

We know no other God besides the
God who made the heaven and the earth,
and the sun and the moon and
all that is visible and invisible.
And we believe in his Son Jesus, who is called the Nazarene.

Or an official confession of the leader of the community of Smyrna about 200 runs:

we know truly of one God,
we know of Christ, we know of the Son,
who suffered as he suffered, died as
he died and rose on the third day
and is at the right hand of God
and will come to judge the living and the dead.

These are no "allusions" to a three-fold creed, but actual two-fold formulas of confession.

The oldest three-fold formula meets us in 2 Cor. xiii. 13: "The grace of the Lord Jesus Christ and the love of God and the fellowship of the Holy Spirit be with you all." And what we see here as a liturgical formula of salutation, meets us as a baptismal formula in Mt. xxviii. 19: "Baptise ye in the name of the Father, and of the Son, and of the Holy Spirit." The letter of the Roman community dating from the end of the first century which goes by the name of the first epistle of Clement also knows this formula: "have we not one God and one Christ and one Spirit of grace which is poured out upon us and on calling in Christ?" (1 Clem. xlvi. 6). This simple trinitarian formula was variously expanded just as was the two-fold one: the way is not far to the nine-fold Egyptian creed discussed above. Instructive in this connection, however, is a confession which occurs in the recently discovered so-called "Letter of the Apostles" preserved in Ethiopic and hence of second century origin. The five loaves of the miraculous feeding of Mt. xiv. 17 are being discussed, and they are interpreted as a symbol of Christian faith:

in the Father, the ruler of the whole world
and in Jesus Christ our Saviour
and in the Holy Spirit, the Paraclete,
and in the holy Church
and in the forgiveness of sins.

We should say that here the third article of the trinitarian confession is expanded: but the author states clearly that he takes this formula of confession as a five-fold formula.

A four-fold formula meets us about the same period in bishop Irenaeus of Lyons (I. 10). He there speaks of the faith:

In one God, the Father, the Almighty, who made the heaven and the earth and the sea and all that is in them (Ps. cxlv. 6),
and in one Christ Jesus, the Son of God, who became flesh for our salvation,
and in the Holy Spirit, who foretold through the prophets
the working of God and the coming and the birth of a virgin and the passion and the resurrection from the dead and the bodily ascension to heaven of the beloved Christ Jesus our Lord and his coming again out of the heavens in the glory of the Father to collect all together (Eph. i. 10) and to raise up all flesh that he created, to give righteous judgement over all, etc.

Here can be plainly seen how a trinitarian confession to Father, Son and Spirit and a one-clause confession to Christ with extensive exposition of his saving work have grown together, but not in the form familiar to us from the Roman creed, but so that the confession to Christ-confession is added as a fourth article to the third one.

The abundant available material from the first three centuries teaches us above all that the early period of Christianity still possessed no definitely formulated confession, but gave to the Christian belief, which in content remained constant, the greatest variety of expression. And then when, in the 4th century and still later, as was acknowledged above, we find throughout the East a variety of confessional formulations to us almost amazing, we shall recognize in it the continuation of the early Christian freedom. A complete parallel to this is afforded by the development of the liturgy which likewise retained in the eastern Churches what to the Westerner is an almost incredible variety and freedom. And this parallel is no accidental one, for the creed also has its root in the liturgy and is nothing else than the liturgical expression of Christian faith. The trinitarian formula of confession especially belonged to the baptismal liturgy, whilst the fully elaborated Christ-confession was developed and fostered preferably in the central prayer of the Eucharist (*see* the example given above). In the West, and indeed predominantly in Rome, we can observe quite early the preference for fixed formulations, and this too in the field of the creedal confession; and analogously the liturgy there became stereotyped much earlier and more rigidly.

The creed is, therefore, by its origin a piece of the liturgy. It arose from the need to sum up the fundamental truths of salvation in ceremonial form and to utter them aloud before the face of God; and this because the pious heart so desires it, because the solemnity of the hour demands it, because the celebration of the sacrament reaches in it its emotional climax or the assaults of the evil one are effectually withstood if rebuked in the very words of the faith. Whether also the exclusion of foreign errors exercised influence in the formation of individual clauses is an open question, which to-day will no longer be so confidently answered in the affirmative as would till recently have been the case. The determining impulses to the formation of the creed were in any case motives acting from within Christianity and the Church, *i.e.* the history of the creed and its formulations would not appear *essentially* different if there had been no heresies. It is with the council of Nicaea first that creeds enter our horizon compiled demonstrably and deliberately in defence against heretical opinions. But even after the 4th century this motive did not finally gain the upper hand, and the creed has remained through the middle ages to the present day an act of liturgical worship.

A typical example of creed formation for the purpose of confuting heretics is the so-called "Athanasian Creed," named after its opening word the *Quicumque*. Neither in content nor formally has it anything to do with the type discussed so far, but is a compendium, compiled in forty theses, of the doctrines of the Trinity and the Incarnation. There is a variety of evidence of its liturgical use since the Carolingian period, and to be sure in the hourly services of the monks as a part of Prime. Opinions about the date of its origin differ very widely. There is only agreement on the one point that this creed, which is unknown to the Greek Church, cannot come from S. Athanasius. Accordingly an author has been sought for in the West, and a great number of theologians have been suggested. Whilst earlier research, under the determining influence of Swainson, ascribed the work to the Carolingian period, A. E. Burn has with great learning argued for the thesis, often adopted before, that it originated in the 5th century, and he has looked for its author in Gaul. Finally in 1909 the acute Jesuit Brewer attempted to render probable the authorship of S. Ambrose, and won agreement from not a few competent scholars. In one of the last of his essays Burn also withdrew his earlier opinion and accepted the 4th century date and the probability of Brewer's hypothesis.

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MODERN CONFESSIONS OF FAITH

1. **New Motives and Forms.**—The form of the confessions of the modern period cannot be understood without glancing back for a moment at the middle ages. From the condemnation of Pelagius onwards the western Church reached numerous doctrinal decisions of its own. They have, in part universal validity (*e.g.*, the dogma of Transubstantiation), in part particular validity (the theology of universities and orders). This increasing body of obligatory doctrine was indeed in part embodied in particular obligations (*e.g.*, the oaths in the universities), but formally these obligations were legal in character. The expansion of existing confessions or the formulation of new ones did not take place. The obligatory doctrine had therefore to be collected from a large and not precisely limited series of single doctrinal decisions. Thus side by side with the great extension of obligatory doctrine there is, oddly enough, a standstill in confessional formulation.

Three elements in this development have been important for the confessional formulation of the modern period: (1) The connection of obligatory doctrine with the taking of oaths. Examples from the Roman Church: Professio fidei Tridentinae 1564 and the oath of the Doctores in s. scriptura 1910; from the Lutheran Church: the Wittenberg doctor's oath (probably of 1532); from the Church of England the oath in conformity with the Test Act of 1673. (2) The formulation of obligatory doctrine in separate articles. Any Reformation confession will serve as an example, and so too the Tridentine decrees. (3) The detailed elaboration of the separate points of theological doctrine. Yet where these mediaeval elements alone are present the peculiar character of the confession, as a comprehensive whole exhaustive of its kind, is lacking. The inducement for this first arose through the Reformation and the consequent contrast between the newly formed Churches and the Roman Church. Here were contrasts involving the whole system. Here too the conscious return to the sources of obligatory doctrine (scripture alone in the newly formed Churches, scripture and tradition in the Roman Church), and the reflexion upon the points of doctrine fundamental for the whole system, were a determining incentive to confessional formulation.

The new confessions which now arose had to be much lengthier than those of the ancient Church, in the face of both the development of a systematic and scientific theology and of the elaboration of the doctrinal details of the contrasting positions. Hence the primitive form of an expanded and explicated baptismal confession was insufficiently subdivided to yield the appropriate divisions. Luther attempted to revive it in his personal confession (*Works,* Weimar ed. xxvi., 500–9), but then himself adopted another course. Thus new forms of the confession arise:

I. Articles of Confession.—In form this is the stringing together of a larger or smaller number of articles, which deal either with doctrine alone or with both doctrine and ceremonial together. In the genuine articles of confession they together attempt to present a conspectus of scriptural doctrine and scriptural rites in sharp contrast with all that is anti-scriptural. This aim of providing a comprehensive system makes the articles of confession a true confession. Where articles of confession deal only with single questions, they are a real confession only when they are understood as expanding existing confessions.

II. The Catechism.—This is the exposition of definite things which concern every layman, like the Decalogue, the Apostles' Creed, the Lord's Prayer, and also the sacramental words of Baptism and the Eucharist. It endeavours to further the education of the laity in the confession of the Church and is therefore consciously confined to what is simple and universally intelligible. It had in the 16th and 17th centuries in fact the significance which the expanded baptismal confessions possessed in the early eastern Church.

Common to both forms is the exclusion of merely academic questions. They limit themselves to what is essential and important according to the new Reformation conceptions of pure evangelical doctrine and faith. Although, however, each is in its own way a complete whole, they are not, either separately or together, the complete basis of the new order. They are that rather in connection with the *orders of service.* The division between the orders of service and the articles of confession was originally indefinite. There is therefore in the orders of service of the continent something really corresponding to the fact that the Church of England regards as the foundation of its new order not the Thirty-Nine Articles alone but also its Book of Common Prayer.

In this account, however, the Church liturgies and rites will not be dealt with. Moreover little need be said of the Roman Church, for it did little in the way of credal formulation. The Tridentine decrees learned certainly from the Reformation practice of embodying the whole system and excluding the purely academic; yet in general they follow the older type of doctrinal decision. The same holds true of the *Vatican Decree.* The Catechismus Romanus of 1566, important as a standard of instruction, follows certainly the new form of the confession; it is a counterpart to Luther's larger Catechism.

Of the Eastern Church it will suffice to mention, that in 1642 it adopted in opposition to the ideas of the Reformation its Confessio orthodoxa.

2. **The Lutheran Churches.**—(i.) *The Augsburg Confession* (*Confessio Augustana*), read before the emperor in the Augsburg Diet in the name of the majority of the Evangelical deputies and presented in writing (Latin and German) on June 25, 1530, has become the common confession uniting the Lutheran Churches—not indeed in exactly the form presented to the Emperor, but in a form differing little from it (the Latin text that of the editio princeps of 1531). It bears the subsidiary title of the "Invariata" (unaltered) in contrast to the materially altered form of 1540, the so-called "Variata," which is not recognized by the Lutheran Churches. The C. Augustana owes its great importance to the possibility, along with the Wittenberg Concord of 1536, of uniting the German Evangelical deputies, and to the imperial recognition which depended upon this. Till the dissolution of the old Romano-Germanic Empire the existence of the Evangelical Churches depended, formally and legally, upon the C. Augustana. Except that since 1648 the reformed German Churches which accepted only the "Variata" expressly shared this legal protection.

The earlier history of the C. Augustana goes back to the year 1525 and has recently had light thrown upon it by H. v. Schubert and Gussman. Of direct importance for its first part (Faith and Doctrine) are the so-called Schwabach Articles, and the Marburg Articles giving an abbreviated form of them, both of 1529 and for the latter the so-called Torgau Articles of April 1530, composed by the theologians of the Electorate of Saxony together and in part by Luther himself. The work of composing a common Evangelical Confession out of these materials fell to Melanchthon. He achieved it by moderating as far as possible the contrast with the ancient Church, *e.g.,* the articles on the Pope and Purgatory are omitted. The opposition to the dogma of transubstantiation is similarly dropped in article 10; the teaching about the invisible Church is removed; even the Evangelical doctrine of Justification finds only brief expression, requiring explanation. Hence the C. Augustana, though always highly honoured, very soon no longer sufficed for the growing Lutheran Churches as an expression of their confession and it was supplemented by other confessions.

Contents: I. *Faith and Doctrine.* 1 God (Trinity); 2 Original Sin; 3 The Son of God (Incarnation and Redemption); 4 Justification; 5 Preaching; 6 The new obedience; 7 and 8 Church; 9 Baptism; 10 The Lord's Supper; 11 Confession; 12 Penance; 13 Use of the Sacraments; 14 Church Government; 15 Liturgies; 16 Civil Government; 17 Christ's Return to Judgement; 18 Free Will; 19 The Cause of Sin; 20 Faith and Good Works; 21 Worship of Saints. II. *Abuses* (with reference to both forms of the Sacrament, the Marriage of Priests, the Mass, Distinction of Meats, Monastic Vows, Authority of Bishops; in all seven articles).

For the understanding of the C. Augustana it is necessary, owing to the brevity of its formulations, first to refer to the Schwabach articles and secondly to consider the Apology for the C. Augustana of September 1530. The *Apology* is a defence of Melanchthon's, directed against the Confutatio Pontificia in which the Emperor in August 1530 declared the C. Augustana refuted, and it soon attained the authority of a confession.

(ii.) Next to the C. Augustana the most important German Lutheran confession is the *Schmalkaldic Articles,* composed by Luther himself. When pope Paul III. summoned the council to Mantua in June 1536, the C. Augustana did not at first appear suited to discussion. So Luther in conjunction with Elector John Frederick wrote for it what were later called the Schmalkaldic Articles (Dec. 1536). They were subscribed by the Wittenberg theologians, and were to have been made the common confession of all Evangelical deputies and theologians at the session at Schmalkalden (Feb. 1537). Melanchthon, furthered by an illness of Luther's, prevented this, and secured that both his own writings (C. Augustana and Apology) together with an explanatory tract on the papacy should be selected as the official confession. The theologians present only subscribed Luther's articles privately. Luther then issued his articles in 1538 as his personal confession, which were to rank also as his witness after his death. Owing to their content they very soon became the official confession of all the German Lutheran Churches.

The Schmalkaldic Articles are the jewel among the Lutheran confessions. Even their construction is lucidly clear. The *first part* contains the fundamental tenets of the ancient Church, which are common to the newly formed Churches and to the Roman Church (Trinity and Christology). The *second part* introduces the great issues connected with the doctrine of redemption, round which the strife turned and on which no compromise was possible: justification by faith only and the rejection of the sacrifice of the mass, monastic vows, and papal authority. The *third part* contains the particular theological problems in which the consequences of the fundamental issue find expression, and on which learned discussion is possible. For Lutheran Christians the Schmalkaldic Articles are still to-day the point of departure in every exploration of relations with the Roman Church. They will therefore still possess considerable importance in the movement for reunion. At the same time it is in them, more than in any other German Reformation confession, that the pathos of confession in the early Christian sense is most evident. In Luther's manuscript they bear the motto: hic satis est doctrinae pro vita aeterna.

(iii.) The large and the small Catechisms, both issued by Luther in 1529, cannot be considered in detail here. Suffice it to mention that the German Lutheran Church reckons them also among its confessions, and that the small Catechism became of special importance in this respect in the 19th century.

(iv.) In addition to these confessions, which won their way everywhere in German Lutheranism, a number of other writings, which cannot here be enumerated, attained the rank of confessions, mostly for a time only, but some also permanently. The sifting and collection of these writings in Books of Confession (Corpora doctrinae) was influenced by the disputes which rent the German Evangelical Churches after the "Interim" of 1548, being concerned with the differences between Melanchthon's and Luther's theology. The great majority of the German Churches learned during these conflicts consciously to feel as Lutherans. In Corpora doctrinae collected by them since 1563 in opposition to a Corpus doctrinae representing purely Melanchthon's position, the writings mentioned under (i.) and (ii.) won their way as confessions. The variety of the centres from which these books of confession arose, on the one side, and the need for an end of disputes, on the other, led to the "Book of Concord" of 1580, which contains, in addition to the classic creeds of antiquity and the confessions mentioned in (i.) to (iii.) above, the "Formula of Concord" completed in 1577. Although a few Lutheran districts, especially in North-west Germany, did not accept the Formula of Concord and the Book of Concord, the two became the characteristic confession of the Lutheran Church. The divergence of the remaining Corpora doctrinae, apart from the failure of the Formula of Concord itself, is of little importance.

This Formula of Concord is the most extensive confessional document of Lutheranism. It deals with a series of twelve controversial points of doctrine in a twofold form, in an "Abstract" (Epitome) and in a "Fundamental exposition" (Solida declaratio). It has become of decisive importance for the course of Lutheran theology for two reasons: (a) through its acceptance of the doctrine of ubiquity (the doctrine of the omnipresence of the risen Christ according to his manhood), and (b) through its mediation between the doctrines of Predestination of Melanchthon and Luther (the sole-efficacy of grace is clearly maintained, but predestination nevertheless made milder).

(v.) Lutheranism outside Germany formed its own confessions as need arose (C. Hafnica in Denmark, 1530), but sooner or later reached confessional union with German Lutheranism by the adoption of the German Lutheran confessions. In Denmark and Norway under the influence of Christian V. (1670–95) only the C. Augustana and the smaller Catechism, apart from the early Christian creeds, became confessions; but in Sweden the C. Augustana in 1593 and the whole Book of Concord in 1686. American Lutheranism is at one with the strictest German. Lutheranism therefore is, even formally, confessionally very well defined, and national differences play a small part; the C. Augustana and the smaller Catechism at least are of world wide validity.

3. **The "Reformed" (Non-Lutheran) Churches.**—The non-Lutheran "Reformed" Churches are distinguished from the Lutheran in the matter of confessional formulation in two respects. First, they are formally less well defined. The fundamental confession is different in each national Church. Secondly, they know no Corpora doctrinae. Most of the national Churches have only *one* fundamental confession. The Dordrecht Decisions of 1619 alone are common to many national Churches and rank as an expansion of their national confessions. An enumeration even of all the important confessions is therefore impossible here. For these the list given in E. F. Carl Müller, *Die Bekenntnisschriften der reformierten Kirche,* Leipzig 1903, p. ix.–xi., should be consulted.

Zwingli's *Fidei ratio ad Carolum quintum* of 1530 is a well-defined theological system of so markedly individual a character that it is not adapted to be the confession of a Church. Of all the pre-Calvinist confessions only one is important, the *Confessio Helvetica prior,* originating early in 1536 in a general consultation of all the Evangelical Swiss Cantons. It possesses two features characteristic of most of the later non-Lutheran "Reformed" confessions. First it contains extensive explanations about Holy Scripture as the only source of doctrine, and secondly it has a separate article on the doctrine of Predestination.

Two writings of Calvin must be mentioned among the "Reformed" confessions. A. *The Geneva Catechism,* composed probably in 1541, printed in 1545. It has never been an official confession of a "Reformed" Church, but yet has in practice been one of the most formative influences in "Reformed" doctrine. The duty of man is to give glory to God; but true worship of God embraces four things: (*a*) to believe in him, (*b*) to obey him, (*c*) to call upon him, (*d*) to recognise him as the source of all good. Therein is contained the underlying idea and division of the Catechism, except that the four points, where more precisely developed, are divided into two parts, the Word of God and Sacraments. Calvin arranged the two parts of the Catechism as a complete whole, but the whole is not a system of doctrine, but has a practical religious purpose. B. *The Confessio Gallicana* of 1559, the fundamental confession of the French "Reformed" Church, which was accepted at the national synod in Paris in 1559, somewhat expanded at La Rochelle in 1571, and is based, according to recent research, upon Calvin's own draft. In 1603 a national synod attempted to add to article 31 a supplement which explained that the Pope was Antichrist; the Catholic government prevented it. Owing to the destruction of the public Evangelical Church in France (1685), the C. Gallicana fell out of use in the "Church of the Wilderness," and it did not regain its old position in the 19th century. So to-day it is only an honoured historical document, the pattern of many other "Reformed" confessions. What is valuable in it, apart from its lucid, systematic, construction and its clear language, which make it the best outline of Calvin's theology, is the full development of all the elements of the doctrines of Justification and of the Church.

Contents. 1 General Idea of God; 2 Revelation; 3–6 Holy Scripture; 7 Trinity; 8 and 9 Creation and Providence; 10 and 11 Original Sin; 12 Double Predestination; 13–17 Christ's Person and Work; 18–24 Justification by Faith Only; 25–33 Church and Word of God; 34–38 Sacraments; 39 and 40 Secular Authority. (Arts. 1–9=Institutio Bk. I.; Arts. 10–17=Bk. II.; Arts. 13–24=Bk. III.; Arts. 25–40=Bk. IV.)

Of the remaining reformed confessions the *Heidelberg Catechism,* composed by Olevianus and Ursinus, and adopted by the Palatinate synod at Heidelberg in 1563, is still very distinctive. It arranges the material of the Catechism in a systematic whole of three parts (Questions 3–11 Of man's sin and misery, Questions 12–85 Of man's redemption, Questions 86–127 Thankfulness). This arrangement shows that older German Reformation theology has had great influence; it is not Calvinism that is the formative principle, Predestination is not dealt with expressly. Of all the "Reformed" confessions of the continent the Heidelberg Catechism is to-day the most living and operative; a fact accounted for by the penetrating simplicity of its formulation.

4. **The Church of England.**—The *Thirty-Nine Articles* have become the great fundamental confession of the English Church; they were adopted by the united convocations in 1563 and confirmed by Queen Elizabeth. They became law by act of Parliament in 1571 in their final redaction, as somewhat altered about 1563. Since 1571 the English Church has made no changes in them. The first step towards them was the *Ten Articles* of Henry VIII. of 1536, the first still tentative expression of the English Reformation movement; these are in part verbally dependent upon the C. Augustana, but still more cautious and reserved, and they do not comprise a complete confession, but only touch the points of chief practical importance. Still nearer to the C. Augustana stand the *Thirteen Articles* of 1538, an outcome of conversations with theologians of the Electorate of Saxony, which indeed were never published, but have nevertheless great importance as the decisive foundation of what followed. When under King Edward VI. the Swiss and Genevan Reformation gained influence in England, the *Forty-Two Articles* were drawn up upon this foundation under the guidance of Cranmer and Ridley; these still stand close to the Wittenberg Reformation, but in their doctrine of the Sacraments, and, with some reserve, also in their doctrine of Predestination, have moved nearer to

that of Geneva. The government of catholic Queen Mary abolished the *Forty-Two Articles.* Under Elizabeth they were not simply restored, but worked over by Archbishop Parker together with Bishops Cox and Guest, in which process renewed Lutheran influences (especially the Confessio Wirtembergica of 1551, composed by Brenz) co-operated. Through this re-working arose the Thirty-Nine Articles.

There are two interpretations of the Thirty-Nine Articles, an older which expounds them in the sense of the theologians whose work they are, and a newer which understands them from the standpoint of the development of the Church of England towards a strictly catholic position. The older, as the more original and in fact historical, must be represented here. According to it the Thirty-Nine Articles are a true and exhaustive expression of the Reformation ideas of the 16th century. Judged according to the articles on Predestination and Sacraments, they belong with the Calvinist confessions, except that they are much milder in expression. In the other articles they reproduce excellently the common convictions of Lutherans and "Reformed" in close association with the language of the German Reformers. The doctrine of Justification is rendered in Lutheran phrasing. The opposition to the Roman Church is altogether more clearly and definitely expressed than in the C. Augustana. The peculiar spirit of the English Reformation betrays itself, apart from the references to the Books of Homilies, particularly clearly in article 37, which denies chief government in the Church to the Pope, and ascribes it to the King's Majesty of England.

CONTENTS. 1 Arts. 1–5 Universally recognized fundamental truths of the Christian religion; 2 Arts. 6–8 Standards of faith; 3 Arts. 9–18 Sin and Grace; 4 Arts. 19–36 Church and Sacraments; 5 Arts. 37–9 Civil order.

Owing to the completeness of the Thirty-Nine Articles the need for their expansion has not been pressing. In the puritan conflicts attempts were made to expand the Thirty-Nine Articles by stricter articles on Predestination (1595 and 1603–04); they fell through. In the confusion of the great English revolution the Thirty-Nine Articles were for the time put aside even in the Church of England in favour of the Westminster Confession. The Restoration restored them unchanged. Owing to the extension of the English Church overseas, especially in the 19th century, the Thirty-Nine Articles have become the confession of a worldwide community. Next to the C. Augustana, the Thirty-Nine Articles have the greatest number of adherents of all the Evangelical confessions of the 16th century. And this all the more as the Methodist communities have retained a considerable part of the Thirty-Nine Articles, at least in a redaction of Wesley's (omitting the article on the ancient creeds, that on Predestination, and others besides).

5. **The Remaining English-speaking Churches.**—The Scottish Reformation, which is independent of the English, produced two confessions of its own. (*a*) The *first Scottish confession* of 1560, composed by John Knox, confirmed in the same year by the Scottish Parliament (not by Queen Mary) and the General Assembly of the Scottish Church, the foundation of the new Reformation order of the Scottish Church, embracing 25 extensive articles; and (*b*) the so-called second Scottish confession, the *Covenant of 1581,* a brief ceremonial confession, to which King and people bound themselves by oath. Both are strongly Calvinist in character. But neither of these has become the permanent confession of the Scottish Church; instead it has been the *Westminster Confession* which was completed by the Westminster Assembly of the first English revolution of 1645–6 under strong Scottish influence, and presented to the English Parliament on April 29, 1647, and passed by it in March 1648. It became the confession of the Scottish Church, in the form in which it still exists, by act of the Scottish General Assembly on August 27, 1647; in 1690 it was finally confirmed for Scotland by Parliament. The two Catechisms which belong with the Westminster Confession were adopted by the Scottish General Assembly in 1648.

The Westminster Confession has an importance extending far beyond Scotland. The English and American Presbyterians received it as their confession, and it has become fundamental for the Congregationalist communities also, at all events with the modifications and the *Platform* which were agreed to by the Savoy Synod in 1658. Thereby the Westminster Confession was originally the Confession of the most influential of the American communities. To-day that is so no longer. For, first, the remaining American communities for which the Westminster Confession, even so far as they are Calvinist, possesses no official importance, have greater importance to-day than in North America's colonial period; and, secondly, Presbyterians and Congregationalists have to-day separated themselves from the old unchanged Westminster Confession. For the Presbyterians decisive for the most part are the decisions of 1903, which moderated the doctrine of Predestination and appended two new articles (34 Holy Ghost, 35 Missions). The Congregationalists have since 1883 procured a brief new confession. So one can speak of a constant influence, but only in a limited sense of an enduring validity, of the Westminster Confession in North America. This course of events is explained by the nature of the Westminster Confession. In itself a master-piece of theological precision and clarity and so far of great weight, it is yet, owing to its length, more closely interwoven with the theological work of the century of orthodoxy than any other modern confession, and it does not shrink from the deliberate accentuation of its conceptions, even to the wounding of natural feeling, if clarity makes this desirable.

Of the confessions of the other English and American communities nothing can here be said, owing to their bewildering variety.

6. **The Present Position.**—With the beginning of the Enlightenment, or of Deism, confessional formulation or transformation came everywhere to a standstill. As, however, theology did not stand still, but underwent great change as a result of scientific study and contact with the spiritual movements of the modern period, the question of the relation of the theology of a Church to the confession of that Church became acute; that, indeed, did not happen everywhere at the same time (North America was first seriously disturbed by it during the last generation or so), but no Church is any longer quite unaffected by it.

The 18th century produced three temporary solutions favourable to the Church. *I. Moderated Teaching.* This pre-supposes the distinction between fundamental and non-fundamental articles, but fixes the limits between them more boldly and freely than was possible in the 17th century. It presupposes further, that theology must retain certain of the fundamentals of the old confessions, especially the revelation of God in Christ. *II. The distinction between public and private teaching.* The official of the Church must conform to the confession of the Church in his official capacity, but as student and writer he is free to express his own convictions. This presupposes the "theory of accommodation," which regards the confessional form of doctrine as a pictorial expression of real truths suited to the naïve ideas of the people, and allows the use of this expression for the purposes of practical instruction, or even regards it as a duty. *III. The emphasis of the right and duty of private judgment concerning the content of Scripture.* All the Evangelical confessions emphasize that they intend to reproduce Scriptural truth and possess no authority of their own; the Christian must convince himself that the confession is Scriptural. This has been understood to mean that the confessions only claim to be binding so far as private judgment endorses them as Scriptural, and that they are certainly not so completely. The ecclesiastical admissibility of this theory is subject to the limitation that private judgment shall at least be in the position to perceive an agreement between Scripture and confession on the points vital for religion.

There were crises in the 18th century also; the severest was the Deistic crisis in England. Nevertheless with the help of one or more of these solutions peace in the Church was then painfully preserved. Theology sought the way of agreement. In the 19th century the solutions described were certainly further used in practice, especially the third. But the contrasting positions in theology and Church became so acute, owing to the revival of the religious life and the clearer definition of ecclesiastical groups, that confessional disputes led to serious crises. In this conflict there is everywhere the desire for a final and clear decision, but this desire does not always follow the same line. Four different endeavours can be distinguished. (1) The abolition of the confession is demanded. This endeavour has been successful, *e.g.*, in the Churches of Switzerland. (2) The revision and simplification of the confession is demanded. This was attempted in 1846 in the Church of the old Prussian union, but it did not succeed. The American Churches have in part adopted this course, as already mentioned. (3) The confession shall be left unaltered, but regarded as binding only according to its "idea and spirit," not according to its letter. The attempt is consequently made to express the spirit of Evangelical Christendom in the simplest and most inwardly convincing way possible, so that, for all the differences, fellowship of faith with the fathers of the confession may be apparent. This is the course that German theology, in many of its best representatives, has taken again and again. (4) The unaltered confession shall retain its unaltered and strict validity, *i.e.*, there shall be an unconditional renewal of the old Lutheran or "Reformed" orthodoxy. No Church is without a section which desires this.

The position therefore is not cleared up; so much only would seem to be clear, that most of the European Evangelical Churches retain their confessions in some form. Curiously enough events have shown that in the valuation of confessions much keener interest is shown in the ancient creeds than in those to which the Reformation gave rise, and this too in good Reformation circles. It is from this standpoint that the peculiar development of the confessional problem in England is most readily understood. In the English Church, since Newman's *Tract XC.* of 1841, a movement has won its way which, strongly attached to the Church, and holding closely to the ancient creeds, accepts also the Thirty-Nine Articles, but so interprets their sense that they allow a departure from the Reformation doctrine and a return to the ancient catholic position.

The movement for the reunion of the Christian Churches added in the 19th century a new motive for confessional formulation, and it has become powerful in the 20th. This movement commonly seeks to establish a new form, side by side with the creeds of the early Church, which expresses the common convictions of all Churches seeking brotherly feeling with one another. The confession of the evangelical alliance of 1846 was already a first attempt. The latest step in this direction is the message of the Churches to the world which was, not indeed accepted, but received at the Lausanne Conference in 1927.

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(E. Hir.)

CREEK. This, the most important native people of Muskogi (*q.v.*) lineage, was resident in Georgia and Alabama. Comprising a series of local tribal leagues in the days of de Soto and other Spanish 16th century explorers, they had formed themselves by the 18th century into a confederacy of about 50 towns with a population approaching 20,000, divided into the Upper Creeks or Kusa and Lower or Kawita. This confederacy remained consistently hostile to the Spaniards and friendly with the English settlers. They fought against the Americans in the war of 1812–15, and were defeated by Andrew Jackson. Twenty-five years later they removed to Indian Territory, now Oklahoma, where they formed a semi-autonomous "nation," one of the "five civilized tribes." While still an independent confederacy, the Creek absorbed weakened or wasted Muskogian tribes, like the Hitchiti and the Alibamu-Koasati, as well as alien groups such as Yuchi and Natchez. They also held negro slaves, and as a people now contain considerable African and Caucasian blood, by adoption as well as by intermarriage. In 1904, 15,400 persons were officially recognized as Creeks. The Seminole (*q.v.*) are an off-shoot from the Creeks in the historic period.

See Swanton, *Bur. Am. Ethn.* Bull. 73, 1922. (A. L. K.)

CREEK, a small inlet on a low coast or in the lower reaches of a river at the mouth of a small tributary, also applied to a shallow narrow harbour for small vessels. In America and Australia especially there are many long shallow streams intermittent in flow and navigable only at their tidal estuaries, yet of great economic importance. They form complete river-systems, and are the only supply of surface water for considerable areas. Though sometimes a mere chain of "water-holes," occasionally they are strongly flooded. Explorers, advancing up such narrow inlets or "creeks," used the same word for the tributaries.

CREEPER, BROWN, the name given to the North American subspecies of the small brown forest bird known in Great Britain as the tree-creeper (*q.v.*). In the eastern states the form is *Certhia familiaris americana;* the Mexican creeper (*C. f. albescens*); the Rocky Mountain creeper (*C. f. montana*); the California creeper (*C. f. occidentalis*); the Sierra creeper (*C. f. zelotes*), are very similar in colour and habits.

CREEPING BARRAGE. A military term denoting the system (introduced in 1916) whereby infantry advance and the artillery fire are regulated by a time-table, the barrage, or curtain of shells, moving forward a stated number of yards every minute and the infantry following behind it. The limitation of the standing barrage was that the curtain of shells did not move with the troops; and whilst a *creeping barrage* made short bounds of 50 to 100 yards, a *jumping barrage* made longer ones, and was in fact no more than a series of short standing barrages. A *rolling barrage* only differed from a creeping in that the moving forward of the shell curtain was continuous from opening of fire onwards, no definite bounds of fire being made.

CREETOWN, a seaport and county district of Kirkcudbrightshire, Scotland. The village is near the head of Wigtown bay, 18 mi. W. of Castle-Douglas, and is served by railway to Stranraer and Dumfries. Pop. (1931) of district, 3,120; of village, 759. The village dates from 1785. There are important granite quarries in the vicinity, the stone for the Liverpool docks having been obtained from them. Sir Walter Scott laid part of the scene of *Guy Mannering* in this neighbourhood, and Dr. Thomas Brown, the renowned metaphysician (1778–1820), was a native of the parish (Kirkmabreck) in which the modern Creetown lies.

CREEVEY, THOMAS (1768–1838), English politician, son of William Creevey, a Liverpool merchant, was born in that city in March 1768. He went to Queen's college, Cambridge, and graduated as seventh wrangler in 1789. The same year he became a student at the Inner Temple, and was called to the bar in 1794. In 1802 he entered parliament through the duke of Norfolk's nomination as member for Thetford, and married a widow with six children, Mrs. Ord, who had a life interest in a comfortable income. Creevey was a Whig and a follower of Fox, and his active intellect and social qualities procured him a considerable intimacy with the leaders of this political circle. In 1806, when the brief "All the Talents" ministry was formed, he was given the office of secretary to the Board of Control; in 1830, when next his party came into power, Creevey, who had lost his seat in parliament, was appointed by Lord Grey treasurer of the ordnance; and subsequently Lord Melbourne made him treasurer of Greenwich hospital. After 1818, when his wife died, he had very slender means of his own. Creevey died in February 1838, and is remembered through the *Creevey Papers,* published in 1903 and again in 1905 under the editorship of Sir Herbert Maxwell, which, consisting partly of Creevey's own journals and partly of correspondence, give a lively and valuable picture of the political and social life of the late Georgian era, and are characterized by an almost Pepysian outspokenness. They are a useful addition and correction to the *Croker Papers,* written from a Tory point of view. For thirty-six years Creevey had kept a "copious diary," and had preserved a vast miscellaneous correspondence with such people as Lord Brougham, and his step-daughter, Elizabeth Ord, by keeping his letters to her, had assisted him in compiling material avowedly for a collection of Creevey Papers in the future. At his death it was found that he had left his mistress, with whom he had lived for four years, his sole executrix and legatee, and Greville notes in his *Memoirs* the anxiety of Brougham and others to get the papers into their hands and suppress them. Brougham may have succeeded in this, for the diary did not survive and the papers from which Sir Herbert Maxwell made his selection came into his hands from Mrs. Blackett Ord, whose husband was the grandson of Creevey's eldest step-daughter.

CREFELD or **KREFELD-URDINGEN,** a town of Germany, in the Prussian Rhine province, on the left side of and 3 mi. distant from the Rhine, 32 mi. N.W. from Cologne, and 15 mi. N.W. from Düsseldorf. Pop. (1939) 169,485. The town is one of the finest in the Rhine provinces, being well and regularly built. The inner section forms a large rectangle, enclosed by wide boulevards. This rare feature is due to the fact that Crefeld was always an "open place," and therefore the circular form of a fortress town did not develop.

Crefeld is first mentioned in records of the 12th century. It received market rights in 1361 and the status of a town in 1373. It belonged to the counts of Mörs, and was annexed to Prussia, with the countship, in 1702. It remained of little importance until the 17th century, when religious persecution drove to it a number of Calvinists and Separatists from Jülich and Berg who introduced the manufacture of linen. Immigration further increased in the 18th century, when the silk industry was introduced from Holland and the town rapidly developed. The French occupation in 1795 interfered for a time with the prosperity of its new trade which, however, grew in importance during the 19th century. The town is famous for its technical schools which give instruction in textile manufactures. The Friedenskirche is Gothic in style. The town possesses a town hall and a museum.

Among the public monuments there is one to Karl Wilhelm, the composer of *Die Wacht am Rhein.*

Crefeld specializes in silk and velvet manufactures. A special feature is the manufacture of silk for coverings for umbrellas. The other industries of the town, notably dyeing, stuff-printing and stamping, are very considerable, and there are also engineering and machine shops, chemical, soap and other factories. It is an important railway centre and was therefore bombed by the British R.A.F. many times and very heavily during World War II.

CREIGHTON, MANDELL (1843–1901), English historian and bishop of London, was born at Carlisle on July 5 1843. He was educated at Durham grammar school and at Merton College, Oxford, where in 1866 he became tutor and fellow. He was ordained priest in 1873; and during 1872 he had married Louise von Glehn, herself a writer of several text books of history. In 1875 he became vicar of Embleton, Northumberland, with an ancient and beautiful church and a fortified parsonage house, and within reach of the fine library in Bamburgh Keep. Here he planned and wrote the first two volumes of his chief historical work, the *History of the Papacy;* and in 1884 he was appointed to the newly-founded Dixie professorship of ecclesiastical history at Cambridge, where he went into residence early in 1885. At Cambridge his influence at once made itself felt, especially in the reorganization of the historical school. In 1886 he combined with other leading historians to found the *English Historical Review,* of which he was editor for five years. Meanwhile the vacations were spent at Worcester, where he had been nominated a canon residentiary in 1885. In 1891 he was made canon of Windsor; but he never went into residence, being appointed in the same year to the see of Peterborough. He became the first president of the Church Historical Society (1894), and continued in that office till his death.

In 1897, on the translation of Dr. Temple to Canterbury, Bishop Creighton was transferred to London. During Dr. Temple's episcopate ritual irregularities of all kinds had grown up, which left a very difficult task to his successor. His studied fairness did not satisfy partisans on either side; and his efforts towards conciliation laid him open to much misunderstanding. He strained every nerve to induce his clergy to accept his ruling on the questions of the reservation of the Sacrament and of the ceremonial use of incense in accordance with the archbishop's judgment in the Lincoln case; but when, during his last illness, a prosecutor brought proceedings against the clergy of five recalcitrant churches, the bishop, on the advice of his archdeacons, interposed his veto. In accordance with a vote of the diocesan conference, the bishop arranged the "Round Table Conference" between representative members of various parties, held at Fulham in October 1900, on "the doctrine of the Holy Eucharist and its expression in ritual," and a report of its proceedings was published with a preface written by him. As he was a historian before he became a bishop, so it was his historical sense which determined his general attitude as a bishop. It was this, together with a certain native taste for ecclesiastical pomp, which made him—while condemning the unhistorical extravagances of the ultra-ritualists—himself a ritualist. He was the first bishop of London, since the Reformation, to "pontificate" in a mitre as well as the cope, and though no man could have been less essentially "sacerdotal" he was always careful of correct ceremonial usage. He died on Jan. 14 1901, and was buried in St. Paul's Cathedral.

Bishop Creighton's principal published works are: *History of the Papacy during the Period of the Reformation* (5 vols., 1882–97, new ed.); *History of the Papacy from the Great Schism to the Sack of Rome* (6 vols. 1897); *The Early Renaissance in England* (1895); *Cardinal Wolsey* (1895); *Life of Simon de Montfort* (1876, new ed. 1895); *Queen Elizabeth* (1896). He also edited the series of *Epochs of English History,* for which he wrote "The Age of Elizabeth" (13th ed., 1897); *Historical Lectures and Addresses by Mandell Creighton, etc.,* edited by Mrs. Creighton, were published in 1903.

See *Life and Letters of Mandell Creighton, etc.,* by his wife (2 vols., 1904); and the article "Creighton and Stubbs" in *Church Quarterly Review* for Oct. 1905.

CREIL, a town of northern France, in the department of Oise, 32 mi. N. of Paris on the Northern railway, on which it is an important junction. Pop. (1936) 10,493. The church (12th to 15th centuries) is in the Gothic style. There are some traces of a castle in which Charles VI. resided during the period of his madness. The manufacture of machinery, heavy iron goods and nails, and copper and iron founding, are important industries, and the Northern railway has workshops there. The town was bombarded in 1918.

CRELL or **KRELL, NICHOLAS** (*c.* 1551–1601), chancellor of the elector of Saxony, was born in Leipzig and educated at the university of his native town. About 1580 he entered the service of Christian, the eldest son of Augustus I., elector of Saxony, and when Christian succeeded his father as elector in 1586 became his most influential counsellor. Crell's religious views were Calvinistic or Crypto-Calvinistic, and both before and after his appointment as chancellor in 1589 he sought to substitute his own form of faith for the Lutheranism which was the accepted religion of electoral Saxony. In foreign politics, also, he sought to change the traditional policy of Saxony. These proceedings made the chancellor very unpopular, and when the elector died in October 1591 he was deprived of his offices and thrown into prison by order of Frederick William, duke of Saxe-Altenburg, the regent for the young elector Christian II. His trial dragged on for ten years until he was sentenced to death and executed at Dresden on Oct. 9, 1601.

See A. V. Richard, *Der kurfürstliche sächsische Kanzler Dr. Nicholas Krell* (Dresden, 2 vols., 1859); F. Brandes, *Der Kanzler Krell, ein Opfer des Orthodoxismus* (Leipzig, 1873); B. Bohnenstädt, *Das Prozessverfahren gegen den kursächsischen Kanzler Dr. Nikolaus Krell* (Halle, 1901).

CRELLE, AUGUST LEOPOLD (1780–1855), German mathematician, was born at Eichwerder, Wriezen, on March 17, 1780. Crelle was a man of many interests and great organizing ability, and worked for the advancement of the exact sciences.

By profession he was an "Oberbaurat" (civil engineer), and built the first railroad in Germany, but was interested in educational matters, and in 1828 he left the technical institute in which he was employed to take up service with the ministry of ecclesiastical affairs and public education. He was the author of many mathematical papers, mostly unimportant; his great service to mathematics was the founding of the *Journal für die reine und ungewandte Mathematik,* now known as *Crelle's Journal.* Abel and Steiner encouraged Crelle in this venture, and were the chief contributors to the first numbers; Jacobi was another early contributor. Without Crelle's generous encouragement, some of Abel's greatest work might never have been completed and published. In 1829 Crelle started the *Journal für Baukunst.* The Berlin-Potsdam railway was built in 1838–40 according to his plans. Crelle died on Oct. 6, 1855, at Berlin.

CREMA, a town and episcopal see of Lombardy, Italy, province of Cremona, 26 mi. N.E. by rail from the town of Cremona. Pop. (1936) 13,541 (town); 25,163 (commune). It is on the bank of the Serio, 240 ft. above sea level, in the centre of a rich agricultural district. The cathedral has a fine Lombard Gothic façade of the second half of the 14th century, and a campanile; the rest of the church has been restored in Baroque. The clock tower opposite dates from the period of Venetian dominion. Crema was the chief place of the territory of Isola Fulcheria in the 10th century. In the 12th, Cremona attacked it and Milan sided with it; Barbarossa sacked it in 1160, but it was rebuilt in 1185; it fell under the Visconti in 1338, joined the Lombard republic in 1447, and was taken by Venice in 1449, remaining under that Power till 1797, save for the period 1509–29.

CREMATION, the burning of human corpses. This method of disposal of the dead was the general practice of the ancient world, with the important exceptions of Egypt, where bodies were embalmed, Judaea, where they were buried in sepulchres, and China, where they were buried in the earth. Cremation is still practised over a great part of Asia and America, but not always in the same form. Thus, the ashes may be stored in urns, or buried in the earth, or thrown to the wind, or (as among the Digger Indians) smeared with gum on the heads of the mourners.

There can be little doubt that the practice of cremation in modern Europe was at first stopped, and has since been prevented in great measure, by the Christian doctrine of the resurrection of the body; partly also by the notion that the Christian's body was redeemed and purified. It is, however, in the ultimate resort, really a sanitary one. The objectionable results of pit-burial and burial in churches and churchyards, made cemeteries necessary. But cemeteries are equally liable to overcrowding, and are often nearer to inhabited houses than the old churchyards.

In 1874, a congress called to consider the matter at Milan resolved to petition the Chamber of Deputies for a clause in the new sanitary code, permitting cremation under the supervision of the syndics of the commune. It was Sir Henry Thompson, however, who first brought the question prominently before the English public. Thompson's problem was—"Given a dead body, to resolve it into carbonic acid, water and ammonia, rapidly, safely and not unpleasantly." In a reverberating furnace used by him a body, weighing 144lb., was reduced in 50 minutes to about 4lb. of lime dust. The noxious gases, which were undoubtedly produced during the first five minutes of combustion, passed through a flue into a second furnace and were entirely consumed. In the ordinary Siemens regenerative furnace (which was adapted by Reclam in Germany for cremation, and also by Sir Henry Thompson) only the hot-blast was used, the body supplying hydrogen and carbon; or a stream of heated hydrocarbon mixed with heated air was sent from a gasometer supplied with coal, charcoal, peat or wood—the brick or iron-cased chamber being thus heated to a high degree before cremation begins.

Steps were at once taken (1874) to form an English society to promote the practice of cremation. On account of difficulties and prejudices the council of the society was unable to purchase a freehold until 1878, when an acre was obtained at Woking, not far distant from the cemetery. The next important development was an application to the council in 1882 to undertake the cremation of two deceased persons who had left express instructions to that effect. The Home Secretary was applied to, and refused. In 1883 a cremation was performed in Wales by a man on the body of his child, and legal proceedings were taken against him. Mr. Justice Stephen, in Feb. 1884, delivered his well-known judgment at the assizes there, declaring cremation to be a legal procedure, provided no nuisance were caused thereby to others. The council of the society at once publicly offered to perform cremation, laying down strict rules for careful enquiry into the cause of death in every case. They stated that they were fully aware that the chief practical objection to cremation was that it removed traces of poison or violence which might have caused death and adopted a system of very stringent enquiry. At present two death certificates signed by independent medical practitioners are required in England before cremation can be carried out.

On March 26, 1885, the first cremation at Woking took place, the subject being a lady. In 1888 it became necessary, nearly 100 bodies having been by this date cremated, to build a large hall for religious service, as well as waiting-rooms, in connection with the crematorium there. The number of cremations slowly increased year by year, and the total at the end of 1900 was 1,824. Many were persons of distinction.

The Cremation act 1902 (2 ed. VII. ch. 8) and the regulations made thereunder by the Home Secretary have laid down a code of laws applicable and binding where cremation is resorted to.

Undoubtedly in populous communities and in crowded districts the burial of dead bodies may be dangerous to the living, particularly in the case of deaths from contagious disease. In a report by Edwin Chadwick (London, 1843) the existence of such a danger was strikingly demonstrated, and intramural interments were in consequence made illegal. All decaying animal remains emit gases which, ultimately, become converted into vegetable growth of some kind—trees, crops, garden produce, grass, etc. It may be taken as certain that the gaseous products arising from a cremated body—amounting, although invisible, to no less than 97% of its weight, 3% only remaining as solids, in the form of a pure white ash—become in the course of a few hours integral and active elements in some form of vegetable life. The result of this reasoning has been that, by slow degrees, crematoria have been constructed at many of the populous cities in Great Britain and abroad (see *Statistics* below).

The subject of employing cremation for the bodies of those who die of contagious disease is important. Such diseases include small-pox, scarlet fever, diphtheria, tuberculosis, enteric, relapsing and puerperal fevers, the annual number of deaths from which in the United Kingdom in 1926 was upwards of 94,000. In cremation complete disinfection takes place by means of the high temperature to which the body is exposed. At the present day it is compulsory to report any case in the foregoing list of diseases to the local medical officer of health; and it is customary to disinfect the rooms, clothes and furniture used by the patient; but in case of death, the body, which is the source and origin of the evil, and loaded with infectious germs, is left with all the danger attached to its preservation in that condition, when buried in a fit or unfit soil or situation.

The process of preparing a body for cremation requires a brief notice. The plan generally adopted is to place it (in the usual shroud) in a light pine shell, discarding all heavy oak or other coffin, and to introduce it into the furnace in that manner. Thus there is no handling or exposure of the body after it reaches the crematorium. The type of furnace in general use is on the reverberatory principle, the body being consumed in a separate chamber heated to over 2,000° by a coke fire. In a few instances a furnace burning ordinary illuminating gas is used.

Statistics.—The following statistics show the history of modern cremation and its progress at home and abroad. In 1906 in the United Kingdom there were 13 crematoria and 739 cremations took place; in Italy the figures were 28 and 440; Germany, 14 and 2,507; Denmark, 1 and 77; Sweden 2 and 70; Switzerland 4 and 524; France, 4 and 6,906 (including stillbirths); in Tokyo (Japan) alone there are no fewer than 22 crematoria and the numbers of cremations and burials in earth are about equal. In the United States crematoria have been established in more than fifty cities, and about 10,000 cremations take place each year. The movement in favour of cremation is undoubtedly gaining strength. In 1926, in the United Kingdom there were 16 crematoria and 2,877 cremations took place; in Italy the figures were 36 and 18,020; Germany 77 and 40,066; Switzerland, 18 and 3,788; France 5 and 4,600; United States 87 and 17,000; Denmark, 3 and 1,223.

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CREMATION CERTIFICATE, in the United States, a certificate, signed by duly authorized persons, such as trustee, committee, etc., stating that they have witnessed the total destruction by fire of the papers or securities therein named. It is customary to burn retired securities and to retain a cremation certificate as evidence of the destruction.

CRÉMAZIE, OCTAVE (1827–1879), Canadian poet, was born at Quebec on April 16, 1827, and educated at the Seminary of Quebec. An extraordinarily learned man, he started a bookshop with his two brothers, Jacques and Joseph, which became the centre of a literary circle including Etienne Parent, F. Garneau, Louis Fréchette among others. This club published a magazine, *Les Soirées Canadiennes,* with the object of perpetuating the old folklore of French Canada before it could be forgotten. Crémazie also published poems in the *Journal de Quebec* from about 1854 onwards. Unfortunately he became involved in business difficulties, and to escape their consequences, he departed in 1862 for France, where he spent the rest of his life in great poverty, under the assumed name of Jules Fontaines. During this time he wrote the gloomy poem, *Promenade des trois morts,* and a journal *Siège de Paris,* describing the siege of 1870, which he witnessed. His poetry was characterized by a patriotic love of Canada and Canadian nature, shown especially in the *Chant du vieux soldat canadien.*

His *Oeuvres Complètes* have been collected, with an introduction by H. R. Casgrain (Montreal, 1883).

CRÊME DE MENTHE, a peppermint liqueur, usually of a beautiful dark green colour. By a series of distillations the essence of the mint, the scent of it, is separated from oils and impurities. That essence is used in the making of crême de menthe. In former days the French manufacturers came regularly to England to buy their supplies of mint, plantations of which flourished at Mitcham, in Surrey. They regarded it as the finest mint procurable. Some makers use plain natural spirit in the making of the liqueur; but the best manufacturers use good Cognac brandy. The best of these liqueurs are exported from France with an age certificate of not less than five years. The colouring should be, and in the best makes always is, pure vegetable matter. (J. V. M.)

CREMER, JAKOBUS JAN (1827–1880), Dutch novelist, born at Arnhem, started life as a painter. His first tales (*Betuwsche Novellen* and *Overbetuwsche Novellen*), published about 1855—reprinted many times since, and translated into German and French—made his reputation. These short stories of Dutch provincial life are written in the quaint dialect of the Betuwe, the large flat Gelderland island, formed by the Rhine, the name recalling the presumed earliest inhabitants, the Batavi. In his later novels Cremer abandons both the dialect and the slight love-stories of the Betuwe. The principal are: *Anna Rooze* (1867), *Dokter Helmond en zijn Vrouw* (1870), *Hanna de Freule* (1873), *Daniel Sils,* etc. Cremer's *Romantische Werke* were collected in 1887–88 (Leiden, 12 vols.).

CREMER, SIR WILLIAM RANDAL (1838–1908), English pacifist, was born at Fareham, Wilts., on March 18, 1838, and at 12 years of age went to work in a shipyard. He was then apprenticed as a carpenter, and was one of the founders of the Amalgamated Society of Carpenters and Joiners (1860). He was secretary of the British section of the First International (*see* INTERNATIONAL), but resigned owing to dissensions with Robert Applegarth and because the pacifist programme which he advocated was turned down at the Geneva Conference of 1866. Cremer's first piece of definitely pacifist work was done in 1870–71 when he formed a working men's committee for the advocacy of neutrality in the Franco-German War. This committee developed, after this emergency was past, into the Workmen's Peace Association, of which Cremer was secretary until his death, in London, on July 22, 1908. He was M.P. for Haggerston, London, from 1885 to 1895, and from 1900 to 1908. He was secretary of the Interparliamentary Union from 1889 onwards. Cremer received the Nobel Peace Prize in 1903. Of the £8,000 awarded he gave £7,000 in trust to the International Arbitration League.

See Howard Evans, *Sir Randal Cremer* (1911).

CREMERA, a small stream in Etruria (mod. *Fosso della Valchetta*), which falls into the Tiber about 6m. N. of Rome. The identification with the Fosso della Valchetta is assured by Livy's statement that the Saxa Rubra were not far off, and this we know to be the Roman name of the post station of Prima Porta, 9m. from Rome on the Via Flaminia. It is famous for the defeat of the three hundred Fabii, who had established a fortified post on its banks. (*See* FIDENAE.)

CRÉMIEUX, ISAAC MOÏSE ("ADOLPHE") (1796–1880), French lawyer and politician, was born of Jewish parents at Nîmes on April 30, 1796, and died in Paris on Feb. 10, 1880. After practising at the bar of his native city, he went to Paris in 1830, and from that time played a considerable part in politics. He was minister of justice in the provisional revolutionary government of 1848 and in that of 1870–71. As minister of justice in 1870–71 he secured the franchise for the Jews in Algeria by a decree known as the *Décret Crémieux.* Crémieux was president of the Universal Israelite Alliance. He published a *Recueil* of his political cases (1869).

CREMONA, LUIGI (1830–1903), Italian mathematician, was born at Pavia, and fought as a volunteer in the abortive north Italian rising of 1848–49. After studying under Francesco Brioschi at the University of Pavia he became elementary mathematical master at the gymnasium and lyceum of Cremona, and afterwards at Milan. In 1860 he became professor of higher geometry at Bologna, and in 1866 professor of higher geometry and graphical statics at the higher technical college of Milan. In 1873 he became professor of higher mathematics at Rome, and organized the college of engineering. Cremona's reputation was now European. In 1879 he became a corresponding member of the British Royal Society, and a senator of the kingdom of Italy. His life was devoted to the reform of higher mathematical teaching in Italy. Cremona was a prolific contributor to mathematical journals of Italy and Europe, and some of his books have been translated into English; *e.g.,* his manual on *Graphical Statics* and his *Elements of Projective Geometry* (tr. C. Leudesdorf). His reputation mainly rests on his *Introduzione ad una teoria geometrica delle curve piane,* which proclaims him a follower of the Steinerian or synthetical school of geometricians.

CREMONA, a city and episcopal see of Lombardy, Italy, the capital of the province of Cremona, situated on the north bank of the Po, 155ft. above sea-level, 60m. by rail S.E. of Milan. Pop. (1936) 54,564 (town); 64,019 (commune). It is oval in shape, and retains its mediaeval fortifications. The line of the streets is as a rule irregular.

The finest building is the cathedral, in the Lombard Romanesque style, begun in 1107 and consecrated in 1190. The wheel window of the main façade dates from 1273. The transepts, added in the 13th and 14th centuries (before 1370), have picturesque brick façades, with fine terra-cotta ornamentation. The great Torrazzo, a tower 397ft. high (the highest in Italy) which stands by the cathedral, and is connected with it by a series of galleries, dates from 1267–1291. It is square below, with an octagonal summit of a slightly later period. The main façade of the cathedral was largely altered in 1491–1501. The interior is fine, and is covered with frescoes by Cremonese masters of the 16th century

(Boccaccio Boccaccino, Romanino, Pordenone, the Campi, etc.). The choir has fine stalls of 1490. Adjacent to the cathedral is the octagonal baptistery of 1167, 92ft. in height and 75ft. in external diameter, also in the Lombard Romanesque style. The so-called Campo Santo, close to the baptistery, contains a 12th century mosaic pavement with emblematic figures. Of the other churches, S. Michele has a simple and good Lombard Romanesque 13th-century façade, and a plain interior of the 10th century; and S. Agata a good campanile in the former style. Many of them contain paintings by the later Cremonese masters, especially Galeazzo Campi (d. 1536) and his sons Giulio and Antonio. The latter are especially well represented in S. Sigismondo, 1½m. outside the town to the east. On the side of the Piazza del Comune opposite to the cathedral are two 13th century Gothic palaces in brick, the Palazzo Comunale and the former Palazzo dei Giureconsulti. In the Piazza is a statue of the composer Amilcare Ponchielli. The Palazzo Fodri, now the Monte di Pietà, has a beautiful 15th century frieze of terra-cotta bas-reliefs, as have some other palaces in private hands.

Cremona was founded by the Romans in 218 B.C. (the same year as Placentia) as an outpost against the Gallic tribes. It soon became one of the most flourishing towns of upper Italy. It remained prosperous (we may note that Virgil came here to school from Mantua) until it was taken and destroyed by the troops of Vespasian after the second battle of Betriacum in A.D. 69; the temple of Mefitis alone being left standing. One of the bronze plates which decorated the exterior of the war-chest of the *legio III. Macedonica,* one of the legions which had been defeated at Betriacum, has been found near Cremona. Vespasian ordered its immediate reconstruction, but it never recovered its former prosperity, though its position on the north bank of the Po, at the meeting point of roads from Placentia, Mantua (the Via Postumia in both cases), Brixellum (where the roads from Cremona and Mantua to Parma met and crossed the river), Laus Pompeia and Brixia, still gave it considerable importance. It was destroyed once more by the Lombards under Agilulf in A.D. 603, and rebuilt in 615, and was ruled by dukes; but in the 9th century the bishops of Cremona began to acquire considerable temporal power. The commune of Cremona is first mentioned in a document of 1098, recording its investiture by the countess Matilda with the territory known as Isola Fulcheria. In the war of the Lombard League against Barbarossa, Cremona, after having shared in the destruction of Crema, in 1160 and Milan in 1162, finally joined the League, but took no part in the battle of Legnano, and thus procured itself the odium of both sides. In the Guelph and Ghibelline struggles Cremona took the latter side, and defeated Parma decisively in 1250. It was during this period that Cremona erected its finest buildings. There was, however, a Guelph reaction in 1264; the city was taken and sacked by Henry VII. in 1311, and was a prey to struggles between the two parties, until Galeazzo Visconti took possession of it in 1322: it then rebelled, and surrendered to Azzone in 1334. In 1406 it fell under the sway of Cabrino Fondulo, who received with great festivities both the emperor Sigismund and Pope John XXIII., the latter on his way to the council at Constance; he, however, handed it over to Filippo Maria Visconti in 1419. In 1499 it was occupied by Venetians, but in 1512 it came under Massimiliano Sforza. In 1525 it fell under Spanish domination, and was compelled to furnish large money contributions. The population fell to 10,000 in 1668. The surprise of the French garrison on February 2, 1702, by the Imperialists under Prince Eugene, was a celebrated incident of the War of the Spanish Succession. The Imperialists were driven from Cremona after a sharp struggle, but captured Marshal Villeroi, the French commander. Hence the celebrated verse:

> Français, rendons grâce à Bellone;
> Notre bonheur est sans égal;
> Nous avons conservé Cremone,
> Et perdu notre général.

In the 18th century the prosperity of Cremona revived. In the Italian republic it was the capital of the department of the upper Po. Like the rest of Lombardy it fell under Austria in 1814, and became Italian in 1859.

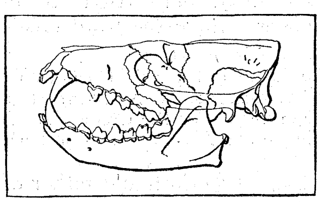
CREMORNE GARDENS, formerly a popular resort by the Thames in Chelsea, London, England. The earl of Huntingdon (*c.* 1750), built a mansion here, which passed into the hands of Thomas Dawson, Baron Dartrey and Viscount Cremorne (1725–1813), who greatly beautified it. It was sold and converted into a place of entertainment, being popular as such from 1845 to 1877. It was later closed down and the site of the gardens was built over. The name survives in Cremorne Road.

CRENELLE, a term specifically designating an embrasure of a battlement, but also commonly applied to the whole system of defence by battlements. In mediaeval times no one could "crenellate" a building without special licence from his supreme lord.

CREODONTA. An extinct suborder of primitive Carnivora characteristic of the older Tertiary. The creodonts were the flesh-eating animals of the northern continents during the Eocene, and included a number of families of diverse or partly parallel specialization, from one of which, the Miacidae, were descended the various families of modern Carnivora. They are distinguished by certain primitive characters, the small brain, separate scaphoid and lunar bones of the carpus, and lack of ossification of the tympanic bulla. Except in the family Miacidae they lack the specialization of $\frac{p^4}{m1}$ as "carnassials" characteristic of the fissiped Carnivora; but another pair of teeth may be enlarged and specialized instead ($m\frac{1}{2}$ in Oxyaenidae, $m\frac{2}{3}$ in Hyaenodontidae). They are distinguished from Insectivora and associated with the modern Carnivora by the enlargement of the canines into powerful laniary teeth, reduction of incisors, the more sectorial characters of the cheek teeth, heavier muzzle and jaws with strong zygomatic arches, also by a number of other characters: in the feet (astragalar trochlea narrower with inner keel imperfect, astragalar foramen present, phalanges more elongate and curved, etc.).

The earliest Creodonta are the *Arctocyonidae* of the Paleocene, with primitive tritubercular teeth, the molars subequal, none of them enlarged as carnassials. These gave rise to a number of different specialized families of creodonts during the Eocene. The *Arctocyoninae* had flattened bearlike teeth and were plantigrade, with sharp compressed claws like the bears.

The Miacidae include a considerable variety of small or medium-sized creodonts with more or less tuberculo-sectorial molars, the first molar the largest of the three and progressively specialized along with the fourth premolar of the upper jaw into enlarged shearing teeth or carnassials. The teeth behind the carnassial are in some genera (*Vulpavus, Oödectes*) of similar shearing type but smaller size; in other genera they are flattened crushing teeth, two in number (*Didymictis, Viverravus*), or three (*Miacis, Uintacyon, Vassacyon*). In the Upper Eocene the Miacidae gave rise to the fissiped carnivores of modern type and they could be classified in the suborder Fissipeda just as well as among the generally more primitive Creodonta.



BY COURTESY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

SKULL OF HYAENODON, A CREODONT OF EARLY TERTIARY AGE, WHICH IN SIZE AND STRUCTURE WAS SOMEWHAT SIMILAR TO THE WOLF

The Oxyaenidae included larger predacious types, *Oxyaena* resembling a wolverine, *Patriofelis* reaching the size of a bear with massive hyenalike teeth, *Palaeonictis* of more feline characters, the smaller *Limnocyon,* analogous in teeth, proportions and probable habits, to modern weasels and martens.

The Hyaenodontidae include many and various types in North America, Europe, Asia and Africa. In the earliest forms, *Sinopa, Proviverra, Tritemnodon,* of the Lower and Middle Eocene, the teeth are tuberculo-sectorial, the molars not very different in size, and the skull is long and slender, the proportions of body and limbs like those of the modern viverrids (civet family) except for the very long and heavy tail. In *Pterodon* and *Hyaenodon* of the Upper Eocene and Oligocene, the teeth are more completely sectorial, the size larger and proportions of skull and limbs are more like those of wolves. Widespread in the Upper Eocene and Oligocene, late survivors occur in the Indian Pliocene.

The most peculiarly specialized group of the creodonts is the Mesonychidae, distinguished by the loss of any shearing action of the teeth, the cusps becoming high, round, blunt-tipped, adapted probably for crushing and piercing some hard, shelly food. The muzzle and jaws are elongate, the limbs and feet in some species slender and cursorial as in the wolf, while others attain large size and massive proportions comparing with the larger bears. The toes are tipped with flattened hoofs instead of claws. These are found in the Eocene of western North America, western Europe and central Asia. Several of them equalled or exceeded the largest living Carnivora in size of skull, and in the Upper Eocene of Mongolia the gigantic *Andrewsarchus* has a skull three feet long, the largest known carnivore, even allowing for the probability that the skull was relatively large in proportion to the skeleton. (W. D. M.; X.)

CREOLE, a word used originally (16th century) to denote persons born in the West Indies of Spanish parents, as distinguished from immigrants direct from Spain, aboriginals, negroes or mulattos (from the Fr. form of *criollo,* a West-Indian corruption of Span. *criadillo,* cognate with Lat. *creare,* to create). It is now used of the descendants of non-aboriginal races born and settled in the West Indies, in various parts of the American mainland and in Mauritius, Réunion and some other places colonized by Spain, Portugal, France, or (in the case of the West Indies) by England. In a similar sense the name is used of animals and plants. The use of the word by some writers as necessarily implying a person of mixed blood is totally erroneous; in itself "creole" has no distinction of colour; a creole may be a person of European, negro or mixed extraction—or even a horse.

Local variations occur in the use of the word as applied to people. In the West Indies it designates the descendants of any European race; in the United States the French-speaking native portion of the white race in Louisiana, whether of French or Spanish origin. The French Canadians are never termed creoles, nor is the word now used of the South Americans of Spanish or Portuguese descent, but in Mexico whites of pure Spanish extraction are still called creoles. In all the countries named, when a non-white creole is indicated the word negro is added. In Mauritius, Réunion, etc., on the other hand, creole is commonly used to designate the black population, but is also occasionally used of the inhabitants of European descent. The difference in type between the white creoles and the European races from whom they have sprung, a difference often considerable, is due principally to changed environment—especially to the tropical or semi-tropical climate of the lands they inhabit. The many patois founded on French and Spanish, and used chiefly by creole negroes, are spoken of as creole languages, a term extended by some writers to include similar dialects spoken in countries where the word creole is rarely used.

See G. W. Cable, *The Creoles of Louisiana* (1884); A. Coelho, "Os Dialetos romanicos on neo latinos na Africa, Asia e America," *Bol. Soc. Geo. Lisboa* (1884–86), with bibliography. For the Creole French of Haiti *see* an article by Sir H. H. Johnston in *The Times* (London), April 10, 1909.

CREON (1) son of Lycaethus, king of Corinth and father of Glauce or Creüsa, the second wife of Jason (*q.v.*).

(2) *See* OEDIPUS.

CREOPHYLUS of Samos, one of the earliest Greek epic poets. According to an epigram of Callimachus (quoted in Strabo xiv. p. 638) he was the author of a poem called *The Capture of Oechalia.* He was said to have been a friend of Homer, who, according to another tradition, was himself the author of the *Capture,* and presented it to Creophylus.

See F. G. Welcker, *Der epische Cyclus* (1865–82).

CREOSOTE or **KREOSOTE.** In 1832 Reichenbach applied the term "kreosote" to a substance possessing powerful antiseptic properties and derived from wood tar. Shortly afterwards, Runge discovered carbolic acid in coal tar and showed that it possessed many of the characteristics of "kreosote." The isolation of similar products from various sources, however, has led to the adoption of the term "creosote" as signifying the mixture of phenol and phenoloid substances derived indifferently from coal, wood, blast furnace, and other tars and from shale and bone oils. In pharmaceutical circles, however, the term "creosote" is still restricted to the product isolated from wood tar, but in industry it is loosely applied to designate that fraction of oils distilling at 200°–300° C. and derived from coal tar. Owing to their distinctive character, the creosotes from wood tar and from blast-furnace tar are known as "wood-tar creosote" and "blast-furnace creosote."

Wood-tar Creosote.—By the distillation of wood tar, particularly of that derived from the carbonization of beechwood, a fraction heavier than water is obtained, from which, after redistillation to remove last traces of acetic acid, a complex mixture of phenolic substances can be isolated by a treatment similar to that described for the extraction of phenol from coal tar. (*See* CARBOLIC ACID or PHENOL.)

Wood-tar creosote, a colourless, transparent, highly refractive oil of specific gravity 1·037 to 1·087 distils between 205° and 225°C and burns with a very smoky flame. It dissolves in 200 parts of water. A powerful antiseptic, it is non-poisonous and much less caustic than carbolic acid. It dissolves sulphur, resins and phosphorus. It is composed of monohydric phenols and the methyl ethers of di- and tri-hydric phenols. Phenol, the cresols and xylenols occur in small quantities, but the major constituents are guaiacol and methylguaiacol. Small amounts of dimethylpyrogallol, the dimethyl ether of methylpyrogallol and other ethers are also present. Propylguaiacol, or coerulignol, is often present in the crude product. This substance possesses such astringent properties that a single drop placed on the tongue causes bleeding. Purified creosote, especially for medicinal purposes, should be free from this compound which may be detected by the blue coloration produced by barium hydroxide. The proportions in which these constituents occur vary with the conditions under which the wood is carbonized. (*See* TARS, LOW TEMPERATURE.).

The distinctive properties of wood-tar creosote are due to the guaiacols. It is insoluble in absolute glycerol and is thus sharply distinguished from coal-tar acids which are completely soluble. It dissolves completely in an ethereal solution of collodion, whereas carbolic acid gives an immediate precipitate.

Purified wood-tar creosote is extensively used for pharmaceutical purposes. Beechwood creosote alone should be used in medicine, as its composition renders it much more valuable than other creosotes. Its constituents circulate unchanged in the blood and are excreted by the lungs. Carbolic acid has no value in the treatment of phthisis (pulmonary tuberculosis) or any other bacterial affection of the lungs; but creosote, being powerfully antiseptic and non-poisonous, is very valuable in this direction. It is administered either suspended in mucilage or in capsules. Like carbolic acid, wood-tar creosote, owing to its local antiseptic and anaesthetic action, is often useful in relieving gastric pain due to ulcer or cancer and in afflictions due to gastric irritation. When inhaled it brings considerable relief to sufferers from bronchitis, bronchopneumonia, lobar pneumonia and other bacterial lung diseases.

In many applications creosote has been replaced by creosotal (creosote carbonate), a mixture of the carbonates of the phenols present in creosote and prepared by the action of phosgene gas on a solution of beechwood creosote in caustic soda solution. It is a viscous, yellow liquid, insoluble in water but soluble in organic solvents. It is odourless, tasteless and non-irritant in its action on mucous membrane and is therefore used in bronchial affections, phthisis and pneumonia, particularly in children. Other salts of creosote used in medicine are the phosphate (phosphote), phosphite (phosphotal) and valerianate (eosote).

Wood-tar creosote is also used as a source of pure guaiacol, the residue being used as a preservative for wood.

Coal-tar Creosote consists mainly of a mixture of liquid hydrocarbon oils with naphthalene obtained in the distillation of coal tar. The content of naphthalene varies, in some cases being so small that the oils are able to hold it all in solution, whilst in others it is so high that the oils are solid at ordinary temperatures. Phenolic compounds (tar acids), to which the fraction owes its disinfectant and preservative qualities, are present to the extent of 8 to 10%; but a creosote much richer in phenols can be obtained by a partial distillation which removes the naphthalene, leaving a residue in which the phenolic content is as high as 30%. The creosote fraction is often mixed with the anthracene oils, owing to the circumstance that the demand for anthracene has practically vanished and that the isolation and purification of this hydrocarbon has become unremunerative and is rendered more difficult by the introduction of vertical-retort tar, which contains paraffinoid substances. The addition of the anthracene oil to the creosote is not altogether a disadvantage, since the specifications for creosote for the preservation of timber demand a certain percentage of high oils. Unfortunately, the creosote storage tank in many places is becoming the refuse pit for all manner of non-marketable oils and tars, such as blast-furnace tar, water-gas tar, etc. It is, therefore, somewhat difficult to assign a definite composition to coal-tar creosote; but a good sample should have a specific gravity of 1·03 to 1·08, be quite clear at 15° C and distil between 200° and 300° C. The phenolic content should be in the region of 10%. For the uses of coal-tar creosote *see* COAL TAR.

Other Creosotes.—The oils derived from low-temperature coal tar and corresponding in boiling point with coal-tar creosote are characterized by the presence of paraffins, the complete absence of naphthalene, a specific gravity less than unity and a high content of tar acids containing a very small amount of phenol. Vertical-retort tar, particularly if steam has been employed in the carbonization of the coal, yields a creosote fraction resembling that from low-temperature tar in many respects, although it usually contains naphthalene. Creosote from producer-gas tar contains large quantities of high-boiling tar acids and paraffins, whilst that from water-gas tar is characterized by the absence of tar acids, richness in paraffins and low specific gravity.

Blast-furnace creosote, sometimes known also as "phenoloid," resembles vertical-retort tar and low-temperature tar creosotes in its content of paraffins and tar acids and its specific gravity. It is noteworthy, however, for the presence of guaiacol and methyl-guaiacol amongst the phenols, which amount to 20 to 35% of the fraction. From this creosote a new antiseptic called "neosote" has been prepared. It is less caustic than carbolic acid, and when freshly prepared is almost colourless and bears a close resemblance to wood-tar creosote.

BIBLIOGRAPHY.—Lunge, *Coal Tar and Ammonia* (1916); Warne, *Coal Tar Distillation* (1923); Allen, *Commercial Organic Analysis.*

(D. D. P.)

CREOSOTE-BUSH (*Larrea tridentata* or *Covillea glandulosa*), a North American shrub of the caltrop family (Zygophyllaceae), called also greasewood, native to hot arid regions in the southwestern United States and adjacent Mexico. It is an evergreen, rank-smelling, diffusely-branched shrub, 2 ft. to 5 ft. high, with brittle stems and very leafy branches. The small, olive-green, copiously resinous leaves emit a strong tarry odor. The bright yellow flowers, a half-inch across, appearing in early spring, are followed by small densely white-woolly globose seed-vessels. At low altitudes and sometimes up to 3,000 ft. the creosote-bush is often a very abundant shrub, forming, in the Mohave, Colorado, Gila and similar deserts, a characteristic zone of vegetation called the "*Larrea* belt."

CREPE DE CHINE. A very light and fine plain woven dress fabric, produced either with a fine warp and weft of all-silk, or else with a silk warp and hard-spun worsted weft. As the name implies, a crepe de Chine texture has a slightly crepe character, a feature which is developed entirely from the employment of weft yarn spun with the twist running in reverse directions and known as "right-hand" and "left-hand" twist, respectively, and as also observed in the manufacture of voile textures (*q.v.*). Thus, during weaving, the picks of weft are inserted in the order of "two-and-two," *i.e.,* with two picks of weft with a "right-hand" twist, and two picks with a "left-hand" twist, uniformly, throughout the fabric.

Hence, during the finishing operation, owing to the abnormal amount of twist in the picks of weft, these tend to untwist and recover their normal condition.

They thereby cause the characteristic effect of typical crepe de Chine.

Crepe de Chine textures of artificial silk are now common and are often difficult to distinguish from the true silk.

CREPUSCULUM: *see* TWILIGHT.

CRÉQUY, CHARLES I. DE BLANCHEFORT, MARQUIS DE, prince de Poix, duc de Lesdiguières (1578–1638), marshal of France, was a member of a French noble house which took its name originally from a small lordship in the Pas-de-Calais. He saw his first fighting before Laon in 1594, and was wounded at the capture of Saint Jean d'Angély in 1621. In the next year he became a marshal of France. He served through the Piedmontese campaign in aid of Savoy in 1624 as second-in-command to the constable, François de Bonne, duc de Lesdiguières, whose daughter Madeleine he had married in 1595. He inherited in 1626 the estates and title of his father-in-law, who had induced him, after the death of his first wife, to marry her half-sister Françoise. He was also lieutenant-general of Dauphiné. In 1633 he was ambassador to Rome, and in 1636 to Venice. He fought in the Italian campaigns of 1630, 1635, 1636 and 1637, when he helped to defeat the Spaniards at Monte Baldo. He was killed in an attempt to raise the siege of Crema, a fortress in the Milanese. He had a quarrel extending over years with Philip, the bastard of Savoy, which ended in a duel fatal to Philip in 1599; and in 1620 he defended Saint-Aignan, who was his prisoner of war, against a prosecution threatened by Louis XIII. Some of his letters are preserved in the Bibliothèque Nationale in Paris, and his life was written by N. Chorier (Grenoble, 1683).

CRÉQUY, FRANÇOIS, CHEVALIER DE, marquis de Marines (1625–1687), marshal of France, grandson of the preceding, took part as a boy in the Thirty Years' War. At the age of 26 he was made *maréchal de camp,* and lieutenant-general before he was thirty. He won the favour of Louis XIV. by his fidelity to the court during the second Fronde. In 1667 he served on the Rhine, and in 1668 he commanded the covering army during Louis XIV.'s siege of Lille, after the surrender of which the king made him marshal. In 1670 he overran the duchy of Lorraine. Shortly afterward, Turenne, his old commander, was made marshal-general, and all the marshals were placed under his orders. Créquy went into exile rather than serve under Turenne. After the death of Turenne and the retirement of Condé, he became the most important general officer in the army. He was defeated at Conzer Brücke on the Moselle (1675) by the duke of Lorraine and was taken prisoner. After his release he took the field again in 1676 in Lorraine, and showed himself again a cool, daring and successful commander. (*See* DUTCH WARS.)

The marshal had two sons. The elder, François Joseph, marquis de Créquy (1662–1702), already held the grade of lieutenant-general when he was killed at Luzzara; and Nicolas Charles, sire de Créquy, was killed before Tournai in 1696 at the age of twenty-seven.

For a detailed genealogy of the family and its alliances *see* Moreri, *Dictionnaire historique; Annuaire de la noblesse française* (1856 and 1867). There is much information about the Créquys in the *Mémoires* of Saint-Simon.

CRÉQUY, RENÉE CAROLINE DE FROULLAY, MARQUISE DE (1714–1803), née de Froullay, was born on Oct. 19, 1714, at the château of Monfleaux (Mayenne). She married in 1737 Louis Marie, marquis de Créquy, who died four years after the marriage. In 1755 Madame de Créquy began to receive in Paris, among her intimates being D'Alembert and J. J. Rousseau. She presently became extremely religious with inclinations to Jansenism. D'Alembert's visits ceased when she adopted religion, and she was nearly 70 when she formed the great friendship of her life with Sénac de Meilhan, whom she met in 1781, and with whom she carried on a correspondence (edited by Édouard Fournier, with a preface by Sainte-Beuve in 1856). She was arrested in 1793 and imprisoned in the convent of Les Oiseaux until the fall of Robespierre (July 1794). The *Souvenirs de la marquise* *de Créquy* (1710–1803) (1834–35), purporting to be addressed to her grandson, Tancrède de Créquy, was the production of a Breton adventurer, Cousin de Courchamps.

See the notice prefixed by Sainte-Beuve to the *Lettres;* Quérard, *Supercheries littéraires, s.v.* "Créquy"; *L'Ombre de la marquise de Créquy aux lectuers des souvenirs* (1836) exposes the forgery of the *Mémoires.*

CRESCAS, HASDAI BEN ABRAHAM (1340–1410), Jewish philosopher, was born at Barcelona and lived all his life in Spain. He is best known for his "Or Adonai" (the Light of the Lord), which is of importance as having affected Spinoza, especially in the distinction between attributes and properties and on the subjects of creation and free-will. It was written deliberately to free Judaism from the domination of Aristotle under which it had been brought by Maimonides, and its most important part is a criticism of the Aristotelian propositions on the nature of God. Crescas also wrote a *Refutation of the Cardinal Principles of the Christians* in Spanish.

See C. E. G. Hirsch in the *Jewish Encyclopaedia* (iv.) 350; Joël, *Zur. Genesis Der Lehre Spinozas* (Breslau, 1871); P. Bloch, *die Willensfreiheit von Chasdai Crescas* (Munich, 1879); "Philosophy of Don Hasdai Crescas" in Columbia University *Oriental Studies,* vol. xvii. (1920).

CRESCENDO (It.) means literally merely "growing," but as used in the familiar musical direction—*cresc.*—implies always increasing in loudness. The sign $<$ expresses the same meaning.

CRESCENT, originally the waxing moon, hence a name applied to the shape of the moon in its first quarter. The crescent is employed as a charge in heraldry, with its horns vertical; when they are turned to the dexter side of the shield, it is called increscent, when to the sinister, decrescent. In modern armory a crescent is used as a difference to denote the second son of a house; thus the earls of Harrington place a crescent upon a crescent, as descending from the second son of a second son. An order of the crescent was instituted by Charles I. of Naples and Sicily in 1268, and revived by René of Anjou in 1464. A Turkish order or decoration of the crescent was instituted by Sultan Selim III. in 1799, in memory of the diamond crescent which he had presented to Nelson after the battle of the Nile, and which Nelson wore on his coat as if it were an order.

The crescent is the military and religious symbol of the Ottoman Turks. Ala ud-din, the Seljuk sultan of Iconium (1245–54), and Ertoghrul, his lieutenant and the founder of the Ottoman branch of the Turkish race, assumed it as a device, and it appeared on the standard of the janissaries of Sultan Orkhan (1326–60). Since the new moon is associated with special acts of devotion in Turkey—where, as in England, there is a popular superstition that it is unlucky to see it through glass—it may originally have been adopted in consequence of its religious significance. According to Professor Ridgeway, however, the Turkish crescent, like that seen on modern horse-trappings, has nothing to do with the new moon, but is the result of the base-to-base conjunction of two claw or tusk amulets, an example of which was brought to light during the excavations of the site of the temple of Artemis Orthia at Sparta (see *Athenaeum,* March 21, 1908). There is nothing distinctively Turkish in the combination of crescent and star: it is also doubtful whether any opposition between crescent and cross, as symbols of Islam and Christianity, was ever intended by the Turks and it is an historical error to attribute the crescent to the Saracens of crusading times or the Moors in Spain.

Crescent is also the name of a Turkish musical instrument. In architecture, a crescent is a street following the arc of a circle; the name in this sense was first used in the Royal crescent at Bath.

CRESCIMBENI, GIOVANNI MARIO (1663–1728), Italian critic and poet, was born at Macerata on Oct. 9, 1663. In 1690, in conjunction with 14 others, he founded in Rome the academy of the Arcadians to combat the affectations of the school of Marini. Crescimbeni was secretary to the Arcadians for 38 years. He died on March 8, 1728, shortly after his admission as a member of the order of Jesus. His principal work is the *Istoria della volgar poesia* (1698), an estimate of all the poets of Italy, past and contemporary. The most important of his numerous other publications are the *Commentarij* (5 vols., 1702–11), and *La Bellezza della volgar poesia* (1700).

CRESILAS, a Cretan sculptor of Cydonia. He was a contemporary of Pheidias, and the sculptor of one of the Amazons in the famous competition at Ephesus (*see* GREEK ART) about 450 B.C. As his Amazon was wounded (*volnerata;* Pliny, *Nat. Hist.* xxxiv. 75), we may perhaps identify it with the figure, of which several copies are extant, represented as drawing back her chiton from a wound under the right breast. Another work of Cresilas of which copies survive is the portrait of Pericles, the earliest Greek portrait which has been with certainty identified, and which fully confirms the statement of ancient critics that Cresilas was an artist who idealized and added nobility to men of noble type. An extant portrait of Anacreon is also derived from Cresilas.

See H. Stuart Jones, *Ancient Writers on Greek Sculpture,* § 148 (1895); E. A. Gardner, *Handbook of Greek Sculpture,* pp. 350–352, 370 (1915); A. Furtwängler (trans. E. Sellars), *Masterpieces of Greek Sculpture,* p. 115 ff. (1895).

CRESOLS or **METHYL PHENOLS.** The three isomeric cresols are found in the tar obtained in the destructive distillation of coal, beech-wood and pine. The crude cresol obtained from tar boils from 185 to 205° and constitutes the "cresylic acid" of commerce (*see* COAL TAR). The formula is $CH_3 \cdot C_6H_4 \cdot OH$, and the proportions of the three isomerides are approximately 35% ortho-, 40% meta- and 25% para-cresol.

Ortho-cresol, $CH_3(1).C_6H_4.OH(2)$, may be prepared by fusion of ortho-toluenesulphonic acid with sodium hydroxide, or by the action of phosphorus pentoxide on carvacrol. It is a crystalline solid, which melts at 30° C. and boils at 190.8° C. Being more volatile than the other two cresols it may be separated by fractional distillation.

Meta-cresol, $CH_3(1).C_6H_4.OH(3)$, is formed when thymol (6-isopropyl-3-methylphenol) is heated with phosphorus pentoxide. Propylene is liberated during the reaction, and the phosphoric acid ester of meta-cresol which is formed is then fused with potassium hydroxide. Meta-cresol can be solidified at temperatures below 3°–4° C. It boils at 202.8° C. Its aqueous solution is coloured bluish-violet by ferric chloride. The mixture of meta- and para-cresols is converted by 94% sulphuric acid into mono-sulphonic acids; the *p*-sulphonate or its sodium salt is then separated by crystallization, after which the two cresols are regenerated by hydrolysing their respective sulphonic acids with superheated steam.

Para-cresol, $CH_3(1).C_6H_4.OH(4)$, may be prepared by the fusion of para-toluene-sulphonic acid with sodium hydroxide; by the action of nitrous acid on para-toluidine; or by heating parahydroxy-phenylacetic acid with lime. It crystallizes in prisms which melt at 36° C. and it boils at 201.8° C. It is soluble in water, and the aqueous solution gives a blue coloration with ferric chloride. Para-cresol is produced during the putrefaction of albumen, and occurs as sulphate in the urine of the horse.

CRESPI, DANIELE (1590–1630), Italian historical painter, was born near Milan, and studied under Giovanni Battista Crespi and Giulio Procaccini. His best work, a series of pictures from the life of Saint Bruno, is in the monastery of the Carthusians at Milan. Other paintings of his are at Brera and at Pavia.

CRESPI, GIOVANNI BATTISTA (1557–1633), called Il Cerano, Italian painter, sculptor and architect, was born at Cerano in the Milanese. He was head of the Milanese academy, founded by Cardinal Frederigo Borromeo, and was the teacher of Guercino. He is best known as a painter.

CRESPI, GIUSEPPE MARIA (1665–1747), Italian painter, called "Lo Spagnuolo" from his fondness for rich apparel, was born at Bologna, and was trained under Angelo Toni, Domenico Canuti and Carlo Cignani. He was a clever portrait-painter and a brilliant caricaturist; and his etchings after Rembrandt and Salvator are in some demand. His greatest work, a "Massacre of the Innocents," is at Bologna; but the Dresden gallery possesses twelve examples of him, among which is his celebrated series of the Seven Sacraments.

CRESS (*Lepidium sativum*). An annual garden plant (family Cruciferae), known in the cultivated state in North America, Europe, North Africa, western Asia and India, but of obscure origin. It is used in salads, the young plants being cut and eaten while still in the seed-leaf, forming, along with plants of the white mustard in the same stage of growth, what is commonly called "small salad." The "golden" or "Australian" cress is a dwarf, yellowish-green, mild-flavoured sort, which is cut and eaten when a little more advanced in growth but while still young and tender. The "curled" or "Normandy" cress is very hardy and of good flavour. In this, which is allowed to grow like parsley, the leaves are picked for use while young, and, being finely cut and curled they are well adapted for garnishing.

CRESSENT, CHARLES (1685–1768), French furniture maker, sculptor and *fondeur-ciseleur,* was born at Amiens on Dec. 16, 1685, and died in Paris on Jan. 10, 1768. As the second son of François Cressent, *sculpteur du roi,* and grandson of Charles Cressent, a furniture maker and sculptor of Amiens, he inherited the tastes and aptitudes which were likely to make a finished designer and craftsman. He was a pupil of André Charles Boulle. Cressent's earlier work had affinities with the school of Boulle, while his later pieces were full of originality. He was an artist in the widest sense of the word. He not only designed and made furniture but created the magnificent gilded enrichments which are so characteristic of his work. Cressent made for the regent one of the finest examples of French furniture of the 18th century—the famous *médaillier* now in the Bibliothèque Nationale, Paris. His bronze mounts were executed with a sharpness of finish and a grace and vigour of outline which were hardly excelled by his great contemporary Jacques Caffieri. His female figures placed at the corners of tables are among the most delicious achievements of the great days of the French metalworker. The Louvre, Paris, and the Wallace collection, London, are especially rich in Cressent's work, his commode in the latter collection, with gilt handles representing Chinese dragons, is perhaps his most elaborate piece.

See F. de Salverté, *Les Ébenistes du xviii Siècle, leurs oeuvres et leurs marques* (1927).

CRESSWELL, SIR CRESSWELL (1794–1863), English judge, was a descendant of an old Northumberland family and was born at Newcastle in 1794. He was educated at the Charterhouse and at Emmanuel college, Cambridge. He took his degree in 1814, studied at the Middle Temple and was called to the bar in 1819, joining the northern circuit. In 1837 he entered parliament as Conservative member for Liverpool, and he soon gained a reputation as an acute and learned debater on all constitutional questions. In January 1842 he was made a judge of the court of common pleas, being knighted at the same time; and this post he occupied for 16 years. When the new court for probate, divorce and matrimonial causes was established (1858), Sir Cresswell became its first judge. He died of heart disease, July 29, 1863.

See Foss's *Lives of the Judges;* E. Manson, *Builders of our Law* (1904).

CRESSY, HUGH PAULINUS DE (*c.* 1605–1674), English Benedictine, was born at Thorpe-Salvin, Yorkshire. In 1626 he became a fellow of Merton college, Oxford, and later dean of Leighlin, Ireland, and canon of Windsor. In 1646, during a visit to Rome, he joined the Roman Catholic Church and in 1649 became a Benedictine. He died on Aug. 10, 1674. His *Exomologesis,* or account of his conversion, appeared at Paris in 1647, but his chief work is *The Church History of Brittanny or England, from the beginning of Christianity to the Norman Conquest* (1st vol. only published, 1668). This gives an exhaustive account of the foundation of monasteries during the Saxon heptarchy and asserts that they followed the Benedictine rule, differing in this respect from many historians. The work was much criticized by Lord Clarendon but defended by Antony Wood in his *Athenae Oxoniensis,* who supports Cressy's statement that it was compiled from original mss. and from the *Annales Ecclesiae Britannicae* of Michael Alford, *Dugdale's Monasticon* and the *Decem Scriptores Historiae Anglicanae.* The unpublished part of the history was discovered at Douai in 1856. To Roman Catholics Cressy's name is familiar as the editor of Walter Hilton's *Scale of Perfection* (1659), of Father A. Baker's *Sancta Sophia* (1657) and of Julian of Norwich's *Sixteen Revelations on the Love of God* (1670).

For a complete list of Cressy's works *see* J. Gillow's *Bibl. Dict. of Eng. Catholics.*

CREST, a town of southeastern France, in the department of Drôme, on the right bank of the Drôme, 20 mi. S.S.E. of Valence by rail. Pop. (1936) 4,120. On the rock which commands the town stands a huge keep, the sole survival of a castle (12th century) which made Crest important in the middle ages and the religious wars. The rest of the castle was destroyed in the 17th century, after which the keep was used as a state prison. Crest ranked for a time as the capital of the duchy of Valentinois, and so belonged before the Revolution to the prince of Monaco. The communal charter, graven on stone and dating from the 12th century, is preserved in the public archives. Crest is a busy little town, carrying on silk-worm breeding, silk-spinning and small manufactures of woollens, paper and leather. Ten miles southeast of Crest is the picturesque Forest of Saou, lying in a girdle of limestone peaks.

CRESTING, in architecture, a decorative termination for the top of a wall, or other architectural member, in which the decoration lies primarily in a vertical plane and achieves its effect by serration of the edge with a band of pierced work or rich carving below.

CRESTLINE, an incorporated village of Crawford county, Ohio, U.S.A., 75 mi. S.W. of Cleveland, on federal highway 30N and served by the Big Four and Pennsylvania railroads. Pop. (1940) 4,337. The county produces chiefly wheat, corn and oats. There are railroad shops in the village, and factories making steel ranges, furnaces, sewer pipe, grain and seed cleaners, pumps and road-making machinery. It was incorporated in 1854.

CRESTON, a city of Iowa, U.S.A., 60 mi. S.W. of Des Moines, at an altitude of 1,310 ft., on the crest of the watershed between the Mississippi and the Missouri basins; the county seat of Union county. It is on federal highway 34 and is served by the Burlington railway. Pop. (1940) 8,033. It is a shipping and trading point for a rich farming and stock-raising region. The town was founded in 1869, when the railroad selected this as the site for its shops. It was chartered as a city in 1871.

CRESWELL, JOHN ANGEL JAMES (1828–1891), lawyer, U.S. congressman, and postmaster general from 1869–1874, brought about many reforms in the postal service: postal laws were codified; one-cent postal cards were introduced; postal treaties with foreign countries were revised; ocean carriage of mail to foreign countries was speeded and cost was lowered; free delivery of mail was extended.

CRESWICK, THOMAS (1811–1869), English landscape painter, was born at Sheffield on Feb. 5, 1811, and educated at Hazelwood, near Birmingham. He was a pupil of J. Vincent Barker at Birmingham. In 1842 he was elected an associate, and in 1850 a full member of the royal academy. English and Welsh streams formed his favourite subjects, and generally British rural scenery. Creswick was industrious and extremely prolific; he produced, besides paintings, numerous illustrations for books. He died at his house in Bayswater, Linden Grove, on Dec. 28, 1869. Frith for figures, and Ansdell for animals, occasionally worked in collaboration with Creswick. In 1873 T. O. Barlow, the engraver, published a catalogue of Creswick's works.

CRETACEOUS SYSTEM, the group of rocks which normally occupies a position above the Jurassic system and below the Tertiary. In many areas, the system (from Lat. *creta,* white chalk, a characteristic rock type of the Upper Cretaceous in N.W. Europe) falls naturally into two divisions; the lower is sometimes regarded as a separate system (the Comanchean) in North America, where the unconformity between the two divisions is well marked. The names of the stages and some of the zones, as generally accepted in England, are given in Table I, which shows also the position in the system of the more important strata in the British Isles. Table II, with Table III for

TABLE I. *Cretaceous in the British Isles*

Division	Zone	Argyll and Mull	Antrim	Devon	Dorset	South England	Central England	Lincs. and Yorks.	
Danian	*Ostrea lunata*	Chalk, glauconitic at base	White limestone, glauconitic at base	Missing		Chalk with flints		Missing	Upper Chalk
Maestrichtian	Missing								
	Belemnitella mucronata								
Campanian	*Actinocamax quadratus*							Chalk with flints	
	Offaster pilula								
Santonian	*Marsupites testudinarius*								
	Micraster coranguinum								
Coniacian	*Micraster cortestudinarium*	?		Chalk					
Turonian	*Holaster planus*		?				Chalk Rock		
	Terebratulina lata					Chalk			Middle Chalk
	Inoceramus labiatus						Mel-bourn Rock	Chalk	
Cenomanian	*Holaster subglobosus*	White sands	Glauconitic sands	Glauconitic sands and sandy limestones	Grey Marl	Belemnite marls Grey Chalk	Totternhoe Stone		Lower Chalk
	Schloenbachia varians	Glauconitic sands			Chloritic Marl	Chalk Marl		Chalk	

	Devon	Dorset	West Weald	East Weald	Central England	Norfolk	Lincolnshire	Yorks.
Albian	Blackdown sands	Glauconitic sands and Sandy clay	Upper Greensand (Malmstone) Gault	Gault	Gault	Red Chalk	Red Chalk	Red Chalk
Aptian	Missing	Sands Clay	Lower Greensand: Folkestone Sands Sandgate Beds Hythe Beds Atherfield Clay		Lower Greensand	Carstone Snettisham Clay	Carstone Tealby Limestone	Speeton Clays
Neocomian	Missing	Wealden: Shales Sands	Weald Clay Hastings sands: Tunbridge Wells Sand Wadhurst Clay Ashdown Sands Fairlight Clay		Missing	Sandringham Sands Missing	Tealby Clay Claxby Ironstone Spilsby Sandstone	

N. America, gives the stages and substages, and an approximate correlation of the better known Cretaceous strata of the world; for correlation over wide areas, the Ammonoidea are (as usual in the Mesozoic) the most satisfactory group of fossils. It should be remembered that the names of the divisions of the Cretaceous given in these tables have been interpreted in widely different senses in the past, and that there is by no means general agreement in their usage even now. The Albian is often regarded as the lowest stage of the Upper Cretaceous.

British Isles.—The Wealden beds, a thick and variable series of estuarine and fresh-water deposits, are found in the Weald, the Isle of Wight, the Isle of Purbeck and the Boulonnais. The lower beds are usually sandy, the upper argillaceous; limestones occur rarely. The Wealden passes conformably down into the Purbeck, which it closely resembles; it is accordingly sometimes regarded as Jurassic. The fossils include fish, reptiles, plants and estuarine and freshwater Mollusca; and the Wealden was evidently deposited in a lagoon or estuary which probably did not extend far beyond the present limits of its outcrop. The beds of the same age found in Norfolk, Lincolnshire and Yorkshire are marine, and their fauna in part is closely allied with that of similar deposits in Russia. The Spilsby Sandstone and lower part of the Speeton Clay are often regarded as Jurassic. Between the Wealden area and Norfolk, the Neocomian is missing, and a barrier of Palaeozoic rocks (now buried under later deposits beneath London) probably separated the estuarine and marine areas.

The Aptian strata are everywhere marine, the Wealden area having been invaded by the sea. The Aptian is well developed in the Weald and the Isle of Wight, where it is usually argillaceous in the lower part and sandy in the upper; the sandstones are occasionally green through the presence of glauconite. It rests conformably on the Wealden, but thins to the westward and overlaps the Wealden in Wiltshire. Between Wiltshire and Norfolk, it is represented by thin sandstones (such as the Faringdon Sponge Bed of Berkshire), resting on Jurassic beds, often with a basal conglomerate. The Snettisham Clay of Norfolk and the Tealby Limestone of Lincolnshire are sometimes considered Neocomian.

The Albian is represented by three facies or types of deposit: a blue clay with phosphatic nodules (Gault); a glauconitic sandstone (Upper Greensand); and a hard red limestone, often with small pebbles (Red Chalk). Since these three rock-types were

Table II.

	European classification: Stage	European classification: Substage	England	Europe	Alpine Region	S. Africa	Peninsular India	S. America	Australia	Japan
Upper Cretaceous				Hippurite limestones of southern France and Mediterranean area	Cretaceous Flysch		Deccan traps			
	Danian			Faxe and Malmö limestones	Gosau (E. Alps) Scaglia (S. Alps)	Beds in Pondoland, Zululand, Portuguese East Africa	Ariyalur	San Martin series	Gingin chalk	Urakawa series
	Maestrichtian									
	Senonian	Campanian	Upper Chalk							
		Santonian								
		Coniacian		Emscher Mergel (N.W. Germany)			Trichinopoly			
	Turonian		Middle Chalk	Upper Pläner (N.W. Germany)						Gyliak series
	Cenomanian		Lower Chalk	Lower Pläner (N.W. Germany)			Utatur	Belgrano series		
				Tourtia of Mons						
Lower Cretaceous	Albian		Gault and Upper Greensand	Flammenmergel (N.W. Germany)					Tambo series	Monobegawa series
	Aptian	Gargasian	Lower Greensand	Urgonian (Jura)					Roma series	
		Bedoulian								
	Neocomian	Barremian	Wealden; Speeton clay	Hils clay (Hanover)	Aptychenkalk (E. Alps) Biancone (S. Alps)	Uitenhage beds		Puegiredon series	Walloon series (*pars*)	Ryôseki series
		Hauterivian								
		Valanginian								
		Infra-Valanginian								

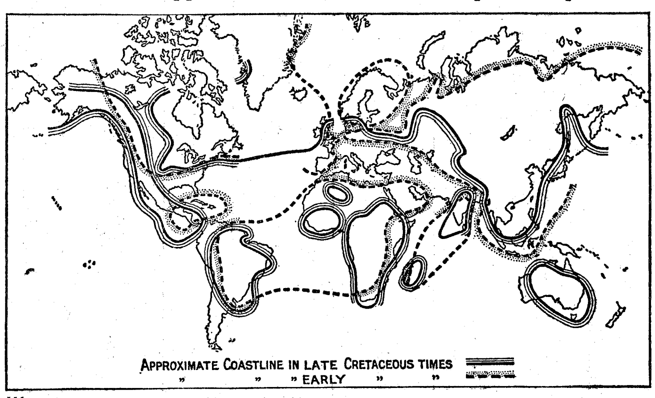
Note to Table II.

Danian from Denmark.
Maestrichtian from Maestricht, Holland.
Senonian from Sens, Yonne, France.
Campanian from Champagne, France.
Santonian from Saintonge, France.
Coniacian from Cognac, France.
Turonian from Touraine, France.
Cenomanian from Le Mans (*Cenomanum*), France.
Albian from Aube, France.
Gargasian from Gargas, near Apt, France.
Bedoulian from la Bedoule, Var.
Aptian from Apt, Vaucluse, France.
Barremian from Barrême, Basses Alpes.
Hauterivian from Hauterive, Lake Neuchâtel.
Valanginian from Château de Valangin, Neuchâtel.
Neocomian from Neuchâtel (*Neocomum*), Switzerland.

TABLE III. *Cretaceous in North America*

	Atlantic Coast	Eastern Gulf Region	Western Gulf Region	Western Interior	Pacific Coast	European
Cretaceous	Manasquan Rancocas	Missing	Missing	Laramie	Missing	Danian
Cretaceous	Monmouth	Ripley Selma	Montana series Navarro	Montana series 2. Fox Hills 1. Fort Pierre and Belly River		Senonian
Cretaceous	Matawan	Eutaw	Colorado series 2. Austin 1. Eagle Ford	Colorado series 2. Niobrara 1. Benton	Chico	Turonian
Cretaceous			Dakota Woodbine	Dakota		Cenomanian Albian
		Uncon	formity			
Comanchean	Potomac series 4. Raritan 3. Patapsco 2. Arundel 1. Patuxent	Tuscaloosa	Washita Fredericksburg Trinity	Kootenay and Morrison	Horsetown } Shastan Knoxville } Shastan	Aptian Wealden

each laid down under different conditions, their faunas are different; but ammonoids are found in each and enable a correlation to be made. The Red Chalk of Norfolk passes laterally into the Gault of Cambridgeshire; and the Gault of the east Weald passes westwards into Upper Greensand which overlaps the Aptian into Devon. The Gault rests upon the Palaeozoic ridge under London, showing that the Albian sea had submerged this barrier.



WORLD MAP SHOWING THE COASTLINES IN EARLY AND LATE CRETACEOUS TIMES. THE COASTLINES ARE GENERALIZED. THE ISLANDS THAT EXISTED IN THE MEDITERRANEAN AREA ARE OMITTED FOR CLEARNESS

The rest of the Cretaceous is represented by the Chalk formation, which stretches from Flamborough Head in Yorkshire to the coast of Dorset (forming the Yorkshire and Lincolnshire Wolds and the Chilterns), encircles the Weald as the North and South Downs, underlies the Tertiary beds round London and Hampshire, and is found in north France. Where it rests upon the Gault, the lower part of the Cenomanian is an argillaceous chalk (Chalk Marl); where on Upper Greensand, a glauconitic sandy limestone (Chloritic Marl); where on Red Chalk, a pure white limestone (Chalk). In Devon, Antrim, Argyll and Mull, it is represented by glauconitic sandstones, indicating the nearness of land. In Cambridgeshire, at the base of the Cenomanian is a glauconitic conglomerate, the Cambridge Greensand, with phosphatic nodules in part derived by erosion from the Gault. Otherwise, the Chalk formation is composed almost entirely of chalk, a white limestone with from 95% to 99% of calcium carbonate. Flints are common in the upper Middle Chalk of East Anglia and the north, and in the Upper Chalk throughout. Marly bands occur sparsely, and nodular beds (such as the Chalk Rock) are more common, especially in the lower Middle Chalk (Melbourn Rock). The top of the Cretaceous is everywhere missing: the Danian may be represented by the *Ostrea lunata* beds of Trimingham, Norfolk. The Tertiary rests unconformably upon the Chalk. Thus in the British Isles, the invasion of the Wealden estuary or lagoon by the Aptian sea; the submergence of the Palaeozoic ridge by the Albian sea; the thinning out of the Lower Cretaceous sediments in the south of England to the west, and to the north against the Palaeozoic ridge; the extension of the upper deposits beyond the limits of the lower into Dorset and Devon, and into Ireland and Scotland: all these facts point to a gradual encroachment of the Cretaceous sea. Igneous activity is unknown, and earth movement is gentle and relatively unimportant—such as the minor folding which led to the removal of the top of the Gault and deposition of the Cambridge Greensand in Cambridgeshire.

Relations of the Cretaceous Strata.—The upper and the lower limits of the Cretaceous system are often sharply defined by unconformities. Since the Cretaceous beds in many areas are transgressive over older formations, the lowest Cretaceous being missing, the lower unconformity is well marked. In the Alps and Himalayas there is sometimes an apparent continuity from Jurassic into Cretaceous marine sediments; a similar continuity in non-marine beds is seen in the south of England and north-west Germany (Wealden), and in Australia (Walloon series). The plant-bearing deposits of the Atlantic coast region of the United States (Potomac series) and Japan (Rhyôseki series) may be in part Jurassic. The lacustrine and fluviatile Laramie formation of the western interior of the United States helps to bridge the gap between the vertebrate faunas of the Cretaceous and the Eocene; the chalky limestones, of Malmö (Fennoscania) and Faxe (Denmark), in which two typical Mesozoic groups (the ammonoids and belemnites) are not found, have been regarded as Tertiary but are usually included in the Cretaceous. (Table II.)

Physiographical Conditions, Earth Movements and Igneous Activity.—Non-marine sediments are found, for the most part, either at the beginning, or, to a less extent, at the end of the period. As examples of Neocomian terrestrial, fluviatile or estuarine deposits may be cited the Wealden of England, the Boulonnais, the Franco-Belgian coalfield and Hanover; the lower part of the Uitenhage series (Enon Beds, Variegated Marls and Wood Beds) of the Cape Province of South Africa; the Potomac, Kootenay and Morrison series of the United States; the upper part of the Walloon series of Australia; and the Rhyôseki series of Japan. The sea invaded some of these areas in Neocomian times, depositing, for instance, the upper part of the Uitenhage series (Sunday's River Beds) in Cape Province, and the Monogebawa series (in part Albian) in Japan. In Australia, the marine Aptian (Roma series and Maryborough Beds) are in part overlapped by the marine Albian (Tambo series). In north-west Europe a similar transgression of the sea continued with minor interruptions from Aptian into Senonian times, invading the Armorican massifs in Ireland, Brittany, Spain and the Ardennes; and chalk practically free from material derived from existing land masses was laid down in the British Isles, northern France, extra-alpine Germany, south Scandinavia, Denmark and Russia. In the Tethys sea, which extended along the Mediterranean area across the site of the Himalayas, the western part of the southern margin—the north of Africa—was also invaded by the sea. In the shallow waters of the Tethys flourished the rudists, with gasteropods and reef-building corals; a similar facies is found in Texas, Alabama, Mexico and the West Indies. The lamellibranch faunas of the sublittoral Neocomian deposits of the south Andes, south Africa and Tanganyika Territory are very similar to each other, and distinct from those of the northern hemisphere: they afford evidence for the hypothetical South Africa—Brazil Cretaceous continent. A similar Neocomian fauna is found in Cutch, Madagascar and New Caledonia; the southern Cretaceous land-masses are often regarded as parts of the hypothetical Permo-Carboniferous Gondwanaland. Evidences of a marine Cenomanian transgression are seen in Brazil and peninsular India.

The unconformity between the Upper and the Lower Cretaceous of North America, and the dissimilarity in the areas of deposition, indicate important earth-movement in mid-Cretaceous times. The more wide-spread unconformity at the end of the Cretaceous and beginning of the Tertiary was due to a more general withdrawal of the sea accompanied by important deformative earth-movements and igneous activity. The folding and elevation of the Cordilleras and the Appalachians date in part from this period. The most important igneous activity was the formation of the Deccan traps. These basic lavas, erupted from fissures, cover 200,000 sq. miles and are from 4,000 to 6,000 feet thick.

Economic Products.—In the British Isles, local limestones of the Wealden (Sussex Marble) and Hythe Beds (Kentish Rag) have been used as building stones. Fuller's earth occurs in the Sandgate Beds, and glass-sands in the Lower Greensand. More important is the manufacture of bricks and tiles from the Gault, and of lime and cement from the Chalk. The clay ironstones of the Wadhurst Clay were once the main source of the English iron supply, and more recently the phosphatic nodules of the Cambridge Greensand have been exploited.

Perhaps the most important economic product of the Cretaceous is coal. The Laramie formation, in the western interior of the United States, contains lignite and also, in places, anthracite. Lower Cretaceous coal seams are known in Dakota, Alaska and New Zealand; in the Senonian may be mentioned the coal-bearing Urakawa series of Japan.

The Cretaceous Fauna and Flora.—The flora is best known from the United States, especially from the Potomac formation of Maryland and Virginia. That of the lower divisions (Patuxent and Arundel series) is very similar to the Upper Jurassic flora; it consists chiefly of ferns, conifers and the now extinct Bennettitales (usually grouped with the modern Cycadales), often well-preserved and known in considerable detail: leaves of an angiosperm type occur very rarely. Similar floras of Lower Cretaceous age are found in the English Wealden, in Belgium and Germany, in the Uitenhage series of South Africa and the Rhyôseki series of Japan, in west Greenland and Spitzbergen. In the third division of the Potomac formation (the Patapsco series), there is a sudden development of angiosperm leaves. In the Upper Cretaceous, the angiosperms are the dominant group, replacing the Bennettitales; the flora is wide-spread, ranging from Alaska to Argentina and occurring in west Greenland, western Europe and Japan; many of the species are referred to modern genera, and the whole has a subtropical aspect (*see* PALAEOBOTANY: *Mesozoic*).

The smaller Foraminifera such as *Globigerina* and *Cristellaria* are important, forming for instance on the average 10% of the Upper Chalk in England; of the larger, the orbitolines (Lower Cretaceous and Cenomanian) and the orbitoids (Campanian to Tertiary) have been used for correlation in deposits of the Mediterranean region. Sponges are locally abundant (*Siphonia, Ventriculites*); calcareous forms are more characteristic of shallow-water deposits, such as the Faringdon Greensand (Aptian) of Berkshire (*Peronidella, Barroisia, Rhaphidonema*). Corals are relatively rare. The widely distributed, free-swimming crinoids, *Uintacrinus* and *Marsupites,* characterise the Santonian. Sea-urchins are especially abundant, both regular (*Cidaris, Salenia, Phymosoma*) and irregular (*Echinocorys, Holaster* and true heart-urchins). The genus *Micraster* in the Upper Turonian and Lower Senonian of England supplies some of the best evidence of evolution by slow continuous change that palaeontology affords (*see* PALAEONTOLOGY). Brachiopods are represented chiefly by terebratulids and rhynchonellids. Polyzoa are abundant. Lamellibranchs are important; *Aucella,* characteristic of the northern Lower Cretaceous, and *Inoceramus,* almost universal in the Upper Cretaceous, are both useful for correlation. More important as time-indices throughout the Cretaceous, to which they are confined, are the massive, sessile, aberrant lamellibranchs, the group of rudists (*Monopleura, Requienia, Toucasia, Hippurites, Radiolites* and *Caprina*), characteristic of a shallow-water facies of the Tethys and Central America. Gastropods are common in the same facies. The ammonoids afford the best means of correlation over wide areas. As in the Jurassic, the Phylloceratidae and Lytoceratidae persist with but little change; it has been suggested that these thin-shelled forms, characteristic of the deeper parts of the Tethys, were the parent stocks, which, by acquisition of ornament and modification (usually simplification) of suture-line, supplied successive groups of short-lived thick-shelled forms which populated surrounding areas. Characteristic genera are *Spiticeras, Polyptychites, Simbirskites* (Neocomian); *Parahoplitoides, Cheloniceras* (Aptian); *Leymeriella, Douvilleiceras, Hoplites, Pervinquieria* (Albian); *Schloenbachia, Acanthoceras* (Cenomanian); *Pachydiscus, Prionotropis* (Turonian); *Mortoniceras, Parapuzosia* (Senonian). With these "normal" ammonites, coiled into a closed plane spiral, are found many abnormal, "uncoiled" types; such forms occur throughout the Mesozoic, but become common only in the Cretaceous (*Crioceras, Baculites, Scaphites, Turrilites*). There is also in some stocks a tendency for the suture-line to become simplified, and occasionally (*Tissotia*) it mimics the type seen in the Triassic *Ceratites.* Of the belemnites, *Belemnitella* is wide-spread in northern seas in the Upper Senonian, and *Actinocamax* in the Senonian of north-west Europe undergoes progressive changes which render it useful as a time-index; the irregularly-shaped *Duvalia* is characteristic of the Mediterranean Neocomian, and *Cylindroteuthis* of the Boreal. Both the ammonoids and the belemnites became extinct at the end of the Cretaceous.

Of the five classes of the Vertebrata, the mammals and birds are of infrequent occurrence in the Cretaceous, but the reptiles and fishes are represented by many genera and species; the Amphibia are not definitely known. Generally, the vertebrates of the Lower Cretaceous are closely allied to Jurassic types, while the higher beds of the Upper Cretaceous are distinguished by the appearance of forms ancestral to those which flourished in the early Tertiary. Thus the fishes may be divided into two groups: a Lower Cretaceous group, characterised by forms closely allied to Jurassic genera; and an Upper Cretaceous group, in which both the bony and the cartilaginous fishes show a marked resemblance to their modern representatives which are found in the ocean depths. Nearly complete skeletons of cartilaginous fishes occur in the Upper Cretaceous of Westphalia and Mt. Lebanon; in the English Cretaceous are found representatives of the dogfishes (Scyllidae), the sharks (Lamnidae) and skates (*Ptychodus*, a gigantic, primitive and extinct form). The bony fishes are represented in the English Wealden (*Lepidotus*), and are known in the uppermost Cretaceous beds of south Scandinavia, northern France, Persia, India and Brazil. As a whole, the Upper Cretaceous fish fauna appears to be more closely allied to the modern fauna than are the mammals, birds and reptiles.

The Mesozoic is often termed the "Age of Reptiles," and in the Cretaceous the reptiles are still the dominant vertebrates, although not so prolific in species and individuals as in the Jurassic period. The dinosaurs (*see* DINOSAURIA) are the most powerful group of Cretaceous animals; they often attain a length of 30 feet, but possess extremely small brain-cavities. Both herbivorous and carnivorous forms are found. The herbivorous dinosaur, *Iguanodon,* occurs in the Lower Cretaceous of England, and nearly complete skeletons have been obtained from the Wealden of Bernissart, Belgium. Dinosaurs are also very abundant in the Cretaceous of North America; they include *Tyrannosaurus,* a predaceous form armed with sabre-like teeth and sharp claws; *Trachodon,* duck-billed and probably living in shallow, muddy waters; *Stegosaurus,* with a median row of plates and spines along its back; and *Triceratops,* with head armed with horns and a massive bony frill. The majority of the remaining reptiles are aquatic forms. The "sea-serpents" are extremely elongated forms, with powerful flippers and long tails. Ichthyosaurs and plesiosaurs are less common than in the Jurassic. The pterosaurs (*Ornithocheirus*), the remarkable flying lizards, attain their maximum development; one digit of each "hand" is prolonged, probably serving as a support for the flying membrane (*see* PTERODACTYL). The crocodiles (*Goniopholis*) show many similarities to present day forms, and the marine turtles are in their external structure definitely modern in type. Lizard-like animals (*Dolichosaurus*) are known, and true snakes appeared towards the later part of the period.

Birds are represented by the well-known toothed forms *Hesperornis* (a giant diving bird) and *Ichthyornis* (built for powerful flight); both are found in the Upper Cretaceous of Kansas.

Mammals are rare. The most primitive forms are the multituberculate mammals; they were probably very small, and are known only by diminutive teeth and fragmentary jaws from the Wealden of Sussex and the Upper Cretaceous of North America. The marsupials are represented by opossum-like creatures, which occur in the Upper Cretaceous of Wyoming and Patagonia. The higher mammals are unknown in Cretaceous rocks.

See PALAEONTOLOGY; MULTITUBERCULATA; ORNITHOLOGY; MAMMALIA; REPTILES. (A. G. B.)

CRETE (ancient *Kefti*), after Sicily, Sardinia and Cyprus the largest island in the Mediterranean, situated between 34° 50′ and 35° 40′ N. lat. and between 23° 30′ and 26° 20′ E. long. Its northeastern extremity, Cape Sidero, is distant about 110 mi. from Cape Krio in Asia Minor, the interval being partly filled by the islands of Carpathos and Rhodes; its northwestern, Cape Grabusa, is within 60 mi. of Cape Malea in the Morea. Crete thus forms the natural limit between the Mediterranean and the Archipelago. The area is 3,199 sq.mi. Pop. in 1938 (estimate) was 441,687:

Department	Chief Town
Canea 126,654	Canea (Khania) 36,810
Herakleion 162,978	Herakleion (Candia) 43,550
Rhethymnon 76,141	Rhethymnon 11,850
Lasithion (Lassithi) 75,914	Hagios-Nicholaos 2,020

The island is of elongated form; its length from east to west is 160 m., its breadth from north to south varies from 35 to 7½ m. The northern coast-line is much indented. On the west two narrow mountainous promontories, the western terminating in Cape Grabusa or Busa (ancient Corycus), the eastern in Cape Spada, shut in the Bay of Kisamos; beyond the Bay of Canea, to the east, the rocky peninsula of Akrotiri shelters the magnificent natural harbour of Suda (8½ sq.m.), the only completely protected anchorage for large vessels which the island affords. Farther east are the bays of Candia and Mallia, the deep Mirabella Bay and the Bay of Sitia. The south coast is less broken, and possesses no natural harbours, the mountains in many parts rising almost like a wall from the sea; in the centre is Cape Lithinos, the southernmost point of the island, partly sheltering the Bay of Mesará on the west. Immediately to the east of Cape Lithinos is the small bay of Kali Liménes or Fair Havens, where the ship conveying St. Paul took refuge (Acts xxvii. 8). Of the islands in the neighbourhood of the Cretan coast the largest is Gavdo (ancient Clauda, Acts xxvii. 16), about 25 m. from the south coast at Sphakia, in the middle ages the see of a bishop. On the north side the small island of Dia, or Standia, about 8 m. from Candia, offers an inconvenient shelter against northerly gales. Three small islands on the northern coast—Grabusa at the north-west extremity, Suda, at the entrance to Suda harbour, and Spinalonga, in Mirabella Bay—remained for some time in the possession of Venice after the conquest of Crete by the Turks. Grabusa, long an impregnable fortress, was surrendered in 1692, Suda and Spinalonga in 1715.

Natural Features.—The greater part of the island is occupied by ranges of mountains which form four principal groups. In the western portion rises the massive range of the White Mountains (*Aspra Vouna*), directly overhanging the southern coast with spurs projecting towards the west and north-west (highest summit, Hagios Theodoros, 7,882 ft.). In the centre is the smaller, almost detached mass of Psiloriti (ʽΥψιλορειτίον, ancient Ida), culminating in Stavros (8,193 ft.), the highest summit in the island. To the east are the Lassithi mountains with Aphenti Christos (7,165 ft.), and farther east the mountains of Sitia with Aphenti Kavousi (4,850 ft.). The Kophino mountains (3,888 ft.) separate the central plain of Messará from the southern coast. The isolated peak of Iuktas (about 2,700 ft.), nearly due south of Candia, was regarded with veneration in antiquity as the burial-place of Zeus. The principal groups are for the greater part of the year covered with snow, which remains in the deeper clefts throughout the summer; the intervals between them are filled by connecting chains which sometimes reach the height of 3,000 ft. The largest plain is that of Monofatsi and Messará, a fertile tract extending between Mt. Psiloriti and the Kophino range, about 37 m. in length and 10 m. in breadth. The smaller plain, or rather slope, adjoining Canea and the valley of Alikianú, through which the Platanos (ancient Iardanos) flows, are of great beauty and fertility. A peculiar feature is presented by the level upland basins which furnish abundant pasturage during the summer months; the more remarkable are the Omalo in the White Mountains (about 4,000 ft.) drained by subterranean outlets (κτάβοθρα), Nida (εἰς τὴν Ἴδαν) in Psiloriti (between 5,000 and 6,000 ft.), and the Lassithi plain (about 3,000 ft.), a more extensive area, on which are several villages. Another remarkable characteristic is found in the deep narrow ravines (φαράγγια), bordered by precipitous cliffs, which traverse the mountainous districts; into some of these the daylight scarcely penetrates. Numerous large caves exist in the mountains; among the most remarkable are the famous Idaean cave in Psiloriti, the caves of Melidoni, in Mylopotamo, and Sarchu, in Malevisi, which sheltered hundreds of refugees after the insurrection of 1866, and the Dictaean cave in Lassithi, the birth-place of Zeus. The so-called Labyrinth, near the ruins of Gortyna, was a subterranean quarry from which the city was built. The principal rivers are the Metropoli Potamos and the Anapothiari, which drain the plain of Monofatsi and enter the southern sea east and west respectively of the Kophino range; the Platanos, which flows northwards from the White Mountains into the Bay of Canea; and the Mylopotamo (ancient Oaxes) flowing northwards from Psiloriti to the sea east of Retimo.

Geology.—The metamorphic rocks of western Crete form a series some 9,000 to 10,000 ft. in thickness, of very varied composition. They include gypsum, dolomite, conglomerates, phyllites and a basic series of eruptive rocks (gabbros, peridotites, serpentines). Glaucophane rocks are widely spread. In the centre of the folds fossiliferous beds with crinoids have been found, and the black slates at the top of the series contain *Myophoria* and other fossils, indicating that the rocks are of Triassic age. It is, however, not impossible that the metamorphic series includes also some of the Lias. The later beds of the island belong to the Jurassic, Cretaceous and Tertiary systems. At the western foot of the Ida massif calcareous beds with corals, brachiopods (*Rhynchonella inconstans*, etc.) have been found, the fossils indicating the horizon of the Kimmeridge clay. Lower Cretaceous limestones and schists, with radiolarian cherts, are extensively developed; and in many parts of the island Upper Cretaceous limestones with *Rudistes* and Eocene beds with nummulites have been found. All these are involved in the earth movements to which the mountains of the island owe their formation, but the Miocene beds (with *Clypeaster*) and later deposits lie almost undisturbed upon the coasts and the low-lying ground. With the Jurassic beds is associated an extensive series of eruptive rocks (gabbro, peridotite, serpentine, diorite, granite, etc.); they are chiefly of Jurassic age, but the eruptions may have continued into the Lower Cretaceous. The arrangement of the rocks is further complicated by a great thrust-plane which has brought the Jurassic and Lower Cretaceous beds upon the Upper Cretaceous and Eocene beds.

The structure of Crete is best understood as a part of the great mountain arc, or scheme of arcs which stretches southward in the Dinaric Alps and fingers out into the southward projecting peninsulas of Greece. Some of these are conjecturably related to the Capes on the western part of the north coast of Crete, the islands of Cerigo and Cerigotto forming intermediate links. Within the island apparently the directive lines curve into the west-east direction, represented in two chains, one running from the west end north of the Mesara plain and the other stretching eastward between that plain and the southern coast. They are to be looked upon as overlapping fragments of mountain-arcs linked, eastwards, with Karpathos, Rhodes and the Lycian Taurus. The Graeco-Creto-Asiatic curve, together with the Lycian-Cypriote-Tauric curve farther east form the southward projecting Tauro-Dinaric arc of the Alpine system, one of a great series of arcs all projecting in the same way on the southern flank of the Alpine system. The others are the Arc of the south side of the west Mediterranean, the Iranian Arc, the crushed-in Hindu-Kush Arc, the Himalayan Arc and the Malayan Arc. South of these, usually beyond a depression of some kind, are the old blocks of Africa, Arabia, the Deccan and Australia. The Aegean Sea is essentially a sinking, in a relatively recent geological period, of the area within the Cretan arc. The occurrence of remains of the small Hippopotamus Pentlandi in Crete in recent deposits shows that the island must still have been connected with the mainland in Pliocene times and that the hippopotamus long survived, in the island, in a dwarfed form; the analogy of the dwarf elephants of Malta may be recalled.

Climate.—The temperature in January may retain an average of 50° or even nearly 54° in the lowlands while the summer on the Mesaran plain is hot and malarious. The relief of Crete is, however, so marked that on the heights snow may fall in autumn and lie till the beginning of the next July. The steppe-winds from the north may blow with such force across the Aegean Sea as to prevent in many exposed places any growth of trees. The winds from the African land mass also blow across to Crete affecting its southern side. In winter the commonest winds at Candia are northerly and southerly; in summer, winds with a westerly component are important.

The mean temperatures at Candia are:

January	51°	May	68°	September	75°
February	52°	June	75°	October	67°
March	55°	July	78°	November	61°
April	61°	August	79°	December	55

with a mean maximum (daily) of 83·5°, and one of 86° for Canea, occurring most often in July and August, the mean maximum (monthly) being as high as 97·5° (recorded for June) in which month a record of 101·8° has been made. The mean minimum (monthly) varies from 40° in February to 68° in August with a record of 33° in February. The temperature range (monthly) is greatest in spring and autumn when it may reach 32°; it is down to 20° in August.

The mean rainfall at Candia is as follows:

January	3·39	May	0·48	September	0·78
February	3·23	June	0·09	October	1·81
March	1·97	July	0·12	November	3·58
April	0·63	August	0·35	December	3·98

Vegetation.—The forests which once covered the mountains have for the most part disappeared and the slopes are now desolate wastes. The cypress still grows wild in the higher regions; the lower hills and the valleys, which are extremely fertile, are covered with olive, and in some parts with carobs. Oranges and lemons also abound, and are of excellent quality. Chestnut woods are found in the Selino district, and forests of the valonia oak in that of Rhethymnon. Pears, apples, quinces, mulberries and other fruit-trees flourish, as well as vines. Though the Madeira vineyards have been twice planted with stock from Malavisi province, the modern Cretan wines no longer enjoy the reputation of mediaeval "Malvoisie." Tobacco and cotton succeed well in the plains and low grounds, though not at present cultivated to any great extent.

Animals.—Of the wild animals of Crete, the wild goat or *agrimi* (*Capra aegagrus*) alone need be mentioned; it is still found in considerable numbers on the higher summits of Psiloriti and the White Mountains. The same species is found in the Caucasus and Mount Taurus, and is distinct from the ibex or bouquetin of the Alps. Other animals of interest are the moufflon, said to be an ancestor of the domestic sheep, and the porcupine. Crete, like several other large islands, enjoys immunity from dangerous serpents—a privilege ascribed by popular belief to the intercession of Titus, the companion of St. Paul, who according to tradition was the first bishop of the island, and became in consequence its patron saint. Wolves also are not found in the island, though common in Greece and Asia Minor. The native breed of mules is remarkably fine.

Population.—The population of Crete under the Venetians was estimated at about 250,000. After the Turkish conquest it greatly diminished, but afterwards gradually rose, till it was supposed to have attained to about 260,000, of whom about half were Mohammedans, at the time of the outbreak of the Greek revolution in 1821. The ravages of the war from 1821 to 1830, and the emigration that followed, caused a great diminution, and the population was estimated by Pashley in 1836 at only about 130,000. In the next generation it again materially increased; it was calculated by Spratt in 1865 as amounting to 210,000. According to the census taken in 1881, the complete publication of which was interdicted by the Turkish authorities, the population of the island was 279,165, or 35·78 to the square kilometre. Of this total, 141,602 were males, 137,563 females; 33,173 were literate, 242,114 illiterate; 205,010 were orthodox Christians, 73,234 Muslims, and 921 of other religious persuasions. The Muslim element predominated in the principal towns, of which the population was—Candia, 21,368; Canea, 13,812; Retimo, 9,274. In June 1900 a Greek census registered a population of 301,273, the Christians having increased to 267,266, while the Muslims had diminished to 33,281. Both Muslims and Christians are of Greek origin and speak Greek. Pop. (est. 1938) 441,687.

Towns.—The three principal towns are on the northern coast and possess small harbours suitable for vessels of light draught. Candia, pop. 43,550, former capital, see of the archbishop of Crete, officially styled Herakleion, is surrounded by remarkable

Venetian fortifications and possesses a museum with a valuable collection of objects found at Cnossus, Phaestus, the Idaean cave and elsewhere. Canea (mod. Gk. *Chaniá*), the seat of government after 1840 (pop. 36,810), is built in the Italian style; its walls and interesting galley-slips recall the Venetian period. The residences of the governor and of the foreign consuls are in the suburb of Halepa. Rhethymnon (Ρέθυμνος) is, like Canea, the see of a bishop (pop. 11,850). The other towns, Hierapetra, Sitia, Kisamos, Selino and Sphakia, are unimportant.

Production and Industries.—Owing to the volcanic nature of its soil, Crete is probably rich in minerals. Modern experiments led to the conclusion that iron, lead, manganese, lignite and sulphur exist in considerable abundance. Copper and zinc have also been found. A large number of applications for mining concessions were received after the establishment of the more civilized government. Olive production, always the principal source of wealth, was increased considerably after the island was annexed to Greece by the planting of young trees and improved methods of cultivation which the government endeavoured to promote. The orange and lemon groves formerly suffered considerably, but new varieties of the orange tree were introduced, and an impulse was given to the export trade in this fruit by removal of the restriction on its importation into Greece. Agriculture is still in a primitive condition; notwithstanding the fertility of the arable land the supply of cereals is far below the requirements of the population. A great portion of the central plain of Monofatsi, the principal grain-producing district, long lay fallow owing to the exodus of the Moslem peasantry. The cultivation of silk cocoons, formerly a flourishing industry, greatly declined in the 20th century, although efforts were being made to revive it.

There are few manufactures. Soap is produced at numerous factories in the principal towns, and there are distilleries of cognac at Candia.

Constitution and Government.—During the 19th century the affairs of Crete repeatedly occupied the attention of Europe. Owing to the existence of a strong Mussulman minority among its inhabitants, the warlike character of the natives, and the mountainous configuration of the country, which enabled a portion of the Christian population to maintain itself in a state of partial independence, the island had constantly been the scene of prolonged and sanguinary struggles in which the numerical superiority of the Christians was counterbalanced by the aid rendered to the Moslems by the Ottoman troops. This unhappy state of affairs was aggravated and perpetuated by the intrigues set on foot at Constantinople against successive governors of the island, the conflicts between the Palace and the Porte, the duplicity of the Turkish authorities, the dissensions of the representatives of the great powers, the machinations of Greek agitators, the rivalry of Cretan politicians, and prolonged financial mismanagement. A long series of insurrections—those of 1821, 1833, 1841, 1858, 1866–1868, 1878, 1889 and 1896 may be especially mentioned—culminated in the general rebellion of 1897, which led to the interference of Greece, the intervention of the great powers, the expulsion of the Turkish authorities, and the establishment in 1899 of an autonomous Cretan government under the suzerainty of the sultan, with Prince George of Greece as high commissioner of the protecting powers. After his resignation in 1906, the modified constitution of February 1907 dispensed with exceptional legislative and administrative powers. An elected chamber exercised complete financial control, and two councillors responsible to the chamber formed a kind of cabinet. After the cession of Crete by Turkey to Greece in 1912, the island was administered as a province of the Greek kingdom with a governor-general. Almost all the Moslem natives emigrated, or became "Tripolitan protected subjects" of Italy, or became merged in the orthodox population; their only coherent settlements now were in the islands of Cos and Rhodes.

On the other hand, Crete received its full share of the Greeks expelled from Asia Minor in 1922, and they greatly increased the production of sultana raisins.

For administrative purposes the Turkish departmental divisions were retained. There were 4 prefectures (formerly *sanjaks*) each under a prefect; these were Canea, Rhethymnon, Herakleion (Candia) and Lasithion. These in turn were divided into 23 eparchies (formerly *kazas*). For municipal and communal government, the island was divided into 86 communes, each with a mayor, an assistant-mayor, and a communal council elected by the people. The councils assessed the communal taxes and maintained roads and bridges. This governmental organization was entirely disrupted by the German occupation of May 1941.

Religion and Education.—The vast majority of the population belongs to the Orthodox (Greek) Church, which is governed by a synod of eight bishops under the presidency of the metropolitan of Candia. Education is nominally compulsory. Improved communications are much needed for the transport of agricultural produce, but Greek finances did not admit of adequate expenditure on road-making and other public works. The prosperity of the island depends on the development of agriculture.

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(J. D. B.; J. L. My.; X.)

ARCHAEOLOGY

History of Excavations.—The archaeological importance of Crete lies chiefly in its prehistoric remains, which attest the development in the island during the Aegean Bronze age of a culture at least equal in aesthetic and material achievement to the contemporary civilizations of Mesopotamia and Egypt. This Cretan culture extended in its maturity to the whole of Greece, and exercised considerable influence in more distant regions of Europe. Ancient literary records had led several scholars to look to Crete for the origin of the Mycenaean art which Heinrich Schliemann and others had revealed in Greece in the second half of the 19th century, but the disturbed political condition of the island at that time was an obstacle to methodical excavation. Schliemann visited Crete in 1886 and recognized a Mycenaean palace at Knossos, but was restrained from indulging his enthusiasm in the excavation of that difficult site by his inability to come to a financial agreement with the proprietors. An Italian mission, actively directed by Federigo Halbherr, and supported after 1893 by the Archaeological Institute of America, had explored and excavated in many districts since 1884, but with no special interest in any period of antiquity.

The first investigator who went to Crete with the purpose of defining its place in Aegean civilization was Arthur Evans, of the University of Oxford. He made his first visit in 1894, in search of a class of sealstones engraved with pictographic characters which he had identified as Cretan, and in the same year acquired part ownership of the land at Knossos. But it was not till 1900, when the provisional Greek Government was established, that Evans was able to complete the purchase of the palace site and to begin his excavations. Since that time the work at Knossos has not stood still. Later in the same year Halbherr initiated the excavation of Phaistos. A small palace at Hagia Triada, between Phaistos and the southern sea, was also dug by the Italian mission. The American Exploration Society, an organization affiliated to the University of Pennsylvania, sent an expedition to the district of Siteia, which excavated town-sites at Gournia and Vasiliki in 1901. The work in this district was ably carried on by Richard Seager until his premature death in Crete in 1925.

With the support of American universities and museums and of the American School of Classical Studies at Athens, he excavated houses and tombs in the islands of Pseira and Mochlos in the Gulf of Mirabella, and tombs at Pachyammos on the isthmus of Hierapetra. Other important cemeteries were explored by Americans in the same district at Sphoungaras and Vrokastro. The British School of Archaeology at Athens excavated houses and tombs at Knossos, cave-sanctuaries at Psychro and Kamares, and towns at Zakro and Palaikastro, at the eastern end of the island. It is an unexplained fact that no prehistoric remains have yet been identified in the western half of Crete.

The field-work of the Greek authorities has been active and efficient. but the Government has liberally allowed foreign workers to undertake the more extensive excavations, using its own resources mainly to deal with the numerous accidental finds of tombs or buildings and the rapid accumulation of material in the Cretan Museum at Herakleion (Candia). The nucleus of this unique collection had been formed by the local archaeological society, the *Syllogos,* in the difficult times of Turkish rule. It was housed by the Greek Government in the old barracks until the new museum was built in 1908, but this commodious edifice was not designed to resist earthquakes, which are a source of frequent and sometimes catastrophic destruction in Crete. In a slight shock, in June 1926, considerable, though not irreparable, damage was done to pottery and fresco-paintings by the fall of plaster ceilings. It is more than likely, so long as the building stands in its original form, that its total collapse will some day bury the collection. Since all important objects found in Crete are bound by Greek law to be kept in this museum, it is fortunate that most of them have been duplicated by mechanical reproductions, which are housed in many museums of Europe and America. The first Cretan ephor of antiquities and director of the Museum was Joseph Khatzidakis, who had been president of the Syllogos. His discoveries include two palaces, a small one at Tylissos, west of Knossos, which he excavated, and a large one at Mallia, on the east, which he transferred to the French School of Archaeology. His successor, Stephanos Xanthoudidis, explored houses at Khamaizi and Nirou Khani, an ossuary cave at Pyrgos, and an important series of early beehive-tombs in the Mesara plain.

Nomenclature and Chronology.—In order to mark a distinction between the pure Cretan culture and its colonial (Mycenaean) form, which may be supposed, at least in its latest phases, to contain some Mainland (*Helladic*) elements, Evans proposed the name *Minoan* for the Cretan Bronze age. The term has no particular reference to the legendary Minos, thalassocrat of an Aegean empire and judge in Hades; indeed tradition seems to point to at least two kings of that name, which may have been a dynastic title. Evans' chronological scheme is a symmetrical framework of nine periods. There are three main periods, Early, Middle and Late Minoan, representing the main artistic phases in the pottery viewed as the index of Aegean art. Each main period is divided into three numbered phases, I., II., III., on the natural principle of its rise, maturity and decline. The names of the nine periods are ordinarily abbreviated to their initial letters and the numerals: E.M.I., etc. Absolute chronology rests upon reciprocal contacts with foreign countries, chiefly with Egypt. The synchronisms and dates of the nine Minoan periods are as follows:

Crete	*Egypt*	*Years B.C.*
E.M. I.	Dyn. I.–III.	3400–2800
E.M. II.	„ IV.–VI.	2800–2400
E.M. III.	„ VII.–XI.	2400–2100
M.M. I.	„ XI.–XII.	2100–1900
M.M. II.	„ XII.–XIII.	1900–1700
M.M. III.	„ XIV.–XVII.	1700–1580
L.M. I.	„ XVIII. (to Thatmosis III.)	1580–1450
L.M. II.	„ XVIII. (to Amenhotef III.)	1450–1375
L.M. III.	„ XVIII.–XX.	1375–1100

It has been found possible to classify the M.M. and L.M. material into earlier and later phases of each period, M.M. I.*a*, M.M. I.*b*, etc.

Egyptian Contacts.—Contact with Egyptian art is visible throughout the Cretan prehistoric age. Neolithic and E.M. stone vases reflect Predynastic and Old Kingdom types. Devices cut on M.M. seals resemble those of Middle Kingdom scarabs, L.M. architectural and ceramic painting was strongly influenced by Nilotic motives, and in several Theban tombs of early Dyn. XVIII. are pictures of Cretan envoys bearing vessels of L.M. I. style. More definite synchronisms are afforded by finds of foreign products on Cretan sites, and of Minoan pottery in Egypt. Fragments of predynastic stone bowls have been found in Neolithic deposits at Knossos. M.M. II.*b* pottery has been found in Egypt in Dyn. XII. rubbish heaps at Lahun and in Dyn. XII. graves at Abydos and Harageh. An alabaster lid bearing the cartouche of the Hyksos king, Khyan, occurred in a M.M. III.*a* context in the palace of Knossos, and part of an inscribed diorite statuette of Dyn. XII.–XIII. was associated there with the M.M. II.*b* stratum. L.M. I. and L.M. II. painted vases have been excavated from Dyn. XVIII. graves and houses at Sakkara and Gurob, and a peculiarly cogent contact is the presence of numerous L.M. III.*a* potsherds (probably of Mycenaean fabric) in remains of the city of Amenhotep IV. (Akhenaten) at El Amarna, which existed only from 1375 to 1350 B.C. Minoan pottery has not been found in Egypt in contexts later than Rameses II. Its absence is doubtless due to political disturbances in the Aegean about that time, which are noted in the Egyptian records. The same disturbances appear to have caused the downfall of the Minoan power and culture, and to have closed the period of the Greek Bronze age.

Palaces and Towns: Architecture.—The most notable monuments are the palaces, and the palace of Knossos is the largest, best preserved, and most thoroughly investigated. The general aspect of a Minoan palace is a vast conglomeration of buildings around a square courtyard, with certain regular details, but no general symmetry of design.

This effect may be largely accidental, the result of long-continued habitation and rebuilding, but it is partly due to a predilection for irregular sites, a peculiarity also of Minoan town-planning. There was sometimes a difference of several storeys between the ground-floors in one building. Skilful use was made of varying levels to admit light and air to interior rooms, one roof serving as a terrace to the apartments next behind it. The ordinary system of interior lighting was through colonnades, or windows opening into small deep courts or shafts. Long porticos, borne by massive square or circular pillars, gave shade and shelter in the great courtyards.

The courts are paved with flag-stones and cement, and are traversed by slightly raised foot-paths. Wide flights of steps mount from one courtyard to another, and an odd arrangement of another flight, set at right angles to the first but leading nowhere, forms a kind of theatre or reception area. The palace entrances were square porticos with a single central column in front, and two doorways behind giving access to a corridor and a porter's lodge.

A typical internal feature is a range of doorways with doors folding back into square jambs. Inside the rooms, round columns carried the ceiling in the alignment of these piers. From such a scheme, by which the open doors convert an outer wall into a colonnade, the Greek *megaron,* with its anteroom and portico, may well have been derived. The columns tapered downwards; they were made of wood, and had variegated stone bases which are still in place. The columns have decayed, but in some instances their forms were moulded in the surrounding earth. In a large house (the Little Palace) at Knossos a shaft had left the impression of its convex fluting.

Columns were often set on stone balustrades. This device appears in its most elaborate form in the grand staircase of Knossos, and its simplest application is seen in small apartments with sunk floors approached by steps, which are a constant feature of all palaces. They were once thought to be baths, but it is likely that they were lustral chambers in which oil or water had some ritual use. Where columns stood in upper rooms the floors were supported by massive pillars at the same points in the rooms below. This was indeed a necessary method of construction where upper floors were made of stone and joists could only be of wood, but it became a sort of fetish, through the extension of baetylic cult to the pillars of the house, with very real significance in a land of earthquakes. The pillar-crypt was a domestic sanctuary. Vats for libation-offerings are sunk in the stone floors, and double-axes set on pedestals beside the pillars. The stones of pillars in such crypts at Knossos and Mallia are incised with the sign of the double-axe, in reference to their sacred function. But the double-axe was one of many mason's marks, and was used in other places where its religious meaning is not evident.

Interior walls were usually built of rubble, set with mortar in a timber frame, and were finished with a plaster face. The outer walls were solid stone, or had stone facing. The heaviest and finest ashlar masonry is found in the earliest portions of the palace structures (M.M. I.), but even here there was a tendency to use timber courses, particularly on the lines of window heads and sills. The stone-faced walls have thin orthostatic slabs set opposite each other on a solid plinth and clamped together crosswise with wooden bars, the space between them being filled with rubble. But even the stone veneer bears traces of external plaster.

Knossos, Plan.—The palace of Knossos lies on a low hill in the broad valley of the river Kairatos. The top of the hill, which is largely formed by Neolithic settlements of great antiquity, was levelled to make the central court. This is a long rectangle running north and south, and entirely enclosed by buildings. Outside the palace on the west is another paved court-yard. The area covered by the courts and buildings is about six acres. The only direct entrance to the central court is in the middle of the short north side. On the east the hill slopes sharply to the river, and here some ground-floor rooms have been preserved entire, together with the last four flights of the grand staircase that led down to them. This was the domestic quarter, with cool secluded rooms and no direct approach from outside. On the opposite side of the central court were public halls and offices, their further walls bordering the west court. The outer ground-floor contained the magazines, a range of narrow rooms, originally 22 in number, opening from one side of a corridor 200 ft. long. The lower walls here have been preserved for half their height. Large earthenware jars still stand along the walls, and in the stone floors of magazines and corridor are rows of square cists. Some of these have traces of lead linings, and fragments of gold foil bear witness to the storage of treasure at some time; but their heavily charred stone edges show that at the moment of their final passing out of use they were filled with oil. On the other side of the long corridor, facing the central court, is the throne room, an apartment evidently used for royal ceremonies. It takes the name from a high-backed gypsum chair which stands in the middle of one wall. On either side of the throne are stone benches, and the wall was painted with large griffins. On the opposite side of the room is a lustral chamber with sunk floor behind a balustrade. An earlier lustral chamber lies at the outer north-west corner of the palace.

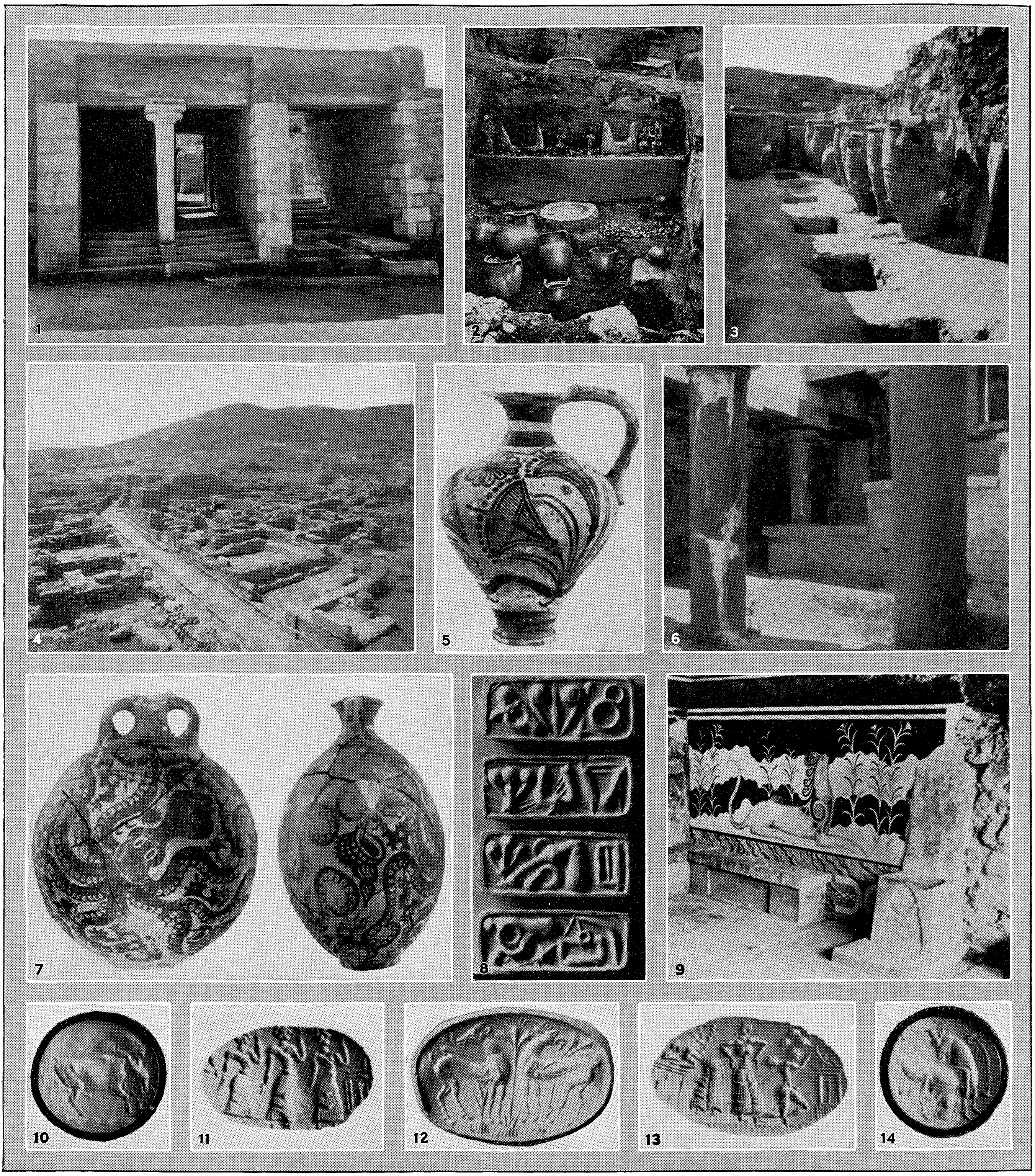
It is not known if both these sanctuaries were in use at the same time, but their existence points to a continuous association of this quarter with the priestly functions of the king. An entrance to the south-west quarter, opening from the west court, seems to have served his secular state. The processional corridor, lined with fresco-paintings of youths bearing ceremonial vessels, began at this porch, and turned left at the angle of the palace to an inner propylaeum, from which a wide staircase led to the principal hall of the west wing. In the east wing the north end contained the industrial and service quarter. Here were found quantities of fine painted pottery, stone vases in the making and unworked Laconian porphyry, and several magazines with storage-jars. The royal apartments are sunk in a deep cutting in the natural slope of the hill. Problems of drainage were complicated here by the difference of ground-floor levels. The living-rooms lie far below the central court, from which they are approached by the grand staircase. Stone shafts and ducts and terracotta pipes led the storm-water safely and even usefully from roofs and courts and terraces to rain-spouts in the outer walls. Each pipe is tapered and fits into the next with a collar-joint. It is thought that the tapered channel would give a thrust to the water and prevent accumulation of sediment. Beside a secondary staircase, stone ducts conveyed the water gently downhill in a series of convex curves. A latrine on the ground-floor was connected with the main drain and flushed with rain-water. A bathroom in the same suite has a cemented floor and an oval earthenware tub.

More illuminating than any description are the names which the excavator has given to some of these apartments: the Hall of the Colonnades, the Queen's Megaron, the Court of the Distaff, the Room of the Plaster Couch. The stone floor above this quarter lies in its original position. Like the steps and balustrades of the grand staircase it was held up by bricks and timber which fell down from the ruin of the upper storeys, and in the course of excavation the decayed beams were replaced by iron girders. On the upper terrace level, at the south-end of the east wing, is a domestic shrine, in its present condition belonging to the latest period of the palace, but probably occupying the site of the original chapel. Its furniture was found in place, crude terracotta idols of a goddess, her doves and votaries, vessels for offerings, and sacred horns for holding double-axes. Similar, but earlier and richer relics of another shrine, were found in two large cists (the temple repositories) in the floor of a room in the west wing. These are coloured faience statuettes of a snake-goddess and two priestesses, with votive robes and ornaments.

Knossos, History.—The chronology of the palace has been defined by observation of successive floor-levels, styles of building and deposits of pottery. It is clear that the existing plan was formed in its main outlines at the beginning of M.M. I. All identifiable remains of the E.M. period were cut away when the site was levelled for this structure. In its earliest form it seems to have consisted of a number of separate blocks built round the central court, some at least of which were fortified. The massive masonry seen, for instance, in the northern entrance belongs to these early works. In the course of M.M. I. the original island blocks were united in a single circuit wall; the gangways between them became corridors, and the entrances and general disposition of the existing quarters were laid out. The final consolidation of the building seems to have been achieved in M.M. II.*a.* It was then that the eastern slope was cut away to admit an enlargement of the residential quarter. At the end of M.M. II. the palace seems to have been partly destroyed. Signs of a similar catastrophe are visible at Phaistos, and the event was connected, at least in time, with the collapse of the Middle Kingdom in Egypt and the beginning of Hyksos raids. The political condition of Crete at the time is not known.

There was, however, no break in the continuity of Minoan culture, nor any diminution of material prosperity at Knossos or Phaistos. Both palaces were rebuilt at once and on a grander scale. The final arrangements of the domestic quarters date from this epoch (M.M. III.*a*), and its grand staircase then received its present form. Another structural catastrophe occurred at the end of the period (M.M. III.*b*) involving the destruction by fire of a large part of the west wing, and plundering of its treasure-cists. The buildings on the east slope were not so severely damaged, but in the rebuilding at the beginning of L.M. I. a good deal of work was done on each side of the cutting. There is reason for supposing that these destructions were primarily due to earthquakes. The L.M. rebuilding was competent and thorough, but shows in many places a reduction in extent. Much of the existing decoration naturally belongs to the latest phase of the palace as a whole, the so-called Palace period (L.M. II.) which is marked by highly decorative art and extreme technical facility. At its end there came another destruction, from which the palace never fully recovered. The whole building was burnt, and all the other palaces and towns of Crete were destroyed at the same time. In L.M. III. *a* there was a partial reoccupation of most of the ruined sites, but with only a shadow of their former grandeur, and with some new elements which seem to have come from Mainland Greece. It looks as if the conquerors of the Minoan mother-country were the Mycenaean colonists. The continual reconstruction of the palace is the reason of its complexity. Blocks originally separate were connected by corridors, which became more and more tortuous as halls and staircase were altered or added, and the process of adaptation ultimately produced a truly labyrinthine plan.

Viaduct, Road, and Caravanserai.—The most drastic changes which followed the catastrophe of M.M. III. are seen at the south end of the palace. At the south-east angle some huge blocks of masonry were found 20 ft. out of place, having been hurled to that distance by the earthquake shock, demolishing a house in their fall. This house, and another that collapsed with it, were not rebuilt, but were filled in after a religious sacrifice had been offered on the spot to propitiate the earth-shaking power. Relics of the rite were found in skulls of long-horned bulls and fragments of tripod-altars. At the same time the most magnificent entrance to the palace, at the south-west corner, was destroyed and not rebuilt, but its place was taken in the following period by private houses, which thus encroached upon the palace site. The



BY COURTESY OF (1) SIR ARTHUR EVANS, (3, 6, 9, 11, 13, 14) THE HELLENIC SOCIETY, (4, 5, 7, 10, 12) THE BRITISH SCHOOL AT ATHENS, (2) SIR ARTHUR EVANS, FROM "A PALACE OF MINOS" (MACMILLAN), (8) SIR ARTHUR EVANS, FROM "SCRIPTA MINOA" (CLARENDON PRESS)

CRETAN CIVILIZATION DURING THE MIDDLE AND LATE MINOAN PERIODS (2100–1100 B.C.)

1. Caravanserai excavated at Knossos, on the road which probably served as the general line of traffic to the north from Lybia and Egypt during the first part of the Late Minoan period (1580–1450 B.C.). 2. A Shrine of later squatters, among remains excavated at Knossos by Sir Arthur Evans. 3. A Magazine in the palace of Knossos, showing huge vats and cists used for the storage of the treasures of the kings. These vessels were probably in use during the whole occupancy of the palace (2100–1375 B.C.) from its early building in the first part of the Middle Minoan period to its fall, Late Minoan. 4. Paved main street of Palaikastro, a Cretan seaport town of the Middle and Late Minoan periods. 5. Vase (oenochoe) with papyrus flowers, found at Palaikastro. 6. Lower flight of the grand staircase in the Hall of Colonnades, palace of Minos. This staircase was constructed in its present form in the last third of the Middle Minoan period (1700–1580 B.C.). 7. Vase (front and side views), found at Palaikastro. Middle Minoan period (1700–1580 B.C.). The octopus design, as well as other marine forms, was frequently used in the decoration of Cretan pottery. 8. Four-sided bead seal of green jasper with conventionalized pictographic script. From Xida near site of Lytos. Style of the period from 1700–1580 B.C. 9. Throne room in the palace of Minos, showing gypsum throne and gypsum bench. About 2000 B.C. 10. Impression of a seal stone. Lion seizing a bull. 11. Gold seal ring. Female votaries before a pillar shrine. Mycenean, 16th century B.C. 12. Pair of wild goats on gold seal ring from Mycenae tomb. *c.* 1400 B.C. 13. Gold ring. Goddess with attendants at sacred tree. Mycenean, 16th century B.C. 14. Impression of seal stone. Bull with figure eight shield and sacred palm tree

original entrance was approached by a stepped portico, which climbed the bank of a stream that feeds the Kairatos. In connection with it, on the further bank, there stand the piers of a colossal viaduct by which the southern road was led across the bed of the torrent. Stepped intervals between the piers, like the spillways of a modern dam, gave passage to the water. Sections of the road itself have been traced across the island, over the low watershed of the central mountains and through the Mesara plain to the Libyan sea. It is visible in ancient cuttings, in retaining-walls, and in guard-houses, residences and shrines along its route. Its terminal port was at Komo, near Phaistos, which it also linked with Knossos, but it doubtless served as the general line of traffic to the north from Libya and Egypt. At the Knossian road-head, near the viaduct, Evans also found a caravanserai. It had a front yard backed with stables and store-rooms, and upper storeys built of brick. There is a refectory in the form of a stepped porch, adorned with a painted frieze of partridges and hoopoes. Attached to this is a smaller porch containing a sunk basin for foot-washing. A small spring-chamber near the caravanserai was choked with gypsum incrustation, but when this was cleared the water again rose in its ancient place, and the whole system was restored to working order.

Phaistos and Hagia Triada.—Phaistos has an imposing position on a mountain spur in the Mesara, 300 ft. above the plain. The palace occupies one summit, on two others were buildings of the town. It is more spacious though smaller than Knossos, and its plan is less complex, because the visible remains belong mostly to one period. The original palace, built in M.M. I. was destroyed as Knossos was in M.M. II., but less use was made of early elements in the M.M. III. rebuilding. After the general destruction at the end of L.M. II. it was not reoccupied. The existing plan is laid out on four slightly different levels. The central court measures about 50 yd. by 25, and has a portico on each long side. The colonnaded hall of state is approached by a noble stairway. The surviving furniture and wall-decorations are not remarkable, but a single find of unique importance was made in one of the magazines, a clay disc bearing pictographic inscriptions. At Hagia Triada, on a lower height of the same ridge, 2 m. from Phaistos and about halfway to the sea, there stands a small palace or villa, which is thought to have been a summer residence of the Phaestian king. It is finely built of ashlar masonry, and the walls stand higher than is usual on Minoan sites, but it was a short-lived structure, built in M.M. III. and destroyed in L.M.I. There was no earlier palace on its site, and nothing replaced it until the Reoccupation period (L.M. III.*a*), when a smaller Mycenaean building was imposed upon its ruins. But its premature destruction was the means of preserving some of the choicest works of Minoan art that exist, particularly some naturalistic fresco-paintings and three carved stone vases.

Mallia, Tylissos, Nirou Khani.—Palaces exist on the north coast at Mallia and Tylissos. That of Mallia is an extensive building with a colonnaded court in the monumental style of M.M. I. The remains at Tylissos belong rather to a large house or houses, but their decoration and contents were in true palatial style. A large house was also found at Nirou Khani, mid-way between Tylissos and Mallia. In one of its rooms were four gigantic double-axes of bronze, and in another were 40 or 50 tripod-altars. It must have been an emporium for religious furniture.

Towns and Houses.—Many houses have been found at Knossos, but the town, as a whole, has not been explored. Indeed, its site is too large for exhaustive excavation, and the Greek and Roman occupations have doubtless destroyed much of the Minoan city. Some of the houses are exceedingly well built, and differ from the structures of the palace only in size. Those which encroached upon the palace area after the M.M. III. earthquake had several storeys. A large house on the west side, connected by a paved road with the west court, has been called the Little Palace. It contains a lustral chamber and a pillar-crypt, and in it was found a magnificent libation-vessel in the shape of a bull's head, half life-size, carved in black steatite, with gilt horns, muzzle inlaid with white shell and enamelled crystal eyes. Another palatial house is the so-called Royal villa, which is probably one of a row of summer residences that stood on the river-bank below the domestic quarter of the palace. Even in some ordinary houses the decorations were not inferior to those of the royal halls; such are the wall-paintings from the House of the Frescos at Knossos.

The perfect type of the provincial town is Gournia. It lies on a low oval hill, to which the houses cling regardless of the slope; some are approached from the street by steps, others had one storey in front and two or three behind. An enclosing road on each side leads to a small palace, which occupies about 12 times the floor-space of an ordinary house. It is built like Knossos, even to the magazines and a court with stepped reception-area, but in humbler style. The streets of the town are about 5 ft. wide, stone-paved, and the houses crowd up to their edges. Some of the cross-streets climb the hill in steps. There is no circuit-wall and the houses are set closely round the palace. In the middle of the town is a built shrine, with furniture of pottery vessels and cult idols. The city flourished in L.M. I. and was partially reoccupied after the general destruction at the end of L.M. II. Its oldest houses are of M.M. date. The palace and some of the larger houses have ashlar masonry, but the ordinary material was rubble.

A few Neolithic structures are known. At Magasa near Palaikastro are a walled rock-shelter and a free-standing house of simple rectangular plan. The floors of two more complex houses were found beneath the pavement of the central court at Knossos. These had fixed hearths, a feature that does not appear again in Crete until L.M. III. An oval house of M.M. I. exists at Khamaizi, but this singular form is more likely to represent an adaptation to the contours of its site than the survival of a primitive plan. Vasiliki has E.M. houses built in the mature Minoan manner, with brick or rubble walls set on stone footings, stiffened with timber framework and plastered with clay and lime. Their roofs were wattled. The clay-plaster is even painted red, foreshadowing later fresco decoration.

No household furniture has survived except pots and pans of earthenware and bronze. Braziers of various kinds were used instead of fixed hearths. A heavy shallow dish supported by three short legs seems most suitable for warming rooms and cooking, and is often associated with sacrificial cult. More easily portable are broad-brimmed bowls with long poke-handles, largely used in tombs for fumigation, and fire-boxes, perforated globes sometimes joined to tripod-stands.

Arts: Pottery.—Much of the household pottery is rough unpainted ware and looks unattractive beside the painted vases which represent Minoan culture in museums. But decorated ware is abundant, and has a special scientific use apart from its aesthetic interest, since the style of decoration adds to the evidence of shape and fabric numerous distinctive features that make a reliable index of culture and chronology. The Cretan series has been accurately classified in reference to the chronological systems of the Neolithic and Bronze ages. The Neolithic deposit at Knossos has been divided into Lower, Middle and Upper Strata. The Lower pottery is plain dark-coloured ware, in its latest phase approximating to the burnished and incised fabrics of the Middle period, the typical Cretan Neolithic style. The decorative patterns are simple rectilinear figures, zig-zags, herring-bones and groups of parallel lines and rows of dots often grouped in triangles. The Upper Neolithic pottery is better fired, showing red or light brown surface, and less elaborately ornamented, both in burnish and incision. With the coming of copper in E.M.I. the pottery kept a sub-Neolithic character, but its fabric was often inferior. A closely-incised *bucchero* is the best product of the period.

Painting began in E.M. II. with rectilinear figures in red-black ferruginous glaze on a natural clay ground. Besides the simple forms of hemispherical bowls and cylindrical cups, flat plates, ladles and little globular pots, with pierced lugs for tie-on lids, which had persisted with slight variation from Neolithic times, some sophisticated and even fantastic forms appear, beaked jugs with loop-handles, and jars with long tubular spouts, which may have been copied from Egyptian or Mesopotamian prototypes in metal. In E.M. III. the mode of decoration was inverted, and the patterns were applied in white paint on a ground of black glaze. In this and the previous period the vase was sometimes covered with the glaze, and fired so as to oxidize in more or less irregular patches of black and red (Vasiliki ware). Curvilinear patterns began in E.M. III., notably the spiral coil, which was apparently introduced from the Cyclades. The potter's wheel was not known in the E.M. age. The manufacture of stone vases was perfected at this time, evidently under influence of Egyptian methods and models, but Minoan stone vessels have the same graceful and elaborate shapes as the pottery, and differ also from their Egyptian relatives in their gay colouring. They are mostly made of breccias and veined marbles, in which the bands of colours are disposed to fit the contours of the pots.

The best examples came from tombs at Mochlos, where a unique series of gold jewels of this early period was also found. These coloured stones, particularly a black marble veined with red and white, seem to have led the vase-painters to the invention of a polychrome style. In many instances the variegated stones were directly imitated, but the normal early types of ornament were simple festoons and bands, together with some rare and strongly stylized naturalistic motives, done in white and various shades of red and yellow on a lustrous black-glaze ground. This is the so-called Kamares ware, a style that is characteristic of all three M.M. periods. Its most brilliant phase was in M.M. I. *b*. and M.M. II. *a*. M.M. I. *a* contains the elements of the style; M.M. II. *b* displays a loss of vigour and some incipient changes. M.M. III. *a* shows artistic decadence, following the political catastrophe, and M.M. III. *b* developed a naturalistic impulse which finally destroyed the style.

At the culminating moment in M.M. II. *a*, the potter's craft was also at its best, just before the introduction of the quick wheel. The clay was worked to eggshell fineness. Waved rims and fluted bodies were copied from delicate metal cups, and heavier vessels had encrusted surfaces. The quick wheel brought industrial uniformity, and put an end to fanciful modelling. In M.M. II. *b* the first approach to faithful rendering of nature is seen in some groups of crocuses on a vase from the Kamares cave. An octopus on a companion vase is very strongly stylized. There was a growing tendency to arrange designs in horizontal bands; another imprint of the quick wheel, and the ornament itself became attenuated, its colouring less rich. The artistic decadence of M.M. III. *a* is represented in large quantities of meagrely decorated vases, in which some shapes were extravagantly elongated, a feature which belongs to Egyptian vessels of the same date. New forms were inspired by ostrich eggs mounted with tips and feet of metal or faience. Polychromy almost vanished, and the ordinary type of decoration consists of conventional coils and scrolls in thin white pigment on a faded black ground, or sprinklings of minute white dots in feeble imitation of mottled stone. A still more humble source of inspiration was the accidental trickle made by hasty painting or spilled contents. In M.M. III. *b* the painters turned definitely to naturalistic subjects, and their first essays of simple leaves and grasses mark the beginning of a new artistic era.

But the new subjects demanded more articulate expression than the old technique allowed. The L.M. age brought a complete return to the original method of painting, which, indeed, had never been quite lost, using the black glaze medium for drawing on the natural clay. Its revival now involved an exceedingly fine finish of the pot. No separate slip was applied, except to large vases of coarse substance, but the clay was smoothed and fired so as to produce a lustrous yellow or pale brown surface. The glaze was also improved in body and lustre, and was fired to a variety of tones from its normal black through brown to red and yellow. Touches of white and red paint were added in L.M. I., but did not long survive. The new exuberance of ornament attached itself to the old geometric motives, sprays of leaves or flowers springing from outer curves of spiral coils or occupying their centres.

Architectural ornaments were adapted from wall-decoration rows of discs and crescents, chequers and triglyphs, mottling and graining in imitation of stone and wood. Animals are never represented (though the bull's head occurs), birds rarely, but sea-creatures were favourite subjects in L.M. I. *b* and later, particularly octopods, argonauts and shells among rocks and seaweed. This was the beginning of the Mycenaean style. Its immediate development was back to formalism. The style of the Palace period (L.M. II.) is very decorative but often pompous. Large jars with rigid schemes of palm-trees or papyrus, and with painted bands and panels imitating stone and metal mouldings, are a common form. Minoan flowers are seldom true to nature, even in the direct and vigorous renderings of L.M. I. Nilotic lotus and papyrus types were freely blended with the native lily. The lesser pottery of L.M. II. has the formalism of this style without its grandeur, and is a stage on the way to the conventional reminiscences that comprise the repertory of L.M. III. This is the pottery of the Reoccupation period on Cretan sites. It consists of two varieties, the native Cretan (Minoan) style, which reflects the heavy formalism of L.M. II., and a simpler Mainland (Mycenaean) fabric, which is rather an atrophied derivative of L.M. I. The latter is the El Amarna style (1350 B.C.). There is no certain explanation of the co-existence of these two styles in Crete, but they suggest that the great destruction which preceded the reoccupation was the work of Mainland colonists. In the latest phases, L.M. III. *b* and sub-Mycenaean, it is no longer possible to differentiate Cretan and Mainland pottery.

Fresco-painting.—The decoration of pottery was closely bound to the greater art of fresco-painting, with the notable difference that human and animal figures, usual in the wall-paintings, were not until the very latest epoch reproduced on vases. Painted walls and floors were universal in Minoan houses, even on surfaces exposed to weather. The process was true fresco on lime plaster. Some E.M. house-walls at Vasiliki (where the plaster contained a large proportion of brick-earth) were painted red. It is probable that the earliest designs were reproductions of structural forms, grained timber friezes and pilasters, courses of discs representing ends of joists, veined and mottled wainscots imitating stone veneer. Such schemes persisted in the mature periods, and pictorial panels and friezes were inserted in these architectural frames.

The earliest known figure-subject is the Saffron Gatherer of Knossos, a blue-painted boy or girl gathering flowers into Kamares bowls in a rocky landscape (M.M. II.). Its style is still archaic, but before the end of the next period the painters had attained full freedom in their art. The masterpieces of the naturalistic phase (M.M. II. *b*–L.M. I. *a*) are landscapes from Hagia Triada, with cats stalking pheasants between rocks and flowers. Similar landscapes came from the House of the Frescoe at Knossos. There, on one fragment, amid luxuriant foliage and delicate flowers is a fountain-jet, on others a blue bird and a Sudanese monkey. Seascapes are represented by a frieze of dolphins from the Queen's Megaron, and by flying-fish from Phylakopi in Melos. A curious subject, of which several examples exist, is the summary representation in miniature of crowds of men and women in the vicinity of sacred buildings; probably spectators at a bull-fight or similar public shows. A small panel from Knossos contains a complete picture of the ceremonial sport of bull-leaping, the human sacrifice offered to the Minotaur in his Labyrinth, the "Place of the Axe." The performers are two girls (white-painted) and a boy. Human figures are represented elsewhere on a larger scale and in elaborate detail.

Painting was also combined with modelling in relief, as in the bust of a woman (Pseira), a bull's head, and a noble figure of a king or god wearing plumes and a lily-crown, who was leading a griffin in a land of flowers and butterflies (Knossos). These belong to L.M. I., as does an important historical subject from the House of the Frescoes, a Minoan officer leading negro soldiers. Processional figures were frequent; one of these is the Cup-bearer, the first great find that was made at Knossos. Landscapes of the closing period are represented by excerpts on large burial-chests. They reproduce the hybrid water-plants and stylized birds of contemporary Egypt.

Sculpture.—Sculpture of large size is poorly represented. That it existed is proved by the stucco reliefs in Crete and the lions of the gateways and two gypsum reliefs from Mycenae, which are purely Minoan. Small works in steatite or ivory are comparatively numerous. The earliest is a long-legged dog on a steatite vase-lid from Mochlos (E.M. II.). The finest pieces in the round are an ivory statuette of a boy leaping, probably from a bull-fight (Knossos), the black steatite bull's head from the Little Palace, and a gold and ivory snake-goddess in the Museum of Fine Arts at Boston. Another ivory statuette in an English collection represents a boy with arms raised in adoration, and may have been the companion figure to the Boston ivory in a group of the goddess and her son-consort. The snake-goddess, with her priestesses and sacred animals from Knossos, is modelled in faience, and lacks the fine finish of carved work. The same heaviness is seen in cast-bronze statuettes, male votaries from Tylissos and elsewhere, a woman from the Troad and another from Hagia Triada, and a group of a man and bull. Three superb examples of sculpture in relief are the Chieftain cup, the Boxer vase, and the Harvester vase from Hagia Triada. They are carved in black steatite, and were, perhaps, plated with gold foil.

Metal Work.—With them must be classed the two gold cups from the Vapheio tomb in Laconia, with *repoussé* designs of men handling wild and domesticated cattle. A peculiar and effective process of Minoan metal-work can only be illustrated from Mainland and Cycladic finds. This is flat inlay of light and dark gold and black alloy, best seen in bronze dagger-blades from the shaft-graves at Mycenae (cats hunting birds beside a river, men hunting lions, etc.). (*See* also BRONZE AND BRASS ORNAMENTAL WORK; SILVERSMITHS' AND GOLDSMITHS' WORK.)

Seal-engraving.—A lesser kind of sculpture, seal-engraving, was practised extensively from the very earliest times and developed to perfection in the M.M. period. The early subjects are pictographs and decorative devices, maeanders, coils and scrolls, often showing Egyptian affinities, and were mostly cut in ivory and steatite. But the process was soon applied to crystal, jasper and other hard stones, and the gem-engravers were, perhaps, the first Minoan artists to exploit naturalistic subjects. By M.M. II. they were producing animal figures with facility and truth, and gems of the finest style (M.M. III.–L.M. I.) are engraved with subtle and powerful studies of birds in flight, wild animals in action and repose, and human subjects. There was, however, a tendency on the one side to reproduce conventional linear designs, which must have had some amuletic meaning, and on the other to invent fantastic monsters. The latter are best seen in a series of clay sealings from Zakro. The human subjects were most frequently engraved on oval bezels of gold signet-rings, and often in religious contexts. There are some elaborate scenes of worship, from which much of the knowledge of Minoan ritual is derived.

Writing.—The earliest script, known only from the sealstones, is pictographic. But before the end of M.M. I. a linear form had been developed (Linear Script, Class A). The use of hieroglyphs seems not to have survived the catastrophe of M.M. II. at Knossos. Another linear script (Class B) is Late Minoan. About one-third of the linear signs can be connected with the pictographs, and only half the characters of Class B are found in Class A. The linear scripts were written with ink on pottery (and doubtless on perishable materials), engraved on stone and metal, and incised in clay. The greatest number of existing documents are flat clay slips or tablets, of which some two thousand have been found at Knossos. They are mostly inventories, bearing ideograms of the property to which they refer (arms and armour, chariots, men and women, and edible stores), together with a simple decimal notation. The script has not been interpreted, nor has the language been identified; but it is generally supposed that the former is preserved to some extent in the Hellenic syllabary of Cyprus, and that the latter was a non-Aryan tongue, which has survived in many names, and in some unintelligible inscriptions in the Greek alphabet found at Praisos. The most remarkable literary document that has come from a Minoan site is the Phaistos disc. This is made of clay, and bears on both sides a long series of pictographic characters impressed with separate stamps. The signs show no relationship with Minoan hieroglyphs, and it is thought (largely on account of a plumed head that occurs among them) that they belong to the south-west coast of Asia Minor. The characters are printed along a spiral line dividing the face of the disc into five coils. A similar arrangement of a Minoan inscription appears on the circular bezel of a gold signet-ring found in a tomb at Knossos (Mavro Spelio).

Physical Type and Dress.—Costumes, religion, and burial customs must join their scanty clues to that of language in the quest for the racial origins of the prehistoric Cretans. The general inference from all considerations is that Minoan affinities were African and Asiatic rather than European, or more definitely Libyan and Anatolian. Human remains are badly preserved in Crete, but about a hundred skulls have been measured, and the great majority of these are dolichocephalic. The male stature is computed by measurements of other bones to have been about 5 ft. 4 in., at least 2 in. below the present average in the island. The size of sword-hilts also indicates a small-boned race. Minoan dress was originally a sort of kilt, persisting with men as a tight loin-cloth, with which they often wore a more or less voluminous sash, perhaps as part of the same garment. Women wore a long wide skirt, sometimes extravagantly flounced, and an open bodice. The aprons worn by the faience snake-goddess and her votaries may have had a ritual significance, and may have been a survival of a single garment originally worn by both sexes. High boots, a tight belt (perhaps a permanent metal cincture) and a penis-sheath completed the simple costume of the men. The only representation of an overcoat occurs on the Harvester vase, where it is worn by the bearded leader and looks like a ceremonial cope. The hair was ordinarily worn long, beard and moustaches shaved.

Religion.—The chief Minoan deity is represented in the image of a woman and in the aniconic form of a pillar. The goddess has as many aspects as nature itself. She is associated in art with trees and rocks, with moon and stars, with birds and snakes, with real and monstrous animals and water-demons, with sea-shells, bulls' heads and sacred horns, with shields and battle-axes, and with holy vessels and vestments. There seems to be no function left for any other deity. Yet the mother-goddess had a consort, who was probably her son and is represented as a youth descending from the sky. There is doubtless a record of their history in the Hellenic cult of Rhea and the infant Zeus in Crete, and the death and burial of Zeus on Iuktas. Connection is evident with the numerous female deities and their youthful and semi-mortal consorts and sacred animals, and with the wide-spread baetylic cults of Syria and Asia Minor. The cult of pillars had a special significance on the domestic side, and the kings seem to have combined priestly functions with their secular powers, and to have been the living representatives of the gods. The bull-sports of the palace were a religious service. On the chthonic side a painted stone sarcophagus from Hagia Triada gives valuable information. A dead man standing at the doorway of his tomb receives offerings of a ship and cattle from male votaries wearing skirts of hide. A woman similarly clad pours a libation into a large vessel set between two pillar-trees on which are double-axes and birds. Another man plays a harp.

Shrines have been found in towns and palaces and are pictured in the frescoes. Built sanctuaries have also been excavated at Petsofas near Palaikastro and on Mount Iuktas. But the ordinary place of public worship was a natural cleft or hollow in the ground. Such are the Kamares cave on Mount Ida, another, perhaps the Dictaean cave, at Psychro, and a small one at Arkalokhori, near Lyttos. These sanctuaries contained offerings of curiously different kinds: at Petsofas were terra cotta statuettes of men and animals and votive limbs; at Kamares, painted pottery; at Psychro, bronze animals and implements, particularly miniature double-axes stuck in stalagmitic pillars; at Arkalokhori, chiefly dagger-blades.

Burial Rites.—Great variety is also found in modes of burial, beyond the constant fact that there was no cremation in the Minoan age. E.M. are single interments in cist-graves (Mochlos and Pseira) and in clay oval coffins of the Mesopotamian type (Pachyammos, Pyrgos and Sphoungaras), and communal burials in caves (Pyrgos), rock-shelters and rectangular enclosures (Mochlos), and in built beehive tombs (*tholoi,* in the Mesara plain). The latter are an important series. They have megalithic doorways and in some instances rectangular antechambers, and were in use during the whole E.M. period. The beehive vaults and square antechambers occur in certain tombs of North Africa, where an origin for the form is indicated in the tents of Libyan nomads. On the other side these early Cretan *tholoi* are the ancestors of the stately Mycenaean tombs, which first appeared in Mainland Greece with the Cretan intrusion at the end of M.M. III. M.M. coffins were usually large household jars, some of which bear splendid decoration (Pseira, Sphoungaras, Pachyammos). Hewn chamber-tombs with entrance passages were in use by the middle of this epoch (M.M. II.: Knossos, Mavro Spelio). Jar-burials also belong to L.M. I., but in the mature L.M. age, and particularly in L.M. III., the oval bath-tub came back to favour, together with rectangular clay chests with gabled lids (*larnakes*), copied from Egyptian wooden models and often painted with Egyptian floral motives. These receptacles were buried singly in shaft-graves or deposited in chamber-tombs. In the latter case they often served for generations of successive burials. No beehive tombs of the finest period have yet been found in Crete, though they are known in the earliest and latest times. The so-called Royal tomb of Isopata, near Knossos, belongs to the same date and style of building as the great Mainland treasuries (L.M.I.), and had a similarly vaulted roof, but its ground-plan is rectangular. Rich funeral furniture was deposited with the dead, weapons and domestic implements, jewellery and personal trinkets, stone and metal vases and painted pottery. But the chamber-tombs which were in constant use, seldom contain intact interments. For the same reason these tombs are often filled with cremation-burials of the Hellenic destroyers of Minoan civilization.

Transition to Iron Age.—The transition from the Bronze to the Iron age, and from Minoan to Hellenic culture, is best illustrated in tombs at Vrokastro. Both funeral rites occur, inhumation in chamber-tombs and cremation-burials in the same tombs and in bone-enclosures. The style of the pottery in the chamber-tombs is sub-Mycenaean or Proto-Geometric; that in the bone-enclosures is solely Geometric. Different types of bronze brooches (*fibulae*) are associated with the pottery; iron weapons were found with both kinds of burials, and in a chamber-tomb there was a bronze tripod of a type that has been found with Transitional material in Cyprus and in Greece. Six Egyptian faience seals were found with the tripod, but are not precisely dated. But it is clear that the Vrokastro finds cover the period between 1200 and 800 B.C., and display the stages by which Hellenic art displaced Minoan, without however offering an historical explanation of the process.

Greek and Roman Periods.—Hellenic structural remains are scanty. Town-walls are visible at Aptera, Itanos and elsewhere. The massive fortifications of Goulas are probably the oldest, and attest the insecure political conditions of the new era. But the few finds of lesser archaeological material that have been made, fragments of sculpture, pottery and inscriptions, are singularly important. They show conclusively that Crete was prominent, if not foremost, in the renascence that produced the art of archaic Greece, a fact of which there is historical record in the traditions of the master-craftsman, Daidalos, and the works of his pupils, Dipoinos and Skyllis. The prominence of Crete in the new movement was partly due to the revival of Minoan elements, but more to the position of the island in regard to Egypt and the Syrian coast, from which had come the inspiration of Minoan culture, and from which the elements of Hellenic art were drawn when contact was again established.

Archaic Painting and Sculpture.—Though the orthodox Geometric style of vase-painting was as much at home in Crete as on the Greek mainland, Minoan decorative survivals soon showed through it, and with them came strong Oriental influences, immediately derived perhaps from Cyprus. Geometric pottery illustrating these developments has been found abundantly in tombs at Knossos, and a remarkable series of archaic orientalizing vases comes from the site of Arkadia (Afrati) in Lasithi. Some of the foreign products by which the Cretan artists were guided are represented in a deposit of hammered and engraved bronze shields and bowls, found in a sacred cave near Anoia on Mount Ida (the Idaean cave) in 1884. Their actual origin has not been established, but there is little doubt that they are examples of the hybrid Egypto-Assyrian art that was broadcast through southern Mediterranean lands about 800 B.C. by Phoenician traders. With them were found some statuettes and other cast bronzes of local fabric. The Cretan types thus indicated are easily identified elsewhere, as in a bronze statuette found at Delphi, a nude youth wearing a tight belt and wig-like hair, and a stone figure of a woman in the Louvre. The date of these pieces is about 600 B.C. To the same period belongs a unique series of temple-sculptures from Prinias, a frieze of horsemen armed with spears and shields, and a free-standing stone beam from a door-head, carved with relief of animals and surmounted at each end by a seated goddess. A somewhat similar but later frieze, in terracotta, with figures of armed men and chariots, comes from the temple of Dictaean Zeus at Palaikastro. Other finds on this site were Phoenician bronze shields like those in the Idaean cave, and a fragmentary inscription containing an archaic hymn to Zeus.

Inscriptions.—Several inscriptions in the Eteocretan language were found in a sanctuary at Praisos. They have not been read. At Gortyna is the famous legal code, inscribed on the inner side of a curved wall which stood, at the time of its discovery, in a mill-stream. The first copy of the text was made by Halbherr in 1884, but it was not till 1912 that the Italian Mission got authority to divert the stream and clear the building to which the wall belongs. It is an archaic Greek structure of circular plan, which was converted into an Odeum in Roman times. It stood in the *agora* of the city.

Roman Gortyna.—Gortyna is the only Roman site that has been excavated. It was one of the three great cities of Crete in the Imperial age, and its remains show that it conformed to the metropolitan pattern in art and architecture. Among its public buildings are an amphitheatre and a theatre, two Nymphaea, an aqueduct and baths, a Basilica or Praetorium, temples of Apollo (the Pythion), Isis and Serapis, and other deities. A great deal of Graeco-Roman statuary belonging to their decoration has survived.

Greek art of the classical period is rare in Crete. The island had then lost its place in international commerce, and its culture was not affected by external influences. The character of the local art is illustrated in the coinage, which contains, besides some bold Greek types, a number of strange pictorial subjects and many lapses into a state of barbarism. It is an archaeological echo of the Cretan heresies that shocked Hellenic theologians.

(E. J. F.)

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HISTORY

ANCIENT

In classical times nothing remained of the Minoan Civilization except a tradition that the first "thalassocracy" or sea-power was that of a Cretan king Minos. The island played no part in Greek history commensurate with its size. It took practically no share in the Persian or Peloponnesian wars.

It was dotted with independent cities which dissipated their energies in internecine wars. For the rest of Greece it was chiefly of importance as a recruiting ground for mercenary soldiers, especially archers; promises of assistance from states, such as caused the fruitless Athenian expedition in 429 against the Peloponnesian war, were generally found to be fallacious. The reputation of the Cretans was low: "all Cretans are liars" (Κρῆτες ἀεὶ ψεῦσται) was the beginning of a popular poem which is the origin of Porson's "Hermann's a German."

Their chief cities were Gortyna, Cydonia and Knossus. Important towns of the second rank, generally to be found in alliance with one or other of the three chief towns were: Phaestus, Rhaucus, Lyttus, Polyrrhenia, Aptera, Eleutherna, Axus, Lappa, Elyrus, Praesus, Itanus and Hierapytna, which was the sole port facing towards Africa. The population was exceedingly mixed. The *Odyssey* (xix., 175) in a passage whose date is of course uncertain, enumerates the inhabitants as Achaeans, Cydonians, Dorians, Pelasgians and Eteocretans. The last named are the most interesting. There is much reason to believe that these were the original, non-Hellenic inhabitants of the island. They were chiefly to be found in the eastern end of the island. There are several of their inscriptions surviving, all—at present—incomprehensible. In historical times the domination of Crete had fallen wholly into the hands of one of these races, the Dorians, whose numbers had been increased by later immigrations. The names of the three tribes, Hylleis, Dymanes and Pamphyli, which always accompanied Dorian migrations, are to be traced in many Cretan cities.

Cretan Constitutions.—The chief interest of Crete, for us as for the ancients, lies in its system of laws; and the great Gortyna inscription discovered in 1884 (*see* GREEK LAW) is our most extensive monument of Greek Law. The constitutions of the Cretan towns, which appear to have all approximated to one model, are a simpler and possibly earlier form of the Spartan constitution.

The population consisted of two classes, citizens and serfs. The citizens were all warriors, and the serfs were of two kinds, state-owned (*μνωῖται*) and private owned (*ἀφαμιῶται*). The serfs seem to have been better treated than the Spartan helots—we hear of no revolts—but they were rigorously excluded from the privileges of the citizens, arms-bearing and exercise in the gymnasia. The kings, who survived in Sparta, had disappeared: their place was taken by ten *kosmoi* who were chosen from certain specified aristocratic clans. They had all executive functions; advised by a council of elders (*γερουσία*) the citizen assembly had the right to say *yes* or *no* to the proposals laid before it, but it had no right to propose reductions or to debate.

The training of the Cretan boy as a warrior began at about 17 when he was admitted into the "herds" supported by the State. He had already learnt to read and write, and to sing certain selected patriotic songs; he now spent his days in military exercises. He was bound to marry but could not live with his wife until he became a full man. He took his dinners in common, at public dining halls like the Spartan *phiditia*.

This constitution appears to have shared the fate of the Spartan (*see* SPARTA). At the end of the classical period Crete, continually at civil war, has become chiefly a recruiting ground for armies. Its wealth and civic organization has declined, and it no doubt shared in the economic depression of all Greece in the Hellenistic age.

See *Cambridge Ancient History,* vol. iii. (1925); J. B. Bury, *History of Greece* ch. ii. (1913); Pauly-Wissowa, *Realencyc. s. vv.* Kosmoi, Kreta; Aristotle's *Politics* Bk. ii. (X.)

MEDIAEVAL AND MODERN PERIODS

Though torn by civil dissensions, the island maintained its independence of the various Macedonian monarchs by whom it was surrounded; but having incurred the enmity of Rome, first by an alliance with the great Mithridates, and afterwards by taking active part with their neighbours, the pirates of Cilicia, the Cretans were at length attacked by the Roman arms, and, after a resistance protracted for more than three years, were finally subdued by Q. Metellus, who earned by this success the surname of Creticus (67 B.C.). The island was now reduced to a Roman province, and subsequently united for administrative purposes with the district of Cyrenaica; until it was incorporated by Constantine in the prefecture of Illyria. Crete formed part of the Byzantine empire until it fell into the hands of the Saracens (823). It then became a formidable nest of pirates and a great slave mart; it defied all the efforts of the Byzantine sovereigns to recover it till 960, when it was reconquered by Nicephoros Phocas. After the capture of Constantinople by the Latins in 1204, Crete was allotted to Boniface, marquis of Montferrat, but sold by him to the Venetians, to whom it continued subject for more than four centuries.

Under the Venetian government Candia, a fortress originally built by the Saracens, and called by them "Khandax," became the seat of government and capital of the island, to which it gave its name. The Venetian administration secured the island external tranquillity, and did much to provide material prosperity and encourage commerce and industry; under it Crete was probably more prosperous than at any other time. But the system was arbitrary and oppressive, and gave rise to many insurrections. Daru mentions 14 between the years 1207–1365, the most important being that of 1361–64, when the Venetian colonists rose against the republic. Disappointed in the hope of a Genoese occupation, the Cretans turned to the Turks. The Turks made no serious attempt to conquer the island until 1645; but in that year they landed an army of 50,000 men and soon reduced Canea. Retimo fell the following year, and in 1648 the Turks laid siege to Candia. After a siege of more than 20 years the city surrendered in Sept. 1669, and its fall was followed by the submission of the island. Venice was allowed to retain possession of Grabusa, Suda and Spinalonga on the north, but in 1691 Grabusa, and in 1715 the other two strongholds fell to the Turks, and the island was finally lost to Venice.

Period of Turkish Rule.—Under the Ottoman rule many of the Cretans embraced Mohammedanism, and thus secured the chief share in the administration of the island. But this did not benefit the population, and in 1837 Crete was considered the worst governed province of the Turkish empire. In 1770 an abortive attempt at revolt, the hero of which was "Master" John, a Sphakiot chief, was repressed with great cruelty. In 1813 the ruthless severity of the governor general, Haji Osman, who obtained the co-operation of the Christians, broke the power of the janissaries; but after Osman had fallen a victim to the suspicions of the sultan, Crete again came under their control. When in 1821 the revolution broke out in continental Greece, the Cretans, headed by the Sphakiots, revolted, and occupied all the open country, while the Turks and Muslims took refuge in the fortified cities. The island was reduced to submission in 1824 by Mohammed Ali, pasha of Egypt, whose help the sultan had asked. The allied powers (France, Great Britain and Russia) decided that Crete should not be included amongst the islands annexed to the kingdom of Greece; but obtained from the sultan Mahmud II., its cession to Egypt, which was confirmed by a firman of Dec. 20, 1832. This change of masters brought some relief to the Cretans; the enlightened government of Mustafa Pasha, an Albanian like Mohammed Ali (1832–52), who encouraged agriculture, improved the roads, introduced an Albanian police, and put down brigandage, has been called the "golden age" of Crete.

In 1840 Crete was taken from Mohammed Ali and replaced under the dominion of the Turks, but Mustafa retained his governorship until appointed grand vizier in 1852. In Feb. 1856 an insurrection broke out, owing to the violation of the provisions of an imperial decree whereby liberty of conscience and equal rights and privileges with Muslims had been conferred upon Christians. The promised concessions were confirmed in July 1858, but again repudiated. A petition to the sultan in 1864 elicited only an injunction to obedience. A general insurrection which broke out in 1866 was put down with great severity, but the "Organic Statute" granted by the sultan in 1868 brought some reforms and a kind of constitutional government.

Constitutional Experiments.—Under this instrument which was afterwards proposed under Article XXIII., in the Berlin Treaty (*q.v.*), as a basis for reforms in other parts of the Ottoman empire, various privileges already acquired by the Christian population were confirmed; a representative general council was brought into existence, composed of deputies from every district; mixed tribunals were introduced, together with a highly elaborate administrative system, under which all the more important functionaries, Christian and Muslim, were provided with an assessor of the opposite creed. The new constitution, however, proved costly and unworkable, and failed to satisfy either section of the population. In 1878 the Greek government, finding Hellenic aspirations ignored by the Treaty of San Stefano, gave the signal for agitation in the island. An insurrection followed, accompanied by the usual barbarities on both sides. Eventually the Cretan chiefs invoked the mediation of Great Britain, which Turkey, exhausted by her struggle with Russia, accepted, and the "Pact of Halepa" was drawn up in 1878 under the auspices of Mr. Sandwith, the British consul, and Adossides Pasha, both of whom enjoyed the confidence of the Cretan population. The privileges conferred by the Organic Statute were confirmed; the judicial and administrative systems maintained; the judges were declared independent of the executive, and an assembly composed of 49 Christians and 31 Muslim deputies took the place of the former general council. The ensuing party government was a mere scramble for office and its rewards. In 1889 a crisis occurred, when the "Conservative" leaders, finding themselves in a minority, took up arms and withdrew to the mountains. The latent fanaticism of both creeds was aroused, and the island again became a scene of devastation. The Porte seized the occasion to proclaim martial law and abrogate many important provisions of the Halepa Pact. The Christians boycotted the elections under the new system, and for the next five years Crete was governed by a succession of Mohammedan valis; the deficit in the budget increased, the gendarmerie, which received no pay, became insubordinate, and crime multiplied. In 1894 the Porte, at the instance of the powers, nominated a Christian, Karatheodory Pasha, to the governorship, and the Christians agreed to take part in the assembly which soon afterwards was convoked; no steps, however, were taken to remedy the financial situation. The refusal of the Porte to refund considerable sums illegally diverted from the Cretan treasury, or even to sanction a loan to meet immediate requirements, caused great exasperation, which was increased by the recall of Karatheodory (March 1895). Before that event an *Epitropé*, or "committee of reform," had appeared in the mountains. The *Epitropé* was at first nothing more than a handful of discontented politicians, but its membership swelled rapidly, and in April 1896 it invested the garrison town of Vamos. Civil war began. Serious disturbances broke out at Canea on May 24 and were only quelled by the arrival of foreign warships. Despite the intervention of the foreign consuls, the sultan proceeded to crush the rising by force. The resulting devastation, and the excitement it aroused in Greece, quickened the energies of the powers. Austria proposed an international blockade of the island, but Great Britain rejected this. At the representations of the powers, the sultan restored the Pact of Halepa, the troops were withdrawn from the interior, financial aid was promised, a Christian governor general was appointed, the assembly was summoned, and an imperial commissioner was despatched to negotiate an arrangement. The Christian leaders proposed a moderate scheme of reforms, based on the Halepa Pact, which, with a few exceptions, was approved by the powers and eventually sanctioned by the sultan.

The Revolt of 1897.—On Sept. 4, 1896, the assembly formally accepted the new constitution and declared its gratitude to the powers. The Muslim leaders acquiesced in the arrangement, which the powers undertook to guarantee. It soon became evident, however, that the Porte was endeavouring to obstruct the execution of the reforms. The indignation of the Christians increased, a state of insecurity prevailed, and the Muslim peasants refused to return to their homes. Hitherto the Greek government had loyally co-operated with the powers in their Cretan policy, but towards the close of the year a secret society known as the *Ethniké Hetairia* began to arrogate to itself the direction of Greek foreign policy. Its aim was war with Turkey with a view to the acquisition of Macedonia, and it found ready allies in the Cretan Christians. Emissaries of the society appeared in Crete, large consignments of arms were landed, and at the beginning of 1897 the island was practically in a state of insurrection. On Jan. 21 the Greek fleet was mobilized. A series of conflicts took place at Canea on Feb. 4; the Turkish troops fired on the Christians, a conflagration broke out in the town, and thousands of Christians took refuge on the foreign warships. The Greek government now despatched an ironclad and a cruiser to Canea, which were followed a few days later by a torpedo flotilla commanded by Prince George. The prince soon retired to Melos, but on the night of Feb. 4 a Greek force landed at Kolymbari, near Canea, and its commander, Col. Vassos, proclaimed the occupation of the island in the name of King George. This move caused immense excitement among the Christian population, who indulged in terrible massacres of the Muslim peasantry. The powers, however, occupied Canea, and afterwards Candia and other towns, blockaded the coast, and bombarded the insurgents' position. They then presented collective notes to the Turkish and Greek governments announcing their decision that (1) Crete could in no case in present circumstances be annexed to Greece; (2) in view of the delays caused by Turkey in the application of the reforms Crete should be endowed with an effective autonomous administration under the suzerainty of the sultan. Cretan autonomy was proclaimed March 20, the Greek force left on May 9, and the insurgent assembly, under its president, Dr. Sphakianakis, cooperated with the international commanders to maintain order. After Germany and Austria had withdrawn from the European Concert (April 1898) the remaining powers divided the island into four departments, which they severally undertook to administer. The last Turkish soldiers quitted the island on Nov. 14, 1898.

Union with Greece.—On Nov. 26 the powers nominated Prince George of Greece as high commissioner for three years. He landed on Dec. 21. Order prevailed, but the Muslims, reduced to great distress by the prolonged insurrection, emigrated in large numbers. On April 27, 1899, a new autonomous constitution was voted by a constituent assembly, and in the following June Cretan officials took over the local administration. Prince George's appointment was prolonged in 1901 and his extensive powers increased. The arbitrary methods of the government awoke strong opposition, led by M. Venizelos, who had played an important part in the insurrection, but had been dismissed from his post of councillor in 1901. In March 1905 M. Venizelos, with the moral support of Dr. Sphakianakis, led a revolt at Theriso in the White Mountains, and proclaimed the union of the island with Greece, and this example was speedily followed by the assembly at Canea. The powers, however, reiterated their decision to maintain the *status quo,* and increased their military and naval forces; the Greek flag was hauled down at Canea and Candia, and some desultory engagements with the insurgents took place, the international troops co-operating with the native gendarmerie. In the autumn M. Venizelos and his followers, having obtained an amnesty, laid down their arms. On July 25, 1906, the powers announced a series of reforms, including the reorganization of the gendarmerie and militia under Greek officers, as a preliminary to the eventual withdrawal of the international troops, and the extension to Crete of the system of financial control established in Greece. On Sept. 25 Prince George left the island. His successor, M. Alexander Zaimis, a former and later prime minister of Greece, arrived in Crete on Oct. 1.

On Feb. 22, 1907 M. Zaimis, as high commissioner, took the oath to the new constitution elaborated by the national assembly. His position was one of singular difficulty. Apart from the rivalry of the factions within the assembly, there was the question of the Muslim minority, reduced to 40,000 but still a force to be reckoned with. M. Zaimis showed great skill and studied impartiality, and his administration was a marked success. Order was restored, and M. Zaimis having called the attention of the powers to the fact that the conditions they had laid down as preliminary to evacuation—(1) the organization of a native gendarmerie, (2) the maintenance of the tranquillity of the island, (3) the complete security of the Muslim population—had now been fulfilled, the powers informed him on May 11, 1908, of their intention to begin the evacuation at once and complete it within a year. The first withdrawal of the troops (July 27), hailed joyfully by the Cretan Christians, led to rioting by the Muslims, who believed themselves abandoned to their fate.

Meanwhile M. Zaimis had made a further advance towards the annexation of the island to Greece by a visit to Athens, where he arranged for a loan with the Greek National Bank and engaged Greek officers for the new gendarmerie. The issue was precipitated by news of the revolution in Turkey. On Oct. 12 the Cretan Assembly once more voted the union with Greece, and in the absence of M. Zaimis, elected a committee of five to govern the island in the name of the king of Greece.

On July 26, 1906, the powers withdrew their remaining troops. The Cretans hoisted a Greek flag; the Turkish Government adopted a minatory tone to Greece, and the powers cut down the offending flagstaff; war was postponed, but the humiliation was not forgotten. On Oct. 14, 1912, the eve of the first Balkan War, M. Venizelos, then Greek premier, admitted the Cretan deputies to the Greek Chamber; S. Dragoumes was sent to Crete as general administrator. Art. 4 of the Treaty of London (1913) ceded Crete to Greece. After that time its history was merged in that of Greece (*q.v.*).

Crete occupied world attention in May 1941 when the Germans, after the conquest of the Greek mainland, attacked the island by air-borne troops. The remnants of the Greek army and a New Zealand division resisted valiantly, but after a struggle lasting from May 19 to June 1, the British had to withdraw their troops to Egypt. Crete was then completely occupied by the Germans, although guerrilla fighting continued for some time. After Germany's surrender, May 8, 1945, Crete was restored to Greek rule. (*See* WORLD WAR II.)

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(J. D. B.; W. M.; X.)

CRETINISM, the term given to a chronic disease, either sporadic or endemic, arising in early childhood, and due to absence or deficiency of the normal secretion of the thyroid gland. It is characterized by imperfect development both of mind and body.

The endemic form of cretinism prevails in the valleys of central Switzerland, Tirol and the Pyrenees. In Great Britain cretins have been found in many places but particularly in Derbyshire. The disease is not confined to Europe, but occurs in North and South America, Australia, Africa and Asia. Wherever endemic goitre is present, endemic cretinism is present also, and it has been constantly observed that when a new family moves into a goitrous district, goitre appears in the first generation, cretinism in the second. The causation of goitre has now been shown to be due to drinking certain waters, though the particular impurity in the water which gives rise to this condition has not been determined (*see* GOITRE). The causation of the sporadic form of cretinism is obscure. In goitre and cretinism, however, there is deficiency of iodine in the thyroid tissue.

Cretinism is usually unrecognized until the child reaches some 18 months or two years, when its lack of mental development and uncouth bodily form attracts attention. Occasionally the condition develops later, any time up to puberty. The essential point in the morbid anatomy of cretinism is abnormality of the thyroid gland (*see* METABOLIC DISEASES). It may be congenitally absent, atrophied, or the seat of a goitre, though this last condition is very rare in cases of sporadic cretinism. The skeleton shows arrested growth, most marked in the case of the long bones. The skull in the endemic form is usually brachycephalic, but in sporadic cases it is more commonly dolichocephalic. When fully grown the cretin's height rarely exceeds 4ft., and is often less than 3ft. The skin feels doughy from thickening of the subcutaneous tissues, and it hangs in folds over the abdomen and the bends of the joints. Very frequently there is an umbilical hernia. The hair is sparse and coarse and is usually absent on the body of an adult cretin. The temperature is subnormal, and the exposed parts tend to become blue in cold weather. The blood often contains less than half the normal amount of haemoglobin. The mental capacity varies within narrow limits; an intelligent adult cretin may reach the intellectual development of a child of from three to four years of age, though more often the standard attained is even below this. The child cretin learns neither to walk nor talk at the usual time. Often it is unable even to sit without support. Some years later a certain power of movement is acquired, but the gait is waddling and clumsy. Speech is long delayed, or in bad cases may be almost entirely lacking. The voice is usually harsh and unpleasant. Of the senses smell and taste are but slightly developed, more or less deafness is generally present, and only the sight is fairly normal. In the adult the genital organs remain undeveloped. If the cretin is untreated he rarely has a long life, 30 years being an exceptional age. Death results from some intercurrent disease.

Cretinism differs clinically from the state of a Mongolian idiot, in whom there is no thickening of the subcutaneous tissues and much greater alertness of mind; from achondroplasia, in which condition there is usually no mental impairment; and from infantilism, which covers a group of symptoms whose only common point is that the primary and secondary sexual characteristics fail to appear at the proper time.

Before 1891 there was no treatment for this disease. The patients lived in hopeless imbecility until their death. But in that year Dr. George Murray published his discovery of the effect of hypodermic injections of thyroid gland extract in cases of myxoedema (*q.v.*) a disease manifestly related to cretinism. In the following years Drs. Hector Mackenzie, E. L. Fox of Plymouth, and Howitz of Copenhagen, each working independently, showed the equally potent effect of the gland administered by the mouth. The remedy was soon after applied to cretinism. It has to be used, however, with care and discrimination, since personal idiosyncrasy seems to be a very variable factor. Even small doses, if beyond the patient's power, may produce fever, excitement, headache, insomnia and vomiting. The administration must be persisted in throughout life, otherwise myxoedematous symptoms appear. The first most apparent result is growth. Once started, 4 to 6in. may be gained in stature in the first year's treatment, but is usually in inverse ratio to the age of the patient, and also diminishes in later stages of treatment. Mackenzie recorded the case of a cretin aged 11 years in 1893, when thyroid treatment was started. He grew very rapidly and became a normal child, passed through school, and in 1908 was at one of the universities.

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CRETONNE, the name of a class of printed cotton fabrics used chiefly for furniture upholstery, hangings, window drapery, many other household purposes, and are also made into smocks, fancy overalls, etc. The finer and lighter textures of cretonnes are also made into fancy overalls and other garments for women and children. The name is said to be derived from Creton, a village in Normandy where linen was made. (*See* also CALICO PRINTING.)

CREUSE, a department of central France, comprising the greater portion of the old province of Marche, together with portions of Berry, Bourbonnais, Auvergne, Limousin and Poitou. Area, 2,165 sq.mi. Pop. (1936) 201,844. It is bounded north by the departments of Indre and Cher, east by Allier and Puy-de-Dôme, south by Corrèze and west by Haute-Vienne. It lies on the north-west border of the Plateau Central and the highest land is in the south-east where some heights exceed 3,000 ft. The principal river is the Creuse, which rises on the border of

Corrèze, and passes through the department, receiving the Petite Creuse from the right, and afterwards flowing on to join the Vienne. The valleys of the head-streams of the Cher and of its tributary the Tardes, occupy the eastern side; those of the heads of the Vienne and its tributary the Thaurion, and of the Gartempe joining the Creuse, are in the west of the department. These rivers have entrenched themselves along lines of weakness and have dissected the plateau of crystalline schists and intrusive granites into blocks which occupy the northern half of the department. Thin soil and a cold, damp climate limit activities on these moorlands to sheep-breeding, with cattle-rearing in more sheltered parts. Agriculture is confined to the valleys, especially where they widen out in the extreme north, but is much handicapped by the scarcity of labour due to emigration. The produce of cereals, chiefly rye, wheat, oats and buckwheat, is not sufficient for home consumption. The chestnut abounds in the north and west; hemp and potatoes are also grown.

Coal is mined in the basin of Ahun. Évaux, in the east, has thermal springs and remains of Roman baths. There are manufactories of carpets and hangings, dyeworks at Aubusson and Felletin, also saw-mills and manufactures of wooden shoes and hats. The Orléans railway line from Montluçon to Périgueux traverses Creuse from east to west. It is divided into the two arrondissements of Guéret and Aubusson, with 25 cantons and 266 communes. With Haute-Vienne, Creuse forms the diocese of Limoges, where also is its court of appeal. It forms part of the académie (educational division) of Clermont and of the region of the XII Army Corps. The principal towns are Gueret and Aubusson. La Souterraine, Chambon-sur-Voueize and Bénévent-l'Abbaye possess fine churches of the 12th century. At Moutier-d'Ahun there is a church, which has survived from a Benedictine abbey. The nave of the 15th century with a fine portal, and the choir with its carved stalls of the 17th century, are of considerable interest. The small industrial town of Bourganeuf has remains of a priory.

CREUTZ, GUSTAF FILIP, Count (1731–1785), Swedish poet, was born in Finland and educated at Åbo. He received a post in the court of chancery at Stockholm in 1751. Here he met Count Gyllenborg, with whom his name is indissolubly connected. They were closely allied with Fru Nordenflycht, and their works were published in common. Creutz's greatest work is contained in the 1762 volume, the idyll of *Atis och Camilla;* the exquisite little pastoral entitled "Daphne" was published at the same time, and Gyllenborg was the first to proclaim the supremacy of his friend. In 1763 Creutz practically closed his poetical career; he went to Madrid as ambassador, and after three years to Paris in the same capacity. In 1783 Gustavus III. recalled him and heaped honours upon him. He died on Oct. 30, 1785. *Atis och Camilla* was long the most admired poem in the Swedish language. Creutz introduced a melody and grace into the Swedish tongue which it lacked before, and he has been styled "the last artificer of the language."

See *Creutz och Gyllenborgs Vitterhetsarbeten* (Stockholm, 1795); A. Hultin, *Gustaf Filip Creutz, hans leovnad och vittra skrifter* (Helsingfors, 1886 etc.). Selections of Creutz's work are also to be found in E. P. L. Meyer, *Svenska Parnassen,* vol. 2 (1889) and O. Levertin, *Sverizes National-Litteratur, 1500–1900,* vol. 3 (1907, etc.).

CREUZER, GEORG FRIEDRICH (1771–1858), German philologist and archaeologist, was born on March 10, 1771 at Marburg, the son of a bookbinder. He was professor of philology and ancient history at Heidelberg for nearly 45 years, with the exception of a short time spent at the University of Leyden. He died on Feb. 16, 1858. Creuzer's first and most famous work was his *Symbolik und Mythologie der alten Völker, besonders der Griechen* (1810–12), in which he maintained that the mythology of Homer and Hesiod came from an Eastern source through the Pelasgians, and was the remains of an ancient revelation.

See the autobiographical *Aus dem Leben eines alten Professors* (Leipzig and Darmstadt, 1848), to which was added in the year of his death *Paralipomena der Lebenskizze eines alten Professors* (Frankfort, 1858); Starck, *Friederich Kreuzer, sein Bildungsgang und seine bleibende Bedeutung* (Heidelberg, 1875); Rohde, *Friedrich Creuzer und Karoline von Gunderode, Briefe und Dichtungen* 1896.

CREVASSE (Fr.), a fissure in a glacier, may be transverse or longitudinal, brought about by tension due to unequal rates of movement, the central part generally moving faster than the margins, and (or) movement over an uneven surface. Irregular pinnacles of ice between crevasses of great magnitude on steep slopes are known as *seracs* (*see* Glacier). The word *crevasse* is also applied to wide cracks in the raised banks of rivers and canals, *e.g.,* in the levees of the Mississippi.

CRÈVECOEUR, MICHEL-GUILLAUME JEAN DE (1735–1813), commonly called Hector St. John, was born near Caen, France, Jan. 31, 1735, of an old Norman family. One of America's first "back to nature" writers, he lives through his *Letters from an American Farmer,* perhaps the most delightful book of the American colonial period.

After being educated at the local Jesuit school, he spent some time in England before emigrating to America. It is possible that he served in the Canadian army before going to the Colonies; that he engaged in trade in Pennsylvania, and acted as a surveyor, travelling widely. But after an act of naturalization for him was passed in 1765, he purchased a farm near the present Chester, N.Y., and settled there with his wife, Mehetable Tippet of Yonkers.

His life, that of any ambitious and industrious farmer, he painted in idyllic colours as he did that of the fishermen and whalers at Nantucket and Martha's Vineyard. The only sombre colouring is in the "Description of Charles-Town," with its terrible indictment of slavery, and in the closing letter depicting the "Distresses of a Frontier-man" in war time.

Crèvecoeur himself suffered in the Revolution, being imprisoned for several months before he was allowed to sail for Europe, and having his home burned while he was away. In France he won the patronage of Mme. d'Houdetot and the duke de la Rochefoucauld, who aided him in the French translation and publication of his letters and secured for him the post of consul at New York.

He returned in Nov. 1783 and, in spite of shattered health, became active in trying to cement the friendship between his two countries, working zealously for the packet service between the two, distributing news items and learned publications, recommending suitable exports to French merchants, etc.

Because of his health, Crèvecoeur was given leave of absence during 1785–87, and in the spring of 1790, from which, owing to the troubled conditions in France and his continued ill health, he never returned. His last years were spent in comparative seclusion at his father's home, at a small estate at Lesches, and at Munich, where his son-in-law had a diplomatic post. He died Nov. 12, 1813. His *Letters from an American Farmer* was first published in England in 1782, and in France in 1784. It is the most charming of his books. His picturesque *Voyage dans la haute Pensylvanie et dans l'État de New York* (3 vols. Paris, 1801) was published in German (1802). An edition of the *Letters,* with a prefatory note by W. P. Trent and an introduction by Ludwig Lewisohn was published in 1904. In 1925 appeared his *Sketches of Eighteenth Century America,* edited by Henri L. Bourdin, R. G. Gabriel and S. T. Williams. Julia P. Mitchell's *St. Jean de Crèvecoeur* (New York, 1916) and Robert de Crèvecoeur's *Saint John de Crèvecoeur, sa vie et ses ouvrages* (Paris, 1883) are good biographies.

CREVILLENTE, a town of eastern Spain, in the province of Alicante, and on the Murcia-Alicante railway. Pop. (1940) 10,145 (mun., 11,403). Crevillente is situated in the eastern foothills of the Sierra de Crevillente, amid orange, palm and aloe groves broken by great rocky masses. Careful irrigation has allowed the district, naturally sterile, to produce much oil, wine, esparto and fruit, especially melons, for which it is famous. Crevillente makes coarse cloth and esparto fabrics.

CREW, NATHANIEL CREW, 3rd Baron (1633–1721), bishop of Durham, was born on Jan. 31, 1633, and educated at Lincoln college, Oxford. After holding various ecclesiastical appointments, he became bishop of Oxford in 1671, of Durham in 1674, and, under James II., dean of the Chapel Royal. After Compton's suspension Crew shared the administration of the See of London with Spratt, bishop of Rochester. During the last years of James's power he made a bid for the favour of the new government by voting for the motion that James had abdicated. He was excepted from the General Pardon of 1690, but afterwards was allowed to retain the See of Durham. In 1697 Crew succeeded his brother Thomas as 3rd Baron Crew. He died on Sept. 18, 1721, when the barony became extinct.

CREWE, ROBERT OFFLEY ASHBURTON CREWE-MILNES, 1st Marquess of (1858–1945), English statesman and writer, born Jan. 12, 1858, being the son of Lord Houghton (*q.v.*), and was educated at Harrow and Trinity, Cambridge. He inherited his father's literary tastes, and published *Stray Verses* in 1890, besides other miscellaneous literary work. A Liberal in politics, he became private secretary to Lord Granville when secretary of State for foreign affairs (1883–84), and in 1886 was made a lord-in-waiting. In the Liberal administration of 1892–95 he was lord-lieutenant for Ireland, having John (afterwards Lord) Morley as chief secretary. In 1895 he was created 1st earl of Crewe, his maternal grandfather, the 2nd Baron Crewe, having left him his heir. In 1905 he became lord president of the council in the Liberal government; and in 1908, in the Asquith cabinet, he became secretary of State for the colonies and he acted as Liberal leader in the Lords until Dec. 1916.

He succeeded Lord Morley at the India Office in Nov. 1910, and attended, as secretary of State, the King and Queen on their visit to India in the winter of 1911-12. He was responsible for the high acts of policy announced at the Delhi durbar; the removal of the capital of India from Calcutta to Delhi, and the reunion of the two Bengals under a governor-in-council. At the coronation of King George V he was created a marquess. In the first Coalition Government he was Lord President of the Council, but he followed Asquith in declining to take office under Lloyd George and continued for six years to lead the independent Liberal opposition in the Lords. In Nov. 1922 he quitted active party politics, accepting from Bonar Law the post of British ambassador in Paris. For a number of years before his death, he was again active in politics as leader of the Liberal party and of the Liberals in the lords. He resigned from both positions in Dec. 1944 due to failing health. He died at Leatherhead in Surrey on June 20, 1945.

CREWE, a municipal borough in the Crewe parliamentary division of Cheshire, England, 158 mi. N.W. of London, on the main line of the L.M.S.R. Pop. (1938) 45,830. Area, 6.9 sq.mi. The town was built on an estate called Oak farm in the parish of Monk's Coppenhall, and takes its name from the original station's having been placed in the township of Crewe, in which the seat of Lord Crewe is situated. It is a great railway junction where lines converge from London, Manchester, north Wales and Holyhead, north Stafford and Hereford, and is inhabited principally by employees of the L.M.S.R. company, who practically created the town at a point where in 1841 only a farmhouse stood in open country. Crewe is not only one of the busiest railway stations in the world, but has one of the largest locomotive and rolling stock works. They cover an area of 130 ac., of which 42½ are covered, and employ about 6,500 hands.

CREWKERNE, a market town and urban district of Somersetshire, England, on the S.R., 8 mi. S.W. of Yeovil. Pop. (1938) 3,450. Area 2 sq.mi. It is in the upper valley of the river Parret. The fine church of St. Bartholomew is Perpendicular; the west front is especially notable. The grammar school dates from 1499.

CRIBBAGE, a game of cards. A very similar game called "Noddy" was formerly played, the game being 15 or 21 up, marked with counters, occasionally by means of a noddy board. Cribbage seems to be an improved form of Noddy. According to John Aubrey (*Brief Lives*) it was invented by Sir John Suckling (1609–1642).

A complete pack of 52 cards is required, and a cribbage board for scoring, drilled with 60 holes for each player and one hole (called "the game hole") at each end, the players usually scoring from opposite ends. Each player has two scoring pegs. The game is marked by inserting the pegs in the holes, one after the other, as the player makes a fresh score, commencing with the outer row at the game-hole end and going up the board. When the 30th hole is reached the player comes down the board, using the inner row of holes, until he places his foremost peg in the game-hole. If the losing player fails to obtain half the holes, his adversary wins a "lurch," or double game.

The game may be played by two players, five or six cards being dealt to each, and each putting out two for what is called "crib"; or by three players (with a triangular scoring board), five cards being dealt to each, each putting out one for crib, and a card from the top of the pack being dealt to complete the crib; or by four players (two being partners against the other two, sitting and playing as at whist, and one partner scoring for both), five cards being dealt to each, and each putting out one card for crib.

Two-handed five-card cribbage was formerly considered the most scientific game, but this verdict has now been reversed in favour of the six-card game. In six-card cribbage both hands and the crib contain four cards, and 121 holes are scored.

The players cut for deal, the lowest dealing. If more than one game is played, the winner of the last game deals. The cards rank from king (highest) to the ace (lowest). At the two-handed five-card game, the non-dealer scores three holes (called "three for last") at any time during the game, but usually while the dealer is dealing the first hand. This is not part of the six-card game, which we take as our example.

The dealer deals six cards to each, singly. The undealt cards are placed face downwards on the table. The players then look at their hands and "lay out," each putting two cards face downwards on the table, on the side of the board nearest to the dealer, for the "crib." A player must not take back into his hand a card he has laid out if the cards have been covered, nor must the crib be touched during the play of his hand.

After laying out, the non-dealer (when more than two play, the player to the dealer's left) cuts the pack, and the dealer turns up the top card of the lower packet, called the "start," or "turn-up." If this is a knave, the dealer marks two "for his heels." This score is forfeited if not marked before the dealer plays a card.

The non-dealer plays first by laying face upwards on the table on his side of the board any card from his hand; the dealer then does the same, and so on alternately. When more than two play, the player to the leader's left plays the second card, and so on. As soon as the first card is laid down the player calls out the number of pips on it; if a picture card, ten. When the second card is laid down, the player calls out the sum of the pips on the two cards played, and so on until all the cards are played, or until neither player can play without passing the number 31. If one player has a card or cards that will come in and the other has not, he is at liberty to play them; at the six-card game he must play as long as they can come in, and he can score runs or make pairs, etc., with them. If one player's cards are exhausted, the adversary plays out his own, and can score with them. When more than two play, the player next in rotation is bound to play, and so on until no one can come in. At the two-handed five-card game, when neither can come in the play stops; at the other games the cards are played turned down, and the remainder of the cards are played in rotation, and so on until all are played out.

The object of the play is to make *pairs, fifteens, sequences* and the *go,* and to prevent the adversary from scoring.

Pairs.—If a card is put down of the same denomination as the one last played, the player pairing scores two holes. If a third card of the same denomination is next played, a "pair royal" (abbreviated to "prial") is made, and the maker scores six holes. If a fourth card of the same denomination is next played, twelve holes are scored for the "double pair royal." Kings pair only with kings, queens with queens, and so with knaves and tens, notwithstanding that they all count ten in play.

Fifteens.—If either player during the play reaches fifteen exactly, by reckoning the values of all the played cards, he marks two.

Sequences.—If during the play of the hand three or more cards are consecutively played which make an ascending or descending sequence, the maker of the sequence marks one hole for each card forming the sequence or run. King, queen, knave and ten reckon in sequence in this order, notwithstanding that they are all tenth cards in play; the other cards according to the number of their pips. The ace is not in sequence with king, queen. If one player obtains a run of three, his adversary can put down a card in sequence and mark four, and so on. And, if there is a break in the sequence, and the break is filled up during the play, without the intervention of a card not in sequence, the player of the card that fills the break scores a run. Thus the cards are played in this order: A-4, B-3, A-2, B-ace, A gets a run of three, B a run of four. Had B's last card been a five, he would similarly have scored a run of four, as there is no break. Had B's last card been a four, he would have scored a run of three. The cards need not be played in order. Thus the cards being played in this order, A-4, B-2, A-5, B-3, A-6, A-4, B-2, A-5, B-3, A-5, B-6, B takes a run of four for the fourth card played, but there is no run for any one else, as the second five intervenes. Again, if the cards at six-card cribbage are thus played, A-4, B-2, A-3, B-ace, A-5, B-2, A-4, B-ace, A takes a run of three, B a run of four, A a run of five. B then playing the deuce has no run, as the deuce previously played intervenes.

The "*go*," end hole or last card is scored by the player who approaches most nearly to thirty-one during the play, and entitles to a score of one. If thirty-one is reached exactly, it is a *go* of two instead of one. After a *go* no card already played can be counted for pairs or sequences.

Compound Scores.—More than one of the above scores can be made at the same time. Thus a player pairing with the last card that will come in scores both pair and go. Similarly a pair and a fifteen, or a sequence and a fifteen, can be reckoned together.

When the play is over, the hands are shown and counted aloud. The non-dealer has first show and scores and marks first; the dealer afterwards counts, scores and marks what he has in hand, and then takes what is in crib. In counting both hands and crib the "start" is included, so that five cards are involved.

The combinations in hand or crib which entitle to a score are fifteen, pairs or pairs royal, sequences, flushes and "his nob."

Fifteens.—All the combinations of cards that, taken together, make fifteen exactly, count two. For example, a ten (King, Queen, Knave or Ten) card and a five reckon two, called as "fifteen two." Another five in the hand or turned up would again combine with the ten card, and entitle to another fifteen ("fifteen four"); if the other cards were a two and a three, two other fifteens would be counted ("fifteen six," "fifteen eight")—one for the combination of the three and two with the ten card, and one for the combination of the two fives with the three and two. Similarly two ten cards and two fives reckon eight; a nine and three threes count six; and so on for other cards.

Pairs.—Pairs are reckoned as in play.

Sequences.—Three or more cards in sequence count one for each card. If one sequence card can be substituted for another of the same denomination, the sequence reckons again. For example, 3, 4, 5, and a 3 turned up reckon two sequences of three; with another 3 there would be three sequences of three, and so on.

Flushes.—If all the cards in hand are of the same suit, one is reckoned for each card. If the start is also of the same suit, one is reckoned for that also. In crib, no flush is reckoned unless the start is of the same suit as the cards in crib.

His Nob.—If a player holds the knave of the suit turned up for the start he counts one "for his nob."

A dialogue will illustrate the technical conversation of the game, in a game at six-card cribbage. The cards for crib having been discarded, A holds knave of hearts, a four and a pair of twos: B holds a pair of nines, a six and a four. Two of hearts is turned up by B. The hand might be played thus: A lays down a two and says "Two": B plays a nine and says "Eleven": A follows with a four, saying "Fifteen two"; pegging two holes at once: B plays his four and says "Nineteen; two for a pair," and pegs: A putting on his knave, "Twenty-nine": B says "Go." A lays down his two, his last card, and says "Thirty-one; good for two." B plays his nine and six, saying "Fifteen two, and one for my last—three." The points are marked as they are made. A then counts his hand aloud. "Six for a pair-royal" or "Three twos—good for six," and "One for his nob—seven," and throws down his hand for B's inspection. B, "Fifteen two, fifteen four, fifteen six, fifteen eight, and a pair are ten." B then looks at his crib and counts it. It contains, say, king, eight, three, ace and the "start" is also reckoned. B counts "Fifteen two and a run of three—five."

After the points in hand and crib are reckoned, the cards are shuffled and dealt again, and so on alternately until the game is won.

The highest possible score in hand is 29—three fives and a knave, with a five, of the same suit as the knave, turned up.

Bibliography.—Berkeley, *Bézique and Cribbage* (1890); Cavendish, *Pocket Guide to Cribbage* (De la Rue, 1924); Rawdon Crawley, *Cribbage* Goodall's Handbooks of Card Games (1925); *Cribbage and Bézique,* Fleetgate Publications (1927).

CRICCIETH, a watering place, urban district and contributory parliamentary borough of Caernarvonshire, Wales, on Cardigan bay, served by the G.W.R. Pop. (est. 1938) 1,462. Area, 2.3 sq.mi. The ruined castle, perched on a green hill projecting into the sea, was repaired in the time of Edward I; portions of two towers are on the verge of the rock, and a double fosse and vallum, with the outer and inner court lines, can be traced. The view includes a wide sweep of Cardigan bay, backed by the Lleyn peninsula and the Merionethshire hills, with Harlech castle on the margin of the bay. Criccieth forms a good centre for excursions and offers facilities for sea-bathing.

CRICHTON, JAMES (1560?–1582), commonly called the "Admirable Crichton," was the son of Robert Crichton, lord advocate of Scotland in the reign of Mary and James VI., and of Elizabeth, daughter of Sir James Stewart of Beath, through whom he claimed royal descent. He was born probably at Eliock in Dumfriesshire in 1560, and when ten years old was sent to St. Salvator's college, St. Andrews, where he took his B.A. in 1574 and his M.A. in 1575. In 1577 Crichton was undoubtedly in Paris, but his career on the Continent is difficult to follow. That he displayed considerable classical knowledge, was a good linguist, a ready and versatile writer of verse, and above all that he possessed an astounding memory seems certain, not only from the evidence of men of his own time but from the fact that even Joseph Scaliger (*Prima Scaligerana,* p. 58, 1669) speaks of his attainments with the highest praise. It is known that for two years Crichton served in the French army and that in 1579 he arrived in Genoa. The latter event is proved by a Latin address (of no particular merit) to the doge and senate entitled *Oratio J. Critonii Scoti pro Moderatorum Genuensis Reipubl. electione coram Senatu habita . . .* (Genoa, 1579). The next year Crichton was in Venice, and won the friendship of Aldus Manutius by his Latin ode *In appulsu ad urbem Venetam de Proprio statu J. Critonii Scoti Carmen ad Aldum Manuccium . . .* (Venice, 1580). The best contemporary evidence for Crichton's stay in Venice is a handbill printed by the Guerra press in 1580 (and now in the British Museum), giving a short biography and an extravagant eulogy of his powers. This work is undoubtedly by Manutius, as it was reprinted with his name in 1581 as *Relatione della qualità di . . . Crettone,* and again in 1582 (reprinted Venice, 1831).

In Venice Crichton met and vanquished all disputants except Giacomo Mazzoni, was followed from place to place by crowds of admirers, and won the affection of the humanists Lorenzo Massa and Giovanni Donati. In March 1581 he went to Padua, where he held two great disputations. In the first he extemporized in succession a Latin poem, a daring onslaught on Aristotelian ignorance, and an oration in praise of ignorance. In the second, which took place in the church of St. John and St. Paul, and lasted three days, he undertook to refute innumerable errors in Aristotelians, mathematicians and schoolmen, to conduct his dispute either logically or by the secret doctrine of numbers, etc. According to Aldus, who attended the debate and published an account of it in his dedication to Crichton prefixed to Cicero's "Paradoxa" (1581), the young Scotsman was completely successful. In June Crichton was once more in Venice, and while there wrote two Latin odes to his friends Lorenzo Massa and Giovanni Donati, but after this date the details of his life are obscure. Urquhart states that he went to Mantua, became the tutor of the young prince of Mantua, Vincenzo di Gonzaga, and was killed by the latter in a street quarrel in 1582. Aldus in his edition of Cicero's *De universitate* (1583), dedicated to Crichton, laments July 3 as the fatal day; and this account is apparently confirmed by the Mantuan State papers recently unearthed by Douglas Crichton (*Proc. Soc. of Antiquaries of Scotland,* 1909). Sir Sidney Lee (*Dict. Nat. Biog.*) argued against this date, on the ground that in 1584 and 1585 Crichton was alive and in Milan, as certain works of his published in that year testified, and regarded it as probable that he died in Mantua *c.* 1585–86. But these later works seem to have been by another man of the same name. The epithet "admirable" (*admirabilis*) for Crichton first occurs in John Johnston's *Heroes Scoti* (1603).

Bibliography.—Sir Thomas Urquhart's *Discovery of a most excellent jewel* (1652) is reprinted in the Maitland club's edition of Urquhart's works in 1834. *The Life of Crichton,* by P. Fraser Tytler (2nd ed., 1823), contains many extracts from earlier writers; *see* also Douglas Crichton, *James Crichton of Eliock* (St. Andrews, 1911).

CRICKET. The origin of the word, as applied to the most important of British games, is still the subject of much dispute. The *New English Dictionary* (vol. v. 1893) somewhat hesitatingly identifies it with the French "criquet," first met with in a manuscript dated 1478 which reads—"Le suppliant arriva en ung lieu ou on jouit a la boulle près d'une atache on criquet:" this "criquet," Jusserand, in his *Les Sports dans l'ancienne France,* defines as "un bâton planté en terre, qui servait de but dans une des formes du jeu." The conclusion of the *New English Dictionary* seems based on the argument that no reference to cricket so early as this was to be found in our own literature, and that in cricket one certainly did bowl at a mark. The *Century Dictionary* adopts the same view, and as long ago as 1671 Stephen Skinner, in his *Etymologicae Lingua Anglicanae* had explained cricket as "Ludos, a Franco Gallico 'crosser,' hoc ludo exerceri, 'crosse,' baculus ille obliquus quo pueri ludunt." Against this view it may be said (i.) that an *argumentum e silentio* is never convincing; (ii.) that in all the major and many varieties of club-ball, *e.g.,* hockey, golf, bandy, even in the Frenchman's own La Crosse, the game takes its name from the striking implement and not the mark; (iii.) that the Latin peoples adopted and developed the racket as opposed to the club variety of ball games (the crosse is itself a modification of the racket); and finally (iv.), that even if in the 15th century the French were playing at cricket in our sense of the term, it is at least as possible that in the four centuries' intimate contact between the two peoples, they should have learnt it from the English, as the English from them.

It seems better to follow Dr. Johnson, himself probably following Junius (1589–1678), in deriving cricket from "cryce, Sax. —a stick," though his definition of the game as "A sport at which the contenders drive a ball with sticks in opposition to one another" is less worthy of respect. Gouldman (1664), Strutt (1742–1802) and Skeat (1835–1912) also subscribe to this derivation. There was certainly in the parent Nordic tongue a syllable beginning with "cr," ending with a hard "c," having for its middle letter every variety of vowel, and meaning a staff or stick: *cf.* the Psalterium Davidis version of verse 4, Ps. xxiii., "Gird thin and *cricc* thin me frefredon"; the word still survives in Cornwall and Devon in the sense of hedge sticks. The termination "et" is itself a common enough diminutive suffix, *cf.* pocket, and tippet; the game would then, in harmony with golf, hockey, billiards, bandy, take its name from its weapon of attack, a little staff, stick or bat (*cf.* the Parliament of Bats and Wycliffe's version "Then came they with swerdis and battis"): a "little" bat for a reason that will appear later.

Early References.—Cricket, like much else in English history, was not born, but slowly evolved itself as a specialized variety of the generic club-ball. Various authorities have tried to identify its infancy with the Scottish "Cat-and-Doug," with stool-ball, or with a 15th century game "Handyn or Handoute": but Cat-and-Doug was a species of tip-cat, not specifically referred to as a game until 1688 when cricket had already a local habitation and a name: stool-ball was a cousin to cricket, but a younger one and of the weaker sex, an adaptation of the country-boys' game for the dairymaids' use. The claims of "Handyn or Handoute" to be cricket's parent rest solely on the opinion of an 18th century lawyer: commenting in 1766 on the Statute 17 Edw. IV. c. 3 which banned with heavy penalties the said game as one of those detrimental to the practice of archery, he says: "This is perhaps the most severe law ever made against gaming, and some of these forbidden sports seem to have been manly exercises, particularly the handyn and handoute, which I should suppose to be a kind of cricket, as the term hands is still retained in that game." Such a coincidence is surely far too slender to support his deduction: it would, incidentally, be far more appropriate to rackets, in which game both terms still survive intact.

For the practice of cricket in its elementary form of club-ball there is pictorial evidence as early as the middle of the 13th century (*Chronique d'Angleterre, depuis Ethelbert jusqu'à Hen. III.*), and again in a ms. dated 1344 No. 264 in the Bodleian library and as part of the illumination to a decretal of Pope Gregory IX., *circa* 1230 (British Museum, Royal mss. 10 E iv.). This latter has been reproduced in postcard form and is on sale (No. 11 of Set 58) at the British Museum. The first written reference to the game is possibly to be found in an extract from the wardrobe accounts of the 28th year of Edward I.'s reign which, written as was customary in Low Latin, speaks of certain sums disbursed by his chaplain on behalf of the young Prince Edward "ad ludendum ad creag' et alios ludos." It is, at least, arguable that the word "creag" was an attempt to reproduce phonetically a French version (Piers Gaveston was a Gascon) of the native cric- or crig- et, the termination being represented by the ' as was the scribe's practice.

Be this as it may, cricket was being played by boys of the free school of Guildford in or about 1550: for in 1598, John Derrick, then aetat. 59, giving evidence before a jury, testified in so many words to his having played there as a boy himself at "crickett and other plaies." (*History of Guildford,* 1801, p. 202.) In 1598 the London edition of Giovanni Florio's *A World of Words* defines "squillare" as "to make a noise as a cricket, to play cricket-a-wicket, and be merry"; in 1611 Randle Cotgrave's *A Dictionary of French and English* translates "crosser" as "to play at cricket."

Sir William Dugdale (born 1605) refers in some royalist propaganda to Oliver Cromwell as indulging in his youth in "cricket and football," and as acquiring "the name of royster." John Timbs (b. 1801), on the enthusiastic but rather dubious authority of the Rev. Lisle Bowles (b. 1762), refers in his *Schooldays of Eminent Men* to Thomas Ken, in his first week as a scholar at Winchester (Jan. 1650) as "attempting to wield a cricket bat." To support this statement there is evidence for the game being played by Winchester scholars on "Hill's" as early as 1637 (*vid.* the Latin poem by Robert Mathew included in A. K. Cook's *About Winchester College*).

In *The Life and Death of Thomas Wilson* (1672) George Swinnock tells us how that Puritan divine (1601–?1653) went far to convert Maidstone to the proper observance of the Sabbath, though that was "formerly a very profane town insomuch as I have seen morrice dancing, cudgel playing, stool-ball, *crickets* and many other sports openly and publicly on the Lord's Day." In 1654 the churchwardens and overseers of Eltham fined seven of their parishioners for playing cricket on the Lord's Day. Four years later there is a ludicrously lugubrious reference to a cricket ball in *The Mysteries of Love and Eloquence* by John Milton's nephew, Edward Phillips. There appears to have been a cricket club at St. Albans as early as 1666, and ten years later comes the first reference to cricket overseas in the diary of Henry Teonge, chaplain to H.M.S. "Assistance," who records how in May of that year some of the ship's company rode up from Antioch to Aleppo and there "did in a fine valley pitch a princely tent and divert themselves with various sports including 'Krickett'."

Already, in 1668, the proprietor of the Ram Inn, Smithfield, had been rated for a cricket ground; in 1699 the author of *A Worlde Bewitched* is lamenting that cricket in summer "will be very much in fashion"; by 1707, Chamberlayne's *State of England* has been forced to include cricket among the people's recreations and in 1720, the Rev. John Strype, editing Stow's *Survey,* has followed suit.

Organization and Development.—The first definite match of which there is record is to be found in *The Post-Boy* of March 1700, billed to take place on Clapham Common. In 1707 London plays as such, and in 1719 "the Londoners" meet "the Kentish men" in what is virtually the first county match, London being synonymous with Middlesex. There seems no doubt that for the first half of the 18th century, Kent enjoyed the cricket ascendancy, though Sussex had a great cricket nursery in Slindon, and a great champion in Richard Newland, captain of "England" in 1744, and cricket tutor to Richard Nyren, the head and right arm of the famous Hambledon club. Surrey, too, encouraged by the patronage of Frederick Louis, prince of Wales, often pressed Kent hard: Hants is first mentioned in 1728, but though Gloucester appears to have played the game as a county in the same year, and half a dozen other counties had taken the field well before the end of the century, there is no doubt that the greatest enthusiasm and the most expert skill was concentrated in London and in the enclave of the Weald. This was the veritable home of cricket where it had first been developed from the haphazard play of boys with, in all probability, much variant and local custom, into the systematized and serious game of men. Here, on the short turf of the open downs and the meadows of the Inner Weald, it was discovered by Society, when Society, during the Commonwealth, found London uncomfortable and withdrew to its country seats, and from here it was transplanted at the Restoration, partly to the home grounds of its great patrons, the Vine, at Sevenoaks, belonging to the Sackvilles, Bishopsbourne Paddock, near Canterbury, Sir Horace Mann's ground, and perhaps at Goodwood park, where the second and fourth dukes were very great patrons of the game. In London great matches were played on all the southern commons from Chelsea to Clapham, on the White Conduit fields, near King's Cross station, and Lamb's Conduit fields, near the Foundling hospital. But by far the most famous cricket centre was "The Artillery Ground," Finsbury, where the H.A.C. still play to-day. In the middle of the 18th century it seems to have been leased, at least for cricket purposes, to a certain George Smith, host of the "Pyed Horse" inn who settled the gate, normally 2d. but occasionally raised to 6d., did good business over luncheons, dealt faithfully with a gate sometimes, it is said, amounting to 20,000, and numbered among his patrons many of the most distinguished gentlemen in the land. Here was played on June 18, 1744, the famous match Kent *v.* All England, the first game of which the full score is preserved, the first to be enshrined in *Scores and Biographies* and celebrated by the well-known heroic poem by James Love (*alias* Dance) (*see* Ashley-Cooper's edition published by Richards of Nottingham).

The enthusiasm for the game shown by many of the most prominent men of the day, naturally provided a target for the criticism of political opponents and moralizing pedants: Pope and Soames Jenyns both echo this note, whilst in 1778 a bitter lampoon, "The Noble Cricketers," was levelled at the earl of Tankerville and the 3rd duke of Dorset. Much more deserving of censure were the heavy stake-money and side-bets that more often than not depended on big matches, but in a betting age cricket could not escape. The crowds were often disorderly and violently partisan, but could probably bear comparison with some at, *e.g.,* Sydney, a century and a half later.

The next, and an important stage, in the game's development was marked by the rise of the famous Hambledon club. For long celebrated by cricket historians as the "cradle of cricket," this little Hampshire village, some seven miles S.W. of Petersfield, must now resign the title to the hamlets of the Eastern weald and of an earlier day. But glory enough remains: here on the smiling shoulder of Broad-Halfpenny Down (the historic site is now the property of Winchester college and, we may hope, secure from violation), and later on Windmill Down, much closer to the village, the Hambledon club which, it is only fair to say, cast its net as far afield as western Surrey, for 30 years challenged and held at bay all comers: indeed, in June 1777 they beat a representative England XI. by an innings and 168 runs. This phenomenal ascendancy owed something to the eager activities of its greatest patron, the Rev. Charles Powlett, and of its first captain, nay "general," Richard Nyren, but resulted in the main from the coincidence in the area of some dozen men of extraordinary cricket genius, whose profound influence on the evolution of the game's technique will be studied in another place. Fortunate, too, was the club in its historian, John Nyren, Richard's son; his *Cricketers of My Time,* together with *The Young Cricketer's Tutor,* edited by Cowden Clarke and published in 1833, are the first prose classics in cricket's literature.

The Hambledon club played its last recorded match in 1793, appropriately enough at Lord's. This, the acknowledged Mecca of all cricketers, was first opened as a private ground for the benefit of certain members of the White Conduit club by Thomas Lord, a man of Yorkshire stock whose family had lost their considerable property in the '45 and who had himself become ground bowler to that club. Lord had the backing of the earl of Winchelsea and Charles Lennox, subsequently fourth duke of Richmond, two of cricket's greatest patrons; his first ground was rented from the Portman family in the then almost wholly rural district of Dorset Square: in 1809, on Portman proposing to raise the rent, Lord removed to a new ground, part of the St. John's Wood estate, belonging to the Eyre family, but four years later, with the proposed Regent's canal threatening the site, he removed again to the present situation: in each case he relaid the original Dorset Square turf, enclosing his newest ground with a high fence and building on it a pavilion and a tavern. The Marylebone club, which has always made its home at Lord's, was founded in 1788, and that its authority was from the start accepted as paramount is proved by its revision of the laws in the first year of its existence.

For half a century, at least, the M.C.C. was the great match-making agency in cricket, inviting subscriptions from its members to meet match expenses, and advertising the games in advance at the chief London social clubs. County cricket for long owed its existence to the patronage of local enthusiasts: the days of the regular country cricket club were not yet. Most of the big matches were still played for money and were a field for heavy wagering by professional backers, even the famous Crockford and Gully being sometimes visible with less distinguished "legs" in front of the pavilion at Lord's. With a close match the first consideration, games were constantly arranged at odds, whether of numbers or of given men. Single wicket matches also excited great interest, and at intervals challenge games were played for a so-called single wicket championship: with the laws governing single wicket favouring the fast bowler and hard hitter, it is not surprising that Alfred Mynn in the '30s should have stood *facile princeps.*

In 1836 the first North *v.* South match was played, clear evidence of the spread of cricket: as a matter of fact, Nottingham was playing Sheffield in what was for long a local test match, as early as 1771; and the M.C.C. visited Nottingham 20 years later. Notts. first took the field as a county in 1835 and Yorkshire in 1833: Leicester, Norfolk, with Fuller Pilch as a native, and Cambridgeshire soon followed their lead. The missionary efforts of the M.C.C. began in 1846, to be seconded by the touring cricket of the All-England eleven, a team representing the flower of English cricket, mainly professional, but including one or two of the leading amateurs, the organization and maintenance of which over a period of years was due to the business enterprise of the great Notts. bowler, William Clarke. This eleven played all over the country and were the focus of attraction wherever they went, winning to knowledge and appreciation of the game whole districts where hitherto it had been unappreciated or undeveloped: their matches were the great trials of budding talent, and many a young professional was discovered and launched on a successful career through the medium of the "A.E.E." The success of Clarke's venture, and possibly his close-fistedness, led in 1852 to the secession of some of the leading professionals and their formation, under the management of John Wisden and Dean of Sussex, of the United All-England XI. These two elevens virtually monopolized the best cricket talent in the country, and the annual match between the two at Lord's, on Whit Monday, first played in 1862, continued for nearly 20 years to be voted the great event of the season. Eventually they had both to give way before the rising tide of county cricket.

County Cricket.—The origin of county cricket may be found in the local antagonism of eastern and western Weald: with the adoption of the game by the "gentry" and its rapid systematization, we can trace successive county supremacies enjoyed by Kent (*circa* 1750), Hampshire (1780–90), Surrey (1790–1810), when William Beldham and William Lambert, the two greatest players of their day, made the county a yearly match for the Rest of England; Sussex (*circa* 1825), thanks to their round arm bowlers, Lillywhite and Broadbridge, and the great Kent XI. of the '30s and '40s when

> With five such mighty cricketers 'twas but natural to win,
> As Felix, Wenman, Hillyer, Fuller Pilch and Alfred Mynn.

With the approach of the '60s the balance of power began to move northwards: an explanation may in part be found in the numerical advantage of the industrial areas, now enlightened by the missionary work of the past two decades, partly to the fact that the system of home piecework, in the days before the big mechanical looms, allowed the operatives so to adjust their working week as to make time for both practice and matches. From this time such places as Sutton-in-Ashfield and Lascelles Hall begin to appear as apparently inexhaustible mines of cricket talent.

Surrey, first organized as a county club in 1845, had under F. P. Miller, and thanks to the prowess of Caffyn, Stephenson, Lockyer and George Griffith, enjoyed a renewed ascendancy in the late '50s and early '60s, but in between '67 and '70 Yorkshire, with a wholly professional eleven including a very great fast bowler in Freeman, had been thrice rated as champions. The county championship proper is generally reckoned to date from 1873, when the M.C.C. first laid down rules governing county qualification: in the next five years, Gloucestershire, owing almost everything to the Grace brothers, E. M., W. G. and G. F., were three times champions, but it was another ten years before the honour again came south. The '80s were a great decade for Notts., for whom Shaw and Attewell were marvels of bowling accuracy, Barnes and Flowers two fine all-rounders, and William Gunn and Arthur Shrewsbury the greatest professional batsmen of the age. In 1887 the headship passed to Surrey, under the leadership of J. Shuter, and between that year and 1895, that county was eight times at the head of the table. The great Surrey bowlers were Lohmann, Lockwood and Richardson, the latter of whom actually took over 1,000 wickets in four consecutive home seasons, 290 in 1895, a record till 1928 when Freeman of Kent took 304. The batsmen were the amateur W. W. Read, and the professionals M. Read, Abel, Brockwell, a dashing player and, at the end of the period, T. Hayward, who became the best professional batsman in England and played in the classic style.

Yorkshire, after a very lean period, now enjoyed a great revival in which they owed much to their captain, Lord Hawke; unlike the great majority of their rivals, their eleven consisted almost entirely of native-born men and its success evoked proportionately greater enthusiasm in the county: at the top of the table in 1893, '96 and '98, they were again champions for the first three years of this century, and once more in 1905. Always strong in bowling, Yorkshire had a remarkable sequence of slow left-handers in Peate, Peel and Rhodes: the last mentioned, who first appeared for his county in 1898 and who is still playing, has taken more wickets in first-class cricket than any other man in the game's history: George Hirst, a fast left-hand bowler and vigorous right-handed batsman, particularly strong in the hook and pull, was a man of great personality and unbounded energy: the only cricketer who has ever taken 200 wickets and made 2,000 runs in a season (208 wickets and 2,385 runs in 1906), he was the greatest force in the eleven and has strong claims to be considered the best all-round professional cricketer who has yet appeared. Other good Yorkshire bowlers were E. Wainwright and Schofield Haigh, the latter a bowler of deadly "break-backs." There was a great opening pair of batsmen in Brown and Tunnicliffe, whose partnership of 554 against Derbyshire in 1898 is still a record for the first wicket, and a brilliant, adventurous stroke-player in Denton. Of the amateurs by far the most distinguished was F. S. Jackson (governor of Bengal, 1927–32): captain of England in 1905, Jackson was always, when he could find time to play, a batsman of extraordinary gifts and unbounded confidence: the bigger the occasion the better he played; he was also a very good medium-paced bowler. Another fine all-round amateur was E. Smith. It is arguable that the Yorks. XI. *c.* 1900, were the strongest county side that has yet been seen.

In the last 12 years before the war the championship was won by six different counties, a variety of fortune that was excellent for the game's welfare, and in which no victory was more popular than that of Warwickshire in 1911. The first county outside the Big Six (Yorks., Lancs., Notts., Kent, Surrey and Middlesex) to win the honour for 34 years, Warwick owed her success in great part to the brilliant all-round play of her young captain, F. R. Foster. The most consistent success in this period, however, fell to Kent, who were champions in 1906, '09, '10 and '13. Blest in her beautiful grounds and a fine county cricketing tradition, and owing much to her quondam captain, Lord Harris, Kent at this time played most attractive cricket: J. R. Mason, a very popular captain, gave place about 1906 as the all-round force of the eleven, to an even greater in Woolley, then a good slow bowler and still a most graceful and effective batsman who enjoys the unique distinction of having played in 52 consecutive test matches. Among many fine amateur batsmen, K. L. Hutchings was conspicuous, but the main match-winning forces were Fielder, a fine fast bowler, and Colin Blythe, a wonderful artist with his left-hand slows: in August they were reinforced by D. W. Carr, at this time the one reliable "googly" bowler in England.

Surrey, with Hayward and Hobbs in wonderful batting form, and a hard-working and fast bowler in Hitch, carried off the honours in the curtailed 1914 season. When county cricket was resumed in 1919, it was amid such misgivings that the ill-advised experiment was made of confining championship matches to two days, but all doubts as to public interest were soon set at rest, attendances and enthusiasm for the game being greater than ever. Naturally enough, after so long an interregnum, the standard, especially in bowling, had seriously fallen away, and though the war had not depleted the ranks of the professionals as much as might have been anticipated, a great part of a generation of amateurs was lost to the game. After Yorkshire had won the first post-war championship, Middlesex scored two most popular successes in the next two years. She owed much to the captaincy of P. F. Warner, an admirable batsman and one of the shrewdest and most enthusiastic cricketers, to the batting of Hendren and to the all-round cricket of J. W. Hearne, a younger relative of J. T. Hearne who, 20 years before, had been the best medium-paced bowler in England. In 1922 Yorkshire regained the leadership and retained it for the following three years, actually winning in the period 81 championship games as against six losses. With Rhodes enjoying as a bowler an Indian summer of extraordinary success, two other good left-handers in Kilner and Waddington, a good spin bowler in Macaulay and a "swinger" in Robinson, the Yorkshire attack was in a different class from any other county's. The body of her batting was not perhaps as strong as in the great years 1900–02, but in Sutcliffe and Holmes she had an opening pair whose partnerships for the first wicket have now passed all records. So inevitable was Yorkshire's supremacy beginning to appear that the game was all the better for its interruption by the advance of Lancashire who, with a well-balanced side almost exclusively professional, ended at the head of the table in 1926, '27, '28, '30 and '34. Notts. won the championship in 1929, and Yorkshire re-established herself at the head of the table in 1931, '32, '33 and '35.

County cricket to-day commands as much interest as ever, but the competition is becoming increasingly professionalized; the number of amateurs who are able and willing to play regularly is decreasing, and a more or less settled personnel is important to a team's success. The expenses of county clubs are heavy and though Yorkshire, with a membership of over 6,000, has no financial anxiety, a wet season such as 1927 can land the majority in difficulties; their share distributed by the M.C.C., in the profits arising out of tours in Australia and test matches at home, is an important item in their budgets. In Nov. 1928, the Advisory County Cricket Committee decided that each county must play 28 matches. It also abolished the system of percentages in favour of point scoring. With 17 counties now competing, it is impossible for them all to play each other, and no really satisfactory system of point counting has yet been evolved; the first-class season is overfull and the best English bowlers certainly suffer from overwork. Some are quite naturally tempted away into the League cricket which spreads an enthusiastic and highly-organized network over much of the industrial area from Stoke to Durham; the cricket here is fiercely competitive, and the bowling, for the most part in the hands of professionals, one of whom may play for each club, is of a high class. Conversely, the leagues often furnish recruits to the northern counties.

There is a subsidiary division of 23 second-class counties, and in this competition the majority of players are amateurs, except in the case of the second elevens of some first-class counties who use it as a training ground for their young professionals. Since its official recognition in 1901, Staffordshire, with six championships, leads the field, a success due almost entirely to the phenomenal bowling of Barnes, the England bowler of 1911–12.

INTERNATIONAL CRICKET

Europe.—Wherever Englishmen, and especially English soldiers and sailors or missionaries, have gone, they have taken cricket with them. But for the outbreak of the Revolution it would have been played in Paris in 1789 under the auspices of the British Ambassador; the Light Division enjoyed it at Lisbon before the battle of Busaco; some of the "secretariat" indulged in it on the Prater during the congress of Vienna; the game had been played in Italy by 1828, in Corfu during the British Protectorate (1815–63), in Odessa in 1881, whilst a cricket club was formed in Geneva as early as 1850 and in Christiania by 1866. Of European countries to-day the Dutch and the Danes are the keenest and most proficient.

India.—There was a cricket club in Calcutta before the end of the 18th century, and fostered by the enthusiasm of the Army and the encouragement of such men as Lord Harris, when governor of Bombay, the natives rapidly mastered the game; the triangular tournament between Europeans, Parsees and Hindus dates from 1907, the Mohammedans joining in 1912. The first "test" match with England was played in 1932 in England, when the Indians lost. In India, in 1933–4, the M.C.C. won two matches and drew one. Of test matches played, up to 1935, between England and the West Indies, England won 7, West Indies 3, and 4 were drawn; West Indies winning the rubber against the M.C.C. tourists in 1934–35.

America.—Cricket has been played all over the American continent, and a match at New York took place as early as 1751. The first team of professional cricketers that ever left England toured the U.S.A. and Canada in 1859, an example that has been enjoyably followed by many subsequent teams, including Kent County in 1904. The compliment has been returned by the Philadelphians, Pennsylvania and Haverford universities. Though the U.S.A. has produced some fine cricketers, notably the brothers Newhall in the '70s, J. A. Lester, who captained the Philadelphians in 1904, H. V. Hordern, a first-rate googly bowler, and above all, J. B. King, in 1904, one of the very best bowlers in the world, cricket has never become a national game.

New Zealand.—Cricket is popular in New Zealand, where the standard of play has recently risen so far as to admit of the playing of "test" matches with England and South Africa. Up to 1932, however, New Zealand had failed to win any of these matches; England and South Africa having each won two.

South Africa.—Cricket was brought to South Africa by British troops in the '40s, Maritzburg and Wynberg being the earliest centres, with Pretoria following in the '60s and Johannesburg later still. The standard of play made a real advance after the first visit of a S.A. team to England in 1894, and ten years later a team captained by the old Cambridge cricketer, F. H. Mitchell, only lost three out of 26 fixtures in England, E. A. Halliwell proving himself a great wicket-keeper, J. J. Kotze as fast a bowler as any in England, and J. Sinclair an all-round cricketer of very high class. In 1905 the M.C.C. sent out a strong team under P. F. Warner, only to see it lose four out of the five test matches to a side of great all-round strength, the decisive factor being the googly bowling of R. O. Schwarz, G. A. Faulkner, A. E. Vogler and Gordon White. It was only fair that the S.A. team that visited England in 1907 should be accorded the honour of test matches; they lost the only one of the three that was finished, but only after a desperate fight in which their bowlers had a very fine English batting side in consistent trouble. Their captain, P. Sherwell, made a historic 115 to rescue his team from disaster at Lord's. Another strong M.C.C. XI., sent out in 1909, lost the rubber by three matches to two, only Hobbs, who batted most brilliantly, being able to master the googly bowling; Faulkner, who scored over 2,000 runs for a South African team touring Australia in the following winter, losing four out of the five tests, was at this time perhaps the finest all-round cricketer in the world. From that tour, however, the googly bowlers never recovered, and the side that completed in the Triangular Tournament of 1912 were outclassed and overwhelmed, an inferiority further emphasized by South Africa's heavy defeat at the hands of the M.C.C. XI. which visited her in 1913. Once again Hobbs was superlative, but an even more decisive factor was the bowling of Barnes who, after taking 34 wickets for 282 runs in the three test matches against them in 1912, proved even more difficult on the matting and had all their batsmen, except H. W. Taylor, at his mercy. Since the war the South Africans have visited England in 1924, 1929, 1935, and have been visited by M.C.C. teams in 1922–23, 1927–28, 1930–31. The achievements of South Africans during these post-war matches ranged from heavy defeat in 1924, through a progressive improvement of form, to triumph in 1935, when they won the rubber. Within recent memory the outstanding feature of S.A. cricket has been the batting of H. W. Taylor, who can be ranked in the very highest class for style and effectiveness alike: A. D. Nourse has batted for a quarter of a century with wonderfully consistent success. The most important domestic cricket in South Africa is an inter-provincial tournament, known as The Currie Cup, inaugurated in 1890 and named after Sir Donald Currie who, with Sir Abe Bailey, was the great patron of cricket there. All South African cricket is played on matting, stretched on turf, as at Cape Town, or on ant-heaps, as at the Wanderers' ground, Johannesburg, the headquarters of the country's cricket: this undoubtedly handicaps the South African cricketer when he comes to play under conditions native to the game, a fact that is now recognized and supports a growing movement for the cultivation of turf wickets.

Australia.—The earliest cricket centre in Australia seems to have been Sydney, where the game took root very early in the 19th century, Hobart, Melbourne, Perth and Adelaide all being converted before 1850. Conditions, except at Melbourne, and the standard of play generally, remained, however, somewhat primitive until the visit of the first English team in 1861–62, a professional combination captained by H. H. Stephenson and organized as a business venture by Spiers and Pond, who are said to have cleared over £10,000 as a result. Thereafter, thanks to the coaching of English professionals, the enthusiasm of the Australians, and further visits from English teams in 1863–64, and, under Grace's leadership, in 1873, progress was rapid, and a notable milestone was reached when, in March 1877, Australia won by 45 runs the first of all test matches, a success almost entirely due to an innings of 165 by C. Bannerman. A still more decisive step was taken a year later when the first Australian team visited England: most of the fixtures arranged for them were second class, and so little was generally known of them in advance that a famous English cricketer was heard enquiring about their colour, and Lord's was virtually empty when they drove on to the ground to meet the M.C.C. Before the day was over, F. R. Spofforth and H. F. Boyle had made history by dismissing a really strong M.C.C. eleven for 33 and 19, and winning the match for their team by nine wickets. The monopoly of English cricket was now seriously threatened and the threat became a reality when, after a most honourable defeat in the first home test match at the Oval, in 1880, Australia beat England by seven runs on Aug. 29, 1882, in what is still the most famous of these games, a victory celebrated in the *Sporting Times* by the obituary notice that created the "Ashes" legend. Though Australian batting had made great strides in this decade, and W. L. Murdoch was established as a batsman equal to any but "W. G.," with H. H. Massie, a brilliant hitter and A. Bannerman, a great defensive player, it was the trio of bowlers, Spofforth, Boyle and Palmer, supported by a great wicket-keeper in Blackham, that made the team so formidable. Their bowling was a revelation to English cricketers: Spofforth, originally very fast, but at his best fast medium, with a very fast ball, was universally acclaimed the greatest bowler in the world; his deadly control of his off-break and, on the field, an almost satanic malevolence of bearing, early won for him the still unchallenged title of "the Demon."

Two years later an equally strong side lost the one test match that was finished, but had distinctly the best of the two that were drawn; in the latter of these, at the Oval, Murdoch scored 211, still the highest innings made in an England *v.* Australia match in England, and only a famous ninth wicket partnership of 151 between W. W. Read and Scotton saved England. The years that followed were a black period for Australian cricket, and between Dec. 1884 and Aug. 1893, England won 16 of the 21 games finished; in part this was due to the dropping away of the old stalwarts and the inability of the still limited cricket resources of the country to find at once adequate substitutes, but internal quarrels also contributed, and some of her elevens were far from representative. Moreover, English cricket was very strong indeed at this time; as batsmen, Grace, Shrewsbury and Gunn were at their best, and F. S. Jackson, then the Cambridge captain, made a wonderful début in the matches of 1893. The Australians had a splendid all-round player in G. Giffen, and a really great pair of bowlers in C. T. B. Turner (nicknamed "the Terror") and J. J. Ferris who, on the 1888 tour, together bowled nearly 20,000 balls and took 534 wickets out of 663 that fell. But their batsmen were no match for such bowlers as Lohmann, Peate, Briggs and Peel, the slow left-handers being then, as now, a particular thorn in Australian flesh.

The tide began to turn in the winter of 1894–95 when a very strong team under A. E. Stoddart, for which the captain, A. C. Maclaren, Ward and Brown batted splendidly, and Richardson bowled in his best form, only just won the odd game out of five. Three years later Stoddart's second team was decisively beaten by four matches to one, and in 1899 J. J. Darling's eleven defeated England at Lord's by ten wickets, and drew the other four games. A new and accomplished generation of Australian players had now arrived: Darling himself, and C. Hill, were a very fine pair of left-handed batsmen, S. E. Gregory, a most consistent run-getter, and a brilliant field, M. A. Noble, a great all-rounder, whilst E. Jones's extreme pace, Howell's off-breaks, and Trumble's mastery of length and pace changes made the attack very formidable. An attempt to recover the Ashes by a team under A. C. Maclaren in the winter of 1901–02 was heavily repulsed in spite of brilliant batting by its captain, and in 1902 Darling again led a team to victory, defeating England by two games to one. The Australians' three runs victory at Manchester and England's one wicket success in the fifth game at the Oval, are historic in the series. The feature of the tour was the batting of Victor Trumper, a modest genius whose effortless brilliancy has never been surpassed.

In the winter of 1903–04 the M.C.C., determined to restore the prestige of English cricket, themselves organized a team which, under P. F. Warner's captaincy, succeeded in recovering the Ashes; the batting of R. E. Foster who, in his first test match innings at Melbourne, scored 287 runs, of Tyldesley and Hayward, the bowling of Rhodes and the surprise effect of J. Bosanquet's googlies, were the deciding factors. The following year England's success was repeated, when F. S. Jackson, winning the toss in all five games and batting brilliantly himself, led his side to victory in the only two matches that were finished. In the next winter, however, the advance guard of a new generation of players recovered the honours for Australia, defeating a rather moderate M.C.C. eleven captained by A. O. Jones, by four games to one, and in 1909, Noble, a consummate tactician, profited by some ill-judged decisions by the English selection committee, and won two out of the three finished games. The very fast bowling of Cotter, the all-round form of Armstrong and Macartney, and the success of the two young left-handed batsmen, Ransford and Bardsley, were the features of the tour; the latter created a record by scoring a century in each innings of the last test match. Once again the pendulum swung over and in the winter of 1911–12, the splendid batting of the opening pair, Hobbs and Rhodes, and the most formidable bowling of Barnes and F. R. Foster, won decisive victory for P. F. Warner's second M.C.C. XI. This tour set the seal upon Hobbs's batting reputation, whilst Australian opinion was unanimous that Barnes was the finest English bowler they had yet seen; he and Foster, whose pace off the pitch was a revelation to his opponents, took 66 wickets of the 95 that fell, but were well supported by J. W. H. T. Douglas. The Australian team that took part in the Triangular Tournament of 1912 was far from representative, and though they easily accounted for the South Africans, they were no match for a very strong England XI.

The war hit Australia much less hard than England and she was soon into her cricket stride again. A tour in England by an Australian Imperial Forces eleven in 1919 served to introduce J. M. Gregory, for whose pace as a bowler the game in England could offer no approach to a parallel. There now followed the greatest humiliation ever sustained by English cricket when her representatives suffered defeat in eight consecutive tests; weakness in bowling and fielding was mainly responsible for the loss of all five games by the M.C.C. side which toured under Douglas's captaincy, but at home it was the complete inability of the English batsmen to deal with the fast bowling of Gregory and Macdonald, whose energies were carefully husbanded for the tests, well used by an able captain in Armstrong and ably supported by the slow bowling of the captain himself and of A. A. Mailey, a most persevering and successful googly bowler. England made a better showing in the last two test matches which were drawn, and heavy though the blow was to her prestige, her cricketers, in the long run, benefited by this reverse which served to recall the cardinal principles of a straight bat and a good length. Three winters later a M.C.C. team, under A. E. R. Gilligan, though only winning one test match in Australia, gave a much better account of themselves. Hobbs and Sutcliffe did wonders as an opening pair, running up over 100 together four times—thrice in succession. Sutcliffe's first four test match innings were 59, 115, 176 and 124, whilst Hobbs, with three centuries, bringing his total to nine, surpassed Trumper's previous record of six for the series; unfortunately, the body of our batting was disappointing and failed to profit by the successful starts. Conversely the Australians, time after time, made splendid recoveries from disastrous starts, for which the bowling of Tate was responsible. This young Sussex professional beat even Barnes's figures by taking 38 wickets in the five matches, bowling with a fire and persistency that won universal acclamation from the Australians, who rated his bowling as high as any that had been seen in their country. The English change bowling was, however, very weak. For the first time in cricket history, eight-ball overs were obligatory, an innovation confined to Australia and since abandoned. These matches, the first three of which ran to seven days apiece, were premonitory of the endurance tests into which, thanks to the pluperfect pitches formed of the Bulli soil, and the intense determination of all batsmen not to get themselves out, cricket in Australia seems fast degenerating.

In 1926, after losing 12 tests out of 13 completed, England at last turned the tables, and after bad weather had played a large part in drawing the first four games, won decisively in the fifth at the Oval which was, in any case, to be played to a finish—an innovation in England—but for which, as it turned out, four days sufficed. Once again it is a case of Hobbs and Sutcliffe, the famous pair defying some very accurate bowling on a very difficult wicket throughout the third morning and laying the foundations for a long score; in the last innings the Australians quite collapsed before some accurate bowling of the old-fashioned type by Rhodes, who had played his first test match 27 years before, and some good fast bowling by a new star, Larwood of Notts. Hobbs, who in the previous year had, at the age of 42, surpassed "W.G.'s" achievement of 126 centuries, batted with marvellous consistency in these five test matches, scoring 486 runs with an average of 81, and easily outstripping Hill's previous record aggregate of 266 for this cricket. Sutcliffe's batting was on the same level. For Australia, Macartney batted as brilliantly as ever, and Woodfall and Ponsford did excellently on this, their first tour: but the attack was the weakest for many years and sadly lacked medium-paced spin bowling. England's victory created enthusiasm.

Up to and including the tour of the Australian team visiting England in 1934, 134 test matches have been played; Australia won 53 (38 in Australia), England 52, 29 being drawn. Considering the initial handicap of inexperience, the disparity in population, and the natural difficulty of adapting themselves to English conditions, Australian cricketers may well be proud of such a record; but it is to be remembered that the climate favours athletic development, that the teams that have visited the country from England have often been far from representative, and that Australian cricketers, especially the bowlers, play much less first-class cricket than their opponents, and avoid the staleness and overwork which has curtailed many an English bowler's best powers. In a domestic season in Australia, first-class cricket is virtually confined to the inter-state matches of the Sheffield Shield competition, so called because played for a cup presented by Lord Sheffield at the close of the tour which he organized to Australia in 1891–92. In the winter seasons of 1926 and 1927, W. H. Ponsford scored centuries in eleven consecutive matches in these games; and in 1929–30 D. G. Bradman made 452 not out for N. S. Wales *v.* Queensland at Sydney—the highest individual innings ever played in a first-class match.

The tables opposite summarize the work of the outstanding players in England *v.* Australia matches to the close of 1934 tour.

Amateur Cricket.—Though economic pressure and possibly a changing standard of values is steadily reducing the number of amateurs able and willing to play first-class cricket with any regularity, and though the highest standard of technique must always depend upon professional cricketers, especially bowlers, yet amateurs have in the past played a vital part in the game's development, and it cannot to-day dispense either with their leadership, or with the spirit of enterprise and the attractive method that, as a rule, characterizes their play. Though county elevens have been successfully captained by professionals, notably Notts., and Yorkshire in the middle of the 19th century, and though such men as Lilley of Warwickshire have captained the Players' eleven with marked ability, professionals as a whole would not welcome the responsibilities involved in regular captaincy, which naturally extend far beyond the field of play. It is not too much to say that some counties have, for a time, at least, been made by their captains, amongst whom the outstanding figures in the last half-century are perhaps Lord Hawke (1860–1938) (Yorks.), Lord Harris (Kent), A. N. Hornby (Lancs.), J. Shuter (Surrey), I. D. Walker, A. J. Webbe and P. F. Warner (Middlesex), A. O. Jones (Notts.) and S. M. J. Woods (Somerset).

There have, of course, been brilliant professional batsmen—Hammond in 1927 was probably the most attractive in the world—but it is only natural that men who depend on the game for their livelihood should concentrate first on security and that it should be left to the amateur to supply what has been termed "the champagne of cricket." Certainly the great stylists in cricket history have often been amateurs, *e.g.*, C. G. Taylor (1817–1869), R. Hankey (1832–1886), R. A. H. Mitchell (1843–1905), A. Lyttelton (1857–1913), A. G. Steel (1858–1914), A. E. Stoddart (1863–1915), L. C. H. Palairet (1870–1933), A. C. Maclaren (1871–1944), the brothers, H. K. (1873–) and R. E. Foster (1877–1914), R. H. Spooner (1880–), D. J. Knight (1894–) and A. P. F. Chapman (1900–). Naturally, the ranks of the hitters have been mainly recruited from amateurs, the two greatest of them, by general consent, being C. I. Thornton (1850–1929) and G. L. Jessop (1874–). If Thornton was consistently the longer driver (several hits of 150–160yd. are authenticated for him), Jessop, thanks to his extraordinary quickness of foot and freedom of swing, was the more versatile and the fastest scorer that the game has known. In 1900 he made 157 runs against the West Indians between 3:30 P.M. and 4:30 P.M., and a rate of 100 runs an hour was normal with him when at his best.

In bowling, the amateurs have, as a rule, been definitely inferior to the professionals, especially in accuracy, but they have numbered amongst them some of the greatest fast bowlers, *e.g.*, Alfred Mynn, Harvey Fellows, a positive terror in the '40s, S. M. J. Woods, C. J. Kortright, W. Brearley and N. A. Knox. Of all bowlers, Kortright is still thought to have been the fastest. Mention must also be made of one or two slow spin bowlers who stood, in their respective epochs, as figures of creative originality: such were David Buchanan, a slow left-hander who did wonders for "the Gentlemen" between 1868 and '74; "W. G." himself who, with his flight and generalship was for two decades "the best change bowler in the world"; A. G. Steel who re-discovered the leg-break in the later '70s, and B. J. T. Bosanquet, the inventor of the googly at the beginning of this century. Similarly as V. E. Walker was almost alone in bowling lobs in the middle of the

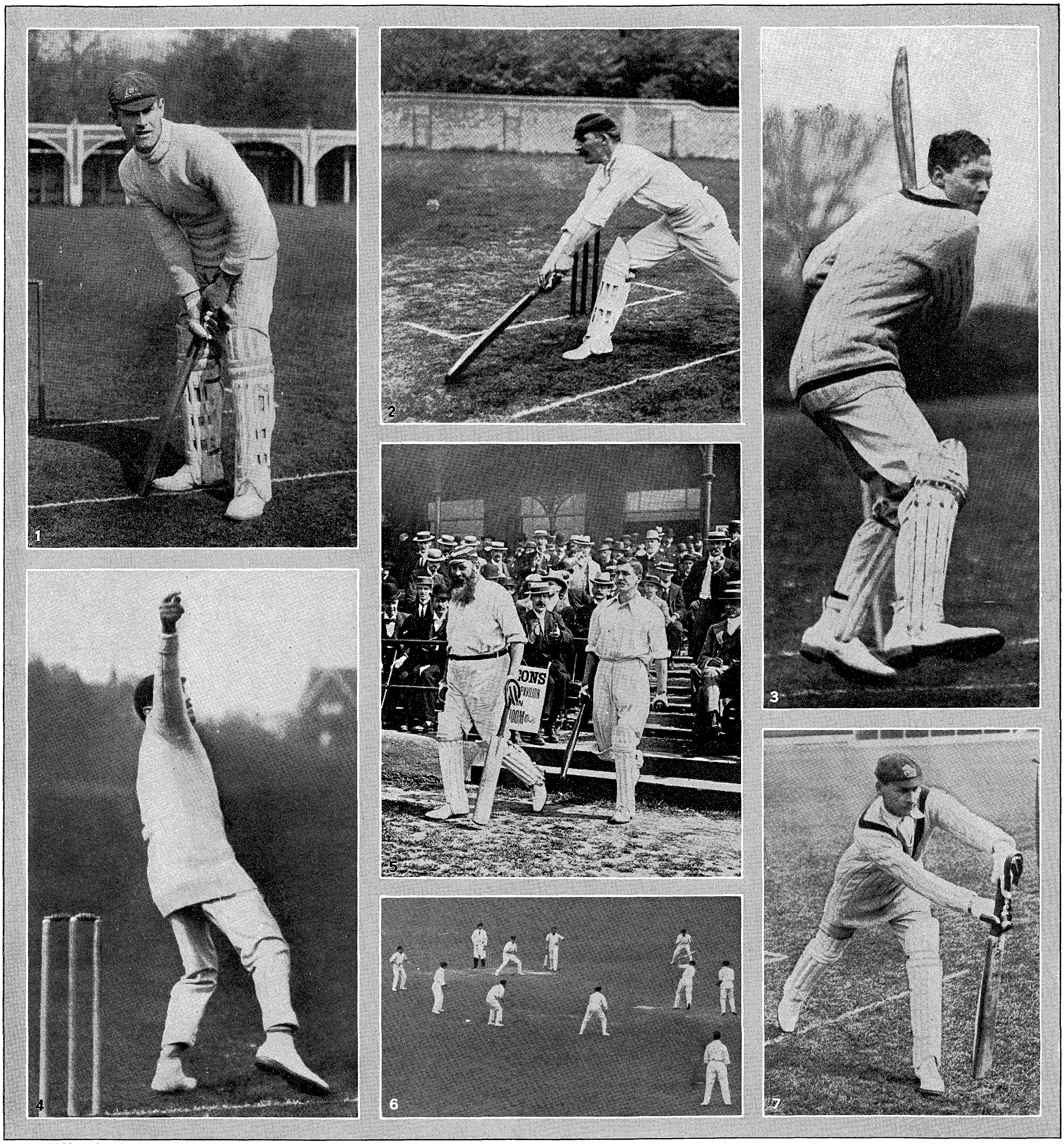
Batting

	Innings	Times not out	Highest score	Aggregate	Average
England					
Sutcliffe, H . . .	46	5	194	2741	66·85
Hammond, W. R. .	35	2	251	1813	54·93
Hobbs, J. B. . .	71	4	187	3636	56·26
Leyland, M. . .	24	3	153	1077	51·28
Jackson, Rt. Hon. F.S.	33	4	144*	1415	48·79
Hendren, E. . .	48	4	169	1740	39·54
Hayward, T. . .	51	2	137	1747	35·65
Shrewsbury, A. . .	40	4	164	1277	35·47
Maclaren, Mr. A. C.	61	4	140	1931	33·87
Woolley, F. E. . .	51	1	133*	1664	33·28
Grace, Dr. W. G. .	36	2	170	1098	32·29
Rhodes, W. . .	69	14	179	1706	31·01
Tyldesley, J. T. . .	46	1	138	1389	30·86
Australia					
Bradman, D. G. .	31	2	334	2596	89·51
Ponsford, W. H. .	35	2	266	1558	47·21
McCabe, S. J. . .	26	3	187*	1078	46·86
Ryder, J. . . .	28	4	201*	1060	44·16
Woodfull, W. M. .	41	3	155	1675	44·07
Macartney, C. G. .	42	4	170	1640	43·15
Collins, H. L. . .	26	0	162	1012	38·92
Hill, C. . . .	76	1	188	2660	35·46
Armstrong, W. W. .	71	9	158	2172	35·03
Bardsley, W. . .	49	4	193*	1487	33·04
Trumper, V. T. . .	74	5	185*	2263	32·79
Duff, R. A. . . .	34	1	146	1079	32·69
Noble, M. A. . .	68	6	133	1905	30·72
Darling, J. . . .	55	2	178	1632	30·79
Oldfield, W. A. . .	53	13	65*	1037	25·92
Gregory, S. E. . .	92	7	201	2193	25·80
Giffen, G. . . .	53	0	161	1238	23·35
Bannerman, A. C. .	50	2	94	1108	23·08

* Signifies not out.

Bowling

	Balls	Runs	Wickets	Average
England				
Lohmann, G. A. .	3301	1002	77	13·01
Barnes, W. . .	2285	793	51	15·54
Bates, W. . .	2362	821	49	16·75
Peel, R. . . .	5216	1715	102	16·81
Ulyett, G. . .	2527	983	49	20·06
Briggs, J. . . .	4941	1993	97	20·54
Lockwood, W. H. .	2029	884	43	20·55
Blythe, C. . .	1977	877	41	21·39
Barnes, S. F. . .	5749	2288	106	21·58
Hearne, J. T. . .	2936	1070	48	22·29
Rhodes, W. . .	5798	2616	109	24·00
Richardson, T. .	4448	2220	88	25·22
Larwood, H. . .	4051	1916	64	29·93
Tate, M. W. . .	7686	2536	83	30·55
Hirst, G. . . .	3461	1585	49	32·34
Woolley, F. E. .	3590	1555	43	36·16
Braund, L. C. . .	3672	1769	46	38·45
Australia				
Ferris, J. J. . .	2030	684	48	14·25
Turner, C. T. B. .	5329	1670	101	16·53
Spofforth, F. R. .	4185	1731	94	18·41
Trumble, H. . .	7889	2945	141	20·88
Palmer, G. E. . .	4519	1678	78	21·51
Noble, M. A. . .	6845	2850	115	24·78
Saunders, J. V. .	3268	1621	64	25·32
O'Reilly, W. J. .	4304	1422	55	25·85
Giffen, G. . .	6391	2791	103	27·09
Cotter, A. . .	3465	1916	67	28·59
Jones, E. . . .	3586	1757	60	29·28
Armstrong, W. W. .	6788	2288	74	30·91
Grimmett, C. V. .	9164	3439	106	32·44
Gregory, J. M. .	4880	2364	70	33·77
Mailey, A. A. . .	5159	2935	86	34·12
Wall, T. W. . .	3821	1663	43	38·67

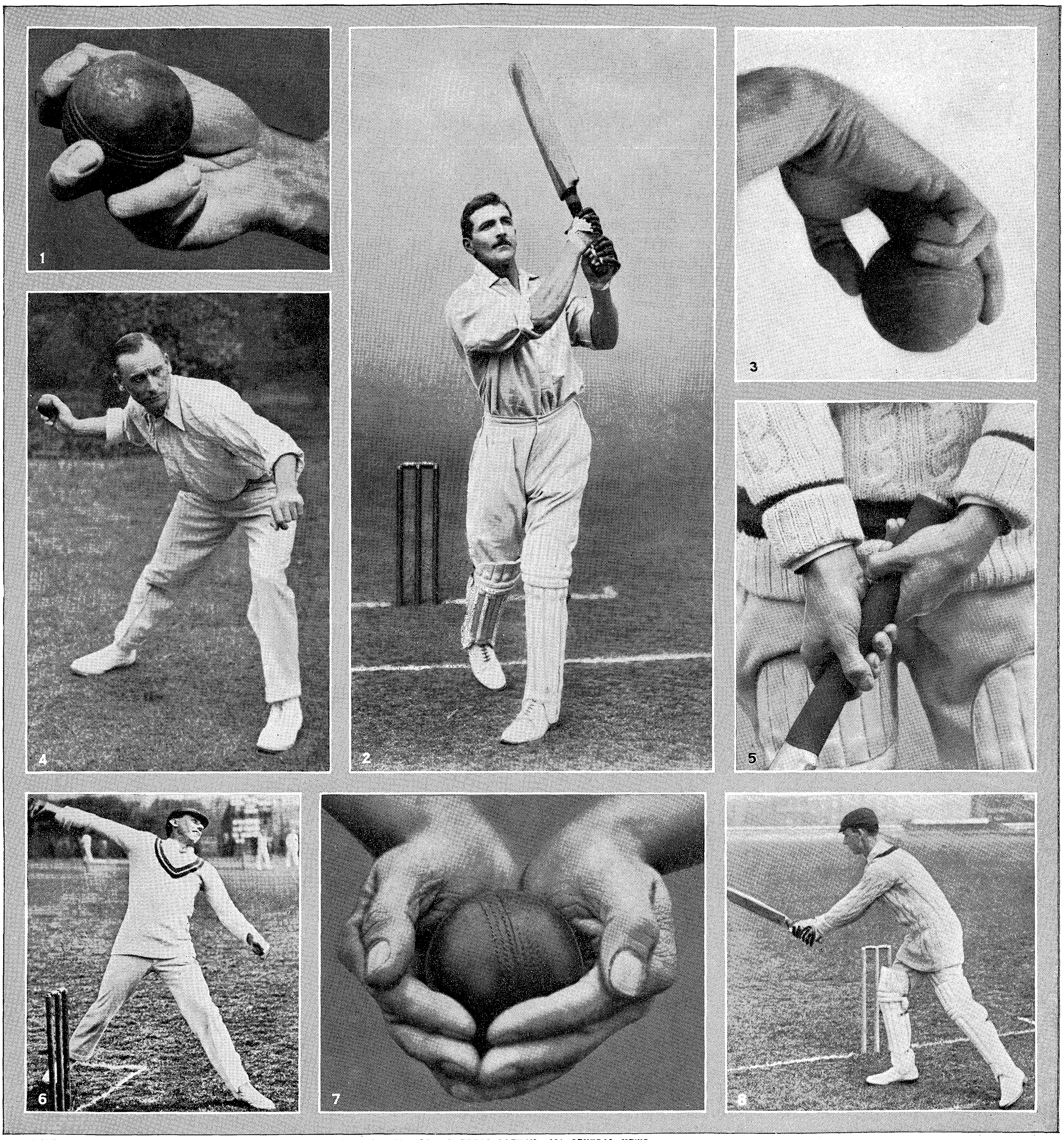


PHOTOGRAPHS, (2, 4) W. A. ROUCH, (6, 7) CENTRAL NEWS

FAMOUS CRICKET PERSONALITIES AND INCIDENTS

1. Victor Trumper at the wicket: Trumper was the most brilliant of all Australian batsmen
2. A. C. MacLaren, Harrow, Lancashire and England, making a cut
3. A. P. F. Chapman, Kent, who captained England in 1926 and 1928–29, at the beginning of an off-drive
4. Wilfred Rhodes, Yorkshire and England, perhaps the greatest of slow left-hand bowlers
5. W. G. Grace (left) and C. B. Fry opening the innings for England at Nottingham in 1899: Grace's last test match, Fry's first
6. The Test Match at the Oval in August 1926: Richardson bowling to Hobbs on a sticky wicket (note the leg-traps): this partnership of Hobbs and Sutcliffe recovered the Ashes
7. J. B. Hobbs playing forward

CRICKET



PHOTOGRAPHS, (1, 3, 4, 5, 7) "THE STAR," (2) W. A. ROUCH, (6) TOPICAL PRESS AGENCY, (8) CENTRAL NEWS

BATSMEN AND BOWLERS

1. The bowler's grip of the ball for an off-break
2. C. B. Fry, Sussex and England, at the finish of a straight drive
3. The grip of the ball for the "googly"
4. The return from cover-point, illustrated by Hobbs, one of the finest fieldsmen in that position
5. The normal grip of the bat
6. M. W. Tate, Sussex and England, in action
7. "Safely held"
8. J. B. Hobbs making a late cut

19th century, so D. L. A. Jephson and G. H. Simpson-Hayward were the sole, though successful, exponents of the art 50 years later.

The Gentlemen v. Players Match.—In any purely domestic season the match played in the middle of July at Lord's between the best amateurs and professionals, stands as the high-water mark, and selection for these elevens is a much coveted distinction. The match was first played in 1806, and not again until 1819, since when it has been played regularly. For many years, the Gentlemen were no match at all for the Players, and various handicaps, odds, given men and unequal sized wickets, were vainly tried to equalize the sides. The '40s brought them a spell of some success, due largely to Alfred Mynn, but from 1850–64, the Players won every match except that in 1853 when Sir Frederick Bathurst and M. Kempson bowled unchanged throughout both innings. In these dark days the amateurs' batting was hopelessly outclassed. In 1865 "W.G." played for the Gentlemen for the first time, and in the next 16 years he was only twice on the losing side; for this wonderful run of success his personal prowess both with bat and ball was mainly responsible. No cricketer has a record for these matches even comparable with his, but he was well supported by the bowling of his brother, E. M. Grace, and of D. Buchanan, whilst a strong vein of batting talent was running from the 'varsities, Eton and Harrow, notably in the persons of W. W. Yardley, A. Lubbock, the Lytteltons and a little later, A. G. Steel, one of the greatest all-round amateur cricketers, and A. P. Lucas. The Players recovered most of their lost ground in the '80s, but the next decade saw honours fairly divided: in 1894, F. S. Jackson and S. M. J. Woods bowled unchanged through the match and won it for a side, the average age of which, leaving out "W. G." was but 25; two years later, one of the strongest of all elevens that have represented the Gentlemen, won a notable fight by six wickets, and in 1898, a match timed to coincide with "W. G.'s" 50th birthday, produced cricket wholly worthy of the occasion. The fast bowling of Woods and Kortright, and the batting of Shrewsbury, lent peculiar distinction to this epoch.

In the present century the match has continued to provide much splendid cricket, though the amateurs of recent years have found the task of dismissing the very strong batting sides of the Players increasingly beyond their powers. In the opening match of this period, R. E. Foster made 102 and 136, but the Players won the game by scoring over 500 runs in the last innings. Three years later the Gentlemen turned the tables when, after being outplayed for two days, they made 500 for two wickets—C. B. Fry (232 not out) and A. C. Maclaren (168 not out), adding 309 runs in less than three hours.

The centenary celebration in 1906 is always known as "the fast bowlers' match"; Fielder took all 10 wickets in the amateurs' first innings, and N. A. Knox and W. Brearley, with H. Martyn of Somerset standing up to both behind the stumps, combined in a terrific and, in the end, successful assault. In the years just before the World War, the Players were very strong, Barnes bowling superbly, and Hobbs inaugurating an extraordinary series of batting achievements; but the Gentlemen won a fine victory in 1911, and again in 1914, when J. W. H. T. Douglas bowled with splendid persistency and control of swerve. In the matches since the war the amateurs have won only in 1934, though A. P. F. Chapman and D. R. Jardine have batted admirably. Hobbs, in these games, has a remarkable record, having now scored five centuries since 1919, four in successive years. Amongst the best teams that have appeared in this match may be noted the Gentlemen elevens of 1878, 1896, 1898, 1906 and 1911, and the Players in 1887 and 1911, whilst some of their post-war sides, if not reaching the highest bowling standard, have been as strong in batting as any of their predecessors. Though never enjoying the same prestige as the Lord's fixture, similar matches between Gentlemen and Players have taken place regularly at the Oval since 1860, at Scarborough since 1885 during the very popular festival there at the end of the season, and, intermittently, at Prince's, London, Brighton and Hastings.

University Cricket.—Though by no means enjoying the virtual monopoly that they once did, the universities of Oxford and Cambridge are still the chief nurseries of amateur cricket; the competition for cricket "blues" is keener than ever, and for a young cricketer there can be no more thrilling and exacting moment than his first appearance in the University match. This game was first played in 1827, when Charles Wordsworth (O.) and Herbert Jenner (C.) were captains. With the exception of five games, all at Oxford, it has always been played at Lord's and, apart from the war years, regularly since 1838. Of the 91 matches now played, Cambridge has won 43, Oxford 36, and 10 have been drawn. The match has produced sensations in plenty, notably the finishes of 1870 when F. C. Cobden "did the hat-trick" with the last three balls to win the game for Cambridge by two runs, and of 1875 when the Oxford captain, A. W. Ridley, put himself on with "lobs" at the crisis and won the match by six runs. By common consent the Cambridge XI. of 1878 was the best that has ever appeared in the match; they won all eight matches they played, annihilated Oxford, and beat the Australians by an innings. The brothers, E. and A. Lyttelton and A. P. Lucas were splendid batsmen, Morton a destructive fast bowler, and A. G. Steel, then a freshman from Marlborough, almost the best all-round player in England. The Cambridge side of 1882 also beat the Australians and was very strong, and so were those of 1890–93 in which G. MacGregor kept wicket to the fast bowling of S. M. J. Woods, and F. S. Jackson played himself into an undisputed place in the England XI., and as many as eight men subsequently appeared for the Gentlemen at Lord's. Since the war they have had good teams in 1920 and 1922. For Oxford the elevens of 1863–4–5 under the captaincy of R. A. H. Mitchell were very strong; M. C. Kemp led a fine side in 1884 which included seven freshmen, that beat both the Australians and Cambridge by seven wickets, whilst the batting, and even more the fielding, of H. D. G. Leveson-Gower's team which in 1896 scored 330 in the last innings for six wickets, will long be remembered. It is impossible here to refer to individual performances and players, but mention must be made of the distinguished part played by some families in the match: such were the Lytteltons, Fords, Studds and Ashtons for Cambridge; the Riddings, Fosters and Evans for Oxford. The Cambridge brothers, C. E. M. and E. R. Wilson, have an astonishing family record. The University match may no longer provide so much of the "champagne of cricket" as of old, but it still remains a unique feature in the English season, a focus for ardent patriotism, a rendezvous where generations of friends and foes renew happy memories, and an arena where the best cricket, especially the fielding, reaches a high level, and the worst is raised to a higher power by the chivalrous vigour with which the game is fought. Both universities have fine grounds, known at Oxford as "the Parks," at Cambridge as "Fenners," where a professional coaching staff is engaged. The colleges also have admirable grounds, though in the last generation lawn tennis has made distinct inroads into college cricket.

School Cricket.—Cricket being in origin a boy's game, it is not surprising to find the schools supplying some of our earliest references to it; it was being played at the Free School at Guildford in the middle of the 16th century, the Wykehamists were playing it on "Hills" 100 years later, at Eton the game was firmly established by the beginning of the 18th, the duke of Marlborough was probably playing it at St. Paul's a few years earlier, and Westminster provided at least three men to form the "Star and Garter" committee that revised the laws in 1774. Cricket at Harrow was of rather later growth, possibly introduced by an Etonian headmaster (!) but certainly established well before the end of the 18th century. The most famous of all school matches, Eton *v.* Harrow, was first played at Lord's in 1805, the poet Byron being a member of the Harrow team; from 1822 this game has been played virtually without a break and of exactly 100 matches now played, Eton has won 40, and Harrow 35. Between 1851 and 1869 Eton only won once, and again only once between 1888 and 1903, but the pendulum swung with a vengeance in this century and Eton had a run of successes. Once quite a domestic affair, the match has long constituted almost the climax of the London season and now attracts a huge and brilliantly dressed crowd, an important item in the financial budget of the M.C.C. who dispense a large yearly grant to support cricket at the two schools. In 1825 Harrow first met Winchester at Lord's, and a year later Eton followed suit, thus inaugurating what was known as "the Schools' Week," a triangular contest which lasted till 1854, when Winchester withdrew subsequently playing Eton home and home matches, and reviving the Harrow match after the war. For more than half last century these three schools supplied a very high percentage of university "blues," with Rugby an easy fourth, but following the lead of Uppingham, who had five Cambridge blues in 1876, other schools, noticeably Malvern and Repton, have successfully challenged that monopoly, and the composition of the university teams is now quite catholic, with some of the most notable of recent performances standing to the credit of Rhodes scholars and other students from the Dominions. Rugby and Marlborough, Cheltenham and Haileybury, Tonbridge and Clifton all play each other at Lord's at the end of the summer term, and these matches are now followed by representative games, organized by the M.C.C., between an eleven selected from the schools that play at Lord's and "the Rest," and subsequently between a public school eleven and the Army. In 1926 a XV. of the public schools played the Australians. Cricket at the schools, from the junior nets at a preparatory school to the matches just mentioned, is now intensively organized, and young cricketers of promise are systematically coached; of the professional coaches, the most famous was H. H. Stephenson at Uppingham in the '70s; of amateurs we may cite the Hon. R. Grimston and the Hon. F. Ponsonby for Harrow, and R. A. H. Mitchell and C. M. Wells for Eton, whilst many others, if less illustrious, have worked most unselfishly and with splendid results in the same cause. Largely as a result the general standard of school cricket has shown a steady advance, immense in the aggregate since, say, 1860: the best school batsmen have always been able to take their places at once in first-class cricket, but bowlers who have made a similar immediate mark are so few that we can specify A. G. Steel and H. Rotherham of Uppingham, C. L. Townsend of Clifton, E. M. Dowson of Harrow, J. N. Crawford of Repton and G. T. S. Stevens of University College school: the latter in 1919 was actually selected to play for the Gentlemen at Lord's, whilst still at school.

Evolution of Technique.—Cricket, the boys' game, was no doubt played in Tudor and perhaps even in Plantagenet times, in a haphazard, makeshift way; in the woodland districts of the Weald, the natural base for attack and defence was the tree "stump," of which the exigencies of Cinque Ports shipbuilding would provide no lack; the mark being low, it would be natural to "bowl" at it. On the down lands, however, the shepherd lads used another mark, the hurdle gate into their sheep pens, consisting of two uprights and a crossbar resting on their slotted tops; the latter is still called by stockmen a "bail" and the whole gate a "wicket," deriving its name from the A.S. wican, to give way, *i.e.*, the place where the pen yields and admits entry. The fact that the bail could be dislodged when the wicket was struck made this preferable as a mark to the "stump," and the "woodmen" were converted to its use, preserving, however, a memory of their original habit by applying the term stumps to the hurdle uprights.

The dimensions of this wicket would at first vary widely in different districts; Nyren speaks of "a small manuscript" enshrining the recollections of an old cricketer about the game as he knew it at the beginning of the 18th century. This describes the wicket as 1ft. high by 2ft. wide, with a hole between the uprights into which the ball had to be "popped" (*cf.* popping crease) to run-out or stump a batsman; this tradition is also supported by a picture at Lord's, No. 17 in the M.C.C. collection, and the wider than high wicket by other representations of the game. It is probable, however, that this practice was local to the Western Weald, and that the true tradition of the game's home, Kent and East Sussex, is preserved in the first official regulations that we know, the "London Laws" of 1744. These laws clearly represent a sophisticated edition, probably by the cricket committee of the Artillery Ground, of a much earlier and probably oral version: indeed "H. P-T's" pamphlets (*see* Bibliography) have convincingly disentangled the new from the old. The other important authority for the earliest "regulation" game is a Latin poem by William Goldwin, sometime scholar of Eton and King's, published in 1706 as one of a collection called "Musae Juveniles." The original wicket then was 22in. by 6in., the popping crease (or "scratch"—whitening did not come in until "W.G's" time) was 46in. in front of it, and the pitch was 22yd. long. These measurements all correspond with divisions or multiples of the early Tudor units of length measure, the "gad" of 16½ft. and the ell or cloth yard of 45 inches. The further evolution of the wicket took place as follows:—A middle stump was added in, or shortly after, 1775; by 1798 two inches had been added to the height and one to the width, and in 1817 the size of the wicket was increased to its present dimensions (27in. by 8in.) and, perhaps a year later, the original bail was split into two.

The ball was probably much the same in the 17th century as it is to-day: Duke of Penshurst told Farington, the diarist, in 1811 that his family had been making cricket balls for 250 years. It was certainly leather-covered (coriaceus orbis in Goldwin) and crimson dyed, almost certainly hemp or hair stuffed. By the 1744 laws it might weigh anything between five and six ounces; its present precise specifications in weight and circumference were laid down in 1774 and 1838 respectively.

The primitive bat was no doubt a shaped branch of a tree; at the beginning of the 18th century it resembled a modern hockey stick, but was considerably longer and very much heavier, well adapted for dealing with the only form of attack, then at least properly called "bowling." It has been customary to credit the Hambledon men with the invention of "length-bowling," but a poem, "The Game of Cricket: an Exercise at Merchant Taylors' School," published in *The Gentleman's Magazine* in Oct. 1756, and conceivably the work of James Dance (Love), who entered that school in 1732, refers to the ball as

> "now toss'd, to rise more fatal from the ground,
> exact and faithful to the appointed bound,"

which looks uncommonly like a cult of "length." It is at least certain that the Hambledon cricketers elaborated this instinct into an art: David Harris, learning his lesson from Richard Nyren, became a great bowler with the three sovereign qualities of length, pace and quickness of rise from the pitch. In reaction the batsmen, following the example of John Small of Petersfield, one of the most picturesque characters in Nyren's pages, evolved a new technique, meeting the length ball with the straight bat, shortened in the handle and straightened and broadened in the blade; for a time perhaps their play was rather defensive, "puddling about the crease," but a new generation of Hambledon men opened up the game by forward play, quick-footed driving and the cut. Even Harris's bowling was no greater than the batting of William Beldham (1766–1862) who "took the ball as Burke did the House of Commons, not a moment too soon or too late."

In spite of the combination of length with break and swerve and flight, with which the Hambledonians, Lamborn, Noah Mann and Tom Walker are respectively credited, or rather because of the scarcity of men who could master and maintain those arts, the batsmen steadily asserted their superiority, even after the attempt of one, "Shock" White of Reigate, to use a bat of preposterous width had been defeated by the legislators of 1774 who limited its width to 4½in.; about the same time the original provision of "standing unfair to strike" was elaborated into the first l.b.w. law by which the umpire was confronted with the impossible task of deciding whether such obstruction had been deliberate. With the dawn of the 19th century, most bowlers seem to have been favouring the high-tossed, lobbing variety, originally evolved by Tom Walker of Hambledon, hailed by his contemporaries as "baby-bowling," but at first, no doubt by reason of its novelty, highly successful. But the batsmen, notably Beldham, and a left-handed hitter, John Hammond, soon learnt to "give her the rush," and run-getting once again rapidly increased.

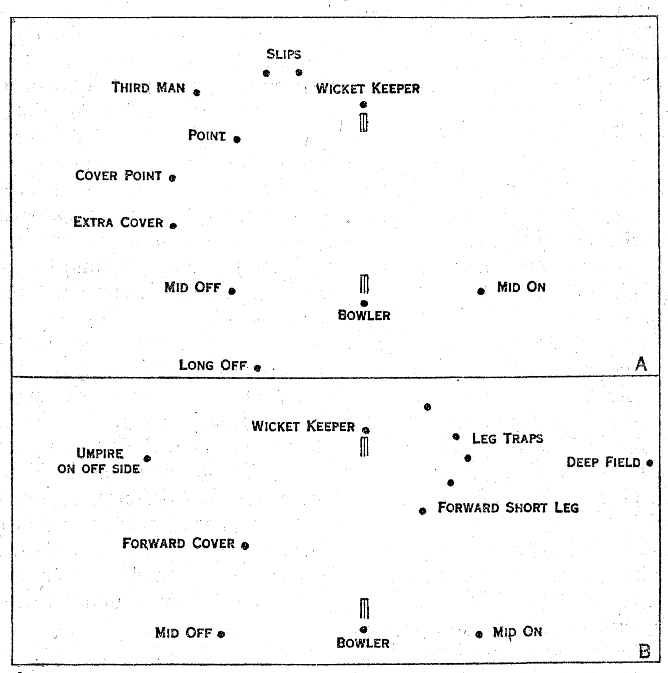
An answer was found in the next great bowling development, "the Round Arm Revolution," or, as it was then called, bowling of the "March of Intellect" style. Though Tom Walker had apparently attempted something of the sort before the break up of the Hambledon club, and been barred for his pains, the true apostle of the new bowling seems to have been one John Willes of Sutton Valence, inspired, it is said, by the model of a cricketing sister who used to bowl, or throw, at him in practice. From 1806 to 1822 Willes persevered in his missionary endeavour in face of determined opposition, until he was no-balled for throwing in a great match at Lord's and rode out of the ground and the game for ever. His mantle fell on two great Sussex bowlers, William Lillywhite and James Broadbridge who, perfecting the new style, carried all before them. Eventually, in 1827, three "experimental matches" were played between Sussex and All England, of which Sussex won the first two, and a reconstituted England side the third. Controversy raged furiously, but the M.C.C. wisely moved with the times, though the reshaping of Law X. to their satisfaction caused them great difficulty; in 1835 it countenanced the hand being raised as high as the shoulder, but ten years later the bowler was taking such liberties that the umpire was then expressly forbidden to give him the benefit of the doubt.

The new style was rapidly attended with a great increase in pace: of the new "fast and ripping" school, Alfred Mynn, Samuel Redgate and John Wisden were the first great exponents. As time went on bowlers tended to raise the hand higher and higher in defiance of the law, until it became more honoured in the breach than the observance. Eventually, Edgar Willsher of Kent was no-balled for throwing in a big match at the Oval (Aug. 27, 1862), and the whole fielding eleven, except its two amateur members, left the field in protest. This brought matters to a head and in 1864 the bowler was officially accorded full liberty to bowl. There has, at intervals since, been trouble over the "throwing" question. In the mid-'80s, Lancashire had three offenders in their team, whose activities were, in the end, curbed by the stand taken up by Lord Harris. There was more unfair bowling in the nineties, but the County captains in 1900 took concerted action, and to-day the evil is virtually unknown.

With the exception of William Clarke, V. E. Walker and Tinley, of Notts, all three successful "throw-backs" to the old high and lobbing school, most bowling continued to be fast through the middle of the 19th century, and good though such wicket-keepers as T. Box (Sussex), T. Lockyer (Surrey) and Herbert Jenner (C.U.C.C.) were, the rôle of long stop became most important: in fact, two long stops were at times necessary for dealing with some of the very wild bowling that was all too common, especially in amateur cricket. The number of wides in some of the university and big school matches of this period was really preposterous. Against this onslaught the batsman learnt to protect himself with additional armour: H. Daubeny invented pads in 1836 and N. Felix the tubular batting glove about the same date, whilst in 1853 Nixon greatly increased the resiliency of the bat by inventing the cane handle. Fortified by these aids, the batsman refused to be intimidated and actually developed the scope of his art. George Parr, the "Lion of the North," exhibited the perfection of leg-hitting; Julius Caesar of Surrey, experimented with "the pull"; William Caffyn of Surrey and Ephraim Lockwood of Yorkshire excelled in the cut. Carpenter of Cambridgeshire was a great back player who was, at the same time, quick on his feet to punish slow bowling, and Thomas Hayward the elder, his compatriot, the first man to develop forcing strokes to the on off the over-pitched ball, whilst the classic principles of elegance and the straight bat, inherited through Fenner and Fuller Pilch, were transmitted in apostolic succession by the Notts. players, Joseph Guy and Dick Daft, to the later generation of Shrewsbury and William Gunn. Though, however, these champions, all, be it noted, professionals, held their own with any bowling they had to meet, the fast bowlers had less gifted men, and nearly all amateur batsmen, rather at their mercy, nor is this surprising when we recall that such men as Jackson of Notts. and Tarrant of Cambridgeshire were as fast as any men bowling to-day, whilst the grounds were incomparably worse. There were, in fact, in the '50s and '60s, only four grounds—The Oval, Brighton, Canterbury and Fenners—where good wickets were the rule, and until 1849, when permission was first given to sweep and roll the pitch at the beginning of each innings, it was unlawful to touch it from beginning to end of a match.

Such was the general state of cricket when W. G. Grace (b. 1848) played his first county match in 1864. Grace is still acclaimed by universal consent the greatest all-round cricketer that the game has yet known and volumes have been written upon his career. No one player has had so decisive an effect on the game, perhaps on any game. By his extraordinary achievements, arresting appearance (he was a big man with a black beard who always wore the M.C.C. red and yellow cap), and of lovable, if at times, cantankerous, personality, he concentrated upon himself, and, through himself, upon the game, an attention quite unparalleled before; wherever he went thousands swarmed to watch; he was, at least, as well known to every class of Englishman as was Gladstone at his zenith. His personal prowess restored the prestige of amateur cricket in the Gentlemen *v.* Players matches at Lord's. As a batsman, Grace revolutionized the art: "he turned it from an accomplishment into a science; he united in his mighty self all the good points of all the good players and made utility the criterion of style; he turned the old one-stringed instrument into the many-chorded lyre. But in addition he made his execution equal his invention." Incidentally, Grace killed fast bowling; to the very end of his career, pace, even on a fiery wicket, had no terrors for him, and in his prime he dealt with it so mercilessly that its exponents were almost afraid to bowl within his reach.

This decline of fast bowling coincided, in the '70s, with a rapid improvement of grounds, due to the advent of the heavy roller even more than to the perfection of the lawn-mower, and under "W.G.'s" example, batsmen generally, though they never succeeded in imitating his intensely individual methods, adopted a more generally aggressive attitude to the attack. The bowlers sought to hold their own by concentrating on accuracy of length at the sacrifice of pace, and a new school of slow or slow medium



A. PLAN OF FIELD AS SET FOR AN "OFF-THEORY" BOWLER IN 1895
B. PLAN OF "LEG-TRAP" FIELD AS SET FOR ROOT, THE ENGLISH TEST MATCH BOWLER, IN 1926

bowlers gradually emerged, with Alfred Shaw of Notts. as its model and master. The astonishing accuracy of Shaw's bowling is well attested by the fact that in a cricket career of 31 years he actually bowled 16,922 maidens out of a total of 24,700 overs, his 2,051 wickets costing him less than 12 runs apiece. The bowlers of this era often sought to curb further the batsmen's aggression by keeping the ball some distance wide of the off stump; of this "off-theory" bowling, as it was called, the Gloucester amateur, R. F. Miles, is said to have been the originator; Attewell of Notts. was its greatest exponent; it was accompanied, of course, by a concentration of the fieldsmen on the offside of the wicket, mid-on very often being the solitary man left to guard the "on." A few natural "rebels," notably W. W. Read (Surrey) took advantage of the opportunity to defy the canons of orthodoxy, follow the example of E. M. Grace ("W.G.'s" elder brother) and pull the off-ball round to the denuded on, but for the most part the off-theory was countered by a policy of masterly inactivity. It was nothing out of the way, especially with some of the northern professionals, to see a whole over allowed to go by with no attempt made to play the ball. Indeed, the pace of some county cricket became so funereal that interest in the game sensibly flagged and attendances fell off. In a Yorks. *v.* Notts. match in 1887, three fine days and a fast wicket produced 702 runs in 625 overs. Cricket was in some danger of falling victim to an academic formalism. From such a fate it was saved by a transfusion of new and vigorous blood.

Profiting by the coaching and example of English professionals, some of whom stayed on in their country as coaches at the end of the earliest tours and working at the same with immense enthusiasm, the Australians developed their cricket, especially their bowling, so rapidly that when, on their first visit in 1878, they startled England and four years later actually defeated her full strength, it was recognized that a further evolution in technique had taken place. Their great bowlers, notably Spofforth, Boyle, Allen and Palmer, combined pace with spin and variety of flight, bowled much straighter than was the convention in England and made full use of a much more elastic field; when the pitch helped his off break, Spofforth would get many wickets from catches by Boyle standing in the then unprecedented place of silly mid-on, some six or seven yards from the bat. Blackham, in standing up to a bowler of Spofforth's pace, dispensing with a long-stop and taking the ball cleanly even on the leg side, set a new standard in wicketkeeping. Gradually English bowling, too, began to show greater versatility: A. G. Steel had resurrected with immense success the leg-break with which, in an earlier day, Buttress of Cambridgeshire, and Martingell, first of Eton's professional bowlers, had done great execution; Peate of Yorkshire was the first of a great sequence of slow left-arm bowlers, destined to play a major part in England's battles with Australia where, perhaps, owing to the super-excellence of the wickets, they have rarely arisen, while Lohmann (Surrey) was a master of subtle pace-changes and, in Grace's opinion, the greatest medium-pace bowler he had met. With the beginning of the nineties, we find a new generation of fast bowlers, noticeably Richardson and Lockwood, both of Surrey, and C. J. Kortright, an Essex amateur, whose pace and devil has never been surpassed.

During these last two decades batting continued on generally orthodox lines, with the off drive and the cut as the principal scoring strokes; L. C. H. Palairet (Somerset) was, perhaps, the most beautiful of all off-drivers, and F. S. Jackson and J. T. Brown, both of Yorkshire, and A. C. Maclaren (Lancs.), the best cutters of their day, though neither of them equalled in execution the Hon. C. G. Lyttelton of an earlier generation; most defence, on good wickets, at least, was by forward play; on bad wickets against the best bowlers it was, compared with present-day standards, quite ineffective, though Shrewsbury was a supremely good back-player and, probably, as great a defensive batsman under really difficult conditions, as the game has known.

Back play began its real development at the very end of the century under the influence of K. S. Ranjitsinhji, an Indian prince (now the Jam Sahib of Nawanagar) who got into the Cambridge XI. in 1893, played for England in 1896, and was a batsman of great and original genius whose theory and practice has often been summed up in the cliché "play back or hit." He and his friend and disciple, C. B. Fry, at this time the most versatile athlete in Great Britain and as a batsman profoundly influenced by his association with the Indian prince for Sussex, also developed on-side play to an extent undreamt of before, most noticeably in the hook stroke to the short ball and the forcing strokes wide of mid-on from balls pitching on the line of their legs or of the leg-stump. Indeed, these two batsmen may fairly be said to have laid down the lines upon which first-class batting has subsequently moved. Naturally this made for a strengthening of the on-side field, a tendency already set in motion by the success of a group of leg-break bowlers, notably C. L. Townsend, Braund, C. M. Wells and Vine, who bowled at the batsman's legs and leg-stump with considerable spin from leg, and had as many as six of their fieldsmen on the on-side. A *reductio ad absurdum* of this form of attack was, however, provided by W. W. Armstrong who, in two test matches for the 1905 Australian side, bowled wide of the batsman's legs with virtually all his field to the on, with the sole object of slowing down the English rate of scoring.

The opening years of this century show an orgy of run-getting and drawn games, so formidable as to induce serious debate by the M.C.C. on the reforms desirable to restore a fairer balance between bat and ball; a general meeting of the club agreed so to alter Law X. as to make it no longer necessary for the ball to pitch straight to secure a verdict of l.b.w. The majority, however, though large, was not the two-thirds requisite for any alteration in the laws proper, and the M.C.C. contented itself with a ukase to the counties denouncing the over-preparation of pitches which, at this time, with the help of special clay-dressing—most noticeably Nottingham marl—and of binding solutions such as liquid manure, the groundsmen up and down the country had reduced to a fine art. This appeal by the M.C.C. met with considerable success.

The heavy run-getting of this epoch is not, however, to be put down mainly to the ease of the conditions; it was rather due to a generation of great batsmen—a striking number of them were amateurs—who triumphed over much varied and formidable bowling by methods at once more attractive, more versatile and more individualistic than obtain to-day. As a spectacle, English cricket has never been better than in the years 1900–1905.

The next factor to influence the game—and it did so profoundly—was the so-called "googly" bowling, or the art of bowling at a slow or, at the most, slow-medium pace, an off-break with what appeared to be a leg-break action. This bowling was invented by B. J. T. Bosanquet, first successfully exploited by him in Australia in the winter of 1903–04, learnt from him by his Middlesex colleague, R. O. Schwarz, who took the art with him to South Africa, there to see it brought to something like perfection by himself, G. A. Faulkner, A. E. Vogler and Gordon White. The bowling of these four men, whether on their native matting in 1905, or as visitors in 1907 on our own turf wickets, created a real sensation: R. E. Foster, the England captain in the Tests of that year, hailed Vogler as the most difficult bowler in the world, and both he and A. C. Maclaren expressed grave misgivings as to the effect of googly bowling on cricket generally, suggesting that the batsman, if not positively immobilized, would at least be limited to cramped defence. Fortunately the difficulty of combining the googly with a good length, due largely to the physical strain involved, proved too great for most who attempted it, though both England and Australia have since produced successful bowlers of this type—notably D. W. Carr, Freeman, Richmond and R. Tyldesley in England; H. V. Hordern, A. A. Mailey and Grimmett in Australia.

Nevertheless, the googly's influence on batting, if not decisive, has been considerable; it has reinforced the tendency towards back-play already discernible before its advent, but on new and unfortunate lines. In his anxiety to delay his stroke until the line of the break shall have declared itself, the batsman tended to play back even to the over-pitched ball, and to reinforce his bat with his legs as a second line of defence. Only too often he contracted the habit of moving back and across the wicket with the right foot, before he knew the length of the ball, facing down the pitch with both feet pointing towards the bowler. The initial position inevitably denied to him the use of left-arm, elbow and shoulder, and with them the possibility of making any strokes except those executed with the right forearm, *i.e.,* the jab, the hook and the glide.

To such a practice another factor besides the googly substantially contributed. Ever since Noah Mann, of Hambledon, there have been at intervals in cricket history, bowlers accredited with the gift of the "swerve," *i.e.,* the gift of being able to make the ball change the direction of its flight in the air; the claim was made for Alfred Mynn in the '30s, and can be fully substantiated for Allen of Australia, Walter Wright of Kent, and Rawlin of Middlesex 50 years later, but such men had no idea how and why they swerved; then the American baseball pitchers developed the art, Albert Trott of Middlesex and M. A. Noble of Australia came under their influence, and before the first decade of the new century was ended, swerving was a common phenomenon in English cricket; most right-handers swerved from leg to off and bowled for catches in the slips, but some, such as the great pioneer of the style, J. B. King of Philadelphia, could swerve the ball in from the off, and the left-hand bowlers, such as Hirst and F. R. Foster, were often deadly with the new ball, supported as they were with a semi-circle of close-up fielders, known as leg-traps, ready to catch all edged or mishit balls. Some bowlers, notably Relf, Barnes and J. W. H. T. Douglas, could swerve either way, at least into a head wind. The ability to continue to swerve after the gloss begins to wear off the ball is contingent for most bowlers on one or more of such factors as a suitable breeze, a heavy atmosphere, favourable surroundings, *e.g.*, trees. Contemporary, and in part connected with these developments, there came a much more intelligent and elastic use of the field; great tacticians, amongst whom the Australian captain Noble was unsurpassed, would study each batsman's strokes individually, and block them with an inner and an outer ring. The on-side became increasingly guarded.

The combined influence of the googly and the swerve dominated English batting in the years immediately after the war with disastrous effects; with very few exceptions the leading batsmen concentrated on back-play, and the right-hand on-side strokes, abandoning almost entirely the drive and the cut; the weakness of English bowling in that period encouraged them to believe in their method, but they were cruelly undeceived by their own helplessness before the pace of Gregory and Macdonald, and the accuracy of Armstrong of the 1921 Australian team. Since then English batting has been slowly achieving a reasonable compromise between the new style and the old; it is undeniable that, under the influence of "unlimited" test match cricket in Australia and the yearly increasing rivalry and publicity of county cricket, the game is now less attractive as a spectacle than it was. Admittedly the general level of defence, especially on difficult wickets, is greatly advanced, but first-class batting is much more stereotyped, and less versatile and adventurous. Fortunately there have still been a few—Hobbs, Woolley and Macartney in particular—to prove that genius cannot be fettered, and that it is possible to master the new bowling without sacrificing the glamour and grace of the old batting; but for the most part, first-class cricketers, of whom all other cricketers are only too imitative, have subscribed to the modern doctrine that, even in a game, efficiency must decide.

Some Records and Curiosities.—A list of a few outstanding cricket achievements, compiled by permission, mainly from Wisden's *Almanack*, in first-class cricket may be interesting.

The highest individual innings in a test match was W. R. Hammond's 336 not out *v.* New Zealand at Auckland (1932–33); six centuries in successive innings in first-class cricket were made by C. B. Fry in 1901; 16 centuries in one season of first-class cricket by J. B. Hobbs in 1925; 189 runs in 90 minutes by E. Alletson for Notts. *v.* Sussex at Brighton in 1911; 555 runs for a first wicket partnership by P. Holmes and H. Sutcliffe for Yorkshire *v.* Essex at Leyton in 1932; 3,518 runs in a season's first-class cricket by Hayward (T) in 1906. W. G. Grace, between 1865 and 1908, scored 54,896 runs and took 2,876 wickets in first-class cricket. In 1895, Richardson (T) took 290 wickets, while in the second Australian tour (1880), F. R. Spofforth took 391 wickets in England; G. H. Hirst in 1906 scored 2,385 runs and took 208 wickets. The feat of scoring over 1,000 runs and taking over 100 wickets in the same season has been accomplished by Rhodes (W.) on 16 different occasions. W. G. Grace played his first match for the Gentlemen *v.* the Players in 1865 and his last in 1906, scoring in these games 6,008 runs, with an average of 42·60, and taking 271 wickets for 18·78 runs each. For Australia *v.* South Africa, at Manchester, in 1912, T. J. Matthews took three wickets with successive balls in each inning —a feat without parallel in test matches. In 1896 A. D. Pougher

The Leading Batsmen and Bowlers

Highest Batting Aggregates in a Season

	Innings	Total runs	Highest score	Times not out	Average
1906 Hayward . .	61	3518	219	8	66·37
1928 Woolley (F. E.).	59	3352	198	4	61·03
1932 Sutcliffe . .	52	3336	313	7	74·13
1933 Hammond . .	54	3323	264	5	67·81
1928 Hendren . .	54	3311	209	7	70·44
1901 Abel . . .	68	3309	247	8	55·15
1933 Hendren . .	65	3186	301	9	56·89
1921 Mead . . .	52	3179	280	6	69·10
1904 Hayward . .	63	3170	205	5	54·65
1899 Ranjitsinhji, K. S.	58	3159	197	8	63·18
1901 Fry, C. B. .	43	3147	244	3	78·67
1900 Ranjitsinhji, K. S.	40	3065	275	5	87·57
1933 Ames . . .	57	3058	295	5	58·80
1901 Tyldesley (J. T.)	60	3041	221	5	55·29
1928 Mead . . .	50	3027	180	10	75·67
1925 Hobbs. . .	48	3024	266	5	70·32
1928 Tyldesley (E.) .	48	3024	242	10	79·57
1923 Hendren . .	51	3010	200	12	77·17
1931 Sutcliffe . .	42	3006	230	11	96·96
1928 Sutcliffe . .	44	3002	228	5	76·97
1927 Hammond . .	47	2969	197	4	69·04
1930 Bradman, D. G.	36	2960	334	6	98·66
1926 Hobbs . .	41	2949	316	3	77·60
1920 Hobbs . .	50	2827	215	2	58·89

Most Wickets in a Season

	Overs	Maidens	Runs	Wickets	Average
1928 Freeman. .	1976·1	423	5489	304	18·05
1933 Freeman. .	2039	651	4549	298	15·26
1895 Richardson .	1691·1	463	4170	290	14·37
1888 Turner, C.T.B.	2427·2	1127	3307	283	11·68
1931 Freeman. .	1618	360	4307	276	15·60
1930 Freeman. .	1914·3	472	4632	275	16·84
1897 Richardson .	1603·4	495	3945	273	14·45
1929 Freeman. .	1670·5	381	4879	267	18·27
1900 Rhodes . .	1553	455	3606	261	13·81
1896 Hearne (J.T.)	2003·1	818	3670	257	14·28
1932 Freeman. .	1565·5	404	4149	253	16·39
1901 Rhodes . .	1565	505	3797	251	15·12
1910 Smith (W.C.)	1423·3	420	3225	247	13·05
1896 Richardson .	1656·2	526	4015	246	16·32
1899 Trott . .	1772·4	587	4086	239	17·09
1925 Tate . .	1694·3	472	3415	228	14·97
1898 Hearne (J.T.)	1802·2	781	3120	222	14·05
1925 Parker . .	1512·3	478	3311	222	14·91

took five wickets for 0 runs for the M.C.C. and Ground *v.* Australians at Lord's. In 1884 F. R. Spofforth took 7 wickets for 3 runs for the Australians *v.* an England XI. at Birmingham. C. Blythe for Kent *v.* Northamptonshire at Northampton, in 1907, took 17 wickets in one day. In the season of 1913, F. H. Huish, keeping wicket for Kent, took 102 wickets, catching 70 men and stumping 32. The highest aggregate innings in first-class cricket is 1,107 runs scored by Victoria *v.* New South Wales at Melbourne in 1926–27.

For many years A. C. Maclaren's 424 runs, scored for Lancashire against Somerset in 1895, held the record for a single innings score, but this has been three times exceeded: twice by W. H. Ponsford at Melbourne, in 1922–23 with 429 (Victoria *v.* Tasmania), and in 1927–28 with 437 (Victoria *v.* Queensland); and by D. G. Bradman in 1929–30 with 452 not out (N.S.W. *v.* Queensland at Sydney). Up to the end of the 1935 season ten players had 100 or more centuries to their credit, J. B. Hobbs' total (197) being the highest.

The highest recorded individual score in any match is A. E. J. Collins's 628 in a junior house match at Clifton in 1899, his innings of 6 hrs. 50 mins. being spread over five afternoons.

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CRICKET, an insect of the family Gryllidae (*see* ORTHOPTERA); universally known because of the musical chirping of the males. Crickets have threadlike antennae, jumping hind legs, three-jointed tarsi, a slender ovipositor and tegmina which lie flat across the abdomen with abruptly downbent sides; many are short-winged or wingless. The hind wings are often ample, folding into slender "tails" that project behind the body. The subfamily *Gryllinae* includes the familiar house and field crickets. The house cricket (*Gryllulus domesticus*), widely distributed in the old world and established in the United States, is yellowish-gray marked with brown. It frequents houses, and often seeks warmth near fireplaces, whence the phrase, "the cricket on the hearth." Its chirp is lively but monotonous. The common European field cricket is *Gryllus campestris,* that of North America *Gryllulus assimilis;* the latter occurs with many variations throughout the new world. Both are large brown or black species with similar habits. They dig short burrows or make chambers under logs and stones; sitting in the entrance the male chirps loudly day and night. Pugnacious, he defends his home against an intruding male with vicious open-jawed lunges accompanied by shrill "angry" chirps; but no damage is ever done in these "fights." Sometimes he seems as much annoyed by the approach of a female as by that of a male, as if he were singing for pure pleasure and did not wish interruption; if seeking a mate, however, he caresses her with his antennae and chirps softly. The musical apparatus consists of about 130 minute ridges on the stridulating vein of one tegmen, which are scraped rapidly over a sharp-edged vein in the other while both tegmina are held in an elevated position. The ground crickets (*Nemobiinae*), abundant in Europe and North America, resemble miniature field crickets in form. The delicate green tree crickets (*Oecanthinae*) have very musical notes; one common N. American species (*Oecanthus niveus*) sings by the thousand in unison at night, a short beat of about 100 to the minute, so that the forest seems to pulsate. The mole crickets (*Gryllotalpinae*) suggest miniature moles in habits and appearance, with their digging fore legs, cylindrical body, and velvety coat of hairs. They are of wide occurrence; the common European species is *Gryllotalpa gryllotalpa,* also established in North America. The latter region also has five other species of two genera; two of them (*Scapteriscus vicinus* and *acletus*) are serious crop pests in Georgia and Florida. Mole crickets burrow through the soil and feed upon tender plant roots and insects. About 1,400 species of crickets are known. In some regions crickets are caged for their song, and cricket fighting is a favourite sport in China. (T. H. HL.)

CRICKHOWELL, market town and civil parish, Breconshire, Wales, in the S.E. of the county on the left bank of the Usk, guarding the northern exit of the road into the county between the Brecon Beacons and the Black mountains. Pop. (1931) 1,076. The town is said to derive its name from Crûg Hywel, an early fortress north-northeast of the town. The mediaeval castle, of which only a tower remains, probably dates from the Norman intrusion. Although tradition regards the manor of Crickhowell as a borough by prescription there are no records of its ever having possessed any municipal institutions. Curfew is still rung there. The region is wholly agricultural and although in touch with the Newport and Brecon canal, the little market town is off the main railway routes. After World War I, communications were much improved by the extended use of motor traffic.

CRICKLADE, market town of Wiltshire, England, 9 mi. N.W. of Swindon, on the G.W.R. Pop. (1931) 1,378. Cricklade owed its importance in Saxon times to its position at the passage of the Thames, and is mentioned in the *Anglo-Saxon Chronicle.* It possessed a mint in the time of Edward the Confessor, and William of Dover fortified a castle here in the reign of Stephen. In the reign of Henry III a hospital dedicated to St. John the Baptist was founded. Cricklade was a borough by prescription at least as early as the Domesday Survey, and returned two members to parliament from 1295 until the act of 1885. The borough was never incorporated, but certain liberties, including exemption from toll and passage, were granted by Henry III and confirmed by successive sovereigns. In 1257 Baldwin de Insula obtained a grant of a Thursday market, which later was much frequented by dealers in corn and cattle, and an annual three days' fair at the feast of St. Peter ad Vincula. During the 14th century Cricklade formed part of the dowry of the queens of England.

The cruciform church of St. Sampson is mainly Perpendicular, with a fine ornate tower, and an old rood-stone in its churchyard. The small church of St. Mary has an Early English tower, Perpendicular aisles and a Norman chancel arch. Pop. of rural district with Wootton Bassett (1938) 11,230. Area, 71.8 sq.mi.

CRIEFF, a small burgh, Perthshire, Scotland, and the capital of Strathearn, $17\frac{3}{4}$ mi. W. of Perth by the L.M.S.R. Pop. (est. 1938) 5,242. It occupies the southern slopes of a hill on the left bank of the Earn. Its climate is healthful, the air being pure and dry, and it has recently become a health resort. Its charter is said to date from 1218, and it was the seat of the courts of the earls of Strathearn till 1747, when heritable jurisdictions were abolished. A Runic sculptured stone, believed to be of the 8th century, and the old town cross stand in High street, but the great cattle fair, for which Crieff was once famous, was removed to Falkirk in 1770. It was probably in connection with this market that the "kind gallows of Crieff" acquired their notoriety, for they were mostly used for the execution of Highland cattle-stealers. Among the principal buildings are Morison's academy (founded in 1859), and Strathearn house, a hydropathic establishment built on an eminence at the back of the town, and itself sheltered by the Knock of Crieff (911 ft.). There is a distillery, and preserves are made. Drummond castle, about 3 m. S., is celebrated for its gardens planned by the 2nd earl of Perth (d. 1662). They cover an area of 10 acres, are laid out in terraces, and illustrate Italian, Dutch and French styles. The keep dates from 1490, but much of the original building was demolished in 1689. The present structure was erected after the Jacobite rebellion.

CRILE, GEORGE WASHINGTON (1864–1943), American surgeon, was born in Chili, O., on Nov. 11, 1864. He graduated from Ohio Northern university, Wooster university medical school, and studied in London, Vienna and Paris. He was distinguished as a surgeon of the respiratory system, developed the nerve-block anaesthesia, and performed the first direct blood transfusion. He was a member of many American and European honorary societies, and was awarded numerous prizes and medals. During World War I he was professional director and consultant of U.S. Base Hospital No. 4 in France, and was awarded the distinguished service medal. He was founder of the Cleveland Clinic foundation. He died in Cleveland, Ohio, Jan. 7, 1943.

He is author of *Surgical Shock* (1897); *Surgery of Respiratory System* (1899); *Certain Problems Relating to Surgical Operations* (1901); *On the Blood Pressure in Surgery* (1903); *Hemorrhage and Transfusion* (1909); *Anemia and Resuscitation* (1914); *Nature of the Emotions* (1915); *A Mechanistic View of War and Peace* (1915); *Man, An Adaptive Mechanism* (1916); *The Kinetic Drive* (1916); *A Physical Interpretation of Shock Exhaustion and Restoration* (1921); *The Thyroid Gland* (with others) (1922); *Notes on Military Surgery* (1924); *A Bipolar Interpretation of Living Processes* (1925); *Problems in Surgery* (1928); *Diseases Peculiar to Civilized Man* (1934); and *The Phenomena of Life* (1936).

CRILLON, LOUIS BALBIS DE BERTON DE (1543–1615), French soldier, called by Henry IV. "the bravest of the brave," was born at Murs in Provence. As a boy of 14 he joined the army of the duke of Guise and won distinction at the capture of Calais and Guines and afterwards at, among other battles, those of Jarnac and Moncontour. At all these engagements Crillon was wounded. In 1570, he went to serve with Don John of Austria against the Turks, and though wounded at the battle of Lepanto, was charged with carrying news of the victory to the pope and the French king. Crillon was in Paris during the massacre of St. Bartholomew, which he strongly condemned. He took part, however, in the siege of La Rochelle, where he was wounded and although he was loyal to Henry III. in his struggle with the League, after the death of that king he gave his whole allegiance to Henry IV. He fought at the battle of Ivry and was present at the siege of Paris. After the peace with Savoy was concluded Crillon retired to his estate and gave himself to pious exercises. It is related of him that being present at church one day when the story of the Passion was being read, the old soldier became enraged at hearing of the outrages which Christ had suffered, and drawing his sword cried out "Where were you then, Crillon?" Crillon, who was one of the greatest captains of the 16th century, died at Avignon on December 2, 1615.

CRIME. Many attempts have been made to find an accurate definition of crime, such as "an anti-social act," "a failure or refusal to live up to the standard of conduct deemed binding by the rest of the community," and "some act or omission in respect of which legal punishment may be inflicted on the person who is in default whether by acting or omitting to act." Under all these definitions the man who rides a bicycle without a light, or pulls the communication cord in a railway carriage as a stupid joke, is as much guilty of crime as the man who shoots a night watchman and runs away with the contents of the safe. Yet, if crime is defined as the commission of a grave offence, manslaughter is a crime and men have been convicted of manslaughter for driving a vehicle so carelessly as to cause the death of another: the offence was not intentional and in the eye of the ordinary citizen the careless driver is not a criminal.

The Nature of Crime.—That brings us to the motive; but here we encounter a new difficulty. Who can divine the secrets of the heart? The only material on which our fallible human judgment can work is the act itself. The matter is further complicated by the question of responsibility, for a certain number of persons who come before the criminal courts—probably not so large a number as is generally supposed—are mentally unstable, even if not certifiably insane. When we know so little of the secret temptations and the hidden faults of our intimate friends, how can we expect the criminal courts, which have not our advantage, to do more than rough justice? As long as human nature remains what it has always been, and what it will continue to be until the race disappears from the globe, that is all that human judges can ever do. Most of us have been guilty at some time of an "anti-social act" and all of us, as we have confessed in places of worship, deserve punishment. It is more difficult to give an answer to the question "What is crime?" than it is to reply to the question of Pontius Pilate who expected no answer.

Crime is not a fixed quantity. Certain acts such as apostasy, or the practice of witchcraft have been savagely punished in the past and are not now treated as crimes. The treacherous seduction of a wife under circumstances condemned in every moral code may be treated as a crime in one country and not in another. A grave offence in one century may be a trivial offence in another. Every new invention, every new social combination, begets new forms of crime among those who use their wits to prey upon society.

Punishment.—Nevertheless, though we cannot give any satisfactory definition, all of us know what we mean by "crime" and why we punish it. What is not so generally recognized is that the criminal is for the most part a man of like passions with ourselves, only less restrained, less prudent and far more unlucky. Human society, even when it was in a rudimentary state, tried to protect itself by punishing those who defied its customary law, not primarily as an act of retribution, but from a sense of compensation—an eye for an eye and a tooth for a tooth—and as civilization advanced, so did the theory of punishment as an instrument of deterrence. It is to this principle that the barbarous punishments that persisted in civilized countries up to the end of the eighteenth century were principally due.

It is now generally recognized that for punishment to be effective in reducing crime, three conditions are necessary—all criminals must be caught, their punishment must be justly awarded and there must be no delay in carrying out the sentence. It was only the third of these conditions that primitive and mediaeval society could achieve; it is the condition which is in danger of being lost sight of in many civilized communities. The first condition has not yet, and probably never will be, achieved at all. If detection and punishment were as certain as it is that a hand thrust into the fire will be burned, one could count upon the fingers the number of persons who would adventure upon crime.

During the centuries covered by history, no doubt for long before history was written, a state of war has existed between the criminal and the forces of law and order, with fluctuating fortune, and whenever the criminal appeared to be victorious, the penalties exacted from those enemies of society who were unlucky enough to fall into the hands of authority became more savage in the vain hope that the majority—the undetected—might take warning and be deterred. The desecration of tombs in Ancient Egypt, then the most serious of all crimes, went on in spite of the atrocious punishments inflicted.

The torture inflicted on accused persons up to 150 years ago to extort confessions was not, as is commonly supposed, resorted to merely from cruelty, but was part of a judicial system which hesitated to execute condemned persons before they had confessed.

Until quite late in the Christian era, the only conception of punishment for crime was death or the infliction of bodily pain. Under the Roman empire prisons were not places of punishment, but were used only for detaining prisoners until they could be tried or executed. In the list of Roman penalties—death by hanging, by hurling from the Tarpeian rock, crucifixion, beheading, and drowning in the sack, exile or beating with rods—there is no mention of the *carcer*. According to the reasoning of that day, a man who had declared war upon society had forfeited his right to belong to it and was better out of the way: society was not called upon to pay for maintaining him upon the doubtful chance that his nature might be regenerated. It was in the monastic system of the early Christian church that the idea of imprisonment first took root. The church attached great importance to solitude as a first condition of penitence. Solitude was the inspiration of the monastic system. "Solitary confinement," as we understand the words, dates from the *detrusio in monasterium* of the old Canonical Law. When the French had the machinery for keeping people in prison, they used their prisons for secluding persons obnoxious to the court under *lettres de cachet*. The Declaration of the Rights of Man enunciated in 1789 contained the first suggestion of a methodical system of imprisonment for lawbreakers, which appeared in the French code of 1791. Beccaria had already published his treatise against arbitrary and savage penalties and had insisted that punishments should be limited to what was necessary for the defence of the community. Before his day there had been sporadic experiments in Europe. In 1593 the Protestants in Amsterdam had built a prison for women who were to be reformed by regular work and religious influences. Experiments of the same kind were made in Germany and the Hanseatic towns. In 1703 Pope Clement XI. had built the famous prison of St. Michel for young prisoners, and later in the century the cellular prison, which evoked the admiration of John Howard, was built at Ghent.

The modern prison system in England dates from Jeremy Bentham and John Howard. Prison reform was older than the reform of English penal laws of which Sir Samuel Romilly said as late as 1817 "The laws of England are written in blood." The savagery of the French criminal law was swept away by the Revolution, but more than twenty years later, men and women were being executed in England for thefts of more than forty shillings in value. This conservatism was due in part to a disinclination to copy the methods of our enemies, but there was also the feeling that unless criminals could be terrorized into good behaviour, they would become the masters of society; as is always the case in communities with a defective police organization. The criminal, and especially the highwayman, was a popular hero; the class from which he sprang was at war with those who possessed property and was glad to shield offenders from a law so sanguinary and pitiless; the lives of the working class in cities were not such as to attract the adventurous, and though to "cut a dash" on the highway generally brought a man to Tyburn before he was twenty-five, he took his last ride in the cart under the admiring eye of the only audience whose opinion he valued, and strutted into Eternity. The policy of terror failed as it has always failed. During the last decade of the 18th century the annual depredations upon property lying in the Thames amounted to the value of more than half a million sterling, and the highways near London were so unsafe for mail coaches that the Government had a force of mounted patrols to escort the coaches to their destination.

Jeremy Bentham did not approach the problem from the humanitarian standpoint: there was no sentiment about his "Panopticon," which was a prison so planned as to give the maximum security against escape with the minimum of expenditure of staff. His plan was to educate, to classify and to provide for the discharged prisoner, but its main purpose was to prevent crime by discovering and removing its causes. He laid, in fact, the foundation of our modern system. Bentham lived before his time. He found few converts in the England of his day, which Lecky described as standing high in political, industrial and intellectual eminence, but "ranked in the treatment of crime and of prisoners shamefully below the average of the Continent."

John Howard was a reformer of a different mould. "He surveyed all Europe," said Burke, "not to view the sumptuousness of palaces, but to survey the mansions of sorrow and of pain; to collect the distresses of men in all countries. His plan was original and full of genius as of humanity: it was a voyage of discovery." Howard had himself been captured by a French privateer and interned in a dungeon at Brest where his experiences had sunk deep into his mind. His book, *The State of Prisons at Home and Abroad,* published at his own expense in a provincial town, awakened the public conscience to the scandal and disgrace of our penal system.

The criminal was gaining on the gallows and the population of Great Britain was then under nine millions. It was thus that transportation came into being. In the reign of Charles II. the moss-troopers of the Border had been transported to North America. In the Bloody Assize of 1685, Judge Jeffreys sentenced no less than 841 persons to slavery on the plantations. When the United States became independent, Australia and Bermuda provided a new outlet, but by 1852, Great Britain was compelled to "consume her own smoke."

Serious crimes may be the result of passion, impulse or premeditation; they may be committed to escape from threatened ruin, or crime may be deliberately adopted as a profession. Experience has shown that the professional criminal is morally far worse than the accidental, and that the murderer from passion is less dangerous to the community than the hardened thief. If all were detected and caught, there would be no professional criminals and it would not matter what punishments were awarded; the certainty of punishment would be an effective deterrent. It is indeed uncertain how far severity of punishment affects the statistics of crime. In the early 'sixties there was a sudden rise in the figures and this was ascribed to the leniency of prison treatment. This was tightened up and the figures fell, but it is far from certain that the one had anything to do with the other. The crime of garroting ten years later was said to have been put down by the award of corporal punishment for highway robbery, but this, too, may be doubted. What is certain at least is that delay in the execution of punishment—either through facilities for criminal appeals, or delays in adjudication—does foster lawlessness, and this mistaken form of humanitarianism is a by-product of civilization in some of our modern States.

Anomalies.—The history of the movement of crime discloses anomalies that are impossible to explain; the lines of particular offences do not follow gentle curves upward or downward, but are subject to sudden leaps with corresponding falls as the years go by. Probably the imitative instinct in criminals has much to do with these fluctuations; one sensational crime widely reported in the newspapers produces others of the same kind. How far the so-called "crook" films affect the problem is a matter of dispute: it is certain that since their exhibition in the Far East, young native criminals equipped with masks, safe-breaking implements and automatic pistols have come into being. But some of the fluctuations seem to defy explanation. During the last five years there has been a dramatic rise in homicides all over the Malay Peninsula, generally unconnected with dacoity or robbery, but rather as the result of sudden passion. After the Napoleonic wars there was a striking increase of crime in England and during the World War this was quoted to prepare the world for a similar phenomenon after the Peace; but there was no increase in crimes of violence; rather the contrary.

Many writers on crime have been betrayed into taking the prison statistics as a basis for their arguments, but these figures depend solely upon the efficiency of the police and the criminal courts. The only real material for comparison is the number of crimes reported to the police and figures of these are not accessible for comparison in all countries.

In Britain the apparent decrease of crime that followed the World War was due to causes independent of the moral well-being of the community. The Borstal system for the treatment of young offenders and the Probation Act had come into force a few years before the outbreak of war, and both have undoubtedly had some influence in reducing the volume of professional crime, though it is not to be supposed that the reduction in the daily average of persons undergoing imprisonment signifies that crime is progressively waning. The total daily average of the prison population in England and Wales has fallen by nearly half what it was in the last years before the World War, and 25 prisons have been closed. Since petty offences are often the product of want, the unemployment dole has no doubt had some influence on the figures. Nevertheless, a scrutiny of the criminal statistics of the last fifty years will show that there is a tide in crime, and that it is unwise to found arguments upon the level at low water. The tide is apt to turn as it did when it reached the high water mark of the first decade of the 20th century.

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CRIMEA (anc. Tauris or Tauric Chersonese), called by the Russians by the Tatar name *Krym* or *Crim,* an A.S.S.R. in the Russian republic, created by decree in Oct. 1921, forming a peninsula on the north side of the Black sea, with the mainland of which it is connected by the Isthmus of Perekop (3–4 mi. across). It extends for 200 mi. between 44° 23′ and 46° 10′ N., and 110 mi. between 32° 30′ and 36° 40′ E. Its area is 9,952 sq.mi. The population in 1939 was 1,126,824; urban, 585,701 and rural, 541,-123, mainly Russians and Crimean Tatars, the latter much modified by racial intermixture with Greek, Turkish and other elements.

Its coasts are washed by the Black sea, except on the north-east, where is the Sivash or Putrid sea, a shallow lagoon separated from the Sea of Azov by the Arabat spit of sand. The shores are broken on the west side of the Isthmus of Perekop by the Bay of Karkinit; on the south-west by the open Bay of Kalamita, on the shores of which the allies landed in 1854, with the ports of Eupatoria, Sevastopol and Balaklava; by the Bay of Arabat on the north side of the Isthmus of Yenikale or Kerch; and by the Bay of Kaffa or Feodosiya (Theodosia), with the port of that name, on the south side of the same. The south-east coast is flanked at a distance of 5 to 8m. from the sea by a parallel range of mountains, the Yaila-dagh or Alpine Meadow mountains, and these are backed, inland, by secondary parallel ranges; but 75% of the remaining area consists of high arid prairie lands, a southward continuation of the Pontic steppes, which slope gently north-westwards from the foot of the Yaila-dagh. The main range of these mountains shoots up abruptly from the deep floor of the Black sea to an altitude of 2,000 to 2,500ft., beginning at the south-west extremity of the peninsula, Cape Fiolente (anc. Parthenium), supposed to have been crowned by the temple of Artemis in which Iphigeneia officiated as priestess. On the higher parts of this range are numerous flat mountain pastures (Turk. *yailas*), which, except for their scantier vegetation, are analogous to the *almen* of the Swiss Alps, and are crossed by various passes (*bogaz*), of which only six are available as carriage roads. In this range are the peaks of Demir-kapu or Kemal-egherek (5,040ft.), Roman-kosh (5,060 ft.), Chatyr-dagh (5,000ft.), and Karabi-yaila (3,975ft.). The second parallel range, 1,500 to 1,900ft., forms steep crags to the south-east and a gentle slope towards the north-west. In the former slope are thousands of small caverns, probably inhabited in prehistoric times; and several rivers pierce the range in picturesque gorges. A valley, 10 to 12m. wide, separates this range from the main range, while another valley 2 to 3m. across separates it from the third parallel range, 500 to 850 feet. Evidences of a fourth and still lower ridge can be traced towards the south-west. Short streams, none of them anywhere navigable, form mountain cascades in spring, *e.g.,* the Chernaya, Belbek, Kacha and Alma, to the Black sea, and the Salghir, with its affluent, the Kara-su, to the Sivash lagoon.

Climate and Flora.—In climate and vegetation there exist marked differences between the open steppes and the south-eastern littoral, sheltered by the Yaila-dagh. The former, although grasses and Liliaceae grow on them in great variety and luxuriance in the early spring, become completely parched by July and August, when the air is filled with clouds of dust. High winds prevail, and snowstorms, hailstorms and frost. Parts of the steppes are impregnated with salt, or studded with saline lakes. Water is scarce, and mainly obtained by sinking artesian wells. *Kurgans* or burial-mounds of the ancient Scythians remain on the steppe. Behind the Yaila-dagh the narrow strip of coast and the slopes of the mountains are smothered with greenery. This Russian Riviera stretches all along the south-east coast from Cape Sarych (extreme south) to Feodosiya (Theodosia), and is studded with summer sea-bathing resorts—Alupka, Yalta, Gursuv, Alushta, Sudak, Theodosia. Numerous Tatar villages, mosques, monasteries, former palaces of the Russian imperial family and Russian nobles, now used as sanatoria and rest homes for workers from all parts of the U.S.S.R., and picturesque ruins of ancient Greek and mediaeval fortresses nestle amongst underwoods of hazel and other nuts, groves of bays, cypresses, mulberries, figs, olives and pomegranates, vineyards, tobacco plantations, and gardens gay with all sorts of flowers. The higher slopes of the mountains are thickly clothed with forests of oak, beech, elm, pines, firs and other Coniferae. In the south-east there have become acclimatized such plants as magnolias, oleanders, tulip trees, bignonias, myrtles, camellias, mimosas and many tender fruit-trees. The vineyards produce wine of a good quality and fruits grow in abundance, especially cherries, apples and pears. In some winters the mountains are covered with snow, but snow seldom falls to the south of them. The heat of summer is moderated by breezes off the sea, and the nights are cool and serene; the winters are mild and healthy. Fever and ague prevail in the lower-lying districts for a few weeks in autumn. Dense fogs occur sometimes in March, April and May, but seldom penetrate inland. The rainfall is everywhere scanty; it varies greatly, however, from year to year; *e.g.,* at Simferopol from 7·5 to 26·4in. per annum. Of the whole area, 35% is under cultivation, and 2% of this is garden, vineyard and tobacco cultivation. Winter wheat 49·1%, barley 31·9% and oats 13·6% are the chief crops. Of summer crops maize occupies the chief place, together with melons, cucumbers, flax and millet. The Yaila mountain area affords pasture for sheep and cattle.

Industries.—Iron is mined in the Kerch peninsula and exported to the Ukrainian factories and salt is exported especially from Lake Sakch near Eupatoria. Porphyry and limestone are also exported. Fish abound all around the coast, such as red and grey mullet, herring, mackerel, turbot, soles, plaice, whiting, bream, haddock, pilchard, a species of pike, whitebait, eels, salmon and sturgeon. Industries include shipbuilding, flour-mills, ironworks, jam and pickle factories, soap-works and tanneries. The Crimean Tatars are peasants noted for their leather, wool and metal work. A railway, coming from Kharkov, crosses the peninsula from north to south, terminating at Sevastopol and sending off branch lines to Theodosia, Kerch and Eupatoria. The chief towns are Simferopol, the capital, the important naval station and trading port of Sevastopol, the ports of Eupatoria, Theodosia, Kerch (*qq.v.*) and Yalta, a health resort on the south-east coast.

History.—The earliest inhabitants of whom we have any authentic records were the Celtic Cimmerians, who were expelled by the Scythians during the 7th century B.C. A remnant, who took refuge in the mountains, became known subsequently as the Tauri. In that same century Greek colonists began to settle on the coasts, *e.g.,* Dorians from Heraclea at Chersonesus, and Ionians from Miletus at Theodosia and Panticapaeum (also called Bosporus). Two centuries later (438 B.C.) the archon or ruler of the last-named assumed the title of king of Bosporus, a State which maintained close relations with Athens, supplying that city with wheat and other commodities. The last of these kings, Paerisades V., being hard pressed by the Scythians, put himself under the protection of Mithridates VI., king of Pontus, in 114 B.C. After the death of this latter sovereign his son Pharnaces, as a reward for assistance rendered to the Romans in their war against his father, was (63 B.C.) invested by Pompey with the kingdom of Bosporus. In 15 B.C. it was once more restored to the king of Pontus, but henceforward ranked as a tributary State of Rome. During the succeeding centuries the Crimea was overrun or occupied successively by the Goths (A.D. 250), the Huns (376), the

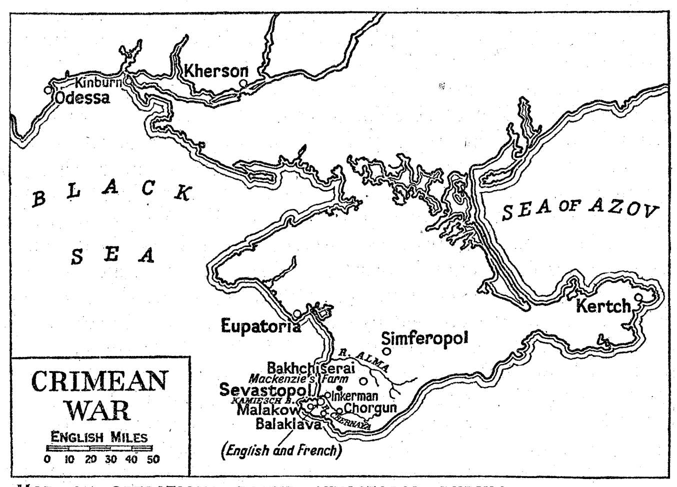
Khazars (8th century), the Byzantine Greeks (1016), the Kipchaks (1050), and the Mongols (1237). In the 13th century the Genoese destroyed or seized the settlements which their rivals the Venetians had made on the Crimean coasts, and established themselves at Eupatoria, Cembalo (Balaklava), Soldaia (Sudak) and Kaffa (Theodosia), flourishing trading towns, which existed down to the conquest of the peninsula by the Ottoman Turks in 1475. Meanwhile the Tatars had got a firm footing in the northern and central parts of the peninsula as early as the 13th century, and after the destruction of the Golden Horde by Tamerlane they founded an independent khanate under a descendant of Jenghiz Khan, who is known as Hadji Ghirai. He and his successors reigned first at Solkhat (Eski-krym), and from the beginning of the 15th century at Bakhchi-sarai. But from 1478 they ruled as tributary princes of the Ottoman empire down to 1777, when, having been defeated by Suvórov, they became dependent upon Russia, and finally in 1783 all of the Crimea was annexed to the Russian empire. The Crimean War of 1854–56 is treated under a separate article. At various times, *e.g.*, after the acquisition by Russia, after the Crimean War of 1854–56, and in the first years of the 20th century, Crimean Tatars emigrated in large numbers to the Ottoman empire. It was occupied by the Germans in 1941. (*See* BOSPORUS CIMMERIUS; RUSSIA: *Bibliography*.)

See Sir Evelyn Wood, *The Crimea in 1854 and 1894* (1895); E. H. Minns, *Scythians and Greeks* (1913); M. Roztovtzeff, *Iranians and Greeks in South Russia* (1922).

CRIMEAN WAR. The causes of the Crimean War, in which Great Britain and France, allies for the first time for two centuries, drifted into war with Russia, were involved if not obscure. Russia, to whom popular opinion of the times, in flat defiance of history, attributed a power in arms little short of invincibility, continued to pursue the policy of expansion towards Constantinople laid down for her in the legendary will of Peter the Great, and early in 1853 seized the opportunity of a petty religious quarrel about "a few Greek priests," to arrogate to herself the unofficial but lucrative rôle of protector of the Orthodox Christians *in partibus infidelium,* as a preliminary to an eventual reversion of the bulk of the estate of "the sick man," as her ruler, tsar Nicholas I., believed Turkey to be. This line of policy brought her in sharp opposition in the first place to England, who saw in a Russian occupation of Constantinople a potential threat to the overland route to India too formidable to be countered even by the possession of Egypt, which the tsar was ready to bestow on her as the reward of complicity. Nicholas, moreover, on the day when he preferred to address the newly-crowned emperor of France as a friend rather than as a brother, had raised up for himself another and more implacable enemy. Napoleon III. was too good a son of the Catholic Church to acquiesce in the Russian claims to special treatment for Orthodox Christianity in the Ottoman empire; too much a Bonaparte not to wish to revenge 1812 and the occupation of Paris; and too uncertain of his new throne not to welcome a successful war, that first and last thought of an insecure dynasty. The emperor of Austria too, who owed it to the tsar's military aid in 1849 that he still sat on the throne of his fathers, was so nervous of Russia's advance in the Balkans that he was prepared to astonish Europe by his ingratitude and take the side of France and Britain. Amid all these jealous and suspicious rivals Turkish diplomacy pursued a sure but tortuous course, in large measure directed from behind the scenes by the British ambassador, Stratford de Redcliffe, another man of whom the tsar had made a powerful personal enemy, and to a greater degree than any other individual the author of the Crimean War. A Russian ultimatum was delivered and politely rejected by the Turks. A European congress met and arrived at a solution of the problem which no one understood, and no one but the tsar accepted; and in July 1853 Russia mobilized and her armies occupied the portion of Turkey lying north of the Danube. A few weeks later a Russian fleet attacked and destroyed a Turkish squadron in the Black sea, despite the presence of French and British warships in the Bosporus. After this, war, though still long in coming, was inevitable; and by March 1854 France and Britain found themselves in alliance with each other against Russia.

In Jan. 1854, as soon as the Allies had decided that the Ottoman empire must be protected against the tsar, Sir John Burgoyne, an engineer officer, had been sent to elaborate a scheme for the defence of Constantinople, and gave it as his opinion that this could best be done by fortifying Gallipoli. Marshal Vaillant, the French minister of war, another engineer, concurred, and the Crimean War began ominously, as far as the Allies were concerned, as a defensive war. But in war one cannot defend unless one is attacked, and before the French and British expeditionary forces had completed their assembly at Varna on the western shore of the Black sea, it became clear that they would not be attacked; for Russia, in obedience to the ungrateful pressure of Austria, drew back her army from the captured trans-Danube provinces, thus leaving the Allies apparently no *casus belli.* But it is easier to let loose the dogs of war than to catch and kennel them again. The expeditionary forces could not be left at Varna, where there had broken out a severe cholera epidemic. Nor was either France or England prepared to bring home troops without something attempted, if not done; so there came up the question of the invasion of the Crimean peninsula, on the southern coast of which was situated Sevastopol, Russia's only naval base in the Black sea.

This distinctly formidable enterprise was certainly undertaken, like another and more formidable one, *à coeur léger.* Little was known of the country; as Prince Albert most sensibly put it, "the first difficulty is the absence of all information as to the Crimea itself." Even the more volatile French court realized this; the great Napoleon was consulted by means of a planchette; two sketches of Sevastopol and Balaklava by Raffet were carefully studied as the possible basis of a plan of campaign; and the great strategical authority, Jomini, was sought out in the *Café Anglais,* where, despite the cheerfulness of his surroundings, he could only prophesy disaster. The British cabinet however, observing from a cursory glance of the map that the Crimea was a peninsula, conceived that there could be nothing easier than for the British fleet to cut it off from the mainland by commanding the isthmus with its guns—nor could there have been but for the fact subsequently discovered, that the depth of the sea on either side of this isthmus was little more than two or three feet. The decisive despatch authorizing the attack on the Crimea, and impressing on its recipient the importance of selecting favourable weather, was sent by the British cabinet to Lord Raglan, the commander-in-chief, on June 29; Marshal St. Arnaud, his colleague, received the less precise but probably no less helpful instructions "to act as circumstances might require." On July 18, therefore, the allied generals and admirals held a council of war, at which the invasion of the Crimea was decided on.



MAP OF OPERATIONS ROUND SEVASTOPOL DURING CRIMEAN WAR, 1853–1856

The siege of Sevastopol ended in the Allies entering, on Sept. 9, 1855, a burning, empty city, in the defence of which the Russians had lost 102,670 men

The British commander, Lord Raglan, the Fitzroy Somerset of the Peninsular War, had seen no service since 1815, and had spent most of his time at the Horse Guards: a courtly and polished gentleman, his chief merit was that, despite his incurable habit throughout the campaign of referring to his enemy as "the French," he was admirably adapted to lessen the friction inevitable in coalition wars. His French colleague, St. Arnaud, had had a variegated career. He had distinguished himself in Algeria at the siege of Constantine, and had helped to engineer the *coup d'état* which placed Napoleon III. on the throne. At the opening of the campaign, however, he was already stricken with a mortal sickness. Omar Pasha, the Turkish commander, who had seen much service in the Near East, was the most experienced soldier of the three. The most remarkable thing about the British divisional generals was their age; all with the exception of the duke of Cambridge were approaching 70, and were of the stock and pipeclay school.

On Sept. 7 the combined forces embarked at Varna, 57,000 in all, the largest expedition that had ever set out for war overseas. The "Caradoc," having on board Raglan, Burgoyne and Brown, preceded the flotilla to look for a likely landing place and steamed so close to the Crimean coast that Russian officers could be seen looking at her through their telescopes, and "on perceiving this the English officers took off their hats and bowed." The Russian governor of Eupatoria, close to which the Allies decided to land, was equally punctilious; on receiving the formal summons to surrender, he first fumigated the document, then read it, and, realizing that he must yield to superior numbers, insisted that the British and French troops on landing must consider themselves in strict quarantine. The disembarkation took place unopposed, and without a hitch.

The English army at this time knew neither training nor manoeuvres outside the barrack square; the "picnics" in Surrey, as field days were then called, had taught it little or nothing. Its generals were, as Lord Wolseley said of those of Wellington's day, "mostly duffers" but the men were of that tough stolid stock whose "phlegm" throughout the Peninsula and at Waterloo had never admitted defeat. Whereas in England the army had been hidden away, in France it had been paraded; and French dash and English solidity made a formidable combination. The Russian army was ever behind the times. The regiment belonged to the colonel, not the colonel to the regiment; peculation and corruption were rife in all branches; and its tactics were still based on Suvorov's motto, "The bullet's a fool, the bayonet's a fine boy." The Russian soldier was armed with a smooth bore, while the Allies had the Minié rifle; and so indifferent a marksman was he that at the Alma the men in the rear rank fired over the heads of those in the front. His obstinate courage was, however, proverbial, and his priests with the ikons accompanied him on to the battlefield to encourage him to fight to the death.

The advance towards Sevastopol, about 30m. away, began on Sept. 19, the French on the right next to the sea, the British inland; the French complained—not for the first or the last time in history—of British slowness. Next day the battle of the Alma was fought. As no combined plan of attack on the Russian position behind the Alma river had been arranged beforehand, co-operation between the Allies was conspicuous by its absence, and they fought two actions side by side. An attempt to turn the left of the enemy line miscarried, so the battle degenerated into a purely frontal attack which was eventually successful in establishing itself on the Russian position. Generalship was equally absent on the side of the Russians where "no one received any orders and every man did what he thought best." The steady advance of the British up the slope across the river made an unforgettable impression on the French general, Canrobert; they went forward, he said, "as though they were in Hyde Park!" Some years later, at a Court ball in Paris given in honour of Queen Victoria and the Prince Consort, as he watched the careful precision with which Her Majesty went through the complicated manoeuvres of a quadrille, never faltering, never missing a step, memories of the Alma came back to him, and he cried "The British fight as Victoria dances."

The battle was an Allied victory, but as the French cavalry had not yet been landed and Raglan was resolved "to keep his in a band box," there was no pursuit. Two days were spent in burying the dead and evacuating the wounded to the fleet, as no provision for their care had been made. On the 23rd, the advance was resumed, and on the 25th the English, much to their astonishment, all but collided with a Russian column marching at right angles to their front. Menschikoff, the Russian commander believing that the Allies would attack Sevastopol from the north side, was moving the bulk of his army out of the fortress towards Bakshiserai, in order to keep open his communications with the mainland. The Allies had no maps of the Crimea, and those in possession of the Russians were so indifferent that one regiment, after marching steadily for the whole of the 20th, finally found itself back in front of Sevastopol. Todleben, Niel and Lord Wolseley have all argued that Sevastopol must have fallen an easy prey to an immediate Allied attack; Burgoyne and Hamley held the contrary opinion. The attempt was not made and the Allies marched solemnly round the fortress and sat down to besiege it in due form, so "playing," as Lord Wolseley said, "into the Russians' hands."

The British took the right or eastern flank of the line, as their fleet had already taken possession of the harbour of Balaklava, the only one on the south coast, believed fit for use as a base. How fateful and fatal was their choice the coming winter was to show. The French on the left established their base at Kamiesch. Scarcely had the armies got into position than St. Arnaud died, and the command passed to Canrobert, a soldier of high character and great personal charm, though to the English he "appeared with his gestures and grimaces like a play actor"; a more serious defect was that he always thought so much was to be said on both sides of any question that he could never make up his mind which side had most to be said for it.

The fortifications of Sevastopol had been rendered formidable by Todleben, the chief engineer in the fortress, and ships sunk by the Russians in the harbour mouth rendered it difficult for the fleet to co-operate in the attack. The Allied bombardment opened on Oct. 17, but no assault followed, and a week later the Russian field army made its first essay at relieving the fortress by a sudden attack on the British right and rear aimed at Balaklava. Their onset was checked by a brilliant charge of the Heavy Cavalry Brigade but unfortunately in the first stage of the action some Turkish batteries were overrun and captured, and Raglan, faithful as ever to the tradition of Wellington who "never lost a British gun," sent orders by an aide-de-camp, Nolan, to the Light Cavalry Brigade to retake them. Nolan, who was a cavalry fanatic, and firmly believed in the omnipotence of that arm on the battlefield, so fulfilled his mission as to launch the brigade in quite a different direction—straight at the Russian artillery in position. The charge took place, one of the most heroic and useless episodes in English military history; and the battle ended, on the whole to the advantage of the Russians, who had cut the only good road between the British and their base at Balaklava. A few days later, on Nov. 5, another vigorous blow fell, this time at the junction of the British siege corps and their covering army on Inkerman heights. Thick fog veiled the field, prevented either Russian or Allied commanders from exercising such talents for generalship as they possessed, and reduced the battle to a pounding match between the soldiery. The aid rendered by the French proved invaluable at the crisis. The Russian masses ebbed sullenly back, and the armies settled down to a winter of siege warfare.

The horror, misery and suffering of that winter are, as regards the British, too well known to need detailed description here; Russell and other "low and grovelling" war correspondents with the army told the terrible tale in full in their despatches, and if, as the soldiers said, the information they gave was as useful to the enemy as any that an army of spies could have furnished, they aroused people at home to a belated realization of the fatal consequences of sending out men to fight without taking forethought as to how they were to be fed, clothed, warmed and cared for. The French lost even more men from disease, but their more docile press was too effectively muzzled for any whisper of this fact to get out. The plight of the Russians was the worst of all; the sufferings of the garrison in Sevastopol and of the army in the field were terrible enough, but were as nothing to those of the unhappy recruits sent forward to the front from the interior; two out of every three of these last named perished by the wayside of sickness or starvation.

The British situation, which became serious immediately after the loss of their supply ships in the great storm on Nov. 14, was rendered acute by the loss of the paved road from Balaklava to the army; it was said that of the 3,000m. from Plymouth to the British camp it was these last six that offered almost insuperable difficulties. Before the end of the year there were 8,000 men sick, and less than half the army was fit for service; while the state of the hospitals was such as to increase rather than diminish the suffering of those who reached them and to tend to death rather than cure. It was not till the coming of Florence Nightingale—"the angel with the lamp"—that these hospitals attained some degree of efficiency, and it was not till the coming of spring, and with it ample supplies and necessaries from home, that the British force recovered something of its strength and again became fit for action. The construction of the "Balaklava tram" and a new paved road between the base and the army on the heights insured the latter against any repetition of the horrors of the winter months.

The spring, however, brought its own if rather different trials—if not to the armies, at least to their leaders—in the form of an electric cable which reduced the time of transit of correspondence between headquarters in the field and their respective capitals from ten days to 24 hours. The uses to which either nation put this new facility of intercommunication were significantly different; Napoleon III., for whom, as Prince Napoleon acutely remarked, military failure meant not, as in England, merely the doubtful drawback of a change of ministry, but the serious prospect of a change of dynasty, showered advice, instructions and suggestions upon his commander-in-chief; the British War Office on the other hand concerned itself more with enquiries as to the health of Capt. Jarvis, believed to have been bitten by a centipede, and a heated discussion as to whether beards were an aid to desertion. It was small wonder that Gen. Simpson, Raglan's successor, was kept at work answering correspondence from 4 A.M. to 6 P.M. daily, or that he expressed the view that the telegraph had "upset everything."

Meanwhile siege operations, which had continued spasmodically throughout the winter, were actively resumed with the coming of finer weather in April. Tsar Nicholas was dead, the disgraceful failure of a Russian attempt to retake Eupatoria had broken his heart, and the chill hand of "Gen. Février turned traitor" had stricken him into a welcome grave. His successor, however, was no less resolved to continue the struggle; and the attention of the Allied ministers and generals, which should have been concentrated on pushing forward with the siege, was now side-tracked into an attempt to thwart a sudden new plan, conceived by Napoleon III., for a campaign in the field against the main Russian host, to be undertaken by a new army under his personal command. This scheme met with universal discouragement and remonstrance, but it was late summer before its aggrieved author finally abandoned it. Meanwhile the Allied leaders had fallen out over a proposal for a joint expedition to Kertch, the Russian base in the eastern Crimea; Raglan desired it, Canrobert agreed to it, then, on remonstrance from Paris, thought better of it, and recalled his troops. Mutual recrimination ensued; Raglan declined to discuss any more subsidiary enterprises, and Canrobert wisely resigned the chief command and returned to the head of his own corps.

His successor, Pelissier, was a free-spoken, tough, resolute soldier who knew his own mind and feared nobody and nothing. At his suggestion it was agreed to send out another expedition to Kertch, which met with complete success, and also to attempt the assault of Sevastopol on the anniversary of Waterloo, which met with an equally complete failure. One result of this last event was a change in command both on the British and Russian side; Todleben, the soul of the defence, was severely wounded; Raglan, now a weary and disappointed man, fell sick and died, regretted by all who had known him. His chief of staff, Simpson, succeeded him; shortly after his accession to command the Russian field army made a last and unavailing attempt to break the investing ring at the Tchernaya—a battle most noteworthy as giving Piedmont, who had joined in on the Allied side chiefly because her prime minister, Cavour, saw in it a means of publicity for a new power, an opportunity for achieving her war aims. Meanwhile Pelissier was growing weary of being the recipient of incessant strategical disquisitions from Paris, and became more and more curt with his self-constituted counsellors, the emperor and Marshal Vaillant, as also with Niel who, as a *missus dominicus* of Napoleon, had been sent to the Crimea to keep him in leading strings. In the end he sought, but was refused, permission to resign the command, which he stated to be "impossible to carry on at the paralysing end of an electric cable." Eventually the atmosphere was cleared, thanks to the good sense of Vaillant, who first held up and afterwards secured the withdrawal of a somewhat intemperate letter of censure from the emperor, and Pelissier was let go his own way. On Sept. 8 a final assault on Sevastopol was delivered; the English attack on the Redan failed, but the French, assaulting at the hour of relief of the trench garrison, established themselves in the Malakoff. The fate of Sevastopol was sealed, and the Russians withdrew from their works to the north side of the harbour; none thought of pursuing them, and when Simpson, in explanation of this inaction, declared that he must wait to know the Russian plans, Queen Victoria wrote that she "was tempted to advise a reference to St. Petersburg for them." Simpson resigned, and Codrington, though junior to Colin Campbell, took his place; but there was little more fighting to be done. The capture of Kinburn finally convinced Russia of the hopelessness of continuing the struggle; Napoleon had grown weary of the war; and though Britain, smarting under the memory of her inglorious share in the final assault on Sevastopol, would willingly have continued the campaign, she was not prepared to do so alone. The war therefore faded gradually into peace, and the Treaty of Paris, signed in Feb. 1856, had as sole tangible result the exclusion of Russian warships from the Black sea—and even this endured only for 15 years.

As far as concerns the military art, the Crimean War is usually regarded as worthy of remembrance only as perhaps the most ill-managed campaign in English history, and a standing example of the difficulties and dangers of a coalition war. Yet from a broad point of view it may well be regarded as a highly creditable feat of arms on the part of the Allies. An expeditionary force of never more than 200,000 men, composed of troops of different nationalities and under divided and incompetent leadership, was yet able to set foot on the territory of an enemy immeasurably superior in every resource of war; to rend from his grasp a strong fortress, the possession of which was vital to the pursuit of his chosen policy; and to inflict on him during the struggle losses amounting to more than double its own strength. History affords no more striking demonstration of the range and potency of armies based on sea power—a demonstration which for Great Britain at least must always hold a lesson of permanent value. (F. J. Hu.; E. W. S.)

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CRIMINAL APPEAL, COURT OF. In discussing the question of appeals in criminal cases in England and Wales, it is convenient to consider (1) the position before the Criminal Appeal Act 1907, (2) the terms of the act, (3) the experience gained by working the act.

As to (1) the position before the Criminal Appeal Act 1907, for many years the question of criminal appeal in general had been a matter of great controversy. As early as 1844 a bill had been unsuccessfully introduced for the purpose of establishing appeal in criminal cases, and from that time up to 1906 nearly 30 bills were brought forward with the same object, but none succeeded in passing. In 1892 the question was referred to the Council of Judges and favourably reported upon by them. It may be remarked that England was practically the only civilized country in which there was no appeal in criminal cases. It is true there was an appeal on questions of law arising at the trial (*see* APPEAL), a development undoubtedly hastened by the report in the case of Adolph Beck (1904) showing clearly that the Home Office was not a satisfactory tribunal of final appeal. In 1906 the lord chancellor (Lord Loreburn) introduced another Criminal Appeal bill which passed the House of Lords, but was dropped in the House of Commons after a first reading. The next year the act (Criminal Appeal Act 1907) which was ultimately carried was introduced into the House of Commons.

The Criminal Appeal Act 1907.—As to (2) the terms of the Criminal Appeal Act 1907, by s. 1 of the act the court of criminal appeal was constituted and consisted of the lord chief justice of England and eight judges of the king's bench division of the High Court of Justice. By a short amending act, the Criminal Appeal Amendment Act 1908, it was enacted that all the judges of the king's bench division should be judges of the court. The lord chief justice of England, or in his absence the senior member of the court, acts as president. In practice the lord chief justice has almost invariably presided. By s. 3 a person convicted on indictment may appeal under the act to the court (*a*) against his conviction on any ground of appeal which involves a question of law alone, and (*b*) with leave of the court (a single judge may give leave to appeal, s. 17) or upon the certificate of the judge who tried him that it is a fit case for appeal, on any ground of appeal which involves a question of fact alone, or a question of mixed law and fact, or any other ground which appears to the court to be a sufficient ground of appeal, and (*c*) with the leave of the court against the sentence passed on his conviction unless the sentence is one fixed by law. By the Prevention of Crime Act 1908 a person sentenced to preventive detention may appeal against sentence without the leave of the court of criminal appeal. By the Criminal Justice Administration Act, 1914, one sentenced by a court of quarter sessions to detention in a Borstal institution may appeal against the sentence of the court of criminal appeal as if he had been convicted on indictment, and under the Children Act 1908 a parent or guardian may appeal against an order under s. 99 (6), if made by a court of assize or court of quarter sessions. Finally a person convicted at a petty sessional court and subsequently sentenced as an incorrigible rogue under the Vagrancy Act 1824 may appeal with leave against his sentence. There is no appeal by way of bills of exception which are commonly used in criminal cases in the United States or by writ of error, nor is it possible for a new trial to be granted in a criminal case (s. 20 [1]), but where the court comes to the conclusion that a trial has been a nullity, it has power to order that the appellant shall take his trial on the indictment in respect of which the appeal was brought.

The present modes of appeal are (1) under the Crown Case Act 1848 by cases stated by the judge on a question of law arising on the trial, (2) under the Criminal Appeal Act 1907, (3) under the case of indictments of common law for obstruction or non-repair of a highway, the appeal is to the Civil Court of Appeal (s. 20 [3]).

A person who wishes to appeal must apply to the court within ten days of the conviction or sentence, but the court has power in all cases to extend that time except in convictions involving sentence of death (s. 7). The act does not extend to Scotland or Ireland (s. 23), nor does it apply to convictions on indictment, or inquisitions of any peer or peeress convicted of an offence not triable by a court of assize (s. 20 [2]). Nothing in the act affects the prerogative of mercy (s. 19).

In practice application for leave to appeal are dealt with by a single judge from whose decision there is an appeal to the full court. An appellant is entitled to be present, if he desire, at the hearing of his appeal, unless the question of the appeal is one of law only. He has no right to be present at an application for leave to appeal. The court has power to allow witnesses to be called, a power which is, however, seldom exercised, and by an important proviso to s. 4 the court may, notwithstanding that they are of opinion that the point raised in the appeal might be decided in favour of the appellant, dismiss the appeal if they consider that no substantial miscarriage of justice has actually occurred. This proviso has often been acted upon.

On an appeal against sentence the court has power to quash the sentence passed at the trial and pass such other sentence as is warranted in law by the verdict, whether more or less severe (s. 4 [3]). This is a power which is seldom exercised and never without warning to the appellant that the court has the power. It is one of the few checks upon frivolous appeals.

The Court has power to release an appellant on bail pending the determination of his appeal (s. 14 [2]). While waiting in prison pending a determination of his appeal, the appellant is specially treated as an appellant, but if his appeal is unsuccessful, such time of waiting is not counted as part of his sentence, unless leave to appeal has been given, or the court otherwise directs. This is another check on frivolous appeals, the result being that in most cases the appellant is kept in custody for about four or five weeks longer than he would have been had he not appealed or applied for leave to appeal.

Shorthand notes are taken of the proceedings at the trial of any person on indictment who if convicted is entitled or may be authorized to appeal, and copies are made in the event of application for leave to appeal or an appeal. The cost of such shorthand notes is defrayed out of moneys provided by parliament (s. 16).

The court must consist of not less than three judges, of whom, as above pointed out, the chief justice is almost invariably one (s. 1). In some 30 or 40 cases the court has been constituted with more than three judges, and in one case the court consisted of 13 judges. In almost every case one judgment alone is pronounced, but where the question is a question of law, separate judgments may be pronounced if in the opinion of the court such a course would be convenient (s. 1 [5]).

If in any case the director of public prosecutions or the prosecutor or defendant obtain the certificate of the attorney-general that the decision of the court of criminal appeal involves a point of law of exceptional public importance and that it is desirable in the public interest that a further appeal should be brought, he may appeal from that decision to the House of Lords (s. 1 [6]). Otherwise the determination of the court of criminal appeal is final. There have been a few appeals to the House of Lords. For further details reference should be made to the act.

Working of the Act.—As to (3) the experience gained by the working of the act, the court sat for the first occasion on May 15, 1908, so there has been about 20 years' experience. The space at the disposal of the writer forbids full details, but it may be stated that just about 7% of the total number of convicted persons have appealed. The highest number of appellants was in 1910, when there were 712, the lowest number in 1919, when there were 355. Out of the 712 appeals in 1910, convictions were quashed in 39 cases and sentences reduced in 42. Out of the 355 appeals in 1919, convictions were quashed in 17 and sentences reduced in 17 cases. One other figure may be given. In 1926 there were 425 appeals, with 23 convictions quashed and 27 sentences reduced. It should be mentioned that many cases never reached the full court at all, as appellants have an absolute right to abandon their appeals or applications and sometimes do so. For example, in 1926 101 appellants abandoned their appeals or applications, 57 before their cases had been considered at all, and 54 after the single judge had refused leave to appeal. The court has sat on an average 39 days a year in recent years. In 1925 it sat 42 days, in 1926 it sat 35 days and there is always a sitting of the court during the long vacation. The average time that elapses from the receipt of the notice of appeal or application for leave to appeal till the same is finally determined by the court is from four to five weeks, a short time when it is remembered that it is necessary to get copies of the shorthand notes made and the case prepared for the court. The expenses of the court, paid out of money provided by parliament, were for the year ending April 1924 £11,730, for the year ending April 1925 £11,929, for the year ending April 1926, £12,963. These payments do not include any part of the salaries of the judges, nor the salary of the registrar, who as such receives no salary.

It is thought that the court has amply justified its existence. It has improved the administration of the criminal law and established more uniformity and certainty in its practice and procedure. No attempt has been made to standardize sentences, nor is it considered that such a course would be desirable. The prevalence of crime in a particular district or at a particular time may call for an increase in the severity of sentences. On the other hand temptation and provocation may mitigate punishment in particular cases. Whether it is the creation of the criminal court of appeal, or a growing recognition of a more humane treatment of those convicted for crime, it is certain that the sentences imposed to-day are less severe than the sentences imposed a generation ago.

By the Criminal Appeal Scotland Act 1926 a court of criminal appeal on similar lines to the English court was constituted for Scotland with an interesting provision in s. 2 (3) which provides that on an appeal, not only against sentence, but against conviction, the court may quash the sentence passed at a trial and substitute another sentence whether more or less severe. This is a power that the English court does not possess, but it is certainly a useful power as it tends to prevent frivolous appeals.

There have been persons who held the opinion that not only a convicted person should be entitled to appeal to the Crown, but that the prosecutor should be entitled to appeal where the prisoner has been acquitted, and in the early days of the court expressions may be found in some of the judgments favouring such a course. Those expressions have not been made in recent years and the general opinion is that it is not desirable that the court should have a power to order a new trial in cases where the person charged has been found not guilty. Lord Hewart, lord chief justice of England, when visiting Canada and the United States in 1927, gave a lucid and interesting exposition of the history and principles of the act.

See H. Cohen, *The Criminal Appeal Act 1907* (1908); R. E. Ross, *The Court of Criminal Appeal* (1911); W. O. Russell, *A Treatise on Crimes and Misdemeanours* (8th ed., 1923) vol. ii., p. 1840; J. F. Archbold, *Pleading, Evidence and Practice in Criminal Cases* (27th ed., by R. E. Ross, 1927), p. 307. (J. Sa.)

CRIMINAL LAW. By criminal, or penal, law is now understood the law as to the definition, trial and punishment of crimes, *i.e.,* of acts or omissions forbidden by law which affect injuriously public rights, or constitute a breach of duties due to the whole community. The sovereign is taken to be the person injured by the crime, as he represents the whole community, and prosecutions are in his name. Criminal law includes the rules as to the prevention, the investigation, prosecution and punishment of crime (*q.v.*). It lays down what constitutes a criminal offence, what proof is necessary to establish the fact of a criminal offence and the culpability of the offender, what excuse or justification for the act or omission can be legally admitted, what procedure should be followed in a criminal court, what degrees and kinds of punishment should be imposed for the various offences which come up for trial. Finally, it regulates the constitution of the tribunals established for the trial of offences according to the gravity of the infraction of law, and deals with the organization of the police and the proper management of prisons, and the maintenance of prison discipline. (*See* Evidence; Prison; Police.)

Many acts or omissions, which are technically criminal and classified as offences and punished by fine or imprisonment, cannot be said to have a strictly criminal character, since they do not fall within the popular conception of crime. To this class belong such matters as stopping up a highway under claim of right, or failing to repair it, or allowing a chimney to emit black smoke in excessive quantities, or to catch fire from being unswept, or breach of building by-laws, or driving a motor car on a highway at a speed in excess of the legal limit. Such breaches of law are, under the French law, described as *contraventions.* In England most of them are described as misdemeanours or offences punishable on summary conviction, or less happily as "summary offences," and some writers speak of them as *mala prohibita* as distinguished from *mala in se, i.e.,* as not involving any breach of ordinary morality other than a breach of positive regulations. Continental jurists at times speak of crimes *de droit commun* (*i.e.,* offences common to all systems of law as distinguished from offences which are crimes only by a particular municipal law). To this class of crimes *de droit commun* belong most of the offences included in extradition treaties.

Criminal and civil law overlap, and many acts or omissions are not only "wrongs" for which the person injured is entitled to recover compensation for his own personal injury or damage, but also "offences" for which the offender may be prosecuted and punished in the interest of the State. In non-English European systems care is taken to prevent civil remedies from being extinguished by punishment: it is quite usual for the civil and criminal remedies to be pursued concurrently, the individual appearing as *partie civile* and receiving an award of compensation by the judgment which determines the punishment to be inflicted for the offence against the State. Under English common law civil and criminal remedies cannot be pursued in the same proceeding, or compensation awarded to the injured party in criminal proceedings, and he is left to seek his remedy by action. But there are statutory exceptions, and among these are the restitution of stolen goods on conviction of the thief if the prosecution has been at the instance of the owner of the goods (Larceny Act, 1916, sec. 45), and the award of compensation to persons who have suffered injury to property by felony (Forfeiture Act, 1870).

As Sir Henry Maine says: "All civilized systems of law agree in drawing a distinction between offences against the State or community (crimes or *crimina*) and offences against the individual (wrongs, *torts* or *delicta*)." But the process of historical development by which this distinction has been ultimately established has given great occasion for study of early laws and institutions by eminent men, whose researches have disclosed the extremely gradual evolution of the modern notion of criminal law enforced by the State from the primitive conceptions and customs of barbarous or semi-civilized communities. Of the oldest codes or digests of customs which are available to the student it has been said the more archaic a code the fuller and minuter is its penal legislation: but this penal legislation is not true criminal law; it is the law, not of crimes, but of wrongs. The intervention of the community or tribe is in the first instance to persuade or compel the wronged person or his family or tribe to abandon private vengeance or a blood feud and to accept compensation for the wrong collectively or individually sustained; and in the tariffs of compensation preserved in early laws the importance of the injured person was the measure of the compensation or vengeance which he was recognized to be entitled to exact, and the scales of punishment or compensation are fixed from this point of view.

Anglo-Saxon Law.—In England under Alfred some part of the Levitical law (Exod., xxi. 12–15) was incorporated, just as in 1567 the criminal law as to incest in Scotland was taken bodily from Leviticus, xviii. The stage which the development of criminal law had reached in England by the reign of Edward the Confessor is thus described by Pollock and Maitland (*Hist. Eng. Law*): "On the eve of the Norman Conquest what we may call the criminal law of England (but it was also the law of torts or civil wrongs) contained four elements which deserve attention: its past history had in the main consisted of the varying relations between them. We have to speak of outlawry, of the blood feud (*faidus*), of the tariffs of *wer* and *wite* (*fredus* or *friede*), and *bot,* of punishment in life and limb. As regards the malefactor the community may assume one of four attitudes: it may make war on him; it may have him exposed to the vengeance of those whom he has wronged; it may suffer him to make atonement; it may inflict on him a determinate punishment, death, mutilation or the like." The *wite* or sum paid to the king or lord is now thought to have been originally not a penalty but a fee for time and trouble taken in hearing and determining a controversy. But at an early stage fines for breach of peace were imposed. An evil result from the public point of view followed from the system of atoning for crime by pecuniary mulct. "Criminal jurisdiction became a source of revenue." So early as Canute's time certain crimes were pleas of the Crown; but grants of criminal jurisdiction, with the attendant forfeitures, were freely made to prelates, towns and lords of manors, and some traces of this jurisdiction still survive (*e.g.*, the criminal jurisdiction of the justices of the *soke* [*soc*] of Peterborough, and the rights of some boroughs, *e.g.*, Nottingham, to forfeitures). Outlawry soon ceased to be a mode of punishment, and became, as it still is, a process to compel submission to justice (Crown Office Rules, 1906, rules 88–110). Certain crimes, such as murder, rape, arson and burglary, became unamendable or bootless, *i.e.*, placed the offender's life, limb, lands and goods at the king's mercy. These crimes came to be generally described by the name felony (*q.v.*). Other crimes became punishable by fines which took the place of *wites*. These were styled trespasses and correspond to what is now called misdemeanour (*q.v.*).

Anglo-Norman Period.—Minor acts of violence, dishonesty or nuisance, were dealt with in seigniorial and borough courts by presentment of the jurors of courts baron and courts leet, and punished by fine or in some cases by pillory, tumbril or stocks. Grave acts were dealt with by the sheriff as breaches of the peace. He sat with the freeholders in the county court, which sat twice a year, or in the hundred court, which sat every four weeks. So far as this involved dealing with pleas of the Crown the sheriff's jurisdiction was abolished and was ultimately replaced by that of the justices or conservators of the peace. The sheriff then ceased to be a judge in criminal cases, but remained and still is in law responsible for the peace of his county, and is the officer for the execution of the law. The royal control over crime was effectually established by the itinerant justices sent regularly throughout the realm, who not only dealt with the ordinary proprietary and fiscal rights of the Crown but also with the graver crimes (treason and felony), and ultimately were commissioned to deal with the less grave offences now classed as indictable misdemeanours. The change resulted from the strengthening of royal authority throughout England, which enabled the Crown gradually to enlarge the pleas of the Crown and to weaken and finally to supersede the criminal jurisdiction, notably of the sheriff, but also of prelates and lords in ecclesiastical and other manors and franchises. "In the early English laws and constitution there existed a national sovereignty and original criminal jurisdiction, but the ideas of legislative power and crime were very slowly developed." During the 12th century the criminal law was affected by the influence of the Church, which introduced into it elements from the Canon and Mosaic laws, and also by the memory of the Roman empire and the renewed study of the Roman law, which enabled lawyers to draw a clearer distinction than had before been recognized between the criminal (*dolus*) and civil (*culpa*) aspect of wrongful acts. The Statute of Treasons (1351) is to a large extent an admixture of Roman with feudal law; and to the same source is probably due the more careful analysis of the mental elements necessary to create criminal responsibility, summed up in the somewhat misleading expression *nemo reus est nisi mens sit rea*.

In the 14th century justices of the peace and quarter sessions were established to deal with offences not sufficiently important for the king's judges, and from that time the course of criminal justice in England has run substantially on the same lines, with the single and temporary interruption caused by the court of Star Chamber.

Classification of Crimes.—The penal laws of modern States classify crimes somewhat differently, but in the main on the same general principles, dividing them into: (1) Offences against the external and internal order and security of the State; (2) Offences against the administration of justice and against public authority; (3) Acts injurious to the public in general; (4) Offences against the person; (5) Offences against property.

The terminology by which crimes are described by reference to their comparative gravity varies considerably. In many Continental codes distinctions are drawn between crimes (Ger. *Verbrechen;* Norse *vorbrydelser;* Span. *crimenes;* Ital. *reato*), delicts (Ger. *Vergehen;* Ital. *delitti;* Span. *delitos*), and contraventions (Ital. *contravenzioni;* Span. *faltas*).

The classification adopted by English law is peculiar to itself, "treason," "felony" and "misdemeanour," with a tentative fourth class described as "summary offences." The particular distinctions between these three classes are dealt with under the titles TREASON; FELONY; MISDEMEANOUR, etc. Here it is enough to say that the distinction is a result of history, and that felonies were those crimes that formerly involved capital punishment, and until 1870 forfeiture of the offender's property. Treason and most felonies and some misdemeanours would under foreign codes fall under the head of crime. Misdemeanour, roughly but not exactly, corresponds to the French *délit,* and summary offence to *contravention.*

Elements of Criminal Responsibility.—In all systems of criminal law it is found necessary to determine the criterion of criminal responsibility, the mental elements of crime, the degrees of criminality and the point at which the line is to be drawn between intention and commission.

The full definition of every crime contains expressly or by implication a proposition as to a state of mind, and in all systems of criminal law, competent age, sanity and some degree of freedom from coercion, are assumed to be essential to criminality; and it is also generally recognized that an act does not fall within the sanction of the criminal law if done by pure accident or in an honest and reasonable belief in circumstances which if true would make it innocent; *e.g.*, when a married person marries again in the honest and reasonable but mistaken belief that the former spouse is dead. Honest and reasonable mistake of fact stands on the same footing as absence of the reasoning faculty, of which *Reg.* v. *Tolson* (16 Cox. C.C. 629) is a good example, as in infants, or perversion of that faculty, as in lunatics. But ignorance of law does not excuse.

Besides the elements essential to constitute crime generally, particular mental elements, which may differ widely, are involved in the definition of particular crimes; and in the case of statutory offences adequately and carefully defined, the mental elements necessary to constitute the crime may be limited by the definition so as to make the prohibition of the law against a particular act absolute for all persons who are not infants or lunatics. As a general rule of English law, it is enough to prove that the acts alleged to constitute a crime were done by the accused, and to leave him to rebut the presumption that he intended the natural consequences of the acts by showing facts justifying or excusing him or otherwise making him not liable. Children are conclusively presumed to be incapable of crime up to seven years of age; and from seven to 14 the presumption is against the capacity, but is not absolute.

Under the common law, insanity was an absolute answer to an accusation of crime. As to insanity the rule applicable is to be found in *McNaghten's Case* (10 Cl. and F. 200), decided in 1843, where it was laid down that to establish a defence on the ground of insanity it must be proved that at the time of committing the offence the accused was labouring under such a defect of reason as not to know the nature and quality of the act he was doing, or, if he did know it, he did not know that what he was doing was wrong. It is true that the rules in *McNaghten's Case* have been much criticized by writers, but they have been accepted and acted upon by the courts down to the present time. Since 1883, where insanity is proved to have existed at the date of the commission of the incriminated acts, the accused is found guilty of the acts but insane when he did them, and is relegated to a criminal lunatic asylum. Insanity produced by drunkenness would be a defence to crime, but that may be considered the limit to drunkenness as an excuse for crime, save when a specific intent is necessary to constitute a crime. But the mere fact that the mind is so affected by drink that violent passions are not controlled affords no defence, and it was so held by the House of Lords, in 1920, reversing the Court of Criminal Appeal in *Beard's Case* (26 Cox. C.C. 573) where the accused, under the influence of drink, in the course of committing an act of rape suffocated his victim.

Physical compulsion or coercion is an excuse for crime, but not where the force is moral such as threats or duress. There was also at common law a presumption that a married woman committing certain crimes in the presence of her husband did so under his coercion. But this presumption was abolished by the Criminal Justice Act, 1925, and coercion made a matter of proof. Speaking generally, the attitude of English law towards criminal responsibility is to be found in the maxim *actus non facit reum nisi mens sit rea*. But to this there are certain well-defined exceptions. By a particular statute the *necessity* for intent or knowledge may be negatived, such as in the case of breaches of the licensing law and the law as to the adulteration of food. Again, as we have said, ignorance of the law is no excuse, so *a bonâ fide* belief that the accused has been divorced, where only a decree *nisi* has been pronounced, is no defence to a charge of bigamy (*Rex* v. *Wheat*, 26 Cox. C.C. 717).

Distinctions are also drawn between degrees of guilt or complicity.

English criminal law punishes attempts to commit crime if the attempt passes from the stage of resolution or intention to the stage of action, when the completion of the full offence is frustrated by something other than the will of the accused. Except in the case of attempt to commit murder, which is a felony, attempts to commit a crime are punished as misdemeanours. It also punishes the solicitation or incitement of others to commit crime, as a separate offence if the incitement fails, as the offence of being accessory before the fact or abettor if the offence is committed as a result of the incitement; and it punishes persons who, after a more serious crime—felony—has been committed, do any act to shield the offender from justice. In the case of the crimes described as felonies the law distinguishes between principals in the first or second degree and accessories before or after the fact. In the case of misdemeanours the same punishment is incurred by the principal offenders, and by persons who are present aiding and abetting the commission of the offence, or who, though not present, counselled or procured the commission of the offence. (*See* ACCESSORY.) Besides these degrees of crime there is one almost peculiar to English law known as conspiracy, *i.e.*, an agreement to commit crime or to do illegal acts (including interference with the due course of justice), which is punishable even if the conspiracy does not get beyond the stage of agreement. (*See* CONSPIRACY.)

The English law does not, but most European laws do, allow the jury to reduce the penalty of an offence by finding in their verdict that the commission of the offence was attended by extenuating circumstances; but when the jury recommend to mercy a person whom they find guilty the judge may give effect to the recommendation or report it to the Home Office.

In systems of criminal law derived from England the forms of crime or degrees of complicity above stated reappear with or without modification, but as to conspiracy with a good deal of alteration. In the Indian penal code, for instance, conspiracy is limited to cases of treason (sec. 121 A), and when it goes beyond agreement in the case of other offences it is merely a form of abetment or participation (sec. 107).

The criminal law of England is not codified, but is composed of a large number of enactments resting on a basis of common law. A very large part is reduced to writing in statutes. In 1861 various consolidation acts were passed dealing with larceny, malicious damage, forgery, coinage offences, and offences against the person. And of recent years, still further progress has been made in dealing with the law relating to particular subjects in one consolidating statute, examples of which are the Children Act, 1908, the Perjury Act, 1911, the Forgery Act, 1913, the Indictment Act, 1915, and the Larceny Act, 1916. The unwritten portion of the law includes (1) principles relating to the excuse or justification of acts or omissions which are *prima facie* criminal, (2) parts of the law relating to procedure. The law is very rich in principles and rules embodied in judicial decisions and is extremely detailed and explicit. So far as the legislature is concerned there is an absence of systematic arrangement. The definitions of many crimes are still to be sought in the common law and the decisions of the judges. Thus the crime of murder, as settled by the existing law, would include offences of such very different moral gravity as killing a man deliberately for the sake of robbing him, and killing a man accidentally in an attempt to rob him. On the other hand, offences which ought to have been criminal were constantly declared by the judges not to fall within the definition of the particular crimes alleged, and the legislature has constantly had to fill up the *lacunae* in the law as interpreted by the judges.

Jurisdiction.—The jurisdiction to deal with crime is primarily territorial, and can be exercised only as to acts done within the territory or territorial waters, or on the ships of the law-giver. *Extra territorium jus dicenti impune non paretur.* No State will enforce the penal laws of another nor permit the officer of another State to execute its laws outside its own territory. But international law recognizes the competence of a State to make its criminal law binding on its own subjects wherever they are, and perhaps even to punish foreigners who outside its territory do acts which menace its internal or external security, *e.g.*, by dynamite plots or falsification of coin. Apart from extradition arrangements the national law cannot reach such persons, be they citizens or aliens, until they come within the territory of the State whose law has been broken.

The codes of France, Germany and Italy make the penal law national or personal and not territorial. In some British colonies whose legislatures have a derived and limited legislative authority, indirect methods have been taken to deal within the colony with persons who commit offences outside its territory.

Throughout the development of the English criminal law it showed one particular characteristic that crime was treated as local, which means not merely that the common law of England was limited to English soil, but that an offence on English soil could be "enquired of, dealt with, tried, determined and punished" only in the particular territorial division of England in which it was committed, which was and is known as the *venue* (*q.v.*). But from time to time exceptions have been made by statute, and now by the Criminal Justice Act, 1925, a prisoner can be tried where he was apprehended, and there are wide powers under that statute to commit for trial to "convenient" assizes or sessions if the accused will suffer no hardship. Each township was responsible for crimes within its boundaries, a responsibility made effective by the "view of frankpledge," now obsolete, and the guilt or innocence of every man had to be determined by his neighbours. This rule excluded from trial by the courts of common law, treasons, etc., committed by Englishmen abroad and piracy; and it was not till Henry VIII.'s reign (1536–1544) that the common-law mode of trial was extended to these offences. The legislature has altered the common law as to numerous offences, but on no settled plan, and except for a bill introduced about 1888, at the instance of the 3rd marquess of Salisbury, no attempt has been made to make the English criminal law apply generally to subjects when outside the realm; and in view of the complicated nature of the British empire and the absence of a common criminal code it has been found desirable to remain content with extradition in the case of crimes abroad, and with the provisions of the Fugitive Offenders Act, 1881, in the case of criminals who flee from one part to another of the empire.

The localization in England of crime, and the procedure for punishing it, differ largely from the view taken in France and most European countries. The French theory is that a Frenchman owes allegiance to the French State, and commits a breach of that allegiance whenever he commits a crime against French law, even although he is not at the time within French territory. In modern days this theory has been extended so as to allow French and German courts to punish their subjects for crimes committed in foreign countries, and by reason of this power certain countries refuse to extradite their subjects who have committed crimes in other States.

The principle of the French law, though not expressly recognized in England, must be invoked to justify two departures from the English principle—(1) as regards offences on the high seas, and (2) as regards certain offences committed outside Great

Britain. In early days offences committed by Englishmen on the high seas were punished by the lord high admiral, and he encroached so much on the ordinary courts as to render it necessary to pass an act in Richard II.'s reign (15 Rich. II. st. 2, c. 3) to restrain him.

In the time of Henry VIII. (1536, 28 Hen. VIII. c. 15) an act was passed stating that, as the admiral tried persons according to the course of civil law, they could not be convicted unless either they confessed or they or the witnesses were submitted to torture, and that therefore it was expedient to try the offences according to the course of the common law. Under that act a special commission of oyer and terminer was issued to try these offences at the Old Bailey, and English law was satisfied by permitting the indictment to state that the offence was committed on board a ship on the high seas, to wit in the county of Middlesex. Further provision was made by the Admiralty Offences Act, 1844, and in 1861 each of the Criminal Law Consolidation Acts of that year provided that all offences in those statutes mentioned committed on the high seas may be tried as if they had been committed in England. As regards offences on land, it was found necessary as early as the reign of Henry VIII. (1543) to provide for the trial in England of treasons and murders committed on land outside England. This was largely due to the constant presence in France of the king and many of his nobles and knights, and the aid of this statute was invoked in 1903 in the case of Lynch, tried for treason in South Africa, and in the case of Casement in 1917. By sec. 9 of the Offences against the Person Act, 1861, any murder or manslaughter committed on land out of Great Britain, whether within the king's dominions or without, and whether the person killed were a subject of His Majesty or not, may be dealt with in all respects as if it were committed in England. The jurisdiction has been extended to other cases such as slave trade, bigamy, perjury committed with reference to proceedings in an English court, and offences against the Foreign Enlistment Act, 1870, and the Official Secrets Acts, 1911 and 1920. But these offences must be committed on land and not on board a foreign ship, because if a man takes service on board a foreign ship he is treated for the time as being a member of the foreign State to which that ship belongs. The principle has been also extended to misdemeanours committed in India, and oppressions, crimes and offences committed by public officers out of Great Britain, whether within or without the British dominions. Thus a governor or an inferior officer of a colony, if appointed by the British Government, may be prosecuted for any misdemeanour committed by him by virtue of his office in the colony; and cases have occurred where governors have been so prosecuted, such as that of Gen. Picton at the beginning of the 19th century, and of Governor Eyre of Jamaica in 1865.

Punishment.—An essential part of the criminal law is the punishment or sanction by which the State seeks to prevent or avenge offences. *See* also under CRIMINOLOGY. Here it is enough to say that during the 19th century great changes have been made throughout the world in the modes of punishing crime.

In England until early in the 19th century, punishments for crime were ferocious. The severity of the law was tempered by the rule as to benefit of clergy and by the rigid adherence of the judges (*in favorem vitae*) to the rules of correct pleading and proof, whereby the slightest error on the part of the prosecution led to an acquittal. Bentham pointed out that certainty of punishment was more effective than severity, that severe punishments induced juries to acquit criminals, and that thus the certainty of punishment was diminished. But his arguments and the eloquence of Sir Samuel Romilly produced no effect until after the reform of parliament in 1832, shortly after which statutes were passed abolishing the death sentence for all felonies where benefit of clergy existed. Subsequent statutes have abolished the death penalty save in the cases of murder, treason, piracy and offences against the Dockyards Protection Act, 1772. By the Children Act, 1908, the death sentence is not to be pronounced or recorded where the offender is under 16. The severity of capital sentences was greatly modified by the pardoning power of the Crown, which pardoned convicts under sentence of death on their consenting to be transported to convict settlements in the colonies. (*See* DEPORTATION.)

The punishments now in use under the English law for indictable offences are:—

1. Death, inflicted by hanging, and carried out within prison walls since 1868, with a provision that decapitation may be authorized by royal warrant in cases of high treason.

2. Penal servitude, which in 1853 was substituted for transportation to penal settlements outside Great Britain. The minimum term of penal servitude is three years (Penal Servitude Act, 1891), and the sentence is carried out in a convict prison, in Great Britain, but there is still power to send the convicts out of Great Britain.

3. Imprisonment in a local prison, which must be without hard labour unless a statute specially authorizes a sentence of hard labour. At common law there is no limit to a term of imprisonment without hard labour for misdemeanour; but for many offences (both felonies and misdemeanours) the term is limited by statute to two years, and in practice this limit is not exceeded for any offence. But where a person is liable to terms of imprisonment in the aggregate for three years or more, the court by the Penal Servitude Act, 1926, substitutes penal servitude for imprisonment. The treatment of prisoners is regulated by the prison acts and rules.

4. Police supervision under the Prevention of Crimes Act, 1871, and preventive detention on conviction as an habitual criminal under the Prevention of Crimes Act, 1908. This statute also instituted Borstal treatment for youthful offenders between 16 and 21 years of age.

5. Pecuniary fine, a punishment appropriate only to misdemeanours and never imposed for a felony except under statutory authority, *e.g.*, manslaughter (Offences against the Person Act, sec. 5). The amount of the fine is in the discretion of the judge, subject to the directions of Magna Carta and the Bill of Rights and of any statute limiting the maximum for a particular offence.

6. Whipping was a common law punishment for misdemeanants of either sex. The whipping of females was prohibited in 1820, and the punishment by the Criminal Justice Administration Act, 1914, may not be inflicted on males except under statutory authority. That is given in the case of certain assaults on the sovereign, of certain forms of robbery with violence, of some offences against women and girls, of incorrigible rogues and certain other offences by youthful offenders.

7. Recognizances to keep peace and be of good behaviour, *i.e.*, a bond with or without sureties creating a debt to the Crown not enforceable unless the conditions as to conduct therein made are broken. It may be required in addition to other punishment. This bond may be taken from any misdemeanant, and, under statutory authority, from persons convicted of felony (except murder). *See* the Malicious Damage, Coinage Offences, and Offences against the Person Acts of 1861, the Forgery Act, 1913, and the Larceny Act, 1916.

8. In the case of any offence which is not capital the court, if any grounds for mercy appear, may simply bind the offender over to come up for judgment when required, intimating to him that if his conduct is good no further steps will be taken to punish him. Provisions as to probation orders and recognizances are contained in the Probation of Offenders Act, 1907, the Criminal Justice Administration Act, 1914, and the Criminal Justice Act, 1925. By the Criminal Justice (Amendment) Act, 1926, the court may order the offender to pay costs, damages or compensation.

Except in the case of the death penalty, the court of trial has a discretion as to the *quantum* of a particular punishment, no minimum being fixed. In the case of offences punishable on summary conviction the maximum punishment is always fixed by statute. As to the punishment of youthful offenders and children *see* JUVENILE OFFENDERS.

In the criminal law of Europe the scale of punishments is on similar lines in most States, and is more elaborate than that of England, and less is left to the discretion of the court of trial.

Tribunals.—In England indictable offences which are not such as can be dealt with summarily by justices and must be tried by a judge and jury are thus dealt with:—

1. Courts of assize (sitting under old commissions known as commissions of assize, oyer and terminer, and general gaol delivery), are held three times or oftener in every year in each county and also in some large cities and boroughs. They are the lineal successors of the justices *in eyre* of the middle ages; but they are now integral parts of the High Court of Justice. These courts can try any offence which is not specifically excluded from their jurisdiction.

2. For the counties of London and Middlesex and certain adjoining districts, a special court of assize known as the central criminal court sits monthly.

3. In all counties the justices of the peace sit quarterly or oftener under the commission of the peace to try the minor indictable offences. In cities and boroughs with a separate court of quarter sessions, cases are tried before the recorder (*q.v.*). (*See* QUARTER SESSIONS, COURT OF.)

4. The High Court of Justice in the king's bench division tries a few special offences in its original jurisdiction, and where justice requires may transfer indictments from other courts for trial before itself.

5. The court of criminal appeal has been instituted by the Criminal Appeal Act, 1907; to it all persons convicted on indictment have a right of appeal; and there is a limited right of appeal from this court to the House of Lords. (*See* APPEAL.)

Summary jurisdiction in criminal cases is exercised by justices of the peace at petty session. It extends to all offences that can be dealt with summarily and certain minor indictable offences. In most cases the bench must consist of two or more justices, but a stipendiary magistrate, who is appointed under statute, can act alone.

The substantive law as to crime applies in England to all persons except the reigning sovereign, and criminal procedure is the same for all subjects alike, except in the case of peers or peeresses charged with felony, who have the right of trial by their peers in the House of Lords if it be sitting, or in the court of the lord high steward.

There are in England no courts of a special character, such as exist in some foreign countries, for the determination of disputes between the governing classes themselves or with the governed classes, whether of a civil or criminal character. There are a few exceptional courts with criminal jurisdiction. The court of chivalry, which used to punish offences committed within military lines outside the kingdom, is obsolete. Special tribunals exist for trying naval or military offences committed by members of the navy and army, but those members are not exempt from being tried by the ordinary tribunals for offences against the ordinary law, as though they were civilians. (*See* MILITARY LAW; MARTIAL LAW.)

The ecclesiastical courts, which were formerly very powerful in England, and punished persons for various offences, such as blasphemy (*q.v.*), perjury, swearing, and sexual offences, have now almost fallen into disuse. Their authority over Protestant dissenters from the Established Church was taken away by statute; their authority over lay members of the Church of England has disappeared by disuse. Occasionally suits are instituted in them against the clergy for offences either against morality or against doctrine or ritual. In these cases their sentences are enforced by penalties, such as suspension, or deprivation of benefice, or by imprisonment, which has replaced the old punishment of excommunication.

Procedure.—A system of procedure, with the judicial machinery required to work it, may be created either by the direct legislative action of the supreme power or by custom and the action of the courts. Both at Rome and in England it was through usage, and by the courts themselves that the earlier system was slowly moulded; both at Rome and in England it was direct legislation that established the later system.

Criminal prosecutions are ordinarily undertaken by the individuals who have suffered by a crime. There is not in England, as in Scotland and all European countries, a public department concerned to deal with all prosecutions for crime. The result is that the prosecution of most ordinary crime is left to individual enterprise or the action of the local police force or the justices' clerk.

The attorney-general has always represented the Crown in criminal matters, and in State prosecutions appears in person on behalf of the Crown, and when he so appears has certain privileges as regards the reply to the prisoners' defence and the mode of trial. In the Prosecution of Offences Acts of 1879, 1884 and 1908 there is to be found the nucleus of a system of public prosecution such as obtains in other countries in case of crime. Under these acts the director of public prosecutions (*q.v.*) (up to 1908 an office conjoint with that of solicitor to the Treasury) acts under the attorney-general, but unless specially directed he only undertakes a limited number of prosecutions, *e.g.*, for murder, coining and serious crimes affecting the Government.

The procedure of the trial of persons accused of criminal offences in England may now be considered; firstly, where such offence may be dealt with summarily by justices at petty sessions; and secondly where the nature of the offence requires a trial before a jury either at quarter sessions, assizes or the central criminal court.

Summary Trials.—Justices of the peace may under many statutes convict in a summary manner (without the intervention of a jury) for offences of minor importance. The procedure for punishing summary offences is before two justices, or a stipendiary magistrate. This proceeding must not be confused with the preliminary enquiry before justices for an indictable offence which may be sent for trial before a jury (which will be dealt with later), nor with the procedure before justices in relation to civil matters, such as the recovery of small sums of money. The proceeding begins either by the arrest without a warrant of the accused, or by the issue of a warrant for the arrest of the person charged, in which case a sworn information must be filed, or by a summons directing the person charged to appear on a certain day to answer the complaint made by the prosecutor. The justices must hear the case in open court; the person charged can make his defence either in person or by his solicitor or counsel, he can cross-examine the witnesses for the prosecution, call his own witnesses and address the justices in his defence. The justices, after hearing the case, either acquit or convict him, and in case of conviction award the sentence. Imprisonment with or without hard labour can be inflicted as the provisions of the statute authorize, but aggregate sentences must not exceed 12 months. If the sentence is a fine, and the fine is not paid, the person convicted is liable to be imprisoned without hard labour for the term fixed by the justices, not exceeding a scale fixed by statute, the maximum of which is three months, but this has been exceeded by some acts of parliament.

Of late years this summary jurisdiction of the justices has received very large extensions, and many offences which were formerly prosecuted as serious offences by an indictment before the court of assize or quarter sessions have, where the offence was a trivial one, been made punishable, on summary proceedings before justices, by a fine or a term of imprisonment.

The principal statutes dealing with the jurisdiction of justices to dispose of cases summarily are the Summary Jurisdiction Acts, 1848 and 1879, the Criminal Justice Administration Act, 1914, and the Criminal Justice Act, 1925. Extended powers were given these tribunals of dealing with children and young persons, save in the case of homicide, and by the last-mentioned statute the power of the justices to deal with adults in specific cases and under certain circumstances, always with the consent of the accused, was further enlarged.

In all cases of summary trial where peremptory imprisonment for more than three months can be inflicted, the accused has a right to trial by jury and must be informed of this right. And by statute there is a general right of appeal to quarter sessions from a conviction by or an order of a court of summary jurisdiction where there has not been a plea of guilty, or even in the latter case against the sentence.

Trials at Quarter Sessions and Assizes.—We now come to consider the trial of the more serious indictable offences at quarter sessions or assizes, which cannot, or owing to their nature should not, be dealt with by justices at petty sessions. Where such an offence has been committed the accused is arrested, with or without the warrant of a justice, according to the nature of the offence, or is summoned by a justice before him. On his appearance a preliminary enquiry is held for the purpose of ascertaining whether there is a *prima facie* case against him. The procedure is regulated by the Indictable Offences Act, 1848, and is entirely different from the procedure for summary offences. It may be, though rarely is, held in private; it is an enquiry and not a trial. The evidence of the witnesses given on oath, and any statement made by the accused is taken down by the clerk, and then the justices have to consider not whether the man is guilty, but whether there is such a *prima facie* case against him that he ought to be tried. If they think that there is, they commit him to prison to wait his trial, or require him to give security, with or without sureties, to the amount named by them, for appearing to take his trial either at quarter sessions or assizes. Otherwise they discharge the accused.

At common law any person could prefer an indictment for an indictable offence to a grand jury, and so, even although justices declined to send an accused person for trial, the prosecutor might proceed further. But by the Vexatious Indictments Act, 1859, in the case of certain offences, which have been extended by subsequent legislation, no indictment is to be presented to a grand jury without the consent of a judge or law officer, or unless the accused has been committed or the prosecutor has been bound by recognizance to prosecute. Justices are bound to take that recognizance even although they have declined to commit.

The Grand Jury.—Whether there has or has not been a preliminary enquiry before a magistrate, no person can be tried for any of the graver crimes, treason or felony, except upon indictment found by a grand jury of the county or place where the offence is said to have been committed or is by statute made cognizable. In olden days, and even now in theory, the grand jury enquire of their own knowledge, by the oath of good and lawful men of the neighbourhood, into the crime of the county, but in practice the charges against the accused persons are always first submitted to the proper officer of the court. The grand jurors are instructed as to their inquisition by a charge from the judge, as regards the indictments concerning which they are called upon to enquire whether there is a *prima facie* case to send them for trial to the petty jury. The grand jury must consist of not less than 12, nor more than 23, good and lawful men of the county. But any person who prefers an indictment is entitled to have it presented to the grand jury. Officers of the court lay the indictments before the grand jury. The charges are then called bills, and if the grand jury considers that there is good ground for the trial of the accused, they find a "true bill," but if they think there is no *prima facie* case the foreman endorses the bill with the words "no true bill," and it is then presented to the judge. The jury are then said to have ignored the bill, and if the person charged is in custody he is released, but is liable to be indicted again on better evidence.

In many colonies the Scottish system has been adopted, by which the ordinary form of accusation is by indictment framed by the public prosecutor, and a grand jury is only empanelled in cases where an individual claims to prosecute an offence as to which the public officials decline to proceed. In England criminal informations by the attorney-general, or by leave of the court without the intervention of a grand jury, are permitted in cases of misdemeanour, but are now rarely preferred.

If a coroner's jury, on enquiring into any sudden death, finds that murder or manslaughter has been committed, that finding has the same effect as an indictment by a grand jury, and the man charged may be tried by the petty jury accordingly. The law and procedure of the coroner's courts are now regulated by the Coroners Acts, 1887 and 1926. But now by the later statute if criminal proceedings are pending, "in the absence of reason to the contrary," the inquest is to stand adjourned until their conclusion.

Trial by Jury.—When an indictment (*q.v.*) is found by the grand jury (12 at least must concur) the person charged is brought before the court, the indictment is read to him, he is arraigned (*see* ARRAIGNMENT) and asked whether he is guilty or not guilty. If he pleads guilty he is then sentenced by the court; if he pleads not guilty, a petty jury of 12 is formed from the panel or list of jurors who have been summoned by the sheriff to attend the court. He may peremptorily challenge jurors in cases of treason or felony and "for cause" also in misdemeanour. He is tried by these jurors in open court.

On the trial before the petty jury the procedure and the rules of evidence differ in few points from an ordinary civil case. The proceedings as already stated are accusatory. The prosecutor must begin to prove his case. Confessions (*q.v.*) and admissions alleged to have been made by the accused are regarded with suspicion and are not admitted unless it is clear that they were not extracted by inducements of a temporal nature held out by persons in authority over him. The accused may not be interrogated by the judge or the prosecuting counsel unless he consents to be sworn as a witness. The accused may, if he choose, be defended by counsel, and if poor may get legal aid at the public expense if the court certify for it. He is entitled to cross-examine the witnesses for the prosecution and to call witnesses in his defence. At the conclusion of the evidence and speeches the judge sums up to the jury both as to the facts and the law, and the jury by their verdict acquit or convict. Immediate discharge follows on acquittal; sentence by the judge on conviction.

Appeal After Trial by Jury.—In English law until 1907, where a criminal case had been tried by a jury, the verdict of the jury of guilt or innocence was final and there was no appeal on the facts. Any considerable defect or informality in the procedure might be the subject of a writ of error. And if any question of law arose at the trial, the judge might, if he chose, reserve it for the opinion of the court for the consideration of Crown cases reserved, by whom the conviction might be either quashed or confirmed.

By the Criminal Appeal Act, 1907, a new court was established to which any person convicted on indictment or criminal information might appeal. This statute abolished writs of error and the old practice of the king's bench as to granting new trials. It allowed appeals on questions of law and fact and on mixed questions of law and fact, and also against sentences, and on the certificate of the attorney-general that a point of law of exceptional public importance is involved, a further appeal is permitted to the House of Lords. There is no provision for appeals against acquittals and no power to order a new trial. A court of criminal appeal was established for Scotland in 1926. (*See* APPEAL.)

Costs.—The expenses of prosecution for crime in England are dealt with in the following manner. In the case of summary offences justices under the Summary Jurisdiction Acts can order the defendant on conviction to pay to the prosecutor all costs that are just and reasonable, and where the information is dismissed can order the prosecutor to pay costs to the accused. At common law there was no jurisdiction to order costs, and the power to do so rests upon statute. The subject, so far as indictable, as opposed to summary offences are concerned, is governed by the Costs in Criminal Cases Act, 1908, and by that statute (1) a court of assize, including the central criminal court, or a court of quarter sessions before which any indictable offence is tried; (2) a court of summary jurisdiction dealing summarily with an indictable offence; and (3) justices examining but not trying an indictable offence may direct the payment of the costs of the prosecution or defence out of the funds of the county or county borough as in the act provided. There is power under the same act for the court to order the costs of the prosecution to be paid by the accused if convicted, and in certain cases a private prosecutor may be ordered to pay the costs of the defence. In the case of an appeal to the court of criminal appeal under the act of 1907, no costs are allowed on either side, but the expenses of assigned counsel or solicitor and of witnesses are to be defrayed out of local funds.

Characteristics of English Criminal Law.—The characteristics of English criminal law and procedure which most distinguish it from the procedure of other countries are as follows:

1. It is litigious or accusatory and not inquisitorial. It is for the prosecutor to prove by legal evidence the commission of the alleged offence, and the accused is not required to prove his inno-

cence.

2. According to the law of England there is no prescription in criminal law (with a few exceptions created by statute). *Tempus non occurrit regi.* An offender is always liable to punishment whatever time may have elapsed since the committal of the offence. On the Continent of Europe the limitation of a judgment and sentence for a crime is 20 years; five years for a *délit,* and for a contravention two years. No proceedings can be taken as regards a crime after a lapse of ten years, whilst as regards a *délit* the limit is three years, and two years for a contravention.

3. A criminal prosecution directed on European criminal procedure at once passes into the hands of the State as an infringement of law which must be repressed, on the ground that the whole community bases its security on obedience to law. It is true that in England prosecutions are carried on in the name of the Crown, but only in serious matters do the attorney-general, the director of public prosecutions, or the police act, and much of the repression of minor crime is left to the injured party.

4. In England every criminal trial from beginning to end is public. Preliminary enquiries into an indictable offence may be, but rarely if ever are, conducted in private. On the Continent of Europe, with rare exceptions all preliminary proceedings in a criminal charge are secret, and there are limitations to the rights of the legal advisers of the accused. At the trial the powers of counsel are much wider. In England also it is an established law that an accused person should have the right of publicity of the proceedings and the right to defend himself by counsel and by witnesses at all stages of the proceedings.

5. In England the single-judge system is universal, save in courts of summary jurisdiction, at quarter sessions for counties and on appeal; on the Continent of Europe plurality of judges is insisted upon, save in the most trivial cases, where the punishment is insignificant.

6. In England the accused has a right to be tried by a jury for all serious crime, and all professional judges are chosen from the bar, and do not form a particular caste, and are only removable for misbehaviour.

Northern Ireland and Scotland.—The criminal law of Northern Ireland is to a great extent the same as that of England, resting on the same common law and on statutes which extend to both countries or are in almost the same terms, and is administered by courts of assize and quarter sessions, and by justices, as in England. In a few instances statutes passed for England or Great Britain before the Union have not been extended to Ireland, or statutes passed by the Irish parliament before the Union or by the British parliament since the Union create offences not known to English law.

In Scotland not many crimes are constituted by statute law, the common law having great elasticity. Criminal procedure in Scotland is regulated by an act of 1887 which greatly simplified indictments and proceedings. The prosecution of crime is in the hands of public officers, procurators fiscal, under the control of the lord advocate. Private prosecutions are possible, but rare. Except in the case of the law of treason, imported from England at the Union, no grand jury is required, and the indictments are filed by the public officer.

The criminal law of England forms the basis of the criminal law of British possessions abroad, with a few exceptions, *e.g.*, the Channel Islands (still subject to the custom of Normandy), and the anomalous case of Cyprus, where Ottoman law is to some extent in force. As to India, see *infra.*

In many British colonies the criminal law has been codified or at the least consolidated. The criminal law of South Africa, which is based on the Roman-Dutch law, including the *Constitutio Criminalis Carolina* (1532), is not codified. In the Transvaal and Orange River colonies codes of criminal procedure are in force, drawn mainly from the common and statute law of the Cape Colony with the addition of provisions borrowed from English and colonial legislation.

Codification.—"Criminal law has everywhere grown out of custom, and has in all civilized States been largely dealt with by direct legislation. In most civilized States (including Japan) it has been codified by statute, to the general satisfaction of the people; and the conspicuous success of the Indian Penal Code shows that English criminal law is susceptible of being so treated" (Bryce, *Studies,* ii. 34).

The expediency, if not the necessity, of codifying the criminal law of England has long been apparent. The writings of Bentham drew attention to many of its substantial defects, and the efforts of Romilly and Mackintosh led to certain improvements embodied in what are known as Peel's Acts (1826 to 1832). In 1833, at the instance of Lord Chancellor Brougham, a royal commission was appointed to deal with the criminal law. The nature of the instructions indicate the crudity of the ideas then ruling as to codification. The commissioners were directed to digest into one statute all enactments touching crimes and the punishment thereof, and into another statute the provisions of the common unwritten law touching the same. The commission was renewed in 1836 and 1837, and in 1843 a second commission was appointed. Numerous and voluminous reports were published, including (1848) a bill for consolidating and amending the law as to crimes and punishments, and (1849) a like bill for criminal procedure, indicating that the commissioners had in the meantime learned the distinction between substantive and adjective law. Lord Brougham in 1848 unsuccessfully introduced the first bill, and in the end the only fruit of the reports has been certain amendments of procedure in 1851 and the passing of the seven Criminal Law Consolidation Acts of 1861, which deal with the statute law as to larceny, forgery, malicious injuries to property, coinage offences and offences against the person. During the present century the law relating to perjury, forgery, indictments and larceny has been consolidated in several statutes.

India.—The Indian Penal Code and Criminal Procedure Code, by their history, their form, and the extent and diversity of the races and peoples to which they apply, are perhaps the most important codes in the whole world. Between 1834 and 1837 Macaulay with three other commissioners, Macleod, Anderson and Millet, prepared a draft penal code for India, for which they drew not only upon English and Indian laws and regulations but also upon Livingstone's Louisiana code and the Code Napoléon. Little or nothing was taken from the Mohammedan law. A revised draft of the Penal Code by Sir B. Peacock, Sir J. W. Colville and others was completed in 1856. In framing it the reports of the English criminal law commissioners (published after Macaulay's draft code) were considered. The draft was presented to the Legislative Council in 1856, but owing to the mutiny and to objections from missionaries, etc., its passing was delayed until Oct. 6, 1860. A draft scheme of criminal procedure was prepared in India in 1847–48, which, after submission to a commission in England, was moulded into a draft code which passed the India Legislative Council in 1861 (Act No. XXV.) and came into force in 1862. It has been re-enacted with amendments on various occasions and in 1898 (Act V.).

The result is that in India the criminal law is the law of the conqueror, though for many civil purposes the law of race, religion and caste governs. Under the codes, one set of courts has been established throughout the country, composed of well-paid, well-educated judges, many of the high judicial appointments being held by Englishmen; all those who hold subordinate judicial posts at the same time are subjected to a combined system of appeal and revision. The arrangement of the Indian Penal Code is natural as well as logical; its basis is the law of England stripped of technicality and local peculiarities, whilst certain modifications are introduced to meet the exigencies of a country such as British India.

Passing on to the system of criminal procedure which is set forth in detail in the Code of Criminal Procedure as re-enacted in 1898, it is no doubt modelled on the English system, but with considerable modifications. The principal steps are: (1) arrest by the police and enquiries by the police; (2) the issue of summons or warrant by the magistrate; (3) the mode of procedure before the magistrate, who may either try the accused himself or commit him to the sessions or the high court, according to the importance of the case; (4) procedure before the court of session;

(5) appeals, reference and revision by the high court.

Foreign Codes.—It has already been stated that most European States had codified their criminal law. The earliest of Continental codes is that of Charles V., promulgated in 1532, and known as *Constitutio Criminalis Carolina.* Austria made further codes in 1768 (*Constitutio Criminalis Theresiana*) and 1787 (Emperor Joseph's Code). A new code was framed in 1803, and amended in 1852 by reference to the Code Napoléon; and in 1906 a completely new code existed in draft. The Hungarian Penal Code dates from 1880. The Bavarian Code of 1768 of Maximilian, revised in 1861, and the Prussian Code of 1780, have been superseded by the German Penal Code of 1872.

The most important of the Continental criminal codes are those of France, the *Code Pénal* (1810) and the *Code d'Instruction Criminelle* (1808)—the work of Napoleon the Great and his advisers, which professedly incorporate much of the Roman law.

The Belgian Codes (1867), and the Dutch Penal Code (1880) closely follow the French model. In Spain the Penal Code dates from 1870, the Procedure Code from 1886. The Spanish-American republics for the most part also have codes. Portugal has a Penal Code (1852). In Italy the Procedure Code and the Penal Code, perhaps the completest yet framed, are of 1890, but a new penal code under the Fascist régime is now (1928) under consideration. The Swedish Code dates from 1864. The Norwegian Code was passed in May 1902, and came into force in 1905. Japan has a code based on a study of European and American models.

In the United States no Federal criminal code is possible; but many States have digested their criminal law and procedure more or less effectually into penal codes.

It may be generally stated that the English criminal law and procedure forms the basis of that which obtains in English-speaking countries, while the French Codes of Napoleon are the models of Continental criminal law. (W. DE B. H.; X.)

UNITED STATES

In one sense there is no single body of criminal law of the United States. For purposes of the administration of criminal justice each of the 48 States, and the Federal Government, is a sovereign State with its own law, its own exclusive jurisdiction, its own judges and other officers of justice, its own system of penalties and its own rules of procedure, subject only, in the case of the States, to certain restrictions of the Federal Constitution. Yet, in another sense, there is a criminal law of the United States.

When the American Colonies were first settled by the English, it was held by the settlers and by the judges and lawyers of England, that they brought with them so much of the common law of England and the statutes then in force there as was applicable to their local situation and change of circumstances. But each Colony judged for itself what parts of this common law were applicable to its new condition, and adopted some parts and rejected others. The common law here spoken of is that great body of principles evolved by the English judges during the centuries.

Therefore, while each of the several States of the United States has its own distinct body of criminal law, these bodies of law have a common source, viz., the common law of England, and this common law furnishes a great body of principles which forms the basis of the law of each of the several States and of the Federal Government. Thus, subject to exceptions mentioned hereafter, every act that was a crime by the common law of England at the time the English emigrated to America is a crime to-day in the several States. There are three exceptions to this statement. (1) Under the rule that the English brought with them to America only so much of the common law as was suited to their changed conditions, offences cognizable only in the ecclesiastical courts in England, such as incontinence, were generally held not punishable in America unless made so by statute. (2) In a few States the legislatures have undertaken to codify the criminal law, and the courts of these States have held that in so doing the legislatures intended to include in the code all acts that were thereafter to be punishable, and that no act not animadverted upon in the code should henceforth be a crime in that State. (3) The Federal courts hold that there are no common law crimes against the Federal Government; that only such acts as have been declared criminal by Congress can be punished by the Federal courts.

Not only were some common law crimes rejected in the United States, but many of the common law punishments in vogue in England at the time of the settlement of the Colonies were not accepted there. In an early Pennsylvania case the court said:—"The common law punishment of ducking (which was the punishment for the offence of being a common scold in England) was not received nor embodied by usage, so as to become a part of the common law of Pennsylvania. It was rejected, as not accommodated to the circumstances of the country, and against the notions of punishment entertained by this primitive and humane community; and although they adopted the common law doctrine as to inferior offences, yet they did not follow their punishments. . . . A gross libel in England was sometimes punished by the pillory. I believe Mr. Prynne lost both his ears. Though the offence is the same here, yet the sentence is very different."

On this basis of the common law of England, each of the States and the Federal Government have separately, through the medium of legislation, built their individual bodies of criminal law. The criminal law legislation has been exercised mainly in the direction of the creation of new crimes, the changing of the penalties of the old ones, the organization of courts and changes in procedure.

Classification of Crimes.—Offences are usually classified in the United States in respect to their effect, as offences (1) against the law of nations, (2) against public justice and authority, (3) against the public peace, (4) against trade, (5) against public decency, (6) against the person, (7) against property. The United States has inherited from England the classification of crimes, in respect to their gravity, into treason, felony and misdemeanour. In England many crimes were placed in the category of treason. In the United States this term has been restricted to one offence; viz., the levying of war against the State or adhering to its enemies. Felonies, at common law, included all crimes punishable by death and forfeiture of property, but since forfeiture of property for crime was abolished early in the United States and the death penalty was restricted to a few crimes, this term has lost its original signification and now, generally speaking, characterizes all the more serious crimes. Furthermore, this category has been affected by statutes, so that what is a felony in one State may be only a misdemeanour in another. In some States a general rule has been adopted defining felony, as in New York, where all offences punishable by imprisonment for one year are declared felonies; while in other States, as in Pennsylvania, the legislature, in defining each crime, prescribes whether it shall be a felony or a misdemeanour. The term misdemeanour includes all offences punishable by the State which are not treason or felony.

FIXING RESPONSIBILITY

Elements of Crime.—The elements of a crime, under the laws of the Federal Government and of the States, are the same as in other systems of law. The rule is expressed in the maxim—every crime consists of an act, or an omission to act, and an accompanying state of mind. The act must be a willed act, and the omission must be the omission of a legal, as distinguished from a moral, duty. A blow caused by a mere muscular reflex will not make one criminally liable nor will an omission by a stranger to rescue a drowning person, though such rescue could be effected by a minimum of effort. Except in a small but growing class of statutory offences of a minor character, there must exist, together with the act or omission, an accompanying state of mind, to render the person causing injury criminally liable. This state of mind varies in the case of different offences and is either malice, negligence, knowledge of certain facts or some particular intent. Thus murder consists of an act causing death to a human being, accompanied by malice; voluntary manslaughter consists of the same act with intent to kill, but without malice; while in involuntary manslaughter we have the same act done with a merely negligent mind. Most of the serious offences require, in addition to an act, a certain specific intent. Thus in burglary there must be the act of breaking and entering a dwelling house in the night time, with an intent to commit some felony therein; in larceny there must be coupled with the act of taking an intent to deprive the owner permanently of the property taken; in robbery there must be the forcible taking of property, with the intent required in larceny. In addition to these common law crimes there is a long catalogue of statutory offences requiring a specific intent for their commission; such are assaults, with intent to kill, to maim, to wound, etc.

Elements of Criminal Responsibility.—To be responsible, criminally, for his acts, the person charged must be of competent age and sane. In the United States, as in England, a child under seven years of age is not criminally liable for any act, and between the ages of seven and 14 he is presumed not to have such knowledge and discretion as to make him liable. The burden of proving such knowledge or discretion is on the prosecution. While in the law both of England and the United States an insane person is not responsible for his acts, the legal test of the kind and degree of that insanity which excuses him is not the same. Indeed, it is not the same in all the States of the Union. In England, the test, adopted in 1843, in *McNaghten's Case,* in accordance with the medical theories of the day, was what has become known as the "right and wrong" test, viz., did the accused know the nature and quality of the act he did, or, if he did know it, did he know that he was doing wrong. This test has been adopted in many of the States, and under it it is held in these States that a person is not excused who kills another under an insane irresistible impulse, or homicidal mania. A growing number of States, however, influenced by modern psychiatry, have repudiated the "right and wrong" test and hold that even if the accused knew the nature and quality of his act and knew that it was wrong, yet if he was driven to do the act by an insane, irresistible impulse, he is not responsible. A third group of States hold that there is no legal test of insanity; that insanity is a question of fact, not of law, and if the defendant had a mental disease, and the act done by him was a product of that disease, he should not be convicted. If insanity exists in such a degree as to excuse, the origin, or cause, of such insanity is immaterial; thus insanity brought on by indulgence in liquor, if it be real insanity—a disease of the mind—and not merely a temporary irrationality due to intoxication, is as effective to render one non-liable for acts due to such insanity as though the insanity were congenital. Insanity plays another rôle in the criminal law in that though the accused was sane at the time he committed an offence, he cannot be put on trial if he is insane when his case comes on to be tried, as in such event he cannot intelligently present his defence; nor can he be punished if he is insane at the time of the sentence.

Drunkenness, not involving insanity, is a valid excuse in the case of all crimes requiring a specific intent for their commission, if the drunkenness is so great as to negative the fact that the accused had, at the time he did the act, the accompanying intent necessary to constitute the particular crime with which he is charged. Thus a person cannot be convicted of larceny, if at the time he took the property he was too drunk to entertain the intent to steal; nor can he be convicted of arson if he was too drunk to have the intent to burn. Ignorance or mistake of law or of fact affords a valid excuse for a crime if such crime requires a specific intent or knowledge, and the ignorance or mistake negatives the existence of the requisite intent or knowledge. Thus if a person mistakenly thinking that a piece of property belongs to him, carries it away, he is not guilty of larceny, since his mistake negatives the intent to deprive the owner of the property, which intent is necessary to larceny; or if a person votes, believing erroneously that he has the right to vote under existing law, he cannot be convicted under a statute providing penalties for "knowingly" voting illegally.

Since the theory of the criminal law is that a crime is an offence against the State rather than against the individual, the consent of the person injured affords no defence except in crimes such as rape, larceny, etc., that require the non-consent of such person by their very definition. Thus on an indictment for murder it is no defence to show that the person killed consented to his death or asked the accused to kill him. For the same reason, contributory negligence, or guilt, or condonation, of the person injured, is no defence in criminal law. Physical compulsion or coercion is a valid excuse for what would otherwise be a crime because in such case the act done is not the act of the person seeming to act but of the person compelling. Moral compulsion, such as threats, has been held in the United States to excuse some crimes and not to excuse others. Thus where an American enlisted in the enemy army it was held he was not guilty of treason if he enlisted through fear of immediate death (*Respub.* v. *McCarty,* 2 Dallas, 86). On the other hand, one is never excused for killing an innocent person even to save oneself from immediate death at the hands of a third person (*Brewer* v. *State,* 72 Ark. 145). The fact that one was induced or commanded to commit a crime affords no excuse. There are two partial exceptions to this rule. A wife is excused for the commission of any but one of the more serious crimes if she is coerced by her husband and the crime is committed while he is present; and a person in the military or naval service is excused for illegal acts done by command of his superior officer, unless the order was so clearly illegal that a person of ordinary intelligence would recognize its illegality on its being given. In addition to the above-mentioned excuses, there are certain justifications for acts which, without such justification, would be criminal. In this category are the arrest, detention and, in the case of serious crimes, even the killing, of a person who has committed or is about to commit a serious felony, if there is no other means of arresting him or of preventing the felony. A parent, or one standing *in loco parentis,* may likewise justify a battery on the person in his charge if the battery is for purposes of correction and is not excessive. The well-known doctrine of self-defence likewise comes within the category of justifiable acts. Also, what one may do in self-defence, another may do in defence of him. A person may also protect his dwelling or his property by force, short of killing or serious bodily harm.

Combinations of Persons in Crime.—A person may be concerned in a crime either as a principal in the first degree, a principal in the second degree, an accessory before the fact or an accessory after the fact. The principal in the first degree is one who commits the crime with his own hand or acting through a legally irresponsible agent—such as a child under seven years of age, an animal or a mechanism. A principal in the second degree is one who is present, aiding or abetting the principal in the first degree. An accessory before the fact is one who induces the principal in the first degree to commit the crime but is not present when it is committed. An accessory after the fact is one who, knowing that another has committed a felony, shelters him or aids him to escape. These degrees of participation in crime hold only in the case of felonies. In treason and misdemeanours all persons concerned are principals.

In the United States, as in England, attempts falling short of the commission of the crime intended are themselves regarded as crimes unless the crime intended is of a very minor character. In this class of crime, as in others, there must be a concurrence of act and intent. A distinction is made between preparation to commit the offence and attempt to commit it. If the act done toward the commission of the crime has not gone beyond mere preparation to commit it, the technical "act" has not been done and no offence has taken place. Thus buying a pistol for the purpose of killing a person is not an attempt to kill—it is only "preparation"; but if the actor has proceeded so far as to point the pistol at his victim the attempt is complete though his attempt should be frustrated or he should at this point voluntarily relinquish his design. Many fine-spun distinctions have been made both in England and in the United States as to whether one could be convicted of an attempt to do something, the doing of which was at the time impossible—as an attempt to pick an empty pocket. There is authority in England to the effect that this is not a punishable attempt. The authority in the United States is generally to the contrary. There is general agreement, however, on the proposition that one cannot be guilty of an attempt to do a thing which is legally, as distinguished from factually, impossible. Thus a person could not be guilty of an attempt to steal goods, even though he proceeded far enough in his attempt to pass beyond preparation, if it happened that, unknown to him at the time, the goods were his own goods.

POWERS OF VARIOUS STATES

Punishment.—The punishments inflicted in the United States for crime are: (1) Death. In some States the death penalty is inflicted by hanging, in others by electrocution and in one by lethal gas. In several States the death penalty has been abolished. Death is the usual penalty for treason and for murder in the first degree—generally a wilful, deliberate and premeditated murder, or a killing done in the commission of or attempt to commit one of the more serious felonies. In the Southern States rape is also generally punished by death. (2) Imprisonment in the State penitentiary. The more serious offences not punished by death are thus punished. (3) Pecuniary fines, varying in amount with the gravity of the offence. (4) Whipping, as a penalty for certain offences, is still practised in Delaware. (5) Imprisonment in the county gaol. The less serious crimes are punished in this manner. In many States, second and subsequent offenders are punished more severely than first offenders. New York has gone furthest in this direction, punishing by life imprisonment one who is for the fourth time convicted of any felony.

In general, in the United States, the maximum punishment for each offence is fixed by statute, the trial judge being given discretion to mete out any given penalty less than the maximum. In some States the jury may, in convicting the accused, recommend him to mercy, and in others the jury itself, instead of the judge, fixes the penalty in each case. There are provisions also in many States for the probation and parole of prisoners, especially in the case of first offenders. "Cruel and unusual" punishments are forbidden by the Federal Constitution.

Jurisdiction and Venue.—Jurisdiction as here used means the power of the State to punish offences; venue means the local sub-division of the State in which an offence must be tried. Without a special statute authorizing it, a State can punish only those offences which are committed within its boundaries, and, perhaps, crimes affecting its well-being by its own citizens elsewhere. By statute, however, a State can punish anyone who does an act anywhere against its sovereignty or security. Statutes so providing have been enacted by the U.S. Congress. Also the peace officers of a State have no authority beyond its territory and hence cannot apprehend one who has committed a crime within the State and taken refuge in another State. The only recourse in such a case is for the governor of the offended State to request the governor of the State to which the criminal has fled to procure his arrest and return. Whether the request will be efficacious depends entirely on the good pleasure of the second governor, though in practice the request is seldom refused. By special agreement between some of the States, concurrent jurisdiction has been given these States over crimes committed on rivers separating them. Much difficulty is experienced in the administration of the criminal law in the United States, not only by the fleeing of criminals from one State to another, but also by fugitive witnesses whose testimony is needed at the trial. To obviate this difficulty, agreements have been made by a few States under which the State to which a witness has fled will return the witness to the State needing his testimony. The common law principle that an offence must be prosecuted in the county in which it was committed obtains generally in the United States. Several States, however, have enacted statutes allowing prosecution in another county; *e.g.*, in the cases of a wounding in one county resulting in death in another, of offences committed near the county line of adjoining counties and of offences committed on moving trains.

By the Federal Constitution and by most State Constitutions, all persons are protected from being prosecuted more than once for the same offence. In the Constitutions of a few States this protection is confined to capital cases. These provisions do not prevent the Federal Government from prosecuting a person for an act for which he has already been prosecuted by a State, if the act is an offence against both the State and the Federal Government, and the same principle applies to a prosecution by a State after a prosecution by the Federal Government.

All but a few States provide in their Constitutions that, before conviction, every person accused of crime shall have the right to be released from custody on bail, except in capital cases. In a few States this right is not guaranteed in the case of murder, whether murder be a capital offence or not; and in a few States treason is also excepted.

Though known by varying names, there are in general in the United States three classes of courts having jurisdiction in criminal cases in each State: (1) Courts having cognizance of petty offences. These are generally known as magistrate's courts or courts of the justice of the peace. (2) Courts having jurisdiction of indictable offences—variously named. (3) In some of the larger cities there are also courts having cognizance of juvenile offenders. (4) Courts of appeal. In only two States are there courts of appeal for criminal cases alone. In the other States the same court hears appeals in both civil and criminal cases.

Procedure.—In the United States the prosecution of the criminal is not left, as generally in England, to the initiative of the individual who has suffered by the crime, but is conducted by an officer of the State whose sole public duty is the enforcement of public justice. He is known by various titles, such as States attorney, prosecuting attorney, district attorney, solicitor, etc., of whom there is usually one for each county or district in the State. Important cases are sometimes conducted by the attorney-general. The summary prosecution of cases both before a magistrate or justice of the peace and before a court having jurisdiction of indictable offences in the United States is so similar to the prosecution before the justice of the peace in England as not to require a separate description. In the United States generally, only one magistrate hears the case, though in many States he may call in a magistrate of another county to sit with him if he so desire. It is believed that no legislation similar to the Vexatious Indictments Act of England exists in the United States and that, therefore, an indictment may be considered by the grand jury in all cases of indictable offences whether or not the magistrate has declined to hold an accused person to trial. The finding of a "true bill" by a grand jury as a prerequisite to putting a person on trial for all but petty offences was a part of the common law inherited by the United States from England, and still obtains in half of them. In 24 States, however, the prosecution may be begun, without the intervention of a grand jury, by the filing of an "information," *i.e.*, accusation, by the prosecuting attorney, except, in a few States, in cases punishable by death or imprisonment for more than ten years. It is still lawful to proceed by indictment by a grand jury in these States, but in practice prosecution by information has superseded that by indictment as simpler, less expensive and more expeditious.

Trial by Jury.—When an indictment has been presented, or an information filed, against a person, he is arrested, if he is not already in custody or released on bail, and is brought before the court. On appearing, he is arraigned (*see* ARRAIGNMENT). The indictment is read to him, even though in some States he has been given a copy of the indictment a prescribed time previously. He is then required to plead by being asked whether he is guilty or not. In answer to this he may plead any one of the following pleas: (1) guilty; (2) not guilty; (3) former jeopardy; (4) former acquittal; (5) former conviction; (6) *nolo contendere*—which is, for practical purposes, equivalent to a plea of guilty; (7) to the jurisdiction; *i.e.*, that the court has no jurisdiction of the case; (8) in abatement—as that he has been erroneously named in the indictment; (9) he may demur to the indictment; (10) in some States the accused must enter a special plea of insanity if he desires to defend on this ground; in others this defence may be given under the plea of "not guilty." If the accused pleads guilty, no trial is necessary in most States, but the judge proceeds to sentence. In a few States, however, the judge, or jury, is required to hear the witnesses as to any facts that may aggravate or mitigate the offence. If the accused refuses to enter any plea, a plea of "not guilty" is entered for him by the court. If the defendant pleads "not guilty," or stands mute, a jury is selected to try the case. In most States this jury is composed of 12 persons, and the accused cannot be convicted unless all the jurors unite in finding him guilty. In some States a trial may be had by a smaller number of jurors, and in some a unanimous verdict is not required in the case of all crimes. The burden of proving the accused guilty is on the prosecution and the prisoner is entitled to acquittal unless the jury is satisfied, beyond a reasonable doubt, of his guilt. The accused is entitled to be represented by counsel, and if he is unable to procure counsel, it must be assigned to him, in some States in all cases of felony, in others in cases of trials for homicide. He is entitled, as is the State, to have process to compel witnesses to attend and testify. When the evidence has all been heard, counsel for the State and for the prisoner address the jury, and the judge instructs the jury as to the law of the case. In the Federal courts and in the courts of a few States, the judge may comment on the evidence of the case in order to assist the jury in reaching a just verdict, but in most States the judge is forbidden by law to comment on the facts.

In all States the accused, on conviction, may petition the court which tried him for a new trial of the case, which will be granted if the court is persuaded that his conviction was not in accordance with the law. In addition to this, the accused has the right to have his case reviewed by a higher court—in a few States, as to matters of law only; in most States, as to both the law and the facts. The appellate court in its review is confined to the record and cannot examine witnesses, nor can it modify or increase the sentence. It can only affirm the legality of the original trial or send the case back for a new trial. (W. E. Mi.)

CRIMINOLOGY, a modern term invented to describe the results of recent inquiries into the personal or social factors which determine criminal misconduct, but which has, in the hands of its more recent exponents, come to include the whole problem of crime and its treatment in human society. A comprehensive study of the subject to-day would, therefore, draw its material from history, sociology and law, as well as from psychology, anthropology and social ethics. It gathers criminal statistics with the view of ascertaining the crime rate and its upward or downward trend in different countries and, in the same country, in different areas of population, in communities of varying national or racial origin or living on different economic levels. It seeks the springs of misconduct and of criminal propensity through the intensive study of the mental and social history of the individual delinquent, and it undertakes to classify criminals on the basis of the causative factors thus disclosed. It aims to establish a rationale of punishment or of other treatment of the delinquent by a similar study of the efficacy and the social utility of the machinery of criminal justice in various countries, ranging from the method of the police and the courts to the prisons, the death penalty and the modern devices of probation and parole. All these fields of activity are being industriously and hopefully explored by eager students in all parts of the civilized world. If the results thus far realized are too meagre and uncertain to constitute a body of true scientific knowledge, the same may be said of any other of the so-called social sciences. Certainly criminology has struck at the core of its problem in its present resolute effort to win an understanding of the criminal mind.

It seems incredible, but it is nevertheless a fact, that, prior to the publication of Lombroso's *L'Uomo delinquente* (The Criminal), which was given to the world in 1876, there had never been offered a serious, scientific approach to the study of the criminal. It is true that some 75 years earlier the Viennese physician and phrenologist, Franz Joseph Gall, then resident in Paris, had laid down the proposition that criminal tendencies were probably innate, and might be detected by the conformation of the skull, but his suggestion was not taken up by his disciples. There is no evidence that it was known to Lombroso.

The Positive School.—Lombroso's theory of the criminal as a sub-human anthropological freak, marked by anatomical and other stigmata and doomed by his nature to a criminal career, was at once accepted by a majority of students in Italy, and by scholars and writers of distinction in other European countries. Though subjected to weighty criticism, and though never received in any English-speaking community, it became, and for a generation remained, the dominant doctrine of European students of the problem of crime. The adherents of the doctrine, at first known as the Italian and later as the Continental school of criminology, have, under the influence of its most eloquent and learned modern interpreter, Enrico Ferri, claimed the title of the Positive school.

But the central doctrine of these thinkers did not long stand in the unqualified form in which it was originally promulgated. Even Lombroso himself, before his death in 1909, had modified his views to the extent of admitting that the born anthropological criminals numbered perhaps not more than half of those committing criminal offences. These were the true criminals, the other half being made up of the victims of circumstances. These modifications of the original doctrine were the result partly of the researches and conclusions of some of Lombroso's immediate Italian disciples, such as Raffaele Garofalo and Enrico Ferri, but even more, perhaps, of the challenging writings of the Dutch publicist, William A. Bonger, who emphasized the influence of economic conditions, and of the French philosopher, Gabriel Tarde, and others, who attributed criminality mainly to the psychic impulse of imitation. While all these efforts, like the doctrine impeached by them, were vitiated by the aim of furnishing a single explanation of the extremely complicated and puzzling problem of the persistence of crime in an orderly civilization, each and every one of them, nevertheless, made a contribution to the criminology of the future.

Absence of Physical Criminal Type.—It remained, however, for an English physician, Dr. Charles Goring, medical officer of H.M. prison service, to demonstrate the fallacy of the central assumption of the Italian criminologists. Adopting more rigorous methods of examination and measurement of inmates of the English prisons and correlating the results with similar examination and measurements of members of the law-abiding community, he proved conclusively that criminals, as a class, differ more widely among themselves than they do from the community outside and that the latter show the same stigmata of criminality that criminals possess. In his work, *The English Convict* (1913), Dr. Goring announced, as an "inevitable conclusion" from his researches "that there is no such thing as a physical criminal type," a conclusion which is now accepted by every criminologist of standing. Dr. Goring's further conclusion, stated with equal positiveness, that "there is no such thing as a mental criminal type," while it is also generally accepted, rests upon no such satisfactory basis of evidence and may be regarded as open to contradiction.

Whatever may be the merits or the defects of the specific doctrine which will always bear Lombroso's name, his work has these outstanding merits: it first gave the study of the criminal a scientific basis and it powerfully stimulated technical as well as popular interest in the problem. Prior to his time there had been few to question the traditional view of the criminal as a wicked person deliberately and perversely choosing the evil rather than the good. Even the penal reforms with which the names of the Italian Beccaria and the English Romilly and Bentham are associated were inspired almost entirely by humanitarian motives. But since Lombroso's death the scientific study of the criminal and of the personal and social factors that are favourable to his development has been going on with increasing momentum.

The New Psychology.—Except in the field of penology (*q.v.*), America was late in getting into the current of criminological thought. Here there were eminent prison reformers before Howard and Romilly, and the first American penitentiary, for better or for worse, became the model of the European convict prison. It is in the United States, too, that the most hopeful and daring experiments in the treatment of the convicted offender were undertaken. But it was not till the first decade of the present century that the scientific study of the criminal began to receive the serious attention of students of the subject. This significant change of emphasis was, perhaps, primarily due to the rapidly developing interest of the new psychology in morbid and defective mental conditions, an interest which has powerfully stimulated the growth of that branch of medical science now known as psychiatry (*q.v.*). The psychologist found his most interesting and revealing material for the study of the mind in the asylums or hospitals for the insane, and it was only a short step further to the study of similar abnormal types of personality in the prison, with the result that it is scarcely too much to say that in 1929 every psychiatrist was a criminologist. This development, which went on *pari passu* in England and on the Continent and was, in fact, largely inspired by the writings of Freud, Jung and other European students, has, in recent years, become the dominant influence in criminological thought on both sides of the Atlantic.

Social Mechanism and Crime.—During the same quarter-century that has witnessed this extraordinary development of psychologic thought, the social sciences have been turning more and more from speculation and the discussion of general principles to the concrete study of the workings of the social mechanism. Particularly in America, where sociology is a highly favoured study, the science has been greatly enriched and is being in a measure reconstructed through the critical investigation of existing personal and social conditions. Thus we have surveys of cities and towns or of rural communities in which the social conditions which breed dependency and delinquency are brought to light, and "case-studies" of dependent families or of children "in trouble," through which the domestic or individual factors which lie behind the trouble are disclosed and analyzed. Usually the psychologist with his mental tests or the psychiatrist, with his psychoanalytic apparatus and his interpretation of the reaction of the individual to his specific environment, is at hand to contribute his diagnosis to make up the sum of knowledge which the social worker requires. (*See* SOCIOLOGY.)

From these combined influences three results of first-rate importance are already in evidence. The first of these is that criminology is less and less concerned with the identification and description of the criminal and more and more with the understanding of the individual offender; the second, that the principal emphasis is being laid, perhaps to an excessive degree, on the mental study of the delinquent; and the third, that the medical concept of treatment is by way of superseding the legal concept of punishment. The reference here is, of course, to the attitude of the criminologist and not of the public nor of the agencies of law enforcement, which cling to their idols. It is worthy of note how impervious the public and the courts are to the influence of criminological thought. Even the doctrines of Lombroso, during the generation when they were in the ascendant and commanded the allegiance of most Continental students, made practically no impression on the criminal law or procedure of any European country.

The Criminal and the Community.—Opinion among criminologists differs too much as to causes of criminal misconduct to justify a confident statement of their views, but the following tentative summary may, perhaps, be ventured as representing the trend, if not a consensus, of opinion. There is no criminal class except in so far as criminal misconduct has with certain individuals become habitual. Criminals are selected by force of circumstances (and here the economic factor comes into play) from the community at large. The insane, the mentally defective and the psychopathic stand the best chance of being so selected.

It has been upon the whole a fortunate circumstance that, as outlined above, criminology has been adopted into the family of the social sciences. If this robs it of the independent status conferred upon it by its parentage, it has, on the other hand, enormously enlarged its range and utility. Crime now presents itself as only one of many inter-related social phenomena of a malignant character, such as the persistence of poverty, of widespread disease, and of mental disorder and defect. Criminology profits by, and it makes its peculiar contribution to, the study of each of these related disorders of the social body and, like the other social sciences, it furnishes a reflection of the state of health of the community in which crime is permitted to flourish.

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(G. W. Ki.)

CRIMMITSCHAU or KRIMMITSCHAU, town of Germany, in the *Land* of Saxony, on the Pleisse and the main Leipzig-Hof railway, 7 mi. N.W. from Zwickau. Pop. (1939) 26,942. The most important industries are the spinning of carded yarn and wool, and the processes of dyeing, finishing and wool-spinning connected with these. Among other manufactures are boilers and machinery.

CRIMP, an agent for the supplying of soldiers and sailors, by kidnapping, drugging, decoying or other illegal means. Crimps were formerly regularly employed in the days of impressment (*q.v.*). Now the term is used, first of any one who engages to supply merchant seamen without a license from the Board of Trade, and is not either the owner, master or mate of the ship, or is not *bona fide* the servant, and in the constant employment of the owner, or is not a superintendent (Merchant Shipping Act, 1894, III.); and, with a wide application, of the extortionate lodging or boarding-house keepers, who are generally in league with the "crimp" proper.

Sections 212 to 219 inclusive of the above Act provide for the protection from imposition of merchant seamen in sea-going British ships registered in or out of Great Britain or which ought to be so registered. Local officials at seaports have power to make by-laws for licensing and regulating of sailors' lodging-houses, and to inflict penalties for infringement thereof. If this power be not exercised, the Board of Trade may do so. Penalties are also imposed by the act for overcharging by lodging-house keepers, for detaining of seamen's effects, and for soliciting. Unauthorized persons are prohibited from boarding a ship in port without leave. The Board of Trade officer at a port may provide money for sending a seaman to his home on discharge, and may forward his wages after deducting the expenses. Facilities are also given for having wages sent home from foreign ports at a small charge.

In the ports of the United States of America crimping was long prevalent, especially on the Pacific coast, and its prevention was very difficult, but State regulations as to the licensing of boarding-houses, and the limitation of the amount of so-called "blood-money" paid by masters of vessels to the suppliers of crews to ships denuded by desertions, have reduced the abuse.

CRIMSON, a strong, bright red colour tinged to a greater or less degree with purple. The dye is produced from the dried bodies of the cochineal insect. The word is adapted from the Med. Lat. *cremesinus* or *carmesinus,* the dye produced from the insect *Kermes*. From the Lat. *carminus,* a shortened form of *carmesinus,* comes "carmine" (q.v.).

CRINAGORAS, of Mytilene, Greek epigrammatist, flourished during the reign of Augustus (Strabo, xiii. p. 617). A number of epigrams appear under his name in the Greek Anthology. From inscriptions discovered at Mytilene, he appears to have been one of the ambassadors sent from that city to Rome in 45 and 26 B.C.

The epigrams have been edited by M. Rubensohn (1888).

CRINAN CANAL, a small ship-canal in Scotland, extending from Ardrishaig on Loch Gilp to Crinan on Loch Crinan. It was made by a company incorporated in 1793, and was opened for traffic in 1801. At various times it received grants of public money, and ultimately in respect of these it passed into the hands of the government. In 1848 it was vested by parliament in the commissioners of the Caledonian canal, who had in fact administered it for many years previously. The length of the canal is 9 m., and it saves vessels sailing from the Clyde a distance of about 85 m. as compared with the alternative route round the Mull of Kintyre. Its highest reach is 64 ft. above sea-level;

its locks number 15, and admit vessels up to a draught of $9\frac{1}{2}$ ft.

CRINOIDEA, a class of the Echinoderma (*q.v.*) including the feather stars (*q.v.*) and stalked crinoids or sea lilies. Most stalked crinoids are fossil. In the present seas 80 species in 26 genera are known.

CRINOLINE, a stiffening material made of horse-hair and cotton or linen thread. Substitutes for this, such as the straw-like material used in making hat shapes, are also known by the same name. From the use of the material to expand ladies' skirts the term was applied in the 19th century to the whalebone and steel hoops employed to support the wide skirts then worn (*see* DRESS).

CRINUM, a genus (family Amaryllidaceae) of bulbous plants with fleshy leaves and a solid leafless flower stalk, bearing a cluster of handsome white or red funnel-shaped regular flowers. There are 100 or more species, native to tropical regions, some well known in cultivation. The swamp lily (*C. americanum*), of the southern U.S., is sometimes planted for ornament. *C. longifolium* of South Africa is the best known garden sort.

CRIOBOLIUM, the sacrifice of a ram in the cult of Attis and the Great Mother (Gr. κριοβόλιον). Perhaps it was a ceremony instituted after the rise, and on the analogy of the taurobolium (q.v.), which it probably resembled, but was in honour of Attis, for when it was performed in conjunction with the taurobolium, the altar was almost invariably inscribed to both the Mother and Attis, while the inscription was to the Mother alone when the taurobolium only was performed. It was sometimes performed alone (*Corp. Inscr. Lat.* vi. 505, 506).

CRIPPLE CREEK, a city near the centre of Colorado, U.S.A., in a granite pocket 9,600ft. above sea-level; the county seat of Teller county and the heart of one of the greatest gold-producing districts of the world. It is connected with Colorado Springs by the tortuous Midland Terminal railway. The population in 1940 was 2,358. Gold was discovered in Poverty gulch, just northeast of the present city, in 1891 by Bob Womack, a cowpuncher, who died poor; and the Independence vein, on what is now the site of Victor, was struck on July 4, 1891, by W. S. Stratton, a contracting carpenter, who left a fortune of $20,000,000. Before the spring of 1892 the hills swarmed with prospectors.

The railway to Colorado Springs was completed Dec. 16, 1893; the Florence and Cripple Creek railroad was opened the following July.

Twice the town was almost destroyed by fire, after which it was rebuilt of stone and brick. In 1894 and again in 1903–04 there were serious strikes, attended by violence and loss of life.

The Short Line railway was built into the district in 1901.

The gold output was valued at $1,930 in 1891; in 1893 at $2,025,518; and it increased each year until 1900, when the peak was reached at $18,199,736. In recent years it has averaged about $5,000,000.

The higher price of gold, $35 per ounce, set in 1934 gave new impetus to the mining industry in Cripple Creek. While Cripple Creek has dwindled from the booming town of the early period of its history, mining was responsible for a return to prosperity after the early 1930s.

The Cripple Creek district in 1941 produced, through its many active mines, more gold than the combined output of all other mining districts in Colorado.

CRIPPLES. Cripples may be divided into four main categories:

(1) Those suffering from congenital defects;

(2) Those who have become deformed after birth from lack of light, air, exercise and proper diet;

(3) Those who have become deformed as a result of a crippling disease, of which the chief are infantile paralysis and tuberculosis;

(4) Those who have become deformed as the result of injury.

The first category is relatively small, but important, for, as a rule the congenital defect, if skilfully dealt with at once, can be easily rectified, but if not so dealt with grows progressively worse. The second owes its origin to causes which are essentially, if not easily, preventable. The third category is on a somewhat different footing; here the cripple owes his deformity to a specific disease and the deformity can only be removed with the prevention or prompt cure of that disease. The fourth category includes a large and important group, namely, the cripples who are the victims of injuries to spine and limbs. Most deformities are due not to a predisposing cause but to neglect of proper measures of prevention and cure. The potential cripple only becomes as a rule, a cripple in fact, if the necessary treatment is not given in time. Modern methods aim primarily not at housing or training existing cripples, but at preventing or eliminating their disabilities. Experience has shown that 90% or even 95% of potential cripples would never become deformed if they received the right treatment at the right time. It is the object of all concerned with cripples to devise a successful technique, legal, medical and administrative, for securing the early discovery and prompt treatment of every potential cripple who needs it.

A successful national scheme for dealing with cripples requires:—

(a) Adequate bodies of persons to work it, with the necessary legal and financial sanctions behind them, and

(b) Efficient methods for the discovery, treatment, cure and training of cripples.

EUROPE

The varying measures and methods adopted in some of the leading European countries may be briefly indicated.

Great Britain.—In England and Wales, as regards the first of the above mentioned requirements, there are statutes which lay upon certain public bodies the legal responsibility for the care of cripples. For children under school age, there are the local Committees set up by the Maternity and Child Welfare Act, 1918. Non-tuberculous children of school age fall under the care of the Local Education Authorities, who are required by the Education Act, 1921, to submit all school children to periodic medical examinations and provide the necessary medical care and appropriate education for all physically defective children. Lastly, all tuberculous patients fall to the care of Local Public Health Authorities working under the Public Health (Tuberculosis) Act 1921.

The Local Education Authorities work under the general direction of the Board of Education, and the Maternity and Child Welfare Committees and Public Health Authorities under the Ministry of Health. In each case the actual work is organized and carried out by the Local Authorities who receive from the Government Departments concerned a grant which amounts, as a rule, to 50% of expenditure incurred with their approval. Broadly, the above named acts provide for the care and cure of all cripples other than non-tuberculous cripples over school age for whom at present no public body is responsible.

In addition, there exist many voluntary associations, supplementing the work of the public bodies and working as a rule in close co-operation with them. They frequently act as their agents, supplement their activities by undertaking work which is outside any statutory sanction or which is called for in areas where the Public Authorities are backward. In carrying out their duties, they focus public opinion with a view to stimulating the public authorities to assume their legal responsibilities. These local associations are represented on a central voluntary body known as the Central Council for the Care of Cripples, which has offices at 117 Piccadilly, London, W. 1. This Central body is representative of all the societies and persons, including orthopaedic surgeons, who are concerned with cripples, and is in touch with the Ministry of Health, the Board of Education and the Ministry of Labour. It includes representatives from Wales, Scotland and Ireland. Thus, both centrally and locally, means exist for the co-operation of the public and private bodies concerned.

Preventive and Remedial Measures.—The second requisite for a successful national scheme for dealing with cripples is an efficient organization for the early discovery, treatment, cure and training of cripples. The organization which has now been developed in England and Wales is based upon the fundamental idea of an *orthopaedic unit, i.e.,* an area which contains within itself the personnel, buildings, apparatus, etc., for dealing with all the cripples and potential cripples in that area. The orthopaedic requirements of such an area are:—

(a) A skilled orthopaedic surgeon and a body of trained orthopaedic nurses;
(b) A central orthopaedic hospital, including a hospital school and workshops;
(c) Clinics in convenient parts of the area, served by the surgeon and nurses from the central hospital, with local help.

A case found early may be treated quickly and cheaply in its own home and at the neighbouring orthopaedic clinic. The more serious case will go to the orthopaedic hospital where education will be provided for the child and vocational training in workshops for the older patient. When hospital treatment is over, the patient will be returned to his own home, but will be kept under observation until all fear of a relapse is passed.

Efficient orthopaedic schemes are not yet to be found in every area, but the parts of the country where little or no provision is made for cripples are rapidly growing fewer. The provision made for the training and employment of the formed cripple lags behind. This is due largely to the fear that has existed that advocacy of schemes for training cripples might obscure the greater issue and divert to training, energy and funds more profitably spent in prevention.

The first efforts at hospital organization for cripples date from the foundation of the Birmingham Orthopaedic Hospital in 1817, and the Royal National Orthopaedic Hospital in London in 1838, the Alexandra Hospital, the Sevenoaks Hospital, and the Cheyne Hospital, all founded soon after the middle of the last century, and the special orthopaedic department in general hospitals, starting with that at St. Bartholomew's in 1867. Of open-air hospitals the first founded was that at Heswall in 1899, and this has been followed by the establishment of a large number of country hospitals designed to give their patients the utmost benefit from open-air and sunlight.

The first efforts at the education of cripples consisted in the foundation of vocational schools. One for girls, now situated at Winchmore Hill, was founded in 1851, and two others for boys soon afterwards. The best known vocational school, the Heritage School at Chailey, was only founded in 1903. Special elementary education for invalid and crippled children owes its origin to the late Mrs. Humphrey Ward, who started a day school in London in 1898. This was followed by the passing of an Act of Parliament authorizing Education Authorities to maintain such schools, and a rapid extension of special elementary education of cripples able to get to school has taken place, first in London and afterwards in certain other large cities.

In Scotland the general principles for dealing with cripples follow in the main those of England. The same is true of Ireland where the efforts, though sporadic, are becoming co-ordinated.

France.—In France, tuberculosis of bones and joints is the dominating crippling disease in children and for such patients special hospitals have been available for many years.

In 1919 the segregation and treatment of necessitous individuals suffering from tuberculosis became compulsory. Treatment in French special hospitals is financed from local taxation with additional contributions from the state taxes on racing and gambling. About 8,000 beds are available, either on the sea coast or in high altitudes. Of the marine centres Berck-sur-Mer, on the English Channel, is the most important; here, some 6,000 patients are usually under treatment in various hospitals, clinics or hotels. The large Maritime Hospital at Berck, controlled by the city of Paris and the Department of the Seine, is world famous. Similar centres with less accommodation exist on the Mediterranean coast near Toulon and on the North Sea at Zuydcoote. The mountain hospitals are smaller and are situated in the Pyrenees and Maritime Alps.

In the treatment of non-tuberculous cripples voluntary organizations are still called upon to bear the chief responsibility, but they tend to work more and more under a certain amount of State control, and thus a nucleus of a complete national scheme is foreshadowed. The colony of St. Fargeau in the suburbs of Paris, founded in 1919, deals entirely with children suffering from infantile paralysis. There is adequate provision for the purely surgical treatment of the cripple in the hospitals of the University centres and larger towns.

Italy.—Italy possesses a number of orthopaedic hospitals which are second to none in equipment and efficiency. The most notable are the Istituto Ortopedico Rizzoli, in Bologna, and the Istituto dei Rachitici at Milan. These hospitals and others of a similar type originated many years ago as special schools for the treatment of rickety children. The first school was established at Florence in 1839, followed by similar institutions in Turin, Genoa, Mantua, Cremona, Verona, Venice, Padua, and elsewhere. A striking feature of these special hospitals is the workshop installation in which the Italian reputation for skilled engineering is well exemplified. Special maritime hospitals for the treatment of surgical tuberculosis were founded as long ago as 1853, the most important being at Viareggio, Rimini, Spontorno, Ligure and Palermo. In the newly acquired Trieste region there is now a large hospital of 500 beds, organized by the Italian Red Cross, part of which is devoted to orthopaedic surgery.

The most recent addition (1923) to the special hospital group is the Codivilla Institute for surgical tuberculosis at Cortina, in the Dolomites, which is affiliated to the Rizzoli Instituto at Bologna.

Germany.—The German Association for the Care of Cripples has as its main object the professional training of cripples and their general care and education. Throughout Germany the welfare of cripples is the responsibility of the State and they have by law the right of being educated, instructed and trained for a profession. The law also compels all cripples whose cases cannot be improved by treatment, to enter special institutions where their education and training are dealt with, and when they are trained for a trade or profession the Board of Professional Training is obliged to find suitable work for them. Where parents are not able to meet the cost of treatment, this is paid by Local Care Authorities who are also obliged to hold public lectures on crippledom, its prevention and treatment. There is a Central Institute, the Oscar Helene Heim, at Berlin, for the exploration and continued work for the care of cripples in Prussia and the German Republic. In addition to this, there are 78 Cripple Homes in Germany, of which ten are supported by the State; the others, although recognized by the Authorities, are organized by an independent Association of Cripple Workers under the name of "Selbsthilfebund der Korperbehinderten." Training centres at which instruction in different trades and professions for boys and girls is given, are run in connection with these Homes.

Since 1920, according to the law for the protection of physical defectives, a proportion of physically handicapped workers, at least 50% disabled, has to be employed in certain trades and professions.

Austria.—There is at present no central organization in Austria with the prevention of crippledom and the cause and cure of cripples as its aim. It was hoped that by the end of 1928 such an organization would be founded under the name of the "Austrian Central Council for the Care of Cripples." At the present time the only assistance offered to the cripple by the State is through the Poor Law System.

The city of Vienna has an orthopaedic hospital and an Institute for Cripple Welfare and in the province of Steiermark there is an Institution for Cripples where training is given and employment provided. In 1927 a progressive step was taken by the opening of a School for physically defective children which is run much on the same lines as the schools for physically defective children in England. There is no facility for transport from homes to school although free tickets on trams are provided for each child and attendant.

In 1927 a Society ("First Austrian Society for Work for Cripples") was founded by Herr Braun who is himself a cripple, in Vienna. The aims of the Society are:—

(a) To foster in cripples themselves the desire to escape from pauperism and become self-supporting and useful members of society;

(b) To bring before the country the present position and need of its cripples.

With a view to furthering this work, a census was taken of all cripples in the country and the Austrian Government approached with the idea that:—

(1) Education be made obligatory for crippled children.

(2) In each province of Austria a Committee be appointed consisting of a special medical authority for health for cripples, an education authority and a member of Herr Braun's Association.

(3) Adequate national cripple schools, homes and training homes be erected to provide for the care, training and employment of cripples.

(4) Orthopaedic surgery be included in the ordinary medical examinations.

The society has, since its inauguration, opened workshops for training in various crafts and trades from its headquarters in Vienna and has opened several independent branches.

The city of Vienna, in recognition of the service done for its crippled citizens, gave both the accommodation for the workshops in Vienna and a small subsidy. Other support is raised from subscribers and to a large extent from members of the Association.

Denmark.—Denmark was one of the first countries to realize its responsibility towards its cripples and to see the necessity of combining their treatment with an education and training which enabled them to become useful and self-supporting members of the community. The "Samfundet" founded in 1871 as a central bureau for the assistance of crippled and invalid workers, formed the nucleus of the present central association "Samfundet og Hjemmel" (Association and home for the Help and Protection of the Crippled) in Copenhagen. The administration of the association is carried out by an executive committee which acts in an advisory capacity on all matters concerning the welfare of cripples and which is at the same time responsible for the running of the central Association and all its departments. The "Samfundet" comprises an orthopaedic hospital with all its appliances, a special department for remedial treatment, massage, etc., an out-patient clinic for the examination of patients, the treatment of the less serious cases, the fitting and adjusting of instruments and plaster bandages, and supervision of patients discharged from the wards. In addition a residential school for crippled children, and an industrial home for the vocational training of older cripples of both sexes, are run in connection with the institution. The instructors at the training centre are themselves physically handicapped, and the trainers are, as far as possible, employed by the association when sufficiently proficient in their trade. During their training the students are kept under strict supervision and undergo necessary treatment at the same time.

A convalescent home at Boinely, on the coast, is annexed to the central institute, and accepts patients for the completion of their treatment after leaving hospital and also students from the industrial school who are in need of rest. In most cases the cost of maintenance is borne by the State.

The administrative committee gives its services entirely voluntarily and the institute itself, although partly supported by Government grants, is dependent on the payment of patients, and voluntary donations.

Holland.—In Holland, so far, the State has made no laws to regulate treatment of cripples and gives no financial assistance to the voluntary bodies. Moreover, neither public opinion nor private charity has yet risen to the needs of the country. The Institutes for Cripples are the Johanna Institute with 37 beds; the Adrian Institute, with complete hospital, dispensary, 17 beds, and much land; the Wilhemina Hospital in Amsterdam with an orthopaedic department and 16 beds; and the University of Leyden with a similar Department and three beds. There are in addition five orthopaedic dispensaries.

Norway.—Few, if any, countries have developed their organization for the care of cripples more thoroughly than Norway. There is a central board for cripples established by law under the Minister of Social Affairs, to organize the care of cripples in co-operation with voluntary bodies. One of the first acts of the board was to recommend the various communities throughout the country to elect municipal cripples committees, with the object of securing unity of administration. Practically every community has adopted this recommendation. A register of cripples was soon started and this was followed in 1920 by a general census of cripples taken by the central board. Thus, Norway is exceptionally well provided with the data of the cripple problem. The central board does not maintain institutions of its own, but acts as a central advisory body and publishes pamphlets of interest to cripple committees.

The headquarters of orthopaedic work in Norway is the Central Institute for Cripples in Oslo, itself the outcome of the Handicraft School for Cripples, started in 1892. The institute is designed for 300 cripples and is to include every provision that a first-rate orthopaedic unit involves—hospital, workshops, clinic, show-rooms for work made at the Institute, accommodation for men, women, boys and girls respectively.

An interesting feature is the establishment of more than 1,500 Cripples Unions by the cripples themselves. The originator of the movement was a cripple who now edits a paper "Solglimt" (Sunbeam) devoted to the cause of cripples, which has over 4,000 subscribers. All the work now being done in Norway is voluntary. A "Cripples Law" which would give statutory sanction to a comprehensive national scheme, is under consideration.

Sweden.—There are no laws in Sweden regulating the orthopaedic treatment, industrial training, and social care of cripples. But there are four voluntary associations devoted to their assistance, of which those at Stockholm, Gothenburg and Helsingburg, have established recognized institutions aided by the State. These associations are connected by means of the Central Committee for the care of cripples, which aims at the organization of cripple treatment all over the country. The three institutions have clinics, dispensaries, industrial schools, homes for pupils, evening schools, and in addition a residential school and educational home for badly crippled children. They depend in part, on patients' payments. Those who cannot pay for treatment are helped by the Poor Law. In the 10 years 1915–1925, over 23,000 patients passed through the dispensary and clinic departments, while in 1923 the number of operations was over 4,000. In addition orthopaedic clinics and departments are attached to some of the general hospitals, as for instance, those at Malmo and Lund. The St. Gorens Hospital, Stockholm, has a department for tuberculosis of the bones and joints. There are also certain seaside hospitals for children suffering from non-pulmonary tuberculosis. In 1920 a Royal Commission issued a report urging considerable extension of the present activities, but the necessary financial aid has not yet been granted by the Swedish Government.

UNITED STATES

The public concern which has developed since 1919, aroused by the number of cripples in the United States, and the interest displayed in their welfare are evidences of that broader humanitarianism that characterizes the modern attitude to all defectives. From 1863, when the hospital for the ruptured and crippled was opened in New York city during the Civil War, until 1914, interest in cripples was confined to limited circles, and their care was largely institutional. The White House social workers' conference on dependent children, summoned by President Roosevelt in 1909, first awakened the interest of the public in these unfortunates. This interest became intensified by the sufferings of the crippled victims of the infantile paralysis epidemics in Vermont and New York during the period 1914 to 1916, when in New York city alone 6,574 surviving children required clinical treatment. After the care lavished on disabled soldiers during the World War, the conviction became general that these other cripples should be aided and encouraged also.

Causes and Prevention.—Two of the main causes of crippling are diseases affecting children and industrial accidents. Accidents on streets and highways and in the home also cause much disablement. In 1916 a survey of cripples in New York city disclosed

35,928, 63% becoming crippled before the age of 16. About 8,000 were under 5 and approximately 10,000 between 5 and 15. Of these, 7,000 cases were remediable or correctible and 6,300 cases of rickets might have been benefited by medical and surgical attention. A survey in New York State, 1924–25, showed 30,000 crippled children. In North America, according to an estimate made in 1927, there are 500,000 cripples under 21. Of crippling conditions among children infantile paralysis accounts for 27·26%; bone and joint tuberculosis, 23·65%; congenital deformities, 13·15%; rachitic deformities, 8·05%; traumatic conditions, 4·20%; osteomyelitis, 3·67%; and other conditions, 20·20%. Add to the 58·96% of cripples whose condition is caused by infantile paralysis, bone tuberculosis and rickets the 13·15% of those congenitally deformed, and it is apparent that 72·11% are young children, fully 50% being of pre-school age who, treated soon enough, might be cured or relieved (*see* BLOODLESS SURGERY). Between 12,000 and 15,000 are crippled by infantile paralysis in non-epidemic and probably 40,000 in epidemic years. Legislation indicates the preventive trend. Massachusetts as early as 1905 made a State survey. California, Illinois, Michigan, Ohio, West Virginia and Wisconsin require the enumeration of cripples. Minnesota (1897), New York (1899), Pennsylvania, Nebraska (1905), Massachusetts (1907), New Jersey, Michigan, Montana and Vermont (1913), Iowa (1915), Oregon and Virginia (1917), Kansas and Texas (1920), Indiana (1921), North Carolina (1922), North Dakota and Oklahoma (1923) and California and Missouri (1927) provide orthopaedic treatment in State institutions or elsewhere at public expense.

The hearings before the Congress committee concerned with the bill to promote rehabilitation of persons disabled while following their vocations, in Dec. 1918, brought out the fact that at least 800,000 men in general employment are incapacitated each year for a period of more than four weeks and require physical restoration. The average age of disability is 33. An estimate made in 1927 and based on accident statistics and rehabilitation programmes asserts that 50,000 persons each year are in need of vocational rehabilitation.

Education.—Among the earliest private schools for cripples founded in any country, and the first in the United States, was that conceived in 1861 and established in 1863 in New York city by Miss Cornelia and Dr. James Knight. In 1890 the New York city Children's Aid Society opened the Rhinelander Industrial school for crippled children. Boston followed in 1893 with the well-known Industrial school for crippled and deformed children based on the Milan (Italy) plan; Chicago came next, in 1897, the city assuming the responsibility within two years; and Cleveland in 1900, when the first kindergarten was opened. Excluding the work done at the Minnesota State hospital and home for crippled children, established in 1897, the first institution started entirely by public initiative, the first public school was that planned in 1899 in Chicago and opened in 1900. The board of education little thought that it was taking an advanced step and setting an example. New York city in 1906 took over under its public school system the payment of the teachers and furnished schoolroom equipment for two of the private schools. It also started classes for crippled children, the first at Public school 104, after investigating classwork under the Association for the Aid of Crippled Children, the latter maintaining the buses for transportation up to 1913, when the board of education undertook this responsibility. Among private schools for cripples the Widener Memorial school, built at a cost of $1,132,000 and opened in 1906, for children between 9 and 10 years who remain until between 18 and 20, is noteworthy. It is lavishly and beautifully planned on the cottage system, with a summer home facing the sea at Longport, New Jersey. It is maintained with the income from a $4,000,000 trust fund created by P. A. B. Widener and the expenditure per head is $1,115.

In 1914 there were 2,862 crippled pupils in public and private schools, 988 of whom attended the 51 public school classes in Chicago, New York, Cleveland and Detroit. Fifteen States have now passed laws making the education of crippled children in special schools or classes, or by home teaching for those confined to the home, a public responsibility. According to the survey of the International Society for Crippled Children made in 1923–24 there were 6,225 crippled pupils in 82 special schools. Bus transportation at public expense is in general practice, the boards of education maintaining vehicle, attendant and chauffeur to convey the children to school, to clinic, to hospital or to places of special information or recreation, as required. Crippled children in most rural areas, however, lack facilities afforded those in urban districts unless they leave home for a State institution. Forty out of 88 counties in Ohio do provide home teaching for cripples. Kentucky has a permanent commission which insures education and physical correction in rural territories as well as in large cities. With the State superintendent of public instruction it is responsible for the registration of crippled children; the conduct of public diagnostic clinics; in co-operation with the school authorities and probate courts, for treatment in properly equipped hospitals of the State; education of crippled children during convalescence; payment of costs of care and education of poor patients and pupils; and the proper "follow-up" supervision of cases after discharge. Provision was made for education at about 150 private hospitals, convalescent institutions and homes for crippled children in 1924, which school work is supervised and supported by the educational authorities.

The education of cripples is threefold: the usual curriculum general in most schools; physical exercises and corrective and curative treatment including heliotherapy, special diets and rest cures; and prevocational and vocational training suited to the particular handicap, teaching loom-work, garment, fancy flower and favour making, sheet-metal work and decorative designing. Its "excess cost" averages about $200 per year where the pupil is not boarded. Properly equipped and trained teachers are somewhat lacking. It was advocated in 1928 that training centres for teachers and nurses for crippled children as well as for field workers of both young and adult be established in the various States. The Michigan State Normal college at Ypsilanti, the University of Michigan at Ann Arbor, and Hunter college, New York city, alone make provision, though similar courses were contemplated (1928) at the Ohio State university and in Marion, Ill., in co-operation with the Southern Illinois State teachers college.

Training and Welfare.—Cripples are treated at special hospitals owned and maintained at public expense in connection with State university hospitals; public institutions entirely owned and operated by the State; private institutions receiving various types of State aid; and private institutions for which fraternal or social organizations are responsible. Shriners, Rotarians, Kiwanians, Lions, Elks, the Women's Federation of Clubs, the Parent-Teachers' Association and others all make provision for surgical treatment, hospital care and braces and appliances for cripples. The Ancient and Accepted Order of the Mystic Shrine, for example, has ten hospitals costing from $304,000 to $661,000, and five "mobile units" which reach many crippled children in California, Illinois, Kentucky, South Carolina, Louisiana, Massachusetts, Minnesota, Missouri, Oregon, Pennsylvania, Hawaii, Utah and adjacent territory; the Scottish Rite maintains a hospital in Georgia; and there are Masonic hospitals in Texas, Kentucky and Pennsylvania.

Following the establishment of the Hospital for the ruptured and crippled in New York city referred to, the New York Orthopedic hospital was founded in 1866. Both provided medical attention only. The first home for cripples was the Home of the Merciful Saviour (1884) and the House of St. Michael and All Angels for young coloured cripples (1887) both in Philadelphia, with a summer home at Avon, New Jersey. Two were started next in New Jersey in 1892 and 1893, ten others established before 1900, and 20 between 1902 and 1912. Twenty-seven additional ones cared for a few crippled persons as subsidiary to their main work. Apart from support and training in institutions and a private school for adult men between 16 and 35 opened in New York city in 1912 by Dr. Charles Jaeger in which is taught the making of reed articles, metal work, mechanical drawing, engraving and woodwork, little had been done before 1917 for the rehabilitation of adult cripples. In that year Minnesota began a study into their condition and Wisconsin in 1918 started some placement work. It was the interest of Jeremiah Millbank in them that led to the establishment in January 1918, of what is now the Institute for the Crippled and Disabled, New York city, the work of which indirectly laid the foundation for the vocational rehabilitation of the disabled in the United States.

At first, the institute confined its attention to men but now also includes women. Its experience shows that complete rehabilitation means physical restoration, training for a suitable job, maintenance during training, assistance in obtaining proper artificial aids and appliances and placement through a bureau skilled in finding work for disabled persons. The first is outside its province; in all else its record has won national commendation. Cripples are taught printing, mechanical and architectural drawing, motion picture projection, typewriter repair and jewellery making, optical mechanical work, surface grinding and edge grinding of lenses and oxy-acetylene welding. Artificial appliances are made on the premises with special devices to enable the person to do a particular line of work, as, for instance, a kind of hook by which a one-handed man can drive a five-ton truck and a typing finger for a girl born without fingers. For its placement bureau, a survey was made of 2,000 businesses in New York city. Its "sheltered workroom" gives employment to otherwise unemployable cripples previously considered home-bound and another service takes work on a piece-basis to those confined to their homes. Cleveland and Chicago also have such institutions.

The Federal Government's programme for the vocational rehabilitation of disabled persons was inaugurated on June 2, 1920, following the principle that workmen's compensation alone is inadequate. The original bills introduced in September 1918, by Senator Smith and Representative Bankhead failed to pass the 65th Congress but became law the following session when reintroduced by Senator Kenyon and Representative Fess. Six States had established such a rehabilitation service before the passage of the national act—Massachusetts 1918; New Jersey, Minnesota, Pennsylvania and California, 1919; and New York, 1920. Provisions of the Kenyon-Fess bill were made operative for four years but a 1924 amendment extended the period to June 30, 1930.

In 1928, 41 States had enacted laws accepting the provisions of this Federal act and providing for the promotion under State and Federal auspices of programmes of vocational rehabilitation. Federal aid offered to each State accepting the act is on the basis of dollar for dollar annually in the amount of $1,000,000 for all of the States, each receiving a share on the basis of the proportion of its population to that of the entire country, with the provision that no State shall receive less than $5,000 annually. But in practice the States have expended more money; $3,335,713 for the period 1921–26 as against $2,586,918 from federal funds; 24,034 persons were rehabilitated. The number of women is generally small. In 1926, it was 13% but four times as many men as women become disabled. The cost of rehabilitation per case has decreased from $393 in 1922 to $233 (the cost of maintaining a person unable to work for a living in a poor house or institution is from $300 to $500).

As implied by the title of the act rehabilitation is vocational not physical. Case work methods are used. Maintenance during training is a difficulty when compensation money is lacking or inadequate. Therapeutic treatment, too, must come through other agencies, for this rehabilitation service is held to be "primarily economic and only secondarily social and humanitarian." Another problem in rural areas is lack of employment for the crippled. To achieve complete rehabilitation the State service maintains co-operative relations with all agencies in a position to meet phases of the problem other than the vocational.

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CRISA or **CRISSA,** an ancient city of Greece, is in Phocis, on one of the spurs of Parnassus. In the *Iliad* and the Homeric *Hymns,* it is described as powerful, with rich fertile territory, reaching from the sea to the sanctuary of Pytho. As the town of Delphi grew up around Pytho, and the seaport of Cirrha arose on the Crisean Gulf, Crisa lost importance. By the ancients the name of Cirrha was often substituted for that of Crisa. From its position Cirrha commanded the approach to Delphi, and became obnoxious to Greeks from the heavy tolls exacted from pilgrims. The Amphictyonic Council declared the first "Sacred War" against it in 595 B.C., razed the town to the ground, and consecrated its territory to the temple at Delphi, selling the plunder to defray the expenses of the Pythian games. In 339 B.C. the people of Amphissa began to rebuild the town and to cultivate the plain. This act brought on the second "Sacred War," entrusted by the Amphictyons to Philip of Macedon, who took Amphissa (mod. Salona) in the following year. The ruins of Crisa are at the mouth of the Pleistus ravine; its name is probably preserved by the modern village of Chryso.

See J. G. Frazer, *Pausanias,* v. 459 (note on x. 375).

CRISFIELD, a town of Somerset county, Maryland, U.S.A., on Tangier sound of Chesapeake bay, opposite the mouth of the Potomac river; the terminus of a line of the Pennsylvania railway. The population in 1920 was 4,116 (28% Negroes), and was 3,908 in 1940 by the federal census. Crisfield is the centre of the crab industry of the bay, and it has oyster-packing and shipbuilding plants. The town was settled about 1866 and incorporated in 1872.

CRISPI, FRANCESCO (1819–1901), Italian statesman, was born at Ribera in Sicily on Oct. 4, 1819. In 1846 he established himself as advocate at Naples. On the outbreak of the Sicilian revolution at Palermo (Jan. 12, 1848) he hastened to the island and took an active part in guiding the insurrection. Upon the restoration of the Bourbon government (May 15, 1849) he was excluded from the amnesty and compelled to flee to Piedmont. Here he eked out a penurious existence by journalism. Implicated in the Mazzinian conspiracy at Milan (Feb. 6, 1853) he was expelled from Piedmont, took refuge at Malta, whence he fled to Paris. Expelled from France, he joined Mazzini in London and continued to conspire for the redemption of Italy. On June 15, 1859, he returned to Italy after publishing a letter repudiating the aggrandizement of Piedmont, and proclaiming himself a republican and a partisan of national unity. Twice in that year he went the round of the Sicilian cities in disguise, and prepared the insurrectionary movement of 1860.

Upon his return to Genoa, he organized, with Bertani, Bixio, Medici and Garibaldi, the expedition of the Thousand, and overcoming by a stratagem the hesitation of Garibaldi, secured the departure of the expedition on May 5, 1860. After the fall of Palermo, Crispi was appointed minister of the interior and of finance in the Sicilian provisional government, but he resigned soon after. Entering parliament in 1861 as deputy of the extreme Left for Castelvetrano Crispi acquired the reputation of being the most aggressive and most impetuous member of the republican party, but in 1864 he made at the chamber a monarchical profession of faith in the famous phrase afterwards repeated in his letter to Mazzini. "The monarchy unites us, the republic would divide us." On the outbreak of the Franco-German War he sought to impede the projected alliance with France, and to drive the Lanza cabinet to Rome. The death of Ratazzi in 1873 induced Crispi's friends to put forward his candidature to the leadership of the Left; but Crispi, anxious to reassure the crown, secured the election of Depretis. After the advent of the Left he was elected (Nov. 1876) president of the chamber.

In Dec. 1877 he replaced Nicotera as minister of the interior in the Depretis cabinet, his short term of office (70 days) being signalized by a series of important events. On Jan. 9, 1878, the death of Victor Emmanuel and the accession of King Humbert enabled Crispi to secure the formal establishment of a unitary monarchy, the new monarch taking the title of Humbert I. of Italy instead of Humbert IV. of Savoy. On Feb. 9, 1879, the death of Pius IX. necessitated a conclave, the first to be held after the unification of Italy. Crispi helped by Mancini and Cardinal Pecci (afterwards Leo XIII.) persuaded the Sacred College to hold the conclave in Rome. Unfortunately a storm of indignation was conjured up by Crispi's opponents in connection with a charge of bigamy not susceptible of legal proof and he was compelled to resign office. For nine years Crispi remained politically under a cloud, but in 1887 returned to office as minister of the interior in the Depretis cabinet, succeeding to the premiership upon the death of Depretis (July 29, 1887).

Basing his foreign policy upon the Triple Alliance as supplemented by the naval *entente* with Great Britain, Crispi assumed a resolute attitude towards France, breaking off the prolonged and unfruitful negotiations for a new Franco-Italian commercial treaty. At home he secured the adoption of the Sanitary and Commercial Codes and reformed the administration of justice. Forsaken by his Radical friends, Crispi governed with the help of the Right until on Jan. 31, 1891, an intemperate allusion to the *sante memorie* of the conservative party led to his overthrow. In Dec. 1893 the impotence of the Giolitti cabinet to restore public order, then menaced by disturbances in Sicily and in Lunigana led to a general demand that Crispi should return to power. Crispi's uncompromising suppression of disorder, and his refusal to abandon either the Triple Alliance or the Eritrean colony, or to forsake his colleague Sonnino, minister of finance, caused a breach between him and the radical leader Cavallotti, who then began against him a pitiless campaign of defamation. An unsuccessful attempt upon Crispi's life by the anarchist Lega brought a momentary truce, but Cavallotti's attacks were soon renewed more fiercely than ever. The general election of 1895 gave Crispi a huge majority, but a year later, the defeat of the Italian army at Adowa in Abyssinia brought about his resignation. The ensuing Rudini cabinet lent itself to Cavallotti's campaign and at the end of 1897 the judicial authorities applied to the chamber for permission to prosecute Crispi for embezzlement. A parliamentary commission, appointed to inquire into the charges against him, discovered only that Crispi, on assuming office in 1893, had found the secret service coffers empty, and had borrowed from a state bank the sum of £12,000 for secret service, repaying it with the monthly instalments granted in regular course by the treasury. The commission, considering this proceeding irregular, proposed, and the chamber adopted, a vote of censure, but refused to authorize a prosecution. Crispi resigned his seat in parliament, but was re-elected by an overwhelming majority in April 1898 by his Palermo constituents. Soon afterwards, however, his health began to fail and he died at Naples on Aug. 12, 1901.

In regard to foreign politics Crispi did much to raise Italian prestige and to dispel the reputation for untrustworthiness and vacillation acquired by many of his predecessors. If in regard to France his policy appeared to lack suavity and circumspection, it must be remembered that the French republic was then engaged in active anti-Italian schemes and was working, both at the Vatican and in the sphere of colonial politics, to create a situation that should compel Italy to bow to French exigencies and to abandon the Triple Alliance.

See *Scritti e discorsi politici di F. Crispi, 1847–1890* (1890); W. J. Stillman, *Francesco Crispi* (1899); G. Arcoleo, *Francesco Crispi* (Milan, 1905); *Francesco Crispi: Politico estero*, etc. (Milan, 1912). Eng. trans. 3 vols. (1912–14); G. Castellini, *Crispi* (Florence, 1915); G. Salvemini, *La Politica estera di Francesco Crispi* (1919).

CRISPIN and **CRISPINIAN,** the patron saints of shoemakers, whose feast falls on Oct. 25, have a legendary history, traceable to the 8th century. It is said that they were brothers, of a noble Roman family and that they travelled to Soissons, where they supported themselves by shoemaking and made many converts. The emperor Maximianus (Herculius) condemned them to death but they escaped from the ordeals imposed by his prefect Rictiovarus. At last Maximian had their heads cut off (*c.* 286). Their remains were buried at Soissons, but were afterwards removed, partly by Charlemagne to Osnabrück and partly to the chapel of St. Lawrence in Rome. There are also relics at Fulda, and a Kentish tradition claims that their bodies were cast into the sea and floated ashore at Romney Marsh (see *Acta SS.* Bolland, xi. 495; A. Butler, *Lives of the Saints,* Oct. 25).

In France, especially, the festival of St. Crispin was for centuries the occasion of solemn processions and merry-making, in which gilds of shoemakers took the chief part. In England the day acquired additional importance as the anniversary of Agincourt (*cf.* Shakespeare, *Henry V.* iv. 3).

CRISTÓBAL, Panamá Canal Zone, the American port adjoining the city of Colón, at the northern terminus of the canal. (*See* PANAMÁ CANAL and COLÓN.)

CRITIAS, Athenian orator and politician. In his youth he was a pupil of Gorgias and Socrates. In 415 B.C. he was implicated in the mutilation of the Hermae (*q.v.*) and imprisoned. In 411 he helped to put down the Four Hundred, and was instrumental in procuring the recall of Alcibiades. He was banished (probably in the democratic reaction of 407) and fled to Thessaly, where he stirred up the *Penestai* (the helots of Thessaly) against their masters, and endeavoured to establish a democracy. Returning to Athens he became one of the Thirty Tyrants who in 404 were appointed by the Lacedaemonians. He was killed in battle against Thrasybulus and the returning democrats. Critias was a man of varied talents—poet, orator, historian and philosopher. Some fragments of his elegies will be found in Bergk, *Poeta Lyrici Graeci.*

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CRITICAL POINT, in physics, the point above or below which certain physical changes will not occur. In the study of *change of state* (*see* HEAT and THERMODYNAMICS) the properties of the substance at this point are called its *critical constants.* In mechanics, the smallest angle which an inclined plane must make with the horizontal in order that a body resting on it should slide is called the *critical angle.* (*See* FRICTION.) In an oscillating system the *critical damping* is the minimum amount of damping that will cause the value of its potential energy to fall to zero without further oscillation. (*See* VISCOSITY; CONDENSER [ELECTRICAL] and INSTRUMENTS, ELECTRICAL.) There are numerous other instances of this application of the word critical in the sense of "limiting."

CRITICISM, the art of judging the qualities and values of an aesthetic object, whether in literature or the fine arts. It involves the formation and expression of a judgment on the qualities of anything, and Matthew Arnold defined it in this general sense as "a disinterested endeavour to learn and propagate the best that is known and thought in the world."

It may be laid down as the definition of criticism in its pure sense, that it should consist in the application, in the most competent form, of the principles of literary composition. Those principles are the general aesthetics upon which taste is founded; they take the character of rules of writing. From the days of Aristotle the existence of such rules has not been doubted, but different orders of mind in various ages have given them diverse application, and upon this diversity the fluctuations of taste are founded. Over-legislation has been the bane of official criticism, and originality, especially in works of creative imagination, has been condemned because it did not conform to existing rules. Such instances of want of contemporary appreciation as the reception given to William Blake or Keats, or even Milton, are quoted to prove the futility of criticism. As a matter of fact they do nothing of the kind. They merely prove the immutable principles which underlie all judgment of artistic products to have been misunderstood or imperfectly obeyed during the life-time of those illustrious men. False critics have built domes of glass, as Voltaire put it, between the heavens and themselves, domes which genius has to shatter in pieces before it can make itself comprehended. In critical application formulas are often useful, but they should be held lightly; when the formula becomes the tyrant where it should be the servant of thought, fatal error is imminent. What is required above all else, by a critic is knowledge, tempered with good sense, and combined with breadth of sympathy and an exquisite delicacy of taste.

To pass to an historical examination of the subject, we find that in antiquity Aristotle was regarded as the father, and almost as the founder, of literary criticism. Yet before his day, three Greek writers of eminence had examined, in more or less fullness, the principles of composition; these were Plato, Isocrates and Aristophanes. The comedy of *The Frogs*, by the latter, is the earliest specimen we possess of hostile literary criticism, being devoted to ridicule of the plays of Euripides. In the cases of Plato and Isocrates, criticism takes the form mainly of an examination of the rules of rhetoric. We reach, however, much firmer ground when we arrive at Aristotle, whose *Poetics* and *Rhetoric* are among the most valuable treatises which antiquity has handed down to us. Of what existed in the literature of his age, extremely rich in some branches, entirely empty in others, Aristotle speaks with extraordinary authority; but Mr. G. Saintsbury has justly remarked that as his criticism of poetry was injuriously affected by the non-existence of the novelist, so his criticism of prose was injuriously affected by the omnipresence of the orator. This continues true of all ancient criticism. A work by Aristotle on the problems raised by a study of Homer is lost, and there may have been others of a similar nature; in the two famous treatises which remain we have nothing less important than the foundation on which all subsequent European criticism has been raised. It does not appear that any of the numerous disciples of Aristotle understood his attitude to literature, nor do the later philosophical schools offer much of interest. The Neoplatonists, however, were occupied with analysis of the Beautiful, on which both Proclus and Plotinus expatiated; still more purely literary were some of the treatises of Porphyry. There seems to be no doubt that Alexandria possessed, in the 3rd century, a vivid school of critic-grammarians; the names of Zenodotus, of Crates and Aristarchus were eminent in this connection, but of their writings nothing substantial has survived. They were followed by the scholiasts, and they by the mere rhetoricians of the last Greek schools, such as Hermogenes and Aphthonius. In the 2nd century of our era, Dio Chrysostom, Aristides of Smyrna, and Maximus of Tyre were the main representatives of criticism, and they were succeeded by Philostratus and Libanius. The most modern of post-Christian Greek critics, however, is unquestionably Dionysius of Halicarnassus, who leads up to Lucian and Cassius Longinus. The last-mentioned name calls for special notice; in "the lovely and magnificent personality of Longinus" we find the most intelligent judge of literature who wrote between Aristotle and the moderns. His book *On the Sublime* (Περὶ ὕψους), probably written about A.D. 260, and first printed in 1554, is of extreme importance, while his intuitions and the splendour of his style combine to lift Longinus to the highest rank among the critics of the world.

In Roman literature criticism never took a very prominent position. In early days the rhetorical works of Cicero and the famous *Art of Poetry* of Horace exhaust the category. During the later Augustan period the only literary critic of importance was the elder Seneca. Passing over the valuable allusions to the art of writing in the poets, especially in Juvenal and Martial, we reach, in the silver age, Quintilian, the most accomplished of all the Roman critics. His *Institutes of Oratory* has been described as the fullest and most intelligent application of criticism to literature which the Latin world produced, and one which places the name of Quintilian not far below those of Aristotle and Longinus. He was followed by Aulus Gellius, by Macrobius (whose reputation was great in the middle ages), by Servius (the great commentator on Virgil), and after a long interval, by Martianus Capella. Latin criticism sank into mere pedantry about rhetoric and grammar. This continued throughout the dark ages, until the 13th century, when rhythmical treatises, of which the *Labyrinthus* of Eberhard (1212?) and the *Ars rhythmica* of John of Garlandia (John Garland) are the most famous, came into fashion. These writings testified to a growing revival of a taste for poetry.

It is, however, in the masterly technical treatise *De vulgari eloquio,* generally attributed to Dante, first printed (in Italian) in 1529 that modern poetical criticism takes its first step. The example of this admirable book was not adequately followed; throughout the 14th and 15th centuries, criticism is mainly indirect and accidental. Boccaccio, indeed, is the only figure worthy of mention, between Dante and Erasmus. With the Renaissance came a blossoming of Humanist criticism in Italy, producing such excellent specimens as the *Sylvae* of Poliziano, the *Poetics* (1527) of Vida, and the *Poetica* of Trissino, the best of a whole crop of critical works produced, often by famous names, between 1525 and 1560. These were followed by sounder scholars and acuter theorists: by Scaliger with his epoch-making *Poeticus* (1561); by L. Castelvetro, whose *Poetica* (1570) started the modern cultivation of the unities and asserted the value of the epic; by Tasso with his *Discorsi* (1587); and by Francesco Patrizzi in his *Poetica* (1586).

In France, the earliest and for a long time the most important specimen of literary criticism was the *Défense et illustration de la langue française,* published in 1549 by Joachim du Bellay. Ronsard, also, wrote frequently and ably on the art of poetry. The theories of the Pléiade were summed up in the *Art poétique* of Vauquelin de la Fresnaye, which belongs to 1574 (though not printed until 1605).

In England, the earliest literary critic of importance was Thomas Wilson, whose *Art of Rhetoric* was printed in 1553, and the earliest student of poetry, George Gascoigne, whose *Instruction* appeared in 1575. Gascoigne is the first writer who deals intelligently with the subject of English prosody. He was followed by Thomas Drant, Harvey, Gosson, Lodge and Sidney, whose controversial pamphlets belong to the period between 1575 and 1580. Among Elizabethan "arts" or "defences" of English poetry are to be mentioned those of William Webbe (1586), George Puttenham (1589), Thomas Campion (1602), and Samuel Daniel (1603). With the tractates of Ben Jonson, several of them lost, the criticism of the Renaissance may be said to close.

A new era began throughout Europe when Malherbe started, about 1600, a taste for the neo-classic or anti-romantic school of poetry, taking up the line which had been foreshadowed by Castelvetro. *Enfin Malherbe vint,* and he was supported in his revolution by Regnier, Vaugelas, Balzac, and finally by Corneille himself, in his famous prefatory discourses. It was Boileau, however, who more than any other man stood out at the close of the 17th century as the law-giver of Parnassus. The rules of the neo-classics were drawn together and arranged in a system by René Rapin, whose authoritative treatises mainly appeared between 1668 and 1674. It is in writings of this man, and of the Jesuits, Le Bossu and Bouhours, that the preposterous rigidity of the formal classic criticism is most plainly seen. The influence of these three critics was, however, very great throughout Europe, and we trace it in the writings of Dryden, Addison and Rymer. In the course of the 18th century, when the neo-classic creed was universally accepted, Pope, Blair, Kames, Harris, Goldsmith and Samuel Johnson were its most distinguished exponents in England, while Voltaire, Buffon (to whom we owe the phrase "the style is the man"), Marmontel, La Harpe and Suard were the types of academic opinion in France.

Modern, or more properly romantic, criticism came in when the neo-classic tradition became bankrupt throughout Europe at the very close of the 18th century. It had been heralded in Germany by the writings of Lessing, and in France by those of Diderot. Of the reconstruction of critical opinion in the 19th century it is impossible to speak here with any fullness, it is contained in the record of the recent literature of each European language. It is noticeable, in England, that the predominant place in it was occupied, in violent contrast with Disraeli's dictum, by those who had obviously *not* failed in imaginative composition, by Wordsworth, by Shelley, by Keats, by

Landor, and pre-eminently by S. T. Coleridge, who was one of the most penetrative, original and imaginative critics who have ever lived. In France, the importance of Sainte-Beuve is not to be ignored or even qualified; after manifold changes of taste, he remains as much a master as he was a precursor. He was followed by Théophile Gautier, Saint-Marc, Girardin, Paul de Saint Victor, and a crowd of others, down to Taine and the school of individualistic critics, comparable with Matthew Arnold, Pater and their followers in England. Tolstoi's *What is Art?* was the most revolutionary and challenging book of criticism to appear in the last quarter of the 19th century. Critical writing has become so abundant in recent years that it would be possible to fill a library with the works of living critics alone. Philosophers like Benedetto Croce, and poets like Mr. Bridges have helped to swell the stream. Some of the happiest contributions have been made in England by Mr. G. Saintsbury, Mr. A. C. Bradley, Sir Edmund Gosse and Sir Arthur Quiller-Couch.

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CRITIUS AND NESIOTES, Greek sculptors of the time of the Persian wars. When Xerxes carried away to Persia the statues of Harmodius and Aristogiton made by Antenor, Critius and Nesiotes were commissioned to replace them. By the help of coins and reliefs, two statues at Naples, wrongly restored as gladiators, have been identified as copies of the tyrannicides of Critius; and to them well apply the words in which Lucian (*Rhetor, praecepta,* 9) describes the works of Critius and Nesiotes, "closely knit and sinewy, and hard and severe in outline." Critius also made a statue of the armed runner Epicharinus.

See E. A. Gardner, *Handbook of Greek Sculpture,* pp. 206–211 (1915); H. Stuart Jones, *Ancient Writers on Greek Sculpture* (§65–67), (1895).

CRITOLAUS, Greek philosopher, was born at Phaselis in the 2nd century B.C. He lived to the age of 82 and died probably before 111 B.C. He studied philosophy under Aristo of Ceos and became one of the leaders of the Peripatetic school. In general he was an orthodox Peripatetic (*cf.* Cicero, *De Fin.* v. 5), though in some respects he went beyond his predecessors. For example, he held that pleasure is an evil (Gellius, *Noctes Atticae,* ix. 5. 6), and definitely maintained that the soul consists of aether. The end of existence was to him the general perfection of the natural life. Cicero says in the *Tusculans* that the goods of the soul entirely outweighed for him the other goods ("tantum propendere illam bonorum animi lancem"). Further, he defended against the Stoics the Peripatetic doctrine of the eternity of the world and the indestructibility of the human race. Of the life of Critolaus one incident alone is preserved. He was sent with Carneades and Diogenes to Rome in 156–155 B.C. to protest against the fine of 500 talents imposed on Athens (*Cic. Acad.* [ii] 45). The three ambassadors lectured on philosophy in Rome and Cato had them dismissed from the city.

Consult the article PERIPATETICS and histories of ancient philosophy, *e.g.,* Zeller.

CRITTENDEN, JOHN JORDAN (1787–1863), U.S. statesman, was born in Versailles (Ky.), on Sept. 10, 1787. After he had graduated from the College of William and Mary in 1807, he began the practice of law in his native State. He was attorney general of Illinois Territory, and, from 1811 to 1817, after he had returned to Kentucky, was a member of the Kentucky house of representatives, of which he was speaker 1815–16. From 1817 to 1819 he was a U.S. senator. Again in 1825 and 1829–32 he was in the Kentucky house of representatives, acting as speaker 1829-32. From 1827 to 1829 he was U.S. district attorney. He was removed by President Jackson, to whom he was radically opposed. In 1835, as a Whig, he was again elected to the U.S. Senate, and was re-elected in 1841, but resigned to enter the cabinet of President W. H. Harrison as attorney general, continuing after President Tyler's accession from March until September. He was again a member of the U.S. Senate from 1842 to 1848. In 1848–50 he was governor of Kentucky. He was an ardent and outspoken supporter of Clay's compromise measures, and in 1850 he entered President Fillmore's cabinet as attorney general, serving throughout the administration. From 1855 to 1861 he was once more a member of the U.S. Senate.

He was then one of the foremost champions of union in the South, and strenuously opposed the Kansas-Nebraska bill, which he said would unite the elements of opposition in the North and render the breach between the parts of the country irreparable. Nevertheless, he laboured unceasingly in the cause of compromise, gave his strong support to the Bell and Everett ticket in 1860, and in 1860–61 proposed and vainly contended for the adoption by Congress of the compromise measures which bear his name. When war became inevitable, he threw himself zealously into the Union cause, and lent his great influence to keep Kentucky in the Union. In 1861–63 he was a member of the Federal House of Representatives, where, while advocating the prosecution of the war, he opposed such radical measures as the division of Virginia, the enlistment of slaves and the Conscription acts. He died at Frankfort (Ky.), July 26, 1863.

See the *Life of J. J. Crittenden,* by his daughter Mrs. Chapman Coleman (Philadelphia, 1871); C. A. Keith, *The Life of John J. Crittenden of Kentucky* (University of Indiana, 1926); and Channing, *History,* VI., pp. 293–296.

His son, GEORGE BIBB CRITTENDEN (1812–1880), soldier, was born in Russellville (Ky.), on March 20, 1812, and as a captain of mounted rifles in the Mexican War was breveted major for bravery at Contreras and Churubusco. In June 1861, he entered the service of the Confederacy, was commissioned major-general and given a command in south-east Kentucky and Tennessee; but after the defeat of his forces by General George H. Thomas at Mill Springs (Jan. 9, 1862), he was censured and gave up his command. He then became a volunteer aide on the staff of General John S. Williams. From 1867 to 1871 he was State librarian of Kentucky. He died at Danville (Ky.), Nov. 27, 1880.

Another son, THOMAS LEONIDAS CRITTENDEN (1815–1893), soldier, was born at Russellville (Ky.). He studied law, and in 1842 became Commonwealth's attorney. He served in the Mexican War and from 1849 to 1853 was U.S. consul at Liverpool, England. Like his father, he was a strong Union man, and in Sept. 1861 he was commissioned by President Lincoln a brigadier-general of volunteers. He was promoted to the rank of major-general in July, 1862. He was in command of a corps in the Army of the Ohio, and took part in the battles of Stone river and Chickamauga, and participated in the Virginia campaign of 1864. In July 1866 he entered the Regular Army with the rank of colonel of infantry, received the brevet of brigadier-general in 1867, served on the frontier and in several Indian wars, and retired in 1881. He died on Oct. 23, 1893.

CRIVELLI, CARLO, Venetian painter, was born between 1430–1435. He died after 1493. Though born in Venice, Crivelli worked chiefly in the March of Ancona, and especially in and near Ascoli. He was probably an offspring of the Murano school and was influenced by Squarcione's academy at Padua. He signed as "Carolus Crivellus Venetus"; from 1490 he added "Miles," having been then knighted ("Cavaliere") by Ferdinand II. of Naples. Among his earliest works are the "Madonna" in the Verona museum and an altarpiece at the Municipio of Mazza Fermana (1468). The National Gallery in London has fine examples of Crivelli; in Berlin is a "Madonna and Saints" (1491); in the Vatican Gallery a "Dead Christ"; and the Brera of Milan contains several examples, among which is his masterpiece of later years, "The Coronation of the Virgin" (1493). Crivelli is a painter of marked individuality—hard in form, crudely definite in contour; stern, forced, energetic, yet well capable of a prim sort of prettiness; and sometimes admitting into his pictures objects actually raised in surface; distinct and warm in colour, with an effect at once harsh and harmonious. It is surmised that Carlo was of the same family as the painters Jacopo and Vittorio Crivelli. Pietro Alamanni was his pupil.

See, besides, Crowe and Cavalcaselle, Berenson, *Venetian Painters of the Renaissance* (1899); Morelli, *Italian Painters* (1892–93); Rushforth, *Carlo Crivelli* (1900).

CROATIA-SLAVONIA, formerly part of Austria-Hungary, has since 1918 been a constituent element of the Serb, Croat and Slovene State. (*See* YUGOSLAVIA and BALKAN PENINSULA.)

HISTORY

Mediaeval History.—What has in modern times been known as Croatia-Slavonia formed part of the Roman province of Pannonia, the chief towns being Siscia (Sisek), Emona (Ljubljana) and Sirmium (Mitrovica in Syrmia). It was conquered by the Ostrogoths, recovered by Justinian in 535 and conquered in 568 by the Avars, who also seized most of the Dalmatian towns. The Croats (Chrobati, Hrvati), a Slav tribe closely related to the Serbs, overpowered the Avars in about 640, and held most of the modern Croatia-Slavonia, north-west Bosnia and Dalmatia, except the coast towns, where municipal freedom survived. The Croats and Slovenes were loosely organized under *Župani* or tribal chiefs, and late in the 8th century their western territory fell an easy prey to Charles the Great as he was organizing the marches of the empire. During a century of chaos, in which the Croats stood in changing relations to the Franks, Byzantium, Venice, Moravia, the short-lived Bulgar state in Pannonia and eventually its Magyar conquerors, the Croatian duchy slowly took definite shape, till in 924 Duke Tomislav assumed the royal title (Rex Chroatorum), allied himself with Byzantium and received from it the protectorate of the Dalmatian towns of Zadar, Trogir and Split (Zara, Traù, Spalato). He was recognized by the pope, and Split became the archiepiscopal see: from this early time dates the special Glagolitic Slav rite which still survives in certain Catholic churches along the coast. His fifth successor, Drzislav (969–997), received the coronation insignia from the emperor Basil II., in consideration for his help against the Bulgarians; but Krešimir III. (*c.* 1000–30) had to acknowledge Byzantine suzerainty. Stephen I. married a daughter of the Venetian doge Orseolo, and their son Peter Krešimir (1058–74) further strengthened Croatia's ties with the Roman see; and in 1076 Demetrius Zvonimir was crowned king at Split by the legate of Gregory VII., only after the episcopate in full synod and the future king had ratified the papal demands. Anarchy followed Zvonimir's death in 1089, and certain Croat nobles called in King Ladislas of Hungary, as a kinsman of the royal house. For two years his nephew Almos was king of Croatia, and in 1094 a new bishopric was founded in Zagreb, to which the centre of ecclesiastical gravity soon shifted. In 1097 the last Croat national king, Petrus, fell in battle, and in 1102 King Koloman of Hungary consolidated the work of his uncle Ladislas and was crowned king of Croatia and Dalmatia at Belgrad near Zadar, asserting the triple claims of conquest, inheritance and election.

Croatia and Hungary.—Henceforth Croatia forms for eight centuries an autonomous kingdom under the Holy Crown of St. Stephen. Its bans, or viceroys, were at first chosen sometimes among princes of the house of Árpád, but more and more among great feudal families, some of whom conducted a semi-independent policy in Bosnia and along the coast. It was as sovereigns of Croatia that the Hungarian kings became involved in repeated wars with Venice. On the extinction of the Hungarian national dynasty in 1301, the Croatians crowned the Angevin prince Charles Robert as their king at Zagreb, while Hungary elected first a Bohemian and then a Bavarian prince, only recognizing Charles Robert and reuniting the two Crowns in 1309. On the death of Louis the Great, Croatia turned against his daughter Mary and supported the candidature of her Neapolitan cousins, Charles and Ladislas of Durazzo, the latter being crowned at Zadar in 1403. Mary's husband, Sigismund, however, finally enforced his claim to both thrones, though in 1420 he had to ratify the cession of Dalmatia to Venice, to which Ladislas had rashly consented in 1409 as a means of financing his campaigns. On the fall of Bosnia before the Turks (1463) the Croat nobles played the chief part in organizing the banat of Jajce, as a barrier against further invasion. A minor cause of the fatal defeat of Mohács (*q.v.*) in 1526 was that King Louis gave battle without waiting for the Croat reinforcements under Ban Krsto Frankopan to arrive. While Hungary was disputed between the Habsburgs and John Zápolya, the Croatian estates, sitting at Cetin on Jan. 1, 1527, unanimously elected Ferdinand of Austria as their king, and confirmed the succession to him and his heirs (a step which Hungary only took in 1687). Most of the country between Save and Drave shared the fate of central Hungary and fell into Turkish hands. Zagreb, hitherto belonging to "Slavonia," became a border fortress and henceforth the Croatian capital and seat of the ban and the diet. But the constant danger of invasion is fatal to constitutional development, and the estates were summoned only to vote subsidies. Necessity dictated in 1578 the formation of special provinces known as the "military frontiers" (*q.v.*) (Vojna Krajina)—the Slavonian between Drave and Kulpa with Varaždin as its centre, the Croatian between the Kulpa and the sea, with Karlovac (Karlstadt), so named after Archduke Charles of Styria, who held the supreme command. Their reincorporation was repeatedly demanded by the Croatian estates but without effect, and they retained their identity till long after the expulsion of the Turks.

During the 16th and 17th centuries the Croat nobility, alarmed at the growth of the royal power, drew steadily closer to that of Hungary, and in 1625 the ban first took his seat in the Hungarian house of magnates. Count Nicholas Zrinski won great fame by his defence of Sziget against Sultan Suleiman in 1566, immortalized by his grandson of the same name (1620–64) in the first Hungarian epic written under Italian influence, while his brother Peter translated it into Croat. The latter, with his kinsman Krsto Frankopan and the Magyar magnates Nádasdy and Wesselényi, were in 1671 implicated in a plot against the Habsburgs and in defence of Hungarian and Croat local privileges, and executed at Wiener Neustadt. This event was momentous for Croatia, for the extinction of the Zrinski and Frankopan families and the confiscation of their vast estates definitely turned the scale in favour of the Crown in Croatia and brought foreign elements into the Croat nobility.

By the Treaty of Karlovci (Karlowitz) in 1699 all Croatia-Slavonia was recovered from the Turks; and henceforward Karlovci was to be the centre of the Serbian Orthodox Church, the patriarch of Peć, with thousands of Serbian refugees from Turkey, having settled in Slavonia and south Hungary under a special charter from Leopold I. in 1690. In 1712 the Croatian diet accepted the Pragmatic Sanction 12 years earlier than the Hungarian, declaring in default of male heirs for that Habsburg princess who should rule over Austria, Styria and Carniola; and their assertion that "neither force nor conquest united us to the Hungarians" was not challenged at the time. The name "Croatia" now came to be applied to the whole territory between Save and Drave. In 1767 Maria Theresa erected a special council in Zagreb, dealing direct with Vienna, but in 1779 Croatia was again subjected to the council of lieutenancy in Pest, and was regarded by the Magyars as *partes adnexae* of Hungary, though the Croats claimed the status of *regna socia.* In 1776 Fiume (*q.v.*) was united with Croatia, but in 1779 was declared an integral part of Hungary. In 1769, 1774 and 1776 Serbian national congresses were allowed to meet at Karlovci, and again in 1790 at Temesvár, when Serb privileges were confirmed by Leopold II. Croat national sentiment was stirred in the French revolutionary wars and received a strong impetus from Napoleon's creation of an "Illyrian" state. The east Adriatic territories which Austria had acquired from Venice in 1797 were ceded in 1806 to Napoleon's puppet kingdom of Italy, and after Wagram (1809) these, with Trieste, Istria, Carniola, parts of Croatia and the defunct republic of Ragusa, were united as "the Illyrian Provinces." Their viceroy, Marmont, had his headquarters at Ljubljana (Laibach) and Dubrovnik (Ragusa). The first Croat and Slovene newspapers appeared, schools were opened, roads and public institutions built. In 1813 the Austrians drove out the French, Dalmatia and Ragusa became a single Austrian province. In 1822 Croatia-Slavonia recovered her old boundaries and her connection with the Hungarian Crown was reaffirmed.

Rise of Croat Nationality.—The rise of Magyar national feeling and the linguistic legislation passed by the Hungarian diet from 1830 onwards adversely affected Magyar-Croat relations; and in the forties a strong "Illyrian" movement arose in Croatia under Ljudevit Gaj and Count Drašković, aiming at the eventual union of all Southern Slavs, preferably by Austria's help and in open defiance of Hungary's claims. The law of 1843, passed at the diet of Pressburg, making Magyar compulsory for official business and for education, had given Croatia a special respite for six years; but before the term expired there was an open breach, and in Oct. 1847 the Croatian diet introduced Croat, not Magyar, throughout its territory. The famous series of laws passed by Hungary in April 1848 rode roughshod over Croatia's special position and were firmly resisted by the Croats under Count Josef Jellačić, whom the Court appointed as ban in March and who, in close co-operation with the Serbs under Patriarch Rajačić of Karlovci, defied Hungary, pushed a series of national laws through the diet of Zagreb, and after an abortive attempt at compromise with the revolutionary Hungarian Government, led his troops across the Drave in September and marched against Budapest in the emperor's name. Owing to her racial and political differences with Hungary Croatia found herself identified with Habsburg reaction, and after the suppression of the Hungarian revolution in 1849 "received" (in the words of Pulszky) "as reward what Hungary received as punishment." When, in 1861, the Croatian diet was again allowed to meet it unanimously declined to send delegates to the new centralist *Reichsrat* in Vienna, and was speedily dissolved. In 1866 the Croats followed a federalist policy and claimed that the events of 1848 had dissolved the legal bond with Hungary. But in 1867 Hungary and the Crown concluded the *Ausgleich* over the heads of Austria and still more of Croatia, which was left to make what terms it could with Budapest. The nagoda (or compromise) of 1868 is in the form of a law ratified by the two parliaments of Budapest and Zagreb, though the texts differ on important points (notably Fiume, which was detached from Croatia and given an autonomous status under a governor appointed direct by Budapest). It was only passed at Zagreb as the result of very corrupt elections prepared by the ban, Baron Levin Rauch, on orders from Budapest. Under its provisions Croatia was represented by 40 delegates in the lower and three in the upper house at Budapest. The ban, as head of the Zagreb Government, was nominated by Budapest, yet responsible to the Croatian diet, and there were three autonomous departments (home, justice and education) at Zagreb, with sectional chiefs. Croat was the official language throughout the territory and the judicial system was entirely autonomous. The weakest spot was Croatia's financial subordination to Hungary.

BY COURTESY OF "TRAVEL"
A FAMILY OF CROAT PEASANTS

The period 1868 to 1914 was for Croatia one of great political activity and of steady development in every sphere. Among the most notable Croat leaders of the period were Bishop Strossmayer (*q.v.*) of Djako, to whose munificence the foundation of the Southern Slav academy (1867), Zagreb university (1874) and art gallery (1884) and other public institutions was largely due; Ivan Mažuranić, known as "the Peasant Ban" (1873–80) and author of a famous epic; Rački the historian, and Ante Starčević, founder of the party of right, which followed strongly Serbophobe lines. The Eastern Crisis of 1875–78 evoked a lively agitation in favour of Bosnia's incorporation with Croatia, as part of a Pan-Croat programme; and Dalmatia was always regarded as belonging *de iure* to the "Triune Kingdom of Croatia-Slavonia-Dalmatia," though *de facto* held by Austria. The Bosnian problem accentuated the Magyar-Croat conflict, which broke out in 1883 in riotous protests against the inscriptions over Government offices in Zagreb. The Croatian constitution was temporarily suspended by Hungary and after a general had acted as royal commissioner for some months, Count Khuen-Hédervàry, a cousin of Tisza, was appointed ban in Dec. 1883. His rule of 20 years is regarded as the most humiliating in modern Croatian history.

The Yugoslav Movement.—From 1903 onwards there was a marked growth of national feeling. The disturbances of that year were suppressed, but in 1905 the Croat and Serb parties in all provinces of the Dual Monarchy adopted a joint programme in the Resolutions of Fiume and Zara, and next year the Serbo-Croat coalition in Croatia came into power, as the result of a compact with the Hungarian coalition. Its chief leaders were Supilo and Trumbić (*q.v.*), both Dalmatians. Already in 1907, however, the Croats and Magyars again quarrelled; Baron Rauch became ban and on orders from Budapest "made" elections, but, having failed to secure a majority, suspended the Croatian diet and instituted a repressive régime. This culminated in the scandal of the Zagreb treason trial of 1909, in which 53 Serbs of Croatia-Slavonia were accused of treasonable relations with Serbia. The attempts of Rauch and his chiefs in Budapest and Vienna to implicate the leaders of the Serbo-Croat Coalition during the Bosnian annexation crisis gave to the trial an international importance, which was heightened by scandals in court and by Prof. Masaryk's public intervention in the Austrian parliament. The sequel was a libel action brought by the coalition leaders before a Viennese court against the historian Friedjung and the editor of the *Reichspost* (Dec. 1909), and it was established that the charges of treason rested upon numerous documents forged by the connivance of the Austro-Hungarian minister in Belgrade and his staff and given to Friedjung on the authority of Aehrenthal and the Ballplatz. These trials and the Rauch régime welded the Serbo-Croat coalition still more closely together, and stimulated the movement for Yugoslav unity. After a temporary truce under Rauch's successor, Tomašić, the Hungarian Government on April 3, 1912, suspended the Croatian constitution and appointed Cuvaj as dictator with wide powers. An attempt on his life by the student Jukić on June 8 was followed by further repression and by the suspension of Serbian Church autonomy. The Cuvaj régime caused lively protests among the Yugoslavs of Bosnia, Dalmatia, Istria and Carniola, with increasing support from the Slovenes. The excitement and unrest, already acute, was greatly increased by the victories of the Balkan League and especially Serbia against the Turks; and the younger generation in particular became infected by revolutionary ideas and hailed Serbia as the Piedmont of a future Yugoslav union. The murder of the archduke was the sixth of a series of outrages by young Croats or Serbs, two being upon Cuvaj and two upon his successor Skerlecz.

On Dec. 27, 1912, Cuvaj was replaced by a colourless official, but it was not till Nov. 1913 that the dictatorship was abolished and Baron Skerlecz appointed ban. Elections—the fifth since 1906—still gave the coalition a large majority; and there was still a truce rather than a settlement between Zagreb and Budapest when the World War broke out.

The World War and Union with Yugoslavia.—Measures of extreme severity were taken by the civil and military authorities of Austria-Hungary throughout their Yugoslav provinces. Thanks to the purely opportunist policy of the Serbo-Croat coalition, the diet of Zagreb was still allowed to meet, but while avoiding any pronouncement offensive to Budapest it also steadily refused to disavow the Yugoslav committee which was formed in London early in the war by a number of Serb and Croat exiles (Trumbić, Supilo, Hinković, Meštrović, etc.) and whose programme was complete independence and union with Serbia. In Dec. 1916 the coalition even sent delegates to Charles's coronation in Budapest, and by secret arrangement left all initiative to the committee abroad, and after the resumption of parliamentary life in Austria to the unified Yugoslav Club in the *Reichsrat*, working in close alliance with the Czechs. The maximum Yugoslav programme found expression in the Declaration of Corfu (July 20, 1917) between Pašic and Trumbić, which the Yugoslav parties inside the Dual Monarchy naturally could not publicly endorse, but always declined to repudiate. Count Tisza's visit to Zagreb and Sarajevo in Sept. 1918, to win support for a Magyar solution of the Southern Slav question, met everywhere with a blank refusal. On Oct. 1, encouraged by Bulgaria's surrender, the Czech and Yugoslav deputies in the *Reichsrat* proclaimed their absolute right to decide their own future State allegiance; and on Oct. 10 the Yugoslav national council, which had already been constituted at Ljubljana, was transferred to Zagreb and representatives of all parties were included. A week later the Yugoslavs repudiated Emperor Charles's proposals for federalization, and local committees in Dalmatia and Bosnia, recognizing the authority of the Zagreb council, proceeded to disarm the troops pouring northward from the broken Balkan fronts. On Oct. 23, a Croat regiment took possession of Fiume, and on the 28th the Zagreb military command handed over its authority to the council. Next day the diet declared Croatia's independence from Hungary, appealed to the Entente and urgently invited the help of the Serbian army. On Nov. 23 the union of the Yugoslav provinces of the former monarchy with Serbia and Montenegro was resolved in Zagreb, and on Dec. 1 the council's delegates visited the prince regent Alexander in Belgrade and invited him to proclaim the union. In the first Yugoslav Cabinet the Slovene Clerical leader Korošec was vice-premier and Trumbić foreign minister. The office of Croatian ban was at first retained, but abolished under the new constitution of June 28, 1921. The centralist character of this constitution was largely due to the abstention of the Croat Peasant Party under Stephen Radić. The latter's capitulation to Pašić and his acceptance of office in a Radical Cabinet in 1925 ended the most acute phase of conflict between centralist and federalist tendencies in the new State.

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CROCE, BENEDETTO (1866–), Italian philosopher, born on Feb. 25, 1866, at Pescasseroli, Aquila, of an Abruzzese family, the seat of which had been transferred to Naples by his grandfather. There Croce was educated at a Catholic school. In 1883, having lost both his parents in an earthquake, he went to live in Rome with his paternal uncle and guardian, Silvio Spaventa. He entered the university, but did not pursue his studies there, returning to Naples in 1886, where he occupied himself for several years with researches into local history and antiquities. His contributions to philosophy began with two essays (1893) upon the nature of history and the method of literary criticism, the leading ideas of which he developed in two later papers in 1900 and 1904–5. Between 1896 and 1900 he published also a group of essays on points of Marxian economic doctrine. Shortly after, in 1902, he began the systematic exposition of his Philosophy of the Spirit, divided into Aesthetic, Logic, Philosophy of Conduct (Economics and Ethics) and Theory and History of Historiography. In 1903 he founded the journal *La Critica,* in which he reviewed the whole fine literature of Italy for 50 years, and later similarly reviewed its contributions to historical literature. His collected works in 1926 filled nearly 20 volumes. Though actively interested in educational administration, he never sought or occupied any university office. In 1910 he was nominated to the senate of the kingdom, and was Minister of Education in the Giolitti Cabinet (June 1920–July 1921).

Croce's Philosophy.—The philosophy of Croce, often erroneously classed as "Hegelian," had its avowed sources in the ideas underlying the literary criticism of Francesco de Sanctis, and, more generally and remotely, in those adumbrated in the *Scienza Nuova* of G. B. Vico, both, like himself, Neapolitans. More significantly, it arises from and perpetually returns to his own personal experience in his lifelong and multifarious activity as a student of literature and history. Here he finds himself in vital touch with concrete reality, and deliberately confines his reflections to the content of actual or enacted history with a view to its interpretation. Hence he has been led to assert the identity of concrete philosophy with history, and to define the task of abstract philosophy as the discovery and formulation of the immanent methodology of history. From the common domain of both he excludes any supposed realities which transcend experience, and abstains from speculations about such, as he also does about primal origins and ultimate ends. History as enacted and occurring and history as interpreting what is thus "given" he views as the work of one Spirit, which there expresses and embodies itself. In every part and moment of history that Spirit is wholly and indivisibly present and active. Its presence and operation are not confined to human history, but extend in all directions to the utmost bounds of experience. The Spirit which is thus omnipresent throughout the whole content of experience is indivisibly one, but its unity is also a quaternity, and it has in its structure four eternally distinct and distinguishable "grades," the ordered circle of which in its life or progress it perpetually traverses, so endowing or filling itself with experience and ever enriching its being. Its four functions in their conjoint exercise generate the contents of experience, within which we can and must distinguish four corresponding grades, stages, kinds or realms, the respective subject-matters of aesthetic, logical, economic and ethical theory, departments of philosophy, which together without addition constitute the whole of it.

In its total cognitive function this Spirit manifests itself as art, the first or "dawn" form of knowledge. In this grade it expresses itself in individual embodiments; in so expressing itself it at once creates and beholds what it creates, and has for its objects (which are also its works) whatsoever in experience presents a characteristic individuality. In its second cognitive grade, as logic or abstract philosophy, it expresses, brings to existence and view, and so knows whatsoever is universal. Uniting, as it cannot but do, both functions, and thus becoming concrete in history, it effects an *à priori* synthesis between what is individual and what is universal; in doing so, it wins actual understanding of the real and enters upon a course of knowledge which runs from sense-perception up to explicit history. The history which thus comes to be understood is wholly the work of the same Spirit in the exercise of its total practical function, which has two corresponding grades, in the lower or earlier of which it enacts what is individual, in the higher or later what is universal, or, rather again, in its actual or concrete exercise, enacts both in one, and so fills the stage of history with its deeds. Still more actually or concretely, it is active at once as making or creating and as knowing or understanding its own history, which is its whole self. The only reality which can truly be called absolute is a history without beginning and without end, self-begotten and self-explaining.

The developments and applications which Croce gives to this fundamental doctrine are extraordinarily various, and often highly novel and even paradoxical. They have excited widespread interest and evoked abundant criticism and opposition. Against his critics Croce carries on a sustained and skilful polemic. He exercises an increasingly profound influence on higher thought. To many his philosophy seems to have already established a place in the world of contemporary philosophy comparable with that occupied during a great part of the 19th century by the system of Hegel. For a fuller account of Croce's theory of Aesthetics, *see* that article written by him, in volume I of this *Encyclopædia.*

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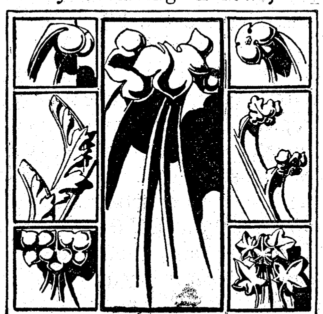
CROCIDOLITE, a mineral described in 1815 by M. H. Klaproth under the name *Blaueisenstein* (blue ironstone), and in 1831 by J. F. Hausmann, who gave it its present name because of its nap-like appearance (Gr. κροκύς, nap of cloth). It is a blue fibrous mineral belonging to the amphibole group and closely related to riebeckite; chemically it is an iron sodium silicate. Its resemblance to asbestos has gained for it the name Cape Asbestos, the chief occurrence being in South Africa. The mineral suffers alteration by removal of alkali and oxidation of the ferrous iron, and further by deposition of silica between the fibres, or by their replacement by silica; a hard siliceous mineral is thus formed which when polished shows, in consequence of its fibrous structure, a beautiful chatoyance or silky lustre. This is the ornamental stone which is known when blue as "hawk's-eye," and when of rich golden brown colour as "tiger-eye." The latter, which represents the final alteration of the crocidolite, has become very fashionable as "South African cat's eye," and is often termed "crocidolite," though practically only a mixture of quartz with brown oxide of iron.

CROCKET, in architecture, a small, independent, sharply projecting mediaeval ornament, usually occurring in rows, and decorated with foliage. In the late 12th century, when it first appeared, it had the form of a ball-like bud, with a spiral outline, like an uncurling fern frond; but in the later Gothic period it took the form of out-curved, fully developed leaves reaching, in the 15th century, complex, involuted richness. Crockets are used especially on the inclined edges of spires, pinnacles and gables, and are also found on capitals, cornices, and, occasionally, around arches.



FROM VIOLLET-LE-DUC, "DICTIONNAIRE RAISONNÉ DE L'ARCHITECTURE FRANÇAISE"

EXAMPLES OF CROCKETS

CROCKETT, DAVID (1786–1836), American frontiersman, son of an Irish immigrant, was born in Greene county, Tenn., on Aug. 17, 1786. His education was obtained chiefly in the rough school of experience in the Tennessee backwoods, where he acquired a wide reputation as a hunter, trapper and marksman. In 1813–14 he served in the Creek War under Andrew Jackson, and subsequently became a colonel in the Tennessee militia. In 1821–24 he was a member of the state legislature, having won his election largely by telling stories. In 1827 he was elected to the national house of representatives and was re-elected in 1829. At Washington his shrewdness, eccentric manners and peculiar wit made him a conspicuous figure, but his opposition to the president's Indian policy led to administration influences being turned against him with the result that he was defeated for re-election in 1831. He was again elected in 1832, but in 1835 lost his seat a second time, being then a vigorous opponent of many distinctively Jacksonian measures. Discouraged and disgusted, he followed his usual remedy of emigration, this time to Texas. There he lost his life as one of the defenders of the Alamo at San Antonio on March 6, 1836.

A so-called "autobiography" (1834), which he very probably dictated, is typical of the crude but racy humour of the frontier; a work purporting to be a continuation of this autobiography and entitled *Colonel Crockett's Exploits and Adventures in Texas* (Philadelphia, 1836) is undoubtedly spurious. There have been several editions of these works in combined form. Numerous popular biographies have been written, the best by E. S. Ellis (Philadelphia, 1884). *See* also D. C. Seitz, *Uncommon Americans* (1925) and the article by C. T. Crowell in the *American Mercury* (Jan., 1925).

CROCKETT, SAMUEL RUTHERFORD (1860–1914), Scottish novelist, was born at Duchrae, Galloway, on Sept. 24, 1860, the son of a Galloway farmer. He was brought up on a Galloway farm, and graduated from Edinburgh university in 1879. After some years of travel he became in 1886 minister of Penicuik, but eventually abandoned the Free Church ministry for novel-writing. The success of J. M. (later Sir James) Barrie had created a demand for stories in the Scottish dialect when Crockett published his successful story of *The Stickit Minister* in 1893., *The Raiders, The Lilac Sun-bonnet* and *Mad Sir Uchtred,* all published in 1894, were followed by many others.

CROCKFORD, WILLIAM (1775–1844), proprietor of Crockford's Club, was born in London in 1775, the son of a fishmonger, and for some time himself carried on that business. After winning a large sum of money (according to one story £100,000) either at cards or by running a gambling establishment, he built, in 1827, a luxurious gambling house at 50 St. James's street, which, to ensure exclusiveness, he organized as a club. Crockford's quickly became the rage; every English social celebrity and every distinguished foreigner visiting London hastened to become a member. Hazard was the favourite game, and very large sums changed hands. Crockford retired in 1840, when, in the expressive language of Capt. R. H. Gronow, he had "won the whole of the ready money of the then existing generation." He took, indeed, about £1,200,000 out of the club, but subsequently lost most of it in speculations. Crockford died on May 24, 1844.

CROCODILE-BIRD (*Pluvianus aegyptus*), a species of plover (*q.v.*) which derives its name from its frequent association with the Nile crocodile (*Crocodylus niloticus*) from the teeth and hide of which it picks and devours parasites. It is also of service to the crocodile by uttering warning cries on the approach of danger.

CROCODILIAN, a name applicable to any member of the reptilian order Crocodilia. The order contains only 24 living species, but the geological history of the group can be traced back at least as far as Jurassic times (*see* REPTILES).

Crocodilians are the largest living reptiles, but it is difficult to be sure of their maximum size owing to the number of exaggerated stories with wide currency. The largest species is the salt-water or estuarine crocodile (*Crocodylus porosus*), which reaches a length of more than 20 ft., and the smallest is one of the South American caimans (*Paleosuchus palpebrosus*), which scarcely attains a length of 4 ft. Very large specimens of any species are undoubtedly becoming more and more rare; modern arms are too well distributed for many very old individuals to survive.

Because of the interest taken in crocodiles regarding their size, their attacks on man and on domestic animals, and the trophies that they yield to the sportsman, a key, based on characters of the head and skull, is given by means of which a specimen may be identified at least as far as its genus.

I. Snout very long and slender; the halves of the lower jaw fused in front as far back as the 15th tooth.
   - (*a*) 27-29 teeth on each side of the upper jaw. *Gavialis* (the gavial of N. India).
   - (*b*) 20-21 teeth on each side of the upper jaw. *Tomistoma* (the false gharial of Borneo and Sumatra).

II. Snout moderately elongate, triangular or rounded; the halves of the lower jaw not fused farther back than the eighth tooth.
   - (*a*) The fourth tooth of the lower jaw fits into a notch in the side of the upper jaw. Crocodiles.
     - (1) Nasal bones dividing the nasal aperture into two. *Crocodylus* (Africa to south China, north Australia and the Fiji Islands; southern United States to Venezuela and Ecuador).
     - (2) Nasal bones not dividing the nasal aperture;

snout turned up in front. *Osteolaemus* (W. Africa).

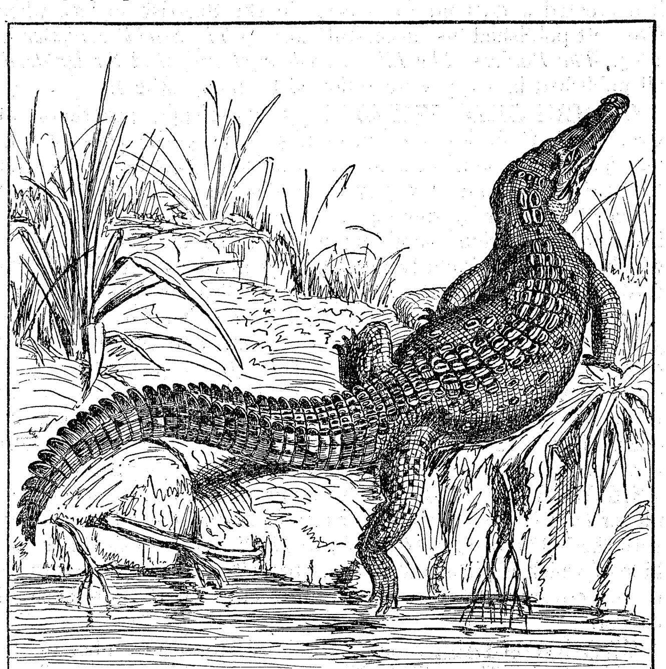
(3) Nasal bones not dividing the nasal aperture; snout not turned up. *Osteoblepharon* (Congo).

(*b*) The fourth tooth of the lower jaw fits into a pit in the upper jaw. Alligators.

(1) Nasal bones dividing the nasal aperture. *Alligator* (southern United States and south China).

(2) Nasal bones not dividing the nasal aperture. *Caiman, Melanosuchus* and *Paleosuchus* (Tropical South America).

The two first-mentioned genera, each with only a single species, are highly specialized fish-eating forms, the long, slender snout



AFTER BREHM

FIG. 1.—THE COMMON AMERICAN CROCODILE

and numerous, sharp, interlocking teeth forming an efficient fish-catching mechanism. The remaining genera are much broader snouted and, though fishes form their staple food, they will also eat anything they can overpower; lying idly in the water with only the nostrils, eyes and perhaps part of the back showing they look like floating logs and any unwary bird or beast approaching within range of the powerful jaws is seized, dragged under water and eaten. There are undoubtedly occasional man-eaters but generally they recognize man as their chief enemy and become wary and difficult to approach.

All the species reproduce by means of eggs. The sexes are able to find one another by hearing and by smell; during the mating season the males, at least, exercise their vocal powers, the call varying with the species but usually being an intermittent bellow that may be heard for a considerable distance. Both sexes are provided with two pairs of scent glands; one pair lies at the sides of the throat and the other inside the cloaca. The glands on the throat are normally only visible as a pair of small slits but excitement may cause them to be turned inside out so that they appear as rounded excrescences. Both pairs of glands are close to the soil when the animal is at rest on the bottom or basking on the shore and their secretion, which has a strong musky odour, leaves a trail that can be followed by other members of the species. The eggs are white, oval, covered with a thick calcareous shell and are laid on land; the number in a clutch varies according to the size of the individual and may vary from 20 to 90. The site and type of "nest" vary. The Nile crocodile (*C. niloticus*) deposits its eggs in the sand, the hole being from 18 in. to 2 ft. deep and the eggs arranged in two layers with a layer of sand between. Many other species including the West African crocodile (*C. cataphractus*) and the North American alligator (*A. mississipiensis*), sweep together a mound of vegetable trash and deposit the eggs in the centre of this pile. Incubation is carried out chiefly by the heat of the sun but in the second case the heat of fermentation of the vegetable matter probably assists; the mother remains in the vicinity of the nest, visiting it from time to time and, warned by the hiccough-like cries which the young produce when ready to leave the egg, scratches away the covering of the nest and conducts her brood to the water. The young are able to break their way through the strong eggshell by means of an "egg tooth," which develops on the tip of the snout but which is lost soon after hatching. The hatchlings are two or three times as long as the eggs from which they emerge and are at once able to fend for themselves. Growth is fairly rapid, usually about a foot a year under favourable conditions for the first few years and more slowly thereafter.

The habits of all, whether crocodiles or alligators, are very similar. They are essentially aquatic, living, as a rule, in sluggish streams and lakes. They swim by powerful strokes of the flattened tail, the limbs being folded against the body. Their powers of locomotion on land are not to be despised. Ordinarily their progress is a mere crawl, the body and tail being dragged along, but when excited they can run at a considerable pace with the body held well off the ground. Much of their time is spent basking in the full glare of the sun on sandbanks, often with the mouth agape. Some species hibernate buried in the mud during the colder parts of the year and others may aestivate in the same manner during the dry season when the rivers and pools dry up; it is not unusual, however, for them to undertake long emigrations overland when in search of new quarters and there are records of the invasion of a town by numbers of the Indian crocodiles (mugger or marsh crocodile, *C. palustris*) which had been compelled to leave their water hole by a severe drought.

The salt-water crocodile (*C. porosus*) has the most extensive range, being found from Bengal to southern China, northern Australia and the Fiji Islands, and this species is the one most frequently found at sea; the remaining species, except for the Nilotic and the common American crocodiles, frequent fresh waters only. The genus *Crocodylus* is found throughout the tropics; the best known species are the Nile crocodile which, though formerly plentiful, is now rare in lower Egypt and which extends southward to Rhodesia; the mugger of the Indian region; the North American crocodile (*C. acutus*), which occurs throughout the West Indies and from the southern United States to Colombia; and the Orinoco crocodile (*C. intermedius*). The genus *Alligator* occurs only in the southern United States (*A. mississipiensis*) and southern China (*A. sinensis*); and the caimans (two species of *Caiman*, one of *Melanosuchus*, and two of *Paleosuchus*) are confined to Central and South America.

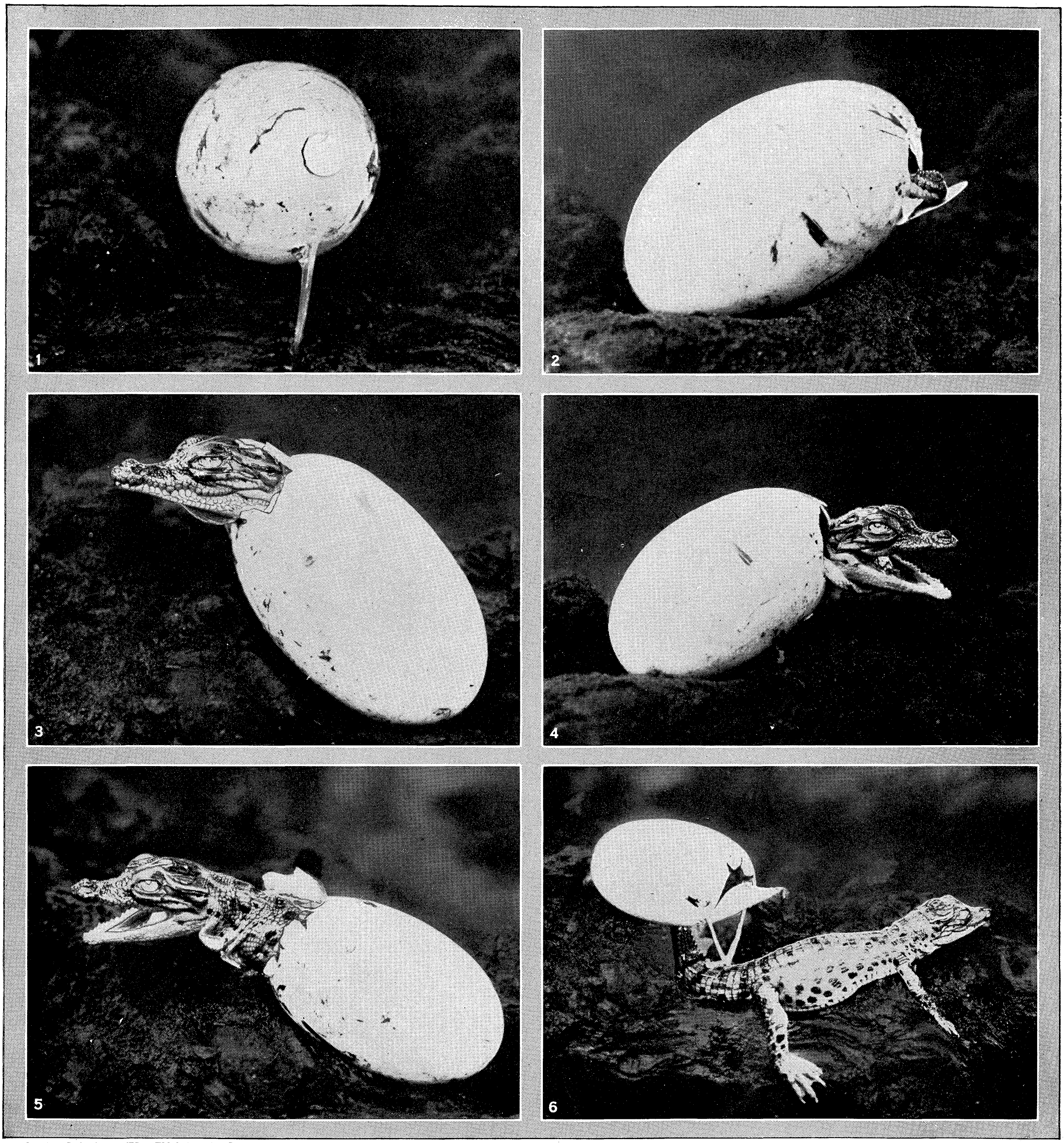
These creatures have a definite economic value, their hides being in demand for the making of fancy leathers; this has led to considerable slaughter and great reduction in the numbers of many species, which is especially the case with the North American alligator. (*See* also ALLIGATOR; REPTILES.)

(D. M. S. W., K. P. S.)

CROCOITE, a mineral consisting of lead chromate ($PbCrO_4$), and crystallizing in the monoclinic system. It is sometimes used as a paint, being identical in composition with the artificial product chrome-yellow. It is found as well-developed crystals of a bright hyacinth-red colour, which are translucent and have an adamantine to vitreous lustre. On exposure to light much of the translucency and brilliancy is lost. The streak is orange-yellow; hardness $2\frac{1}{2}$–3; sp. gr. 6.0. Crystals were first found in the Urals in 1763 in quartz veins traversing granite or gneiss. Gold is often found associated with this mineral. Crystals far surpassing in beauty any previously known have been found in the Adelaide mine at Dundas, Tasmania; they are long, slender prisms, 3 or 4 in. in length, with a brilliant lustre and colour.

(L. J. S.)

CROCUS, a genus of plants of the family Iridaceae, containing 75 species, natives of Europe, North Africa, and temperate Asia, and especially developed in the dry country of south-eastern Europe and western and central Asia. The plants are admirably adapted for climates in which a season favourable to



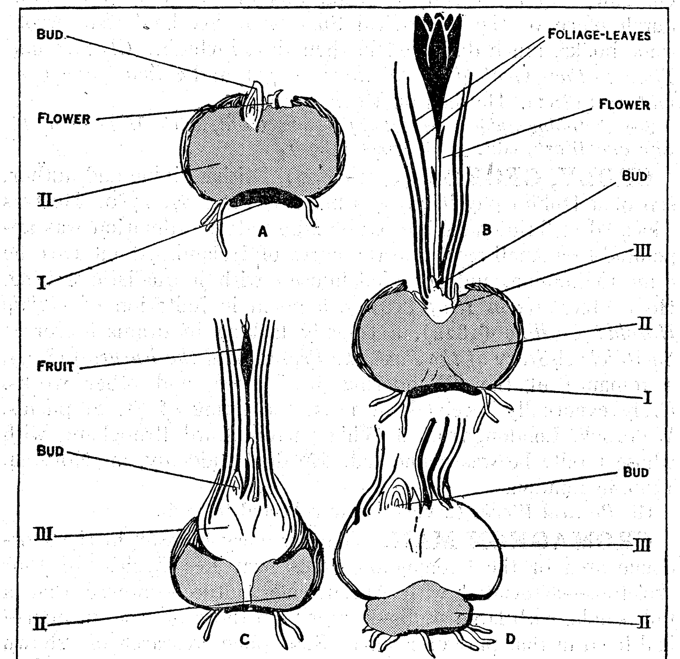
PHOTOGRAPHS, INTERNATIONAL NEWSREEL

HATCHING OF A CROCODILE IN A JAVA LABORATORY

1. A crocodile egg belonging to the *Crocodylus porosus* species, common in the East. The crocodile in the final embryonic stage is preparing to break the shell and emerge
2. The egg a few hours later, with nose of crocodile showing. A strong egg tooth on the tip of the snout helps in breaking through the heavy shell. The tooth is lost soon after hatching
3. Crocodile head protruding from egg
4. The reptile snapping at a finger held near his mouth. Even before being completely hatched, the crocodile shows signs of savagery
5. Crocodile pushing himself still further out of the egg
6. Leaving the egg behind. The new born reptile is three or four times as large as the egg in which he grew. He is at once able to take care of himself

growth alternates with a hot or dry season; during the latter they remain dormant beneath the ground in the form of a short thickened stem protected by the scaly remains of the bases of last season's leaves (known botanically as a "corm"). At the beginning of the new season of growth, new flower- and leaf-bearing shoots are developed from the corm at the expense of the food-stuff stored within it. New corms are produced at the end of the season, and by these the plant is multiplied.

The crocuses of the flower garden are mostly horticultural varieties of *C. vernus, C. versicolor,* and *C. aureus* (Dutch crocus),



FROM GROOM'S "ELEMENTARY BOTANY" (G. BELL & SONS LTD.)

SHOWING THE YEARLY HISTORY OF THE GARDEN CROCUS (CROCUS VERNUS)

A. Resting in winter
B. Flowering
C. Fruiting
D. Preparing for winter—rest after fruiting

the two former yielding the white, purple, and striped, and the latter the yellow varieties. The crocus succeeds in any fairly good garden soil and is often planted as a border plant.

CROESUS, last king of Lydia, of the Mermnad dynasty (560–546 B.C.), succeeded his father Alyattes after a war with his half-brother. He completed the conquest of Ionia by capturing Ephesus, Miletus and other places, but lack of sea-power forced him to give up his project of subduing the islands, whom he enlisted as allies. He also allied himself with Sparta, and extended the Lydian empire as far as the Halys. His wealth, due to trade, was proverbial. He was also a client of the oracle at Delphi, where a number of rich gifts of his dedication were seen by Herodotus. Various legends were told about him by the Greeks, one of the most famous being that of Solon's visit to him with the lesson it conveyed of the divine nemesis which waits upon overmuch prosperity (Hdt. i. 29, *seq.*: but *see* SOLON). After the overthrow of the Median empire (549 B.C.) Croesus found himself confronted by the rising power of Cyrus, and along with Nabonidus of Babylon took measures to resist it. A coalition was formed between the Lydian and Babylonian kings, Egypt promised troops and Sparta its fleet, and Croesus took the initiative by invading Cappadocia. After an indecisive battle at Pteria he returned to Sardis to gather the forces of the confederacy. Cyrus followed him, took him completely by surprise, and stormed Sardis. We may gather from Bacchylides (iii., 23–62) that he hoped to escape his conqueror by burning himself on a funeral pyre, but that he fell into the hands of Cyrus. A different version of the story is given (from Lydian sources) by Herodotus (followed by Xenophon), who makes Cyrus condemn his prisoner to be burnt alive. Apollo, however, came to the rescue of his worshipper with a rainstorm, and the name of Solon uttered by Croesus resulted in his deliverance. According to Ctesias, who uses Persian sources, and says nothing of the attempt to burn Croesus, he subsequently became attached to the court of Cyrus and received the governorship of Barene in Media. Fragments of columns from the temple of Artemis now in the British Museum have upon them a dedication by Croesus in Greek.

See R. Schubert, *De Croeso et Solone fabula* (1868); M. G. Radet, *La Lydie et le monde grec au temps des Mermnades* (1892–1893); A. S. Murray, *Journ. Hell. Studies,* x. pp. 1–10 (1889); *Cambridge Ancient History,* vol. iii. (1925); for the supposition that Croesus did actually perish on his own pyre *see* G. B. Grundy, *Great Persian War,* p. 28; Grote, *Hist. of Greece* (ed. 1907), p. 104. *Cf.* CYRUS; LYDIA.

CROFT, SIR HERBERT, BART. (1751–1816), English author, was born at Dunster Park, Berkshire, son of Herbert Croft of Stifford, Essex, and was educated at University college, Oxford. In 1780 he published *Love and Madness, a Story too true, in a series of letters between Parties whose names could perhaps be mentioned were they less known or less lamented.* In *Love and Madness* Croft inserted, among other miscellaneous matter, information about Thomas Chatterton gained from letters which he obtained from the poet's sister, Mrs. Newton, and used without payment, a proceeding for which he was attacked by Southey in the *Monthly Review.* In 1790 Croft proposed a revised edition of Johnson's *Dictionary,* but subscribers were lacking and his 200 volumes of ms. remained unused. Croft was a good scholar and linguist, and the author of some curious books in French.

See *The Love Letters of Mr. H. and Miss R. 1775–1779,* edited from Croft's book by Mr. Gilbert Burgess (1895). *See* also John Nichols's *Illustrations . . .* (1828), v. 202–218.

CROFT, SIR JAMES (d. 1590), lord deputy of Ireland. After representing Herefordshire in parliament in 1541 he became governor of Haddington in 1549, lord deputy of Ireland 1551, and later governor of Berwick. In 1570 Elizabeth made him a privy councillor and controller of her household. He was one of the commissioners for the trial of Mary Stuart, and in 1588 was sent to arrange peace with the duke of Parma. He died on Sept. 4, 1590.

His grandson, HERBERT CROFT (1603–1691), Chaplain to Charles I., held a prebend's stall at Worcester, a canonry of Windsor, and, under Charles II., the bishopric of Hereford. He was the author of the controversial work: *The Naked Truth or the True State of the Primitive Church* (London, 1675).

BIBLIOGRAPHY.—*See* D. Lloyd, *State Worthies from the Reformation to the Revolution* (2 vols. 1766); Anthony Wood, *Athenae Oxonienses* (ed. Bliss, 1813–20); J. Strype, *Annals of the Reformation* (Oxford, 1824); R. Bagwell, *Ireland under the Tudors,* vol. i. (1885).

CROFT (or CROFTS), **WILLIAM** (1678–1727), English composer, was born at Nether Ettington in Warwickshire. He received his musical education in the Chapel Royal under Dr. Blow whom he succeeded as organist there on the latter's death in 1708, becoming at the same time organist of Westminster Abbey. In 1724 he published, under the name of *Musica Sacra,* an edition of his choral music in 2 vols. folio, including his noble Burial Service which has been justly described as one of the masterpieces of English Church music. He died at Bath and was buried in Westminster Abbey.

CROFTER, a term used, more particularly in the highlands and islands of Scotland, to designate a tenant who rents and cultivates a small holding of land or "croft." This O.E. word, meaning originally an enclosed field, seems to correspond to the Dutch *kroft,* a field on high ground or downs. The ultimate origin is unknown. By the Crofters' Holdings (Scotland) act 1886, a crofter is defined as the tenant of a holding who resides on his holding, the annual rent of which does not exceed £30 in money, and which is situated in a crofting parish. The wholesale clearances of tenants from their crofts during the 19th century, in violation of, as the tenants claimed, an implied security of tenure, has led in the past to much agitation on the part of the crofters to secure consideration of their grievances, which have been the subject of royal commissions and of subsequent amending acts to the Crofters' Act of 1886.

CROISETTE, in architecture, the form produced at the outer ends of the upper part of the architrave of an opening or panel, when the top or lintel projects on either side beyond the width of the architrave below. The form developed through primitive construction in which the lintel stone was much wider than the opening, but remained commonly in use in all the classic styles long after any structural reason existed.

CROKER, JOHN WILSON (1780–1857), British statesman and author, was born at Galway on Dec. 20, 1780, being the only son of John Croker, the surveyor-general of customs and excise of Ireland. He was educated at Trinity College, Dublin, where he graduated in 1800. Immediately afterwards he was entered at Lincoln's Inn, and in 1802 he was called to the Irish bar. His interest in the French Revolution led him to collect a large number of valuable documents on the subject, which are now in the British Museum. In 1804 he published anonymously *Familiar Epistles to J. F. Jones, Esquire, on the State of the Irish Stage,* a caustic satire in verse on the management of the Dublin theatres, which ran through five editions in one year. Equally successful were the *Intercepted Letter from Canton* (1805), a satire on Dublin society, and *The State of Ireland, Past and Present* (1807), in which he advocated Catholic emancipation.

In 1807 he entered parliament as member for Downpatrick and in 1808 became deputy chief secretary for Ireland to Sir Arthur Wellesley. This connection led to a friendship which remained unbroken until Wellington's death. His speech (March 14, 1809) defending the duke of York against the charges of Colonel Wardle won for him in 1810 the office of secretary to the Admiralty, which he held without interruption under various administrations for more than twenty years. Among the first acts of his official career was the exposure of a fellow-official who had misappropriated the public funds to the extent of £200,000.

A determined opponent of the Reform Bill, he vowed that he would never sit in a reformed parliament; his parliamentary career accordingly terminated in 1832. Two years earlier he had retired from his post at the Admiralty on a pension of £1,500 a year. Croker had been an ardent supporter of Peel, but finally broke with him when he began to advocate the repeal of the Corn Laws. He is said to have been the first to use (Jan. 1830) the term "conservatives." He was for many years one of the leading contributors on literary and historical subjects to the *Quarterly Review,* with which he had been associated from its foundation. The rancorous spirit in which many of his articles were written did much to embitter party feeling. It also reacted unfavourably on Croker's literary reputation. He had no sympathy with the younger school of poets who were in revolt against the artificial methods of the 18th century, and he was responsible for the famous *Quarterly* article on Keats. It is, nevertheless, unjust to judge Croker by the criticisms which Macaulay brought against his *magnum opus,* his edition of Boswell's *Life of Johnson* (1831). Croker made no reply, but when the first two volumes of the History appeared he took the opportunity of pointing out inaccuracies in the work. Croker was occupied for several years on an annotated edition of Pope's works. It was left at the time of his death and afterwards completed by the Rev. Whitwell Elwin and Mr. W. J. Courthope. He died at St. Albans Bank, Hampton, on Aug. 10, 1857.

The chief works of Croker not already mentioned were his *Stories for Children from the History of England* (1817), which suggested Scott's *Tales of a Grandfather; Military Events of the French Revolution of 1830* (1831); and several lyrical pieces of some merit, such as the *Songs of Trafalgar* (1806); and *The Battles of Talavera* (1809). He also edited the *Suffolk Papers* (1823), Hervey's *Memoirs of the Court of George II.* (1817), the *Letters of Mary Lepel, Lady Hervey* (1821–22), and *Walpole's Letters to Lord Hertford* (1824). His memoirs, diaries and correspondence were edited by Louis J. Jennings in 1884 under the title of *The Croker Papers* (3 vols.).

CROKER, THOMAS CROFTON (1798–1854), Irish antiquary and humorist, was born in Cork on Jan. 15, 1798, and died in London on Aug. 8, 1854. In 1819 he became a clerk in the Admiralty. Moore was indebted to him in the production of his *Irish Melodies* for "many curious fragments of ancient poetry." In 1825 he produced his most popular book, the *Fairy Legends and Traditions of the South of Ireland,* which he followed up by the publication of his *Legends of the Lakes* (1829), his *Adventures of Barney Mahoney* (1832), and an edition of the *Popular Songs of Ireland* (1839). He wrote *Narratives Illustrative of the Contests in Ireland in 1641 and 1688* (1841), for the Camden Society, *Historical Songs of Ireland, etc.* (1841), for the Percy Society, and several other works. He was a member of many learned societies, and one of the founders of the British Archaeological Association.

CROLL, JAMES (1821–1890), Scottish scientist, was born near Cargill (Perthshire), on Jan. 2, 1821. He was self-educated, but in 1859 was made keeper of the Andersonian museum in Glasgow, and from 1867 to 1880 was in charge of the Edinburgh office of the Geological Survey of Scotland. He wrote some books, much discussed in their day, including *Climate and Time, in their Geological Relations* (1875), and *Climate and Cosmology* (1885). He died on Dec. 15, 1890.

See *Autobiographical Sketch of James Croll, with Memoir of his Life and Work,* edit. J. C. Irons (1896).

CROLY, GEORGE (1780–1860), British divine and author, son of a Dublin physician, was born on Aug. 17, 1780. He was educated at Trinity college, Dublin, and after ordination was appointed to a small curacy in the north of Ireland. About 1810 he came to London, and occupied himself with journalistic writing. He wrote *Paris in 1815* (1817), a poem in imitation of *Childe Harold; Catiline* (1822), a tragedy lacking in dramatic force; *Salathiel: A Story of the Past, the Present and the Future* (1829), a romance of the "Wandering Jew" type, and other works. Croly eventually received, in 1835, the living of St. Stephen's, Walbrook, London, from a Whig patron, Lord Brougham, with whose family he was connected. He died suddenly, on Nov. 24, 1860, in London.

His *Poetical Works* (2 vols.) were collected in 1830.

CROMAGNON MAN. The discovery in 1868 in the Dordogne area of the Cromagnon cave—near Les Eyzies—of four skeletons—associated with Aurignacian culture—showed that a tall people, with large skulls—larger than those of modern man—had lived in that part of France. Subsequent research has shown that people of this type inhabited a wide area in Europe. The women of this race were shorter than the men, and there are features capable of interpretation as evidence of contact with negroid elements.

See Sir A. Keith, *Antiquity of Man,* 2nd ed. (1925).

CROMARTY, GEORGE MACKENZIE, 1ST EARL OF (1630–1714), Scottish statesman, joined the Scottish rising on behalf of Charles II. in 1654 and was in exile until the Restoration when he became a lord of session with the title of Lord Tarbat. His opposition to Lauderdale kept him out of official employment from 1664 to 1678, but he then became lord justice general (1678), lord clerk register and a lord of session (1681), and from 1682 to 1688 he was the chief minister of Charles II. and James II. in Scotland. He made his peace with William, and held high office both under William and Mary and Anne. He received his earldom in 1703, and died on Aug. 17, 1714. His grandson George, 3rd earl (*c.* 1703–1766), forfeited his peerage for his share in the rising on behalf of Charles Edward in 1745. The 3rd earl's son, LORD MACLEOD (1727–1789), was also an active supporter of Prince Charles, and was only pardoned in 1746 on the surrender of all his rights. He went abroad, and served in the Swedish army until 1777, when he returned to Scotland, took service under the crown, and helped to raise, chiefly from the Mackenzie clan, the battalion which became the Highland Light Infantry. His estates were restored in 1784, and he died on April 2, 1789.

CROMARTY, a small burgh and seaport, Ross and Cromarty, Scotland. Pop. (est. 1938) 785, excluding men of the Royal Navy. It is situated on the southern shore of the mouth of Cromarty Firth, 5 m. E. by S. of Invergordon on the opposite coast, with which there is daily communication by steamer, and 9 m. N.E. of Fortrose, the most convenient railway station. Before the union of the shires of Ross and Cromarty, it was the county town of Cromartyshire. Its name gave the title to the earldom of Cromarty. The harbour is a naval station; but the herring fishery, once the staple industry, has failed; some white fishing is carried on. The town, however, is in growing repute as a summer resort. The thatched house with crow-stepped gables in Church Street, in which Hugh Miller (1802–56), the geologist, was born, still stands, and a statue has been erected to his memory on a hill above the town.

The former shire of Cromarty was incorporated with Ross-shire in 1889 under the designation of the county of Ross and Cromarty. Its nucleus consisted of the lands of Cromarty in the north of the peninsula of the Black Isle. To this were added from time to time the various estates scattered throughout Ross-shire—the most considerable of which were the districts around Ullapool and Little Loch Broom on the Atlantic coast, the area in which Ben Wyvis is situated, and a tract to the north of Loch Fannich—which had been acquired by the ancestors of Sir George Mackenzie (1630–1714), afterwards Viscount Tarbat (1685) and 1st earl of Cromarty (1703). Desirous of combining these properties into one shire, Viscount Tarbat was enabled to procure their annexation to his sheriffdom of Cromarty in 1685 and 1698, the area of the enlarged county amounting to nearly 370 sq.m. (*See* ROSS AND CROMARTY.)

Cromarty Firth.—Cromarty Firth, an inlet of the North Sea, extends inland for 19 m. from Moray Firth in a westerly and then south-westerly direction. Except at the Bay of Nigg, on the northern shore, and Cromarty bay, on the southern, where it is about 5 m. wide (due north and south), and at Alness bay, where it is 2 m. wide, it has an average width of 1 m. and a depth varying from 5 to 10 fathoms, forming one of the safest and most commodious anchorages in the north of Scotland. The principal places on its shores are Dingwall near the head, Cromarty near the mouth, Kiltearn, Invergordon and Kilmuir on the north. The entrance is guarded by two precipitous rocks—the one on the north 400 ft., that on the south 463 ft. high—called the Sutors from a fancied resemblance to a couple of shoe-makers (Scots, souter), bending over their lasts. The erection of defenses for the naval base was begun in 1912, and the base was used throughout World War I.

CROME, JOHN (1768–1821), English landscape painter, founder and chief representative of the "Norwich school"—often called Old Crome, to distinguish him from his son—was born at Norwich, on Dec. 22, 1768. His father was a weaver and his early years were spent in work of the humblest kind. During his apprenticeship to a house-painter he sometimes painted signboards, and devoted what leisure time he had to sketching from nature. Through the influence of a rich art-loving friend he was enabled to become a drawing-master; and in this he was engaged throughout his life. About 1790 he was introduced to Sir William Beechey, from whom he gathered additional knowledge and help in his art. In 1805 the Norwich Society of Artists took definite shape. Crome was its president and the largest contributor to its annual exhibitions. Among his pupils were James Stark, Vincent, Thirtle and John Bernay (Barney) Crome (1794–1842), his son. J. S. Cotman, a greater artist than any of them, was also associated with him.

Crome first exhibited at the Royal Academy in 1806. With very few exceptions Crome's subjects are taken from the familiar scenery of his native county. Fidelity to nature was his dominant aim. His most important works are: "Mousehold Heath, near Norwich," now in the National Gallery; "Clump of Trees, Hautbois Common"; "Oak at Poringland"; the "Willow"; "Coast Scene near Yarmouth"; "Bruges, on the Ostend River"; "Slate Quarries"; the "Italian Boulevards"; and the "Fishmarket at Boulogne." He executed a good many etchings, and the great charm of these is in the beautiful and faithful representation of trees. He died at Norwich on April 22, 1821. His son, J. B. Crome, was his assistant in teaching, and his best pictures were in the same style.

A collection of "Old" Crome's etchings, entitled *Norfolk Picturesque Scenery,* was published in 1834, and was re-issued with a memoir by Dawson Turner in 1838, but in this issue the prints were retouched by other hands. *See* also G. A. Stephen, *Norfolk Artists* (1915); H. M. Cundall, *The Norwich School* (1920); C. H. C. Baker, *Crome* (1921).

CROMER, EVELYN BARING, 1ST EARL (1841–1917), British statesman and diplomatist, was born on Feb. 26, 1841, the ninth son of Henry Baring, M.P., and Cecilia Anne, eldest daughter of Admiral Windham of Felbrigge Hall, Norfolk. He passed through Woolwich Academy into the Royal Artillery in 1858, and was appointed in 1861 A.D.C. to Sir Henry Storks, high commissioner of the Ionian Islands; he acted as secretary to the same chief during the inquiry into the Jamaica outbreak in 1864. While in the West Indies he took the opportunity of visiting the United States, and spent some time in Grant's camp before Petersburg. After his return to England he passed through the Staff college and served in the War Office in what became later the Intelligence Division. In 1872 he went out to India as private secretary to his cousin, Lord Northbrook, and in 1877 was appointed British commissioner of the Egyptian public debt office.

The appointment of a comparatively untried major of artillery as the British representative on a financial board composed of representatives of all the Great Powers was considered a bold one. Within a very short time it was recognized that the Englishman, though keeping himself carefully in the background, was unmistakably the predominant factor on the board. He was mainly responsible for the searching report, issued in 1878, of the commission of inquiry, appointed to investigate the financial methods of the Khedive Ismail; and when the khedive was driven to abdicate in 1879, Major Baring became the British controller-general in the renewed Dual Control. He maintained that administrative reform and the easing of the burdens of the fellahin were prerequisite to the collection of interest on the bonds. But he had hardly been in office more than six months before Lord Ripon asked him to go out to India as financial member of the viceroy's council. His Egyptian reputation had preceded him at Simla, but during the three years he spent in India he proved to be a wise and masterly economist.

When the British Government, saddled with the responsibility of re-establishing ordered government in Egypt after Arabi Pasha's revolt (*see* EGYPT), recalled Sir Evelyn Baring (he had received a K.C.S.I. for his Indian services), he returned to Egypt with the style of British agent and consul-general, with plenipotentiary diplomatic rank. Though junior to the other members of the Diplomatic corps, he was in fact the most powerful, because it was known that he had the backing of the British army of occupation. From the date of his return (Sept. 1883), the history of Sir Evelyn Baring, who became Baron Cromer in 1892, G.C.B. in 1895, viscount in 1897, and earl in 1901, is identified with the history of Egypt, and requires only the barest mention here. From the outset he realized that the task he had to perform could only be effected piece-meal and in detail. His very first measure was one which, though severely criticized at the time, has been justified by events. In any case it showed that he shirked no responsibility, and was capable of adopting heroic methods. He counselled the abandonment, at least temporarily, by Egypt of its authority in the Sudan provinces, already challenged by the mahdi. His views were shared by the British ministry of the day and the policy of abandonment enforced upon the Egyptian Government. At the same time it was decided that efforts should be made to relieve the Egyptian garrisons in the Sudan and this resolve led to the mission of General C. G. Gordon (*q.v.*) to Khartum. Lord Cromer subsequently told the story of Gordon's mission at length, making clear the measure of responsibility resting upon him as British agent. The proposal to employ Gordon came from the British Government and twice Sir Evelyn rejected the suggestion. Finally, however, in view of the strength of British popular feeling, Baring gave way and agreed that Gordon would be "the best man," if he clearly understood that his duty was to evacuate the Sudan, not to hold it. Gordon was instructed in London to go by the Nile route, and Baring vetoed his journey via Suakin, a decision which he afterwards repented. Once Gordon was on his way Baring gave him all possible support, and in the critical matter of the proposed despatch of Zobeir to Khartum, he—after a few days' hesitation—cordially endorsed Gordon's request, but the British Government refused.

From Jan. 1884 till the catastrophe at Khartum became known in Feb. 1885, the management of Egyptian affairs was more than usually complicated by the obstruction of the bondholders and the conflicting instructions of the British Government. Gordon's death was a terrible blow to Baring, who regretted that he had not held firmly to his own first judgment. But Baring did not allow his private sorrow to unnerve him in serving Egypt. He gave his mind to securing the reluctant assent of the bondholders to a new loan, necessary for the irrigation works and the relief of the burden on the fellahin. With the assistance of Sir Colin Scott Moncrieff, in the public works department, and Sir Edgar Vincent, as financial adviser, these two great departments were practically put in order before he gave more than superficial attention to the rest. The ministry of justice was the next department seriously taken in hand, with the assistance of Sir John Scott, while the army had been reformed under Sir Evelyn Wood, who was succeeded by Sir Francis (afterwards Lord) Grenfell. Education, the ministry of the interior, and gradually every other department, came to be reorganized, or, more correctly speaking, formed, under Cromer's carefully persistent direction. All this was accomplished with no further patent of authority than that of an adviser to the Khedive Tewfik. The death of Tewfik in 1892 threatened danger for his son and heir; Abbas was in Europe and a minor. But before the Sultan at Constantinople could interfere in the succession, Baring had brought Abbas to Egypt and had circumvented the fact of his minority by reckoning his age in lunar months. His work then proceeded unhindered.

In the meantime, the rule of the mahdi and his successor, the khalifa, in the temporarily abandoned provinces of the Sudan, had been weakened by internal dissensions; the Italians from Massawa, the Belgians from the Congo State and the French from their West African possessions, had gradually approached nearer to the valley of the Nile; and the moment had arrived at which Egypt must decide either to recover her position in the Sudan or allow the Upper Nile to fall into hands hostile to Great Britain and her position in Egypt. Lord Cromer was as quick to recognize the moment for action and to act as he had 15 years earlier been prompt to recognize the necessity of abstention. In March–Sept. 1896 the first advance was made to Dongola under the Sirdar, Sir Herbert (afterwards Lord) Kitchener (*q.v.*); and on Sept. 2, 1898, the battle of Omdurman finally crushed the power of the khalifa and restored the Sudan to the rule of Egypt and Great Britain. In the negotiations which resulted in the Anglo-French Declaration of April 8, 1904, whereby France bound herself not to obstruct in any manner the action of Great Britain in Egypt and the Egyptian Government acquired financial freedom, Lord Cromer took an active part. He also successfully guarded the interests of Egypt and Great Britain in 1906 when Turkey attempted by encroachments in the Sinai Peninsula to obtain a strategic position on the Suez Canal. All this he effected in the face of the greatest difficulties—political, national and international—and at the same time raised the credit of the country from a condition of bankruptcy to an equality with that of the first European powers. He was in England when the Denshawai executions took place, and when he returned to Egypt he found the country seething with discontent. In April 1907, in consequence of the state of his health, he resigned after 24 years in Egypt. In July of the same year parliament granted £50,000 out of the public funds to Lord Cromer in recognition of his "eminent services" in Egypt. In 1908 he published in two volumes *Modern Egypt,* in which he gave an adroit yet impartial narrative of events in Egypt and the Sudan since 1876, and dealt with the results to Egypt of the British occupation of the country. Lord Cromer took some part in the political life at home after his retirement, joining the free-trade wing of the Unionist party.

But in his leisure he turned to the study of the classics, the fruit of which appeared in a lecture delivered to the Classical Association in 1910 on *Ancient and Modern Imperialism.* Three volumes of *Political and Literary Essays* consist of reviews contributed to the *Spectator.* Even during his busy years in Egypt he wrote his *Paraphrases from the Greek Anthology.* He returned to Egyptian affairs in a supplement (1915) to *Modern Egypt.* In 1916 the Government called on him to preside over the Dardanelles Commission. The strain was too great, and after one of the meetings, he collapsed. He died on Jan. 29, 1917.

Lord Cromer married in 1876 Ethel Stanley, daughter of Sir Rowland Stanley Errington, 11th baronet, but was left a widower with two sons in 1898; in 1901 he married Lady Katherine Thynne, daughter of the 4th marquess of Bath.

CROMER, urban district and watering-place of Norfolk, England, 24 mi. N. of Norwich on the L.N.E. and Mid. and G.N. Jt. railways. Pop. (1938) 3,963. Standing on cliffs of considerable elevation, the town has repeatedly suffered from ravages of the sea. A wall and esplanade extend along the bottom of the cliffs, and there is a fine stretch of sandy beach. The church of St. Peter and St. Paul is Perpendicular (largely restored) with a lofty tower. Cromer is a coast-guard and life-boat station, and there is some fishing. Area 1.8 sq.mi.

CROMLECH, a megalithic structure consisting of a large horizontal capstone supported on uprights, forming part of a prehistoric stone chamber. In Britain the word is practically synonymous with *dolmen,* while in France it is applied to the collection of such stones usually known as a "stone circle" (*see* STONE MONUMENTS, PRIMITIVE).

CROMORNE, also **CRUMHORNE,** an ancient wind instrument of wood in which a cylindrical column of air was set in vibration by a reed. The lower extremity was turned up in a half-circle, and from this peculiarity it gained the French name *tournebout.* The reed of the cromorne was not, like that of the bassoon, in contact with the player's lips, but was covered by a cap pierced in the upper part with a raised slit against which the performer's lips rested, the air being forced through the opening into the cap and setting the reed in vibration. The reed itself was therefore not subject to the pressure of the lips, and the compass of the instrument was in consequence limited to the simple fundamental sounds produced by the successive opening of the lateral holes. The cromornes, which were made in various sizes, were in very general use in Europe from the 14th to the 17th century.

CROMPTON, SAMUEL (1753–1827), English inventor, was born on Dec. 3, 1753, at Firwood, near Bolton-le-Moors, Lancashire, and went into a spinning-mill as a lad. The defects of the spinning jenny inspired him with the idea of devising something better, and for five or six years the effort absorbed all his spare time and money, including what he earned by playing the violin at the Bolton theatre. About 1779 he succeeded in producing a machine which span yarn suitable for use in the manufacture of muslin, and which was known as the muslin wheel or the Hall-in-the-Wood wheel, and later as the spinning mule. After his marriage in 1780 a demand arose for the yarn which he made at Hall-in-the-Wood, but he could not afford to take out a patent and decided to reveal the secret of his machine, on the promise of a number of manufacturers to pay him for the use of the mule, but all he received was about £60. He then resumed spinning on his own account, but with indifferent success. In 1800 a sum of £500 was raised for his benefit by subscription, and in 1812 parliament allowed him £5,000. With this money he embarked in business, first as a bleacher and then as a cotton merchant and spinner, but without success. In 1824 friends bought him an annuity of £63. He died at Bolton June 26, 1827.

CROMPTON, an urban district of Lancashire, England, 2½ mi. N. of Oldham. Pop. (est. 1938) 13,360. Area, 4.5 sq.mi. Textile industries (chiefly spinning) are carried on, and there are coal mines.

CROMWELL, HENRY (1628–1674), fourth son of Oliver Cromwell, was born at Huntingdon on Jan. 20, 1628, and served under his father in the latter part of the Civil War. In 1650 he took some troops to assist Oliver in Ireland and was one of the Irish representatives in the Little, or Nominated, Parliament of 1653. In 1655 he was appointed major-general of the forces in Ireland and a member of the Irish council of state. On the departure for England of the lord-deputy, Charles Fleetwood, in Sept. 1655, Henry was left for practical purposes the ruler of Ireland. He diverged from Fleetwood's policy, in protecting the interests of the English settlers and in holding the scales evenly between the different Protestant sects; and his undoubted popularity in Ireland is attested by Clarendon. In Nov. 1657 Henry was made lord-deputy; but on the succession of Richard Cromwell to the office of protector, at his father's death, although Henry was now appointed lieutenant and governor-general of Ireland, it was only with great reluctance that he remained in that country. Having rejected proposals to assist in the restoration of Charles II., Henry was recalled to England in June 1659 just after his brother's fall. He resigned office at once, and although he lost some property at the Restoration, he was allowed to keep the estate he had bought in Ireland. His last years were passed at Spinney Abbey in Cambridgeshire, where he was unmolested by the Government and where he died on March 23, 1674. In 1653 he married Elizabeth (d. 1687), daughter of Sir Francis Russell, and left five sons and two daughters.

See J. Waylen, *The House of Cromwell* (new ed. 1897).

CROMWELL, OLIVER (1599–1658), Lord Protector of England, was the son of Robert Cromwell of Huntingdon and Elizabeth Steward. His father was the great-grandson of Morgan Williams, who married the sister of Thomas Cromwell, the ruthless Minister of Henry VIII. Richard, the son of Morgan, acted as agent to Thomas Cromwell, and took his name. The son of Richard, Henry, inheriting the spoils of the abbey of Ramsey and the priory of Hinchinbrook near Huntingdon, by his splendid profusion earned the name of the Golden Knight, and his eldest son, Sir Oliver, by like extravagance, almost completed the dissipation of those fine properties. Robert, the younger brother, was of a serious character, and lived on his modest portion at Huntingdon. He is alleged to have been a brewer, but his main occupation was no doubt that of a gentleman farmer.

Oliver received his education at Huntingdon School under Dr. Beard, whose belief in the direct interposition of God for the punishment of the wicked may have influenced him throughout all his life. In 1616, Cromwell entered Sidney Sussex College, Cambridge, where he would come again under puritanical influence; but in 1617, on the death of his father, he returned to Huntingdon, to take up, as the only surviving son, the care of his mother, his five sisters and the family affairs. He married in 1620 Elizabeth Bourchier, the daughter of a city merchant, who survived him.

Save for this great event, what is known of his life between 1616 and 1628 is trivial. If he studied law, as is alleged, it was to little effect, for many years later he confessed haughtily that he knew as little of arithmetic as of law. There can be no doubt that he loved horses, as did his son Richard. He may have studied the art of war as set forth in the accounts of the practice of Gustavus, for military experts find him soon after his first appearance in the field strangely skilled in war according to the best manner of the period. There is no doubt that at some time, or at many times, he suffered from religious depression and the searing conviction of sin. It may be inferred that he passed through that spiritual crisis known as conversion, for on his death-bed he drew hope from the recollection that at one time he had certainly been in grace. There is evidence that he was forward in protecting his humbler neighbours against legal and other injustice. But the chief proof of his active, useful and respected life, is in his election as member for Huntingdon to the Parliament of 1628. His family connections were many and widespread; at Westminster he would meet his cousins, John Hampden and Oliver St. John. By their side he was introduced to religious and political controversy on the larger scale. After the dissolution of that Parliament he disappears once more from the public view.

In 1631 he sold his land near Huntingdon and moved to St. Ives, where his business was that of a grazier on hired land. In 1636 he succeeded to the estate of his maternal uncle, Sir Thomas Steward, and to his profits and activities as farmer of the Cathedral tithe of Ely. Huntingdon, St. Ives, Ely, each is within an easy ride of Cambridge, such journeys were taken often, not only for private but for public affairs; important relations must have been formed somehow, for in 1640 he was elected as burgess for Cambridge. A contemporary gives this sketch of his appearance in the House:—"very ordinarily apparelled in a plain cloth suit made by a country tailor, his linen plain and not clean, his hat without a hat-band. His stature of a good size, his sword stuck close to his side, his countenance swollen and reddish, his voice sharp and untuneable, and his eloquence full of fervour, for the matter would not bear much of reason, . . . yet he was very much hearkened unto." Indeed, though no orator, he was active in the House from the first; he moved the second reading of the bill for Annual Parliaments (1640), and served on many committees. He worked with St. John, Harry Vane, Arthur Hazelrigg and Edward Dering for the Root and Branch Bill—to destroy the power of the bishops and transfer it to commissioners to be named by Parliament. In Nov. 1641, he carried a motion appointing the Earl of Essex to command the train-bands of England, south of Trent, and in Jan. 1642, for a committee to put the kingdom "in a posture of defence." It is probable that his zeal for freedom of religion (as conceived by himself) was greater than his love of civic liberty; on the other hand, he declared that, if the Grand Remonstrance had not been carried, he would have sold all and left the country; it is characteristic of the man that he was associated with the two first practical measures for mobilizing armed force against the King.

When Charles had left London (Jan. 1642), when his Queen had left England, when Hotham, the Governor, had refused to admit his monarch within the walls of Hull, war was in sight. The 19 propositions of the Parliament sketched a new constitution for the kingdom which Charles could only accept under duress. On his rejection of those terms Parliament set up a Committee of Safety, and resolved to raise 10,000 men; Essex was made their General. The time for action had come. While one party was endeavouring to enforce the King's Commissions of array, and the other to carry out the ordinance of the Parliament for control of the train-bands, Cromwell was not inactive. He held Cambridge and its resources against the King and for the Parliament; he raised a troop of 60 horse and in August joined the army of Essex. We may assume that he chafed at the delays of his chief, who allowed the king to collect an army and only moved when the king started to march on London. At Edgehill where the forces met (Oct. 23, 1642) Cromwell was present, and his troop stood firm when others had fled. As a leader of cavalry he then learnt a lesson from the errors of Rupert, which served him well thereafter. He also formed the conviction that for this great cause troops must be found with a spirit which would carry them "as far as gentlemen would go; such men as have the fear of God before them." And in Jan. 1643 he asked leave for himself and his men, betook himself to the Eastern Counties, where he was known, and began his work with the Eastern Association which had been shortly before founded by Ordinance of Parliament. Cambridge was its headquarters. By May 1643 he had 12 troops chosen and disciplined to his own high standard. With them he beat twice his own numbers at Grantham, "charging fiercely at a pretty round trot." After a short spell at Nottingham, where the force, assembled for the aid of the Fairfaxes in Yorkshire, was paralysed by treachery, Cromwell returned to the Eastern Association, now assailed by the Royalists, and collected a force for the relief of Gainsborough, where he won a noteworthy success (July 28, 1643). Confronted then with Newcastle's main army, he effected a masterly retreat to Lincoln, and prepared to levy a new force to be led by the Earl of Manchester. Thomas Fairfax shipped his horsemen from Hull and joined Cromwell; under Manchester, the two moved to recover Lincolnshire, and won the day at Winceby, where Cromwell's horse was killed under him. Lincoln and Gainsborough were recovered, and Ferdinando, Lord Fairfax of Cameron, by a sally, raised the siege of Hull. In Jan., 1644, Cromwell was appointed Lieut.-General for the Eastern Association, and in the following month he became a Member of the Committee of Both Kingdoms. He is reported to have had supreme influence with Manchester, and for a time he inspired his chief with his own vigour, and the army with his own discipline and spirit.

In 1644 the Scots under Leslie crossed the border; in April the King's northern army under Newcastle was driven into York, where it was besieged by Leslie and the Fairfaxes. Waller and

Essex were preparing to advance on Oxford, when the army of the Eastern Association took the field in Lincolnshire. In June Manchester joined the armies besieging York. Cromwell was then in command of 3,000 cavalry. But in June Rupert, marching east from Lancashire with a superior force, drew off the besieging armies to meet him, eluded them, and entered York. The Parliamentary armies, thus baffled, retreated southwards; Rupert followed, and forced an engagement at Marston Moor (July 2). The honours of this victory fell to Cromwell, who commanded the cavalry on the left. Victorious after hard fighting over Rupert's horse, he returned to find the right wing of his own party routed and the centre broken, though Manchester's brigades of foot and the Scots were maintaining a valorous struggle. Taking the enemy in the rear, he defeated first the Royalist Horse on the enemy's left, and then turned to attack the infantry who were pressing the Scots back. The Scots and David Leslie deserve high credit, but the highest meed must fall to Cromwell. The three generals, Leven, Manchester and the elder Fairfax, had fled as from a complete rout. In the result, of about 18,000 men, Rupert re-assembled about 6,000, and York, the prize at stake, surrendered a fortnight later. It was at this battle that Rupert gave the name of Ironsides to Cromwell's troops, which could not "be broken or divided."

Meanwhile things had gone badly in the west. Charles had defeated Waller at Cropredy Bridge (June 29). He then followed Essex into Cornwall, while the army of the Eastern Association under Manchester lay idle at Lincoln; the commander himself unwilling to push the war home; Crawford and Cromwell estranged by political and religious dissension. The force of Essex was destroyed, and when Charles moved towards Oxford, Manchester was reluctant to accept the order to march against him. "This army," he said, "cannot be commanded by the Parliament without the consent of the Association which raised it for its own defence." When the armies ultimately met at Newbury, the command on the side of the Parliament had been entrusted to a Committee. In consequence the attack was ill-planned (Oct. 27), and Charles was able to reach Oxford. Cromwell blamed Manchester as unwilling to push the attack against Charles to the extreme conclusion. Manchester replied in kind. The Scotch were ill-disposed to Cromwell, as he to the Presbyterian cause. The incident seemed about to lead to an alliance directed immediately against Cromwell. Cromwell evaded rupture by urging reorganization of the army and a change in its commanders. In the result, the second Self-denying Ordinance was adopted in April, 1645, which required all members of either House holding office to lay down their commissions within 40 days, but did not exclude the possibility of re-appointment. Sir Thomas Fairfax was made general of the New Model army. Cromwell with his regiment was put under Waller, whom he readily accepted as his chief. His command was prolonged on May 10 for another 40 days, and on June 10, at the urgent request of Fairfax, he was named as Lieut.-General.

The essence of the New Model army was a single command, corporate unity without regard to local interests, regular supply and regular pay for officers and men. The numbers were fixed at 22,000, with some supernumeraries, and impressment was ordered to complete this total. The necessary money was to be raised by monthly levies on the counties. The changes in the high command were important, but the changes in organization were equally important. It would appear that these great measures of reform were the work of Parliament actuated then by constructive common sense. The scheme accorded with Cromwell's ideas. He acted with discretion throughout. He refused to be drawn into a quarrel with Manchester. He refused to antagonize the Scots and their friends on the religious question. The thorny question of the Covenant was evaded. The Ordinance appeared at first sight to exclude Cromwell from command; it turned out to admit him as if by a deliberate manoeuvre. He cannot in his heart have been prepared to stand aside, but there is found no evidence of subtle intrigue on his own part. On this occasion, as on many others, the drive of circumstances and the potency of personality shaped events so as to push him to the front. As a passive waiter on the direction of Divine Providence, his attitude mitigated opposition and disarmed jealousy, leaving him ready to accept what presented itself as a duty.

The New Model army took some time to get into shape, and its action was hampered by orders from the Parliamentary committee. At length Fairfax was given a free hand to advance against the forces of Charles and Rupert which had recently taken and sacked Leicester. Just in time Cromwell joined up at Naseby with 600 horse and took command of the cavalry. The King's forces were less in numbers but their foot were veterans, while of the infantry on the side of Fairfax a large part were raw conscripts. The attack of the Royalist foot (June 14) was at first successful; and on the parliamentary left Rupert broke the Parliamentary horsemen under Ireton. But Cromwell, on the right, with his troopers drove all before him, and then turned on the Royalist foot, who after a resolute defence were defeated and captured almost to a man. The Parliamentary army then formed up again and attacked the Royalist horse which had gathered once more; unsupported, they could not stand; they fled and the pursuit continued for many miles. The King took refuge in Wales. A month later, Fairfax and Cromwell defeated Goring at Langport, and drove him into Bridgwater, which was taken by assault. A year was then spent in reducing cities, forts and isolated garrisons, until the war was terminated by the surrender of Oxford on June 24, 1646. King Charles took refuge with the Scots at Newark. His cause was greatly damaged by the discovery of his attempts to obtain aid from Lorraine, from France, from Denmark and from Ireland.

Up to this time Cromwell had shown a natural aptitude for war. Vigorous in action, rapid in decision, steadfast in self-control, firm in discipline, but master of the hearts of his men, what he had learnt by study he had perfected in the field, on the march and in the camp. When things looked hopeless, in April 1647, he seriously thought of accepting service abroad under the Elector Palatine. Two things kept him at home: his zeal for freedom of belief, within his own arbitrary limits—and his devotion to the army with which he had served. These two master motives forced him into politics. The Parliament, having abolished Episcopacy and sequestrated the lands of the Church, seemed about to force upon the nation another religious tyranny—a Presbyterian rule in religion—a religion formulated by Parliament. During the year following the surrender of Oxford, first the Scots had endeavoured to persuade the King—their guest or prisoner—to accept their own Presbyterian system. When they had failed with Charles, they made terms with the Parliament for their arrears of pay, handed over the King, and retired to their own country (Jan. 30, 1647). Charles was taken in custody to Holmby in Northants. Parliament thought that an agreement with the King on a basis of Presbyterianism and the control of the armed forces of the nation was in sight; they accordingly proposed to disband a great part of the army without security for their arrears of pay, and to send 12,000 of the remainder to Ireland. The army elected "agitators" to focus their resistance; and Cromwell, Skippon, Ireton and Fleetwood were sent by the Parliament to headquarters at Saffron Walden, to deal with the malcontents. Cromwell discharged his duty faithfully, attempted to pacify the soldiers, and laid their case before Parliament; but disbandment without satisfaction was ordered for June 1. The army refused to disband; and Cromwell joined the army. On the same day the King was seized at Holmby, and passed into the custody of the army.

The army forthwith organized itself. A Council was set up to represent the army in political matters:—the general officers with four representatives from each regiment. In military matters the general and his council of war were to be supreme. Order and discipline were soon restored. The army then advanced towards London. Toleration was demanded and proposals were made for a new Parliament to be elected on a more equitable scheme of constituencies and representation. Under this pressure Parliament rescinded its orders for disbandment, discharged the soldiers enlisted to resist the army and restored the old committee for the Militia of London which had been displaced by Presbyterians; but the London mob took charge, and forced the repeal of these orders and the issue of an invitation to the King to come to

London. A number of the legislators took refuge with the army, which advanced towards London to "restore the liberty of Parliament." A regiment of cavalry in Hyde Park persuaded Parliament to return to their last position but one. The most ardent Presbyterians took refuge on the continent.

Cromwell, on behalf of the army, now undertook to negotiate with the King. The "Proposals" made to him were more lenient to the Royalists than those of the Parliament. But they involved the reservation to the Parliament for ten years of the control of the militia and the appointment of officers of State, and the limitation of the royal power by a co-ordinate Council of State. They excluded control, Episcopal or Presbyterian, of religious opinion. In details the Council of the Army showed itself conciliatory; but, whatever amendments might be allowed, the King saw his power in the Church annulled, and his power in the State curtailed. He thought he could do better by playing off the army against the Parliament. On the other hand the firebrands of the army thought Cromwell and Ireton too indulgent. The "Agreement of the People" was put forward in Oct. 1647, demanding a new parliament, new constituencies, manhood suffrage, triennial Parliaments, government by Parliament under certain reservations (stated but without sanction or guarantee), and without any mention of the King. This Cromwell and his friends were strong enough to put aside. It was Cromwell who then laid down that in judging any new political scheme the first thing to be considered was, "whether the spirit and temper of the people are prepared to go along with it." On this ground he judged monarchy best; though not a politician, he had sound political sense. The King had a third party to which he could turn—the Scots. To gain greater freedom in negotiation he escaped from Hampton Court to Carisbrooke Castle in the Isle of Wight (Nov. 1647). Charles counted on the dangerous divisions in the army; these were, however, repressed by Cromwell's courage and firmness. But on Dec. 27 Charles made his treaty with the Scots and rejected the terms of the Parliament, in the vain hope that he would be able to escape to the continent and bring aid thence to his Scottish allies. In Jan. 1648, the Parliament voted to break off all dealings with Charles: in their action Cromwell concurred. Soon afterwards the Second Civil War broke out.

The rising began in Wales. In the north the Royalists, preparing for the army promised by the Scots, seized Berwick and Carlisle. In May, 1648, Cromwell left London for Wales: Pembroke Castle held out for six weeks, till it was starved into submission (July 11). Three days earlier the Scots under Hamilton had crossed the border. The Royalists had risen in Kent and Essex, and the fleet in the Downs had declared for the King. Fairfax dealt with these risings and laid siege to Colchester. In the north Lambert had to give way before the Scots, who moved forward slowly. Cromwell sent part of his force to the aid of Lambert and followed himself with the remainder. They joined forces in the West Riding on August 12. Here he learnt that Hamilton was marching south towards Preston; he marched west "choosing to put ourselves between their army and Scotland." He caught Hamilton with his forces divided. Cromwell destroyed Langdale's division and Hamilton's rearguard, occupied Preston, and set out in pursuit of Hamilton's main force. He followed them almost to Warrington, where there was some hard fighting: the main part of the army were prisoners by August 20; the rest surrendered in detail or escaped in disguise. When Colchester surrendered on August 27, the Second Civil War was in effect concluded.

But there was still work to be done. Cromwell marched into Scotland, and aided by a rising in the west made terms with the duke of Argyll and his partisans which protected England for a time against interference. Meanwhile Parliament had been treating with the King; and preliminaries were agreed on at Newport on Sept. 18. The army feared that peace thus made would put the Presbyterians in power and lead to the dismissal of the soldiers without payment of arrears or indemnity for their acts while under arms. On Nov. 20 the army in the south presented to Parliament a Remonstrance drawn up by Ireton, demanding *inter alia* that the King be "brought to justice for the treason, blood and mischief he is guilty of." The Parliament continued to treat, and action was taken. The King was removed by orders of Fairfax from Newport to Hurst. The officers in London allied themselves with the Independent minority in Parliament to drive out the Presbyterian majority. This was effected on Dec. 6 and 7 (Pride's Purge). Cromwell took his seat with the minority.

The assembly thus constituted had no semblance of legality. It was what is called in revolutionary cant a provisional government. The Council of the Army was another such provisional government. Cromwell was a member of both bodies and the strongest personality in each. He cannot escape the fullest responsibility for the act which followed. Yet it seems certain that he struggled long against the ultimate decision, and there is no reason to question the sincerity of his doubts. At last he could see no way except that which was taken. Nowadays the execution of the King might be defended on the ground that the safety of the people is a supreme interest above all law. If Cromwell justified the act by saying that the Providence of God had cast it upon him, that was the manner of thought which he had learnt from the Old Testament. The mutilated House of Commons, ignoring the House of Lords, appointed an arbitrary tribunal to judge the King, of which not half the members accepted the charge laid upon them. The conclusion was inevitable: no plea of law or right or fact could avail; Charles went to his death on Jan. 30, 1649.

After his death, such House of Commons as remained passed laws abolishing the House of Lords, abolishing the monarchy, and establishing a "Commonwealth or Free State," a Republic, with which Cromwell later dealt as he had with his King according to the law of necessity. But first he had tasks to perform which were more congenial to his nature and his gifts. For the moment he was a member of the Council of State created by the purged Parliament. Many tasks were taken in hand, which had hitherto been perforce neglected; in these activities his influence, where not certain, may be surmised. The navy was reorganized and re-equipped. Discontent and anarchical propaganda were rife in the army and demanded severe measures of repression. Though his faith and wisdom were needed for these and other duties, the Council of State was a competent body and for a time could manage home affairs. Where war was needed, Cromwell had no rival, or plausible substitute. The case of Ireland was the most pressing. The rebellion of 1641 had been exacerbated by the measures of the Parliament, which proscribed the Popish religion and offered two and a half million acres of Irish land to adventurers, as a means of raising funds for the reconquest. With the turmoil and confused intrigue that followed this biography is not concerned—until the time in 1647 when Ormonde, Lord Lieutenant for the King, surrendered Dublin to the Parliament. The reconquest of the island was then planned, but postponed owing to the Second Civil War; after this war Ormonde returned and formed a considerable party of Catholics and Anglo-Irish against the Parliament. The prince of Wales was invited to take the lead. Rupert appeared at Kinsale with his ships. The Republican force in Ireland was confined to Dublin, Drogheda and Derry. The situation was critical, and on March 30, 1649, Cromwell accepted the command of an army of reconquest.

Ormonde had at first considerable success, capturing Drogheda and other strongholds, but on Aug. 2 Michael Jones, commander at Dublin, routed him at Rathmines, and when Cromwell landed at Dublin (Aug. 13) there was no longer an opposing army in the field. The best of Ormonde's troops were in Drogheda; thither Cromwell led his men and stormed the town, putting all its defenders and all Catholic priests to the sword. A few days later Wexford shared the same fate. By the end of the year the coast from Londonderry to Cape Clear was in Cromwell's hands, excepting Waterford; but not much beyond the coast. In January his recall was voted to face the threat of a Scottish invasion; but he did not leave till May. Just before his departure he suffered a severe repulse in an assault on Clonmel—though the place came into his hands by the subsequent retirement of the garrison. The Irish expedition adds little to Cromwell's military fame. The ignorance of Irish history displayed in his public utterances is colossal. Claiming to be a judge "to ask an account of the innocent blood" shed in 1641, he lost all sense of justice through religious rancour; and the "righteous judgment" of which he spoke fell upon those who had no part in the original crimes.

The conquest of Ireland was completed in 1652 by his successors in command. The Cromwellian Settlement—as it is called and rightly called, for he approved its principles—was not completed until 1658. The means of the settlement were the transfer to new owners of the property in land over two-thirds of Ireland; the aim was the conversion of Ireland from a Catholic to a Protestant country; the method was called the impartial administration of justice. The Instrument of Government gave to the Irish representation in parliament, but the representatives were so chosen as to represent, not the Irish, but the English in Ireland. It may be conceded that Cromwell used his influence to mitigate for Ireland the burdens of taxation. For the last three years of Cromwell's life, his son, Henry, was acting as governor in the island; under his rule, some order began to emerge from chaos.

The execution of a Scottish King had touched the Scots on the point of national pride. On hearing the news, they at once proclaimed Charles II. king, not only of Scotland, but of Great Britain and Ireland. His first plan was to use Ireland as a starting point; but first the confusion of parties in Ireland, and afterwards the blows of Cromwell, closed to him this field of action. He landed in Scotland on June 23, 1650, having accepted the Scotch terms. They were that he should impose Presbyterianism on England and Ireland, take the oath to both Covenants, and disavow both Ormonde and Montrose. Cromwell urged on the Council of State that they should forestall the Scots by invading Scotland. Fairfax declined to take any part in such action, and Cromwell was made Captain General and Commander-in-Chief. He entered Scotland at the end of July, and was confronted by David Leslie with an army superior in numbers but inferior in quality. He failed to force Leslie to accept battle. A month so passed, until Cromwell found himself with his back to the sea at Dunbar, with the Scots commanding the road to Berwick. In order to prevent the escape of his enemy by sea, Leslie came down from the hills on Sept. 2. Cromwell's force was much reduced by sickness, and in numbers was half that of the Scotch. But he saw his opportunity and planned his attack with Lambert for the dawn of Sept. 3. Feinting an attack on the Scotch left, he threw the whole of his main strength on their right and centre. When the Scottish right wing had been broken, their centre was rolled up between the hills and a ravine which blocked their left. Three thousand Scots were killed, and ten thousand prisoners were taken. This battle was a masterpiece of tactics, resolutely carried out, with full advantage taken of the ground.

Leslie retired with the remnants of his force to Stirling, while Cromwell occupied Edinburgh and Leith. Lambert was sent against the extreme covenanters in the west. Charles was crowned at Scone on Jan. 1, 1651. Cromwell fell ill, and when at length in July he was able to take the field again, he failed to bring Leslie into action where he lay before Stirling. Accordingly he determined to turn his position, risking or inviting an invasion of England. On August 2 he occupied Perth, having passed through Fife. Here he learnt that the whole Scottish army had started on their march south. Cromwell left Monk, with 6,000 men, to hold Scotland, sent his cavalry under Lambert and Harrison to follow the King, the one in the rear, the other on the flank, and himself marched through Yorkshire, as he went, collecting bodies of the English militia. On Aug. 22 Charles reached Worcester. Meanwhile Cromwell had joined forces with Lambert and Harrison and lay at Evesham. Making good use of his superior strength, he sent Lambert and Fleetwood across the Severn to block the retreat into Wales. Himself he advanced from the south-east towards the city, threatening it on the south and on the east. On Sept. 3, the day of action, Fleetwood advanced to the Teme and engaged the army. Cromwell crossed the Severn by a bridge of boats and took Fleetwood's opponents in flank. This enabled Fleetwood to cross the Teme, and the combined forces "beat the Scots into" Worcester. Charles made a sally on the east against the forces left by Cromwell. Thereupon Cromwell again crossed the Severn and completed his victory. The Scottish foot laid down its arms; the horse retreated towards Scotland, but were hunted down by the local militia and the country folk. No organized body of troops reached Scotland. This campaign shows a high mastery of great strategical movements. All Cromwell's forces were collected at the critical time and place; the intelligence must have been good, and the supply well managed; and in the battle itself the difficulties of the ground were made to help rather than to impede the concerted action of the whole army. Charles escaped as is well known; but there was no more fighting in England while Cromwell lived. Monk completed the conquest of Scotland, and in 1654 the last efforts at resistance were crushed.

On Sept. 12, 1651, Cromwell entered London in triumph. Parliament voted to him a revenue of £4,000 a year, and gave him Hampton Court for his residence. His position was that of Captain-General of the Army, a member of the Council of State and a member of such parliament as there was. He entered now on one of those periods when, as we might say, he waited to be convinced by the logic of events that certain action was necessary, or, as he would himself say and believe, to be "put by the Lord on the doing" of certain work. He was anxious that the Parliament should "period" themselves, *i.e.*, that they should fix a date for the termination of their power by a new election. All the members were loth to resign their power; many clung to the illegitimate profit, patronage and influence, which their position put within their reach. He was anxious that an act of indemnity should be framed for the war-like acts done in the course of the rebellion; such an act of oblivion was passed in February 1652, but, in his opinion, it was unduly limited. He desired a settlement of the Church with due regard to the liberty of conscience. The Parliament offered him a scheme fettered by 15 fundamental principles. They drifted into war with the Dutch, not so much because of the Navigation Act passed by them in 1651, as because of disputes arising out of their claim to the right of search for French goods in Dutch vessels. This war was distasteful to Cromwell, whose mind dwelt on joint action with Protestant princes on the Continent for the restoration and maintenance of freedom of conscience. To meet the necessary expenses of army and navy the Parliament resorted once more to the oppressive and impolitic expedient of confiscating the estates of alleged "malignants." They put the crown on their offences and omissions by hurrying forward a bill for a "New Representative" which would leave the sitting members unchallenged in their seats and the judges of the fitness of any new members who might be chosen. The bill was on the point of passage, when on April 20, 1653, Cromwell drove them from the judgment seat. He followed up this action by dispersing the Council of State, whose authority was dependent on that of the disbanded Parliament.

The only established authority left was that of the Captain-General, under whom a temporary Council of State dealt with the current business. In the hope of securing an assembly of "men fearing God and hating covetousness" he called upon the Congregational churches all over the kingdom to nominate suitable persons. From the list thus supplied, the Council of officers chose 140, including five to represent Scotland, and six to represent Ireland. This body went hopefully and prayerfully to work. It constituted itself a Parliament, and nominated a working Government. It undertook to reform the law and reform the Church. It impeded peace with the Dutch, which Cromwell desired. Its doctrinaire attitude encouraged the extremists and the fanatics. Finally the assembly came to hopeless disagreement over the reconstitution of the Church. Under some influence—not, it would seem, that of Cromwell—a majority decided to resign their powers into the hands of the Captain-General. "My power," as he said later, "was again by this resignation as boundless and unlimited as before." (*See* BAREBONE'S PARLIAMENT.)

A scheme had already been put forward by the officers of the army, called the Instrument of Government. This scheme put the executive power in the hands of a Protector and a Council of State, nominated for life. A fixed revenue was assigned to the Government. Legislation was to be by a Parliament to be summoned not less than once in three years, and to sit when summoned for not less than five months. The Protector was to have the appointment of all magistrates, and the command of the forces by sea and land. Only for some of the very highest offices was the assent of Parliament required, or, if Parliament was not sitting, then that of the Council. For all foreign policy the Protector with his Council were made responsible. A ministry was to be established, but liberty of conscience was given to all Christians except papists and prelatists. In the absence of Parliament, the Protector was empowered to make Ordinances with the consent of the Council. In its original form this scheme gave the name of King to the head of the State; the term Protector was adopted to meet Cromwell's doubts or scruples. After the failure of the Little Parliament, Cromwell accepted the Instrument, and was solemnly installed as Protector on Dec. 16, 1653, in the significant black coat of a civilian. The document itself had no authority except that of the heads of the army and the acceptance of the Captain-General. Its validity rested on the logic of facts, but its construction shows practical wisdom. Its chief provisions stood the test of experience during Oliver's lifetime.

It has been said that the events of 1640 to 1660 proved that the King could not govern this country without a Parliament and that the Parliament could not govern without a King. Cromwell's experience under the Instrument of Government supports both theses. His own position as a quasi-king preserved the experiment from complete failure; his actions proved his sincere desire to work in concert with some kind of parliament. But he was not invested with the magic of kingship; those who obeyed his orders had not the legal protection given by statute to those whose acts were covered by the commands of a *de facto* king; and the parliaments which he could bring together lacked the valid title of a royal summons. Owing to the restrictions on free election necessitated by the political situation, Parliament could not claim the full support of the people; and the traditions of the Long Parliament did not encourage harmonious working between Parliament and Protector. It is probable, indeed, that the Protector himself was not well-fitted to work in with popular institutions.

Under the Instrument, Cromwell with his Council had authority to issue Ordinances having the effect of law when parliament was not sitting. Thus from Dec. 1653 until Sept. 1654, there was an opportunity of clearing many difficulties out of the way. Peace was made with Holland in April 1654. The union of the three kingdoms was enacted and provision made for the government of Scotland and Ireland. The attempt to reform the law, civil and criminal, cannot be regarded as successful. Cromwell had not the lucid and logical mind of a Napoleon; the mentality of the English lawyers did not lead them to favour his projects of reform or to assist in their realization. The reform of the ministry was more after his heart. It was tolerant within the limits of the time. A body of "Triers" was appointed to examine the fitness of candidates for livings: without their certificate none was in future to be admitted to a benefice. Presbyterians, Independents and Baptists were eligible as Triers, and from the point of view of doctrine members of any of these sects were acceptable. Grace and godly conversation were the main titles to acceptance. Another body was appointed to weed out the unworthy incumbents. Liberty of worship was allowed to all who "do profess faith in Jesus Christ," excepting papists and prelatists. In practice, the prelatists were little molested, except when the Royalists were active in conspiracy. Cromwell would willingly have extended some indulgence to the Catholics, but the public opinion of the country was too strong for him. Such favour as he showed to Jews and Quakers was in advance of his age, and could not be too openly manifested. He refused to abolish tithe, and recognized the rights of patrons, subject to the review of the Triers. He encouraged and protected the universities, and fostered and supervised the maintenance of schools. By temperament a religious fanatic, in an age of religious war, tired out himself in the bitterest religious strife, he yet made no war upon opinions but on the harmful acts to which opinions led.

When Cromwell became Protector, he was master of a powerful standing army. He had a stronger fleet than any English ruler before him. That fleet had been first built up to deal with the remains of the Royalist navy led by Rupert. It had driven Rupert to the Mediterranean, it had pursued him thither and destroyed his power. It had recaptured the Scilly Islands, Jersey and Guernsey, from other Royalist freebooters; it had reduced Barbados and the West Indian islands and received the submission of Virginia and Maryland. In 1652 there was in effect between England and France a state of war. Since 1652 there had been war with the Dutch, in which the English had more and more the advantage. At the end of 1652 the French king announced the recognition of the British Commonwealth; but mutual seizure of merchant vessels did not cease. After peace had been made with the Dutch in April 1654, the situation was still difficult. Cromwell settled his disputes with Denmark and Portugal, and concluded an alliance with Sweden. He hoped to form a league of Protestant Powers to further religious freedom in Central Europe. But meanwhile he received tempting offers both from France and Spain, who were then at war. Another man might have planned to win popularity by maintaining peace, reducing forces and remitting taxes. But Cromwell was a man of war and had a powerful instrument ready to his hand. The God in whose direct guidance he had faith was a God of battles, by whom power was given that thereby the truth might be spread. Spain was identified in his mind with the extremest school of papistical fanaticism. Yet he played with the idea that by the support of Spain he might win advantages for the Huguenots in France. He also tried to obtain from France recognition of his right to intervene in favour of the Huguenots if their liberties were infringed. Obtaining no satisfaction from either side, he attacked the Spanish colonies in the west without ceasing to capture French ships. Meanwhile Blake in the Mediterranean displayed his country's power, bombarded the castles of the Dey of Tunis, and burnt his ships. When, in 1655, news came of the massacre of the Vaudois by the troops of Savoy, he offered to France his alliance in return for her good offices on behalf of the victims. Spain declared war in consequence of the Protector's attacks on the West Indies; and the treaty with France was concluded (Oct. 24, 1655). The war with Spain was vigorously conducted. Treasure ships were captured or sunk, and Jamaica was occupied. In 1657 Cromwell agreed to join with France in an attack on Spain in Flanders. Mardyke was taken on October 3, 1657, and handed over to Great Britain. In June of the following year the English played a prominent part under Turenne in the Battle of the Dunes. The capture of Dunkirk followed, and Charles's hopes of invading Britain with Spanish help were shattered.

Meanwhile Cromwell was pursuing his plans for furthering the Protestant cause in Central Europe. But he entirely miscalculated the situation. Gustavus of Sweden, whose cause he espoused, was as ready to swallow up Protestant Denmark as Catholic Poland. Protestant Brandenburg saw in Gustavus a rival, an enemy, rather than a friend. The Dutch were more interested in their own commerce than in the propagation of the faith. In truth, the spirited foreign policy of Cromwell was inspired by ignorance and inexperience. The friendship of France was dependent on the needs of the moment; once those needs had been served she was not likely long to endure an English foothold on the southern shore of the Channel. Meanwhile, the expense of all this activity increased the financial difficulties in which the Protectorate was involved.

Cromwell's colonial adventures had little more substantial success. The disastrous attempt to conquer Hispaniola was not compensated by the possession of Jamaica until many years had passed. But action in this district was harmonious with the destiny of Britain as afterwards worked out, while the subsequent sale of Dunkirk was more profitable than its possession could ever have been, and the engagements contemplated in Central Europe would have been perilous if they had not proved ineffectual. Neither Cromwell nor his advisers, it must be remembered, had any traditional knowledge of the art and practice of international politics. Yet even his enemies admitted that England under the Protector was feared and respected in Europe as she had not been since the time of Henry V. Though Oliver ran some risks and entertained some projects that a more experienced ruler would have avoided, yet in action he never hazarded more than he could afford and seldom lost his stake—except perhaps at Hispaniola.

Cromwell entered upon his public career as a champion of the Parliament against the King. Yet from 1647 onwards he was in constant conflict with parliament when there was any parliament to dispute with. Pride's Purge may not have been his work, but he certainly accepted its result, and he acknowledged the authority of the purged remnant. The relations of the Protector with parliament have a permanent as well as a passing interest. This was the age when the prestige of parliament was established, and its evolution as a sovereign body was well begun before the Restoration.

Cromwell drew all the legal authority that he had from the parliament which constituted him Captain-General. The Army itself, on which his power was founded, was the creation of parliament. Although he might expel parliaments, nominate them, reform them, summon them, pack them, hector them, dissolve them, he felt in his heart, and rightly felt, that through parliament alone could a stable and peaceful settlement be reached. That he could not reach it by this means proves in him the lack, which is otherwise patent, of supreme political art. But the task of guiding an inexperienced assembly, inflamed by recent conflict, exalted by success and torn into tatters by religious dissension, religious fever, religious hatred, was, perhaps, beyond the wit of man. His own "Independent" views on religion had their anarchical repercussion in politics; if authority be denied in religion, where can its true basis be found? His advisers who wished him to assume the kingship, his own instinct that impelled him that way, were right in so far as parliament was concerned. The magic and the mystery of a king were sorely needed: they vanished when the Head of the State came down into the arena as a partisan. He needed Ministers—as a screen and as a veil—to fight his parliamentary conflicts, to exercise on his behalf parliamentary persuasion, to carry through parliamentary negotiations and consolidate a party in the House. It must be admitted that his parliaments, even with such expert assistance, would not have been easy either to pull or to push.

The "Barebone's" Parliament, the Parliament of Saints, was ridiculous from its birth (1653), and departed unhonoured and unregretted. The first Parliament of the Protectorate (1654) spent its time in digging under its own foundations. It drew from Cromwell an interesting declaration of the fundamental principles of the Constitution necessary for their joint work. Government must be by a single person and parliament: the control of the armed forces must be divided between Protector and parliament; parliaments must not have the power to perpetuate their own term of authority: they must not interfere with the liberty of conscience. Since the parliament declined to observe these restrictions—especially the liberty of belief—and to make adequate provision for the army, it was dismissed after 20 weeks. The Instrument said five months; by reckoning in lunar months the Protector saved himself from 13 bad days.

The year 1655 was a troubled year—with plots of Royalists and plots of fanatics; it became necessary to shut up no less a man than Major-General Harrison. Fortunately Cromwell's secret service, of which Thurloe was the organizer, was very efficient. In spite of these troubles Cromwell was able to reduce the standing force. In compensation he set up a military police organized in 12 districts, each under a Major-General, to forestall conspiracy, and watch over public morals. The standing militia of 6,000 men, which was put at the disposal of these Governors, was paid for by levies of ten per cent on the revenues of the Royalist country gentlemen. Thus the policy of reconciliation was for the time abandoned. In addressing Parliament in 1654, Oliver had claimed that the sheriffs, the justices of the peace and the other local officers, had accepted his authority, and that the judges had taken new commissions from his hand. Now the lawyers and the judges began to show scruples; there were resignations, and resistance; more accommodating judges were found; inconvenient counsel were punished. "I am as much for government by consent as any man," said Cromwell, "but where shall we find that consent?" Failing consent, what remedy but force?

In 1656 Cromwell called another Parliament. It was thought necessary to exclude 100 of the elected members. Even by the vote of the submissive remainder, the Major-Generals and the "decimation" by which they were maintained were condemned. At length, in March 1657, by a majority of two to one, a new draft constitution—the Humble Petition and Advice—was passed and presented to the Protector. Cromwell was to take the title of King, and to name his successor. The members of the Council and the chief officers of State were to be nominated by him, subject to the consent of parliament. There was to be a Second Chamber, its members to be nominated by the Protector and approved by the Commons. There was to be a permanent revenue, with a special vote for three years to cover the cost of the war. Elections to parliament were to be controlled by parliament itself and not by the Protector or his council. After some weeks' hesitation, Cromwell accepted the constitution, but under pressure from his most trusted officers he declined the "title of king." Cromwell desired the kingship for the greater security of the settlement which it offered. The lawyers desired a king for the legal and constitutional implications attached to the name. The conjecture may be hazarded that the soldiers disliked it because the lawyers and civilians desired it; he was their Cromwell, and they were not willing to share him with the civilians. But no doubt in some of the soldiers republican sentiment was strong. As Cromwell did not live long, the decision was not so important as it appeared. In January 1658 parliament met again. The situation was not improved. About 40 of Cromwell's chief supporters had been called to the Upper House. The fire-brands excluded in 1657 had now to be admitted. The Commons at once began to challenge the constitution, and especially the position of the "other House." Feeling began to rise outside the House, and after a fortnight Cromwell sent his last parliament about their business.

During his last year he was at the culmination of his power and his glory. The Battle of the Dunes was fought on June 4, 1658, and peace with Spain was now in sight. Sir Charles Firth says that "the history of the Protectorate is the history of the gradual emancipation of the Protector from the political control of the army." The most difficult of the officers had been gradually eliminated. The fanatics had been purged out of the ranks. The army had become professional. The military opposition to the assumption of the kingship in 1657 was perhaps the last kick. Finance was embarrassing, the floating deficit was great; but with peace the deficit might be reduced. The heavy and unjust taxation was a greater danger. If Cromwell had lived to meet the parliament which he had summoned for December in the year of his death, he might perhaps have been able to reduce the expenditure and make a more equitable distribution of burdens. If all the circumstances be taken into account, his financial administration deserves praise rather than blame. But he was already aging: though not yet 59, he had lived a hard life, and had been weakened by serious illnesses. His later handwriting shows clear signs of the shock of years and toil. Had he lived longer it is doubtful whether he could have had the strength to achieve a peaceful settlement. On the magic date of Dunbar and Worcester, September 3, at the height of his renown, he died (1658). The frame of his constructive work was swept away, but the impress of his deeds and personality has helped to shape the life of his nation through the succeeding centuries.

The outward history of Cromwell gives the true measure of the man as a fighting and governing force. On the moral side, from the days of the Restoration until the 19th century the verdict of Clarendon was generally accepted—"a brave, bad man, with all the wickedness for which hell fire is prepared." Yet Clarendon relents in a measure—"he had some virtues which have caused the memory of some men in all ages to be celebrated." In the first half of the last century W. S. Landor and John Forster agreed that he "lived a hypocrite and died a traitor." Carlyle by his publication of the Life and Letters in 1845 did a service to history—though he somewhat prejudices the cause of his hero by his smoky rhapsodies. The charge of hypocrisy, when not inspired by party passion, arose from a misapprehension. Cromwell lived in an age when religion had been inflamed to white heat by the revolt against the Church of Rome. Authority had been shaken or thrown down; the right of private judgment was set in its place. Cromwell, like others, believed without qualification that the Old Testament, as well as the New Testament, was the authentic word of God. It would have been blasphemy in his eyes to call in question the morality of the Old Testament or the mental attitude of the belligerent Psalms. He believed that the truth of God could be reached by any man who would faithfully and prayerfully study the word of God. He needed no philosophic dogma to reconcile divergent interpretations. Every man must painfully and sincerely seek; and what is revealed to each comes from God and is truth for him: on that he must act. He believed in the immediate government of the fortunes of men by God. If the virtuous and the faithful suffered misfortune it was a trial for their good, or perhaps a fatherly chastisement for their want of faith, their weakness and their shortcomings. If they were successful in their undertakings it was a direct sign of the favour of the Almighty. If they were in doubt as to the course that it was right to follow, they must seek the Lord with prayer and humility until the path was shown to them from on high. Thus it happened that over and over again when Cromwell was in inward doubt he would speak obscurely, gropingly, this way and that, as though endeavouring to mask his purpose: in truth the purpose had not been formed. When he had reached decision his utterance was plain enough: when prompt action was needed, he was such that decision came to him as a flash: it might well seem to be a flash straight from the God whom he worshipped. His career is to all of us marvellous; to him it might well seem miraculous. He did not look for explanation in the recesses of his unexplored mentality or in any star or luck. He believed that his whole course was directed by God, and that his deeds and inspirations were crowning mercies of the Most High. The language of the Scripture, which was the only literary language he knew well, came to his lips more easily than any other. Thus, what in others might have been hypocrisy was in him the expression of complete faith in the language of faith. That he was in himself a good man is shown in this: that, although highly tried as a revolutionary leader, he has few crimes to his score; he was not greedy, or lustful, or cruel, nor unmerciful—save only, as in Ireland, where his fanatic zeal overmastered his humane qualities. His last biographer, Sir John Fortescue, says: "It is from Cromwell that we derive the origin of our military discipline and especially the great tradition that an army marching through a country must take nothing without payment." In his private life he was a good son, husband and father; he could be cheerful, jovial and merry; he was no ascetic: he was a lover of music. The words of Clarendon—"he possessed a wonderful understanding in the natures and humour of men" explain a great part of his success. (S. Ls.)

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CROMWELL, RICHARD (1626–1712), lord protector of England, eldest surviving son of Oliver Cromwell and of Elizabeth Bourchier, was born on Oct. 4, 1626. He served in the parliamentary army, and in 1647 was admitted a member of Lincoln's Inn. In 1649 he married Dorothy, daughter of Richard Mayor or Major, of Hursley in Hampshire. He represented Hampshire in the parliament of 1654, and Cambridge university in that of 1656, and in Nov. 1655 was appointed one of the council of trade. But he was not brought forward by his father or prepared in any way for his future great position, and lived in the country occupied with field sports, till after the institution of the second protectorate in 1657 and the recognition of Oliver's right to name his successor. On July 18 he succeeded his father as chancellor of the University of Oxford, on Dec. 31 he was made a member of the council of state, and about the same time obtained a regiment and a seat in Cromwell's House of Lords. He was received generally as his father's successor, and was nominated by him as such on his death-bed. He was proclaimed on Sept. 3, 1658. Richard not being "general of the army as his father was," his elevation was distasteful to the officers, who desired the appointment of a commander-in-chief from among themselves, a request refused by Richard. The officers in the council, moreover, showed jealousy of the civil members, and to settle these difficulties and to provide money a parliament was summoned on Jan. 27, 1659, which declared Richard protector, and incurred the hostility of the army by criticizing severely the arbitrary military government of Oliver's last two years, and by impeaching one of the major-generals. A council of the army accordingly established itself in opposition to the parliament, and demanded on April 6 a justification and confirmation of former proceedings, to which the parliament replied by forbidding meetings of the army council without the permission of the protector, and insisting that all officers should take an oath not to disturb the proceedings in parliament. The army now broke into open rebellion and assembled at St. James's. Richard was completely in their power; he identified himself with their cause, and the same night dissolved the parliament. The Long Parliament (which reassembled on May 7) and the heads of the army came to an agreement to effect his dismissal; and in the subsequent events Richard appears to have played a purely passive part, refusing to make any attempt to keep his power or to forward a restoration of the monarchy. On May 25 his submission was communicated to the House. He retired into private life, heavily burdened with debts incurred during his tenure of office, and narrowly escaping arrest even before he quitted Whitehall. In the summer of 1660 he left England for France, where he lived in seclusion under the name of John Clarke, subsequently removing elsewhere, either (for the accounts differ) to Spain, to Italy or to Geneva. He was long regarded by the Government as a dangerous person, and in 1671 a strict search was made for him but without avail. He returned to England about 1680 and lived at Cheshunt, in the house of Sergeant Pengelly, where he died on July 12, 1712, being buried at Hursley, Hampshire. According to Mrs. Hutchinson, Richard Cromwell was "gentle and virtuous but a peasant in his nature and became not greatness."

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CROMWELL, THOMAS, EARL OF ESSEX (1485?–1540), English politician, the only son of Walter Cromwell, alias Smyth, a brewer, smith and fuller of Putney. He is said to have quarrelled with his father, who had a bad local reputation, and fled to Italy, where he served as a soldier in the French army at the battle of Garigliano (Dec. 1503). He escaped from the battle-field to Florence, where he was befriended by the banker Frescobaldi. He is next heard of at Antwerp as a trader, and about 1510 he was induced to accompany a Bostonian to Rome in quest of some papal indulgences for a Boston gild; Cromwell secured the boon by the timely present of some choice sweetmeats to Julius II. In 1512 there is some slight evidence that he was at Middelburg, and also in London. About the same time he married Elizabeth Wykes, daughter of a well-to-do shearman of Putney, whose business Cromwell carried on in combination with his own.

In 1520 we find him advising Wolsey on legal points and from that date he occurs frequently, not only as mentor to the cardinal, but to noblemen and others when in difficulties, especially of a financial character; he made large sums as a money lender. In 1523 he emerges into public life as a member of parliament. In 1524 he was admitted at Gray's Inn. In 1525 he was Wolsey's agent in the dissolution of the smaller monasteries which were designed to provide the endowments for Wolsey's foundations at Oxford and Ipswich. For these he drew up the deeds, and was receiver-general of cardinal's college, constantly supervising the workmen there and at Ipswich. His ruthless vigour and his accessibility to bribes made him exceedingly unpopular, but he grew in Wolsey's favour until his fall. On Wolsey's disgrace many of the cardinal's servants had been taken over by the king, but Cromwell had made himself particularly obnoxious. However, he rode to court from Esher to "make or mar," as he himself expressed it, and offered his services to Norfolk. Cromwell could indeed be most useful to the government in parliament, and the government, represented by Norfolk, undertook to use its influence in procuring him a seat. This was on Nov. 2, 1529; the elections had been made, and parliament was to meet on the morrow. A seat was, however, found or made for Cromwell at Taunton. He signalized himself by a powerful speech in opposition to the bill of attainder against Wolsey which had already passed the Lords. The bill was thrown out, possibly with Henry's connivance, though no theory has yet explained its curious history so completely as the statement of Cavendish and other contemporaries, that its rejection was due to the arguments of Cromwell.

Cromwell's influence over the government from 1529–1533 has been grossly exaggerated. It was not till 1531 that he was admitted to the privy council nor till 1534 that he was made secretary though he had been made master of the jewel-house, clerk of the hanaper and master of the wards in 1532, and chancellor of the exchequer (then a minor office) in 1533. It is not till 1533 that his name is as much as mentioned in the correspondence of any foreign ambassador resident in London. Cromwell, in fact, was not the author of Henry's policy, but he was the most efficient instrument in its execution. Even in this capacity, his power has been overrated, and he is supposed to have invented those parliamentary complaints against the clergy which were transmuted into the legislation of 1532. But the complaints were old enough; many of them had been heard in parliament nearly 20 years before, and there is ample evidence to show that the petition against the clergy represents the "infinite clamours" of the Commons against the Church, which the House itself resolved should be "put in writing and delivered to the king." The actual drafting of the statute, as of all the Reformation Acts between 1532 and 1539, was largely Cromwell's work, and the success with which parliament was managed during this period was also due to him. It was not an easy task, for the House of Commons more than once rejected Government measures, and members were heard to threaten Henry VIII. with the fate of Richard III.; they even complained of Cromwell's reporting their proceedings to the king. There was, of course, room for manipulation, which Cromwell extended to parliamentary elections; but parliamentary opinion was a force of which he had to take account, and not a negligible quantity.

From the date of his appointment as secretary in 1534, Cromwell's biography belongs to the history of England, but it is necessary to define his personal attitude to the revolution in which he was the king's most conspicuous agent. He was included by Foxe in his *Book of Martyrs* to the Protestant faith; more recent historians regard him as a sacrilegious ruffian. Now, there were two cardinal principles in the Protestantism of the 16th century—the supremacy of the temporal sovereign over the church in matters of government, and the supremacy of the Scriptures over the Church in matters of faith. There is no room for doubt as to the sincerity of Cromwell's belief in the first of these two articles; he paid at his own expense for an English translation of Marsiglio of Padua's *Defensor Pacis,* the classic mediaeval advocate of that doctrine; he had a scheme for governing England by means of administrative councils nominated by the king to the detriment of parliament; and he urged upon Henry the adoption of the maxim of the Roman civil law—*quod principi placuit legis habet vigorem* ("what is the pleasure of the ruler has the force of law"). He wanted, in his own words, "one body politic" and no rival to the king's authority, and he set the divine right of kings against the divine right of the papacy. There is more doubt about the sincerity of Cromwell's attachment to the second article; it is true that he set up a Bible in every parish church, and regarded them as invaluable, and the correspondents who unbosom themselves to him are all of a Protestant way of thinking. But Protestantism was the greatest support of absolute monarchy. Hence its value in Cromwell's eyes. Of religious conviction there is in him little trace, and still less of the religious temperament. He was a polished representative of the callous, secular middle class of that most irreligious age. Sentiment found no place, and feeling little, in his composition.

In 1534 Cromwell was appointed master of the rolls, and in 1535 chancellor of Cambridge university and visitor-general of the monasteries. The policy of the Dissolution has been theoretically denounced, but practically approved in every civilized state, Catholic as well as Protestant. The need for reform was admitted by a committee of cardinals appointed by Paul III. in 1535, and it had been begun by Wolsey. Cromwell was not affected by the iniquities of the monks, except as arguments for the confiscation of their property. He had boasted that he would make Henry VIII. the richest prince in Christendom. He had learnt how to visit monasteries under Wolsey, and the visitation of 1535 was carried out with ruthless efficiency. During the storm which followed, Henry took the management of affairs into his own hands, but Cromwell was rewarded in July 1536 by being knighted, created lord privy seal, Baron Cromwell, and vicar general and vice-regent of the king in "spirituals."

In this last, offensive capacity he sent a lay deputy to preside in Convocation, taking precedence of the bishops and archbishops, and issued his famous injunctions of 1536 and 1538; a Bible was to be provided in every church; the Paternoster, Creed and Ten Commandments were to be recited by the incumbent in English; he was to preach at least once a quarter, and to start a register of births, marriages and deaths. During these years the outlook abroad grew threatening because of the alliance, under papal guarantee, between Charles V. and Francis I.; and Cromwell was allowed to proceed with his one independent essay in foreign policy. Under these circumstances Henry acquiesced in Cromwell's negotiations for a marriage with Anne of Cleves. Anne herself was the weak point in the argument. Henry conceived an invincible repugnance to her from the first; he was restrained from an immediate breach with his new allies only by fear of Francis and Charles. In the spring of 1540 he was reassured on that score; no attack on him from that quarter was impending; there was a rift between the two Catholic sovereigns, and there was no real need for Anne and her German friends.

From that moment Cromwell's fate was sealed; the Lords loathed him as an upstart even more than they had loathed Wolsey; he had no church to support him; Norfolk and Gardiner detested him from pique as well as on principle; his only friend in the council was Cranmer, and the royal favour now failed him. Cromwell did not succumb without an effort, and a desperate struggle ensued in the council. In April the French ambassador wrote that he was tottering to his fall; a few days later he was created earl of Essex and lord great chamberlain, and two of his satellites were made secretaries to the king; he then despatched one bishop to the Tower, and threatened to send five others to join him. At last Henry struck as suddenly and remorselessly as a beast of prey; on June 10, Norfolk accused him of treason; the whole council joined in the attack, and Cromwell was sent to the Tower. A vast number of crimes was laid to his charge, but not submitted for trial. An act of attainder was passed against him without a dissentient voice, and after contributing his mite towards the divorce of Anne, he was beheaded on Tower Hill on

July 28 repudiating all heresy and declaring that he died in the Catholic faith.

In estimating Cromwell's character it must be remembered that his father was a blackguard, and that he himself spent his formative years in a vile school of morals. Yet he civilized himself to a certain extent, and his atrocious acts were done in no private quarrel, but in what he conceived to be the interests of his master and the State. Where those interests were concerned he had no heart and no conscience and no religious faith; no man was more completely blighted by the 16th century worship of the State.

The authorities for the early life of Cromwell are the Wimbledon manor rolls, used by Mr. John Phillips of Putney in *The Antiquary* (1880), vol. ii., and the *Antiquarian Mag.* (1882), vol. ii.; Pole's *Apologia*, i. 126; Bandello's *Novella*, xxxiv.; Chapuy's letter to Granville, 21, Nov. 1535; and Foxe's *Acts and Mon.* From 1522 see *Letters and Papers of Henry VIII.*, vols. iii.–xvi.; Cavendish's Life of Wolsey; Hall's *Chron.*; Wriothesley's *Chron.* These and practically all other available sources have been utilized in R. B. Merriman's *Life and Letters of Thomas Cromwell* (1902). For Cromwell and Machiavelli *see* Paul van Dyke's *Renascence Portraits* (1906), App.

CRONJE, PIET ARNOLDUS (*c.* 1840–1911), Boer general, was born about 1840 in the Transvaal about the time of the Great Trek, and began the insurrection in the Transvaal after 1880 by resisting the distraint for taxes on the goods of a Boer who had declined to pay. He took part in the first Boer War with the rank of commandant, and commanded in the siege of the British garrison at Potchefstroom (1881), though he was unable to force their surrender until after the conclusion of the general armistice. The Boer leader was at this time accused of withholding knowledge of this armistice from the garrison. He held various official positions in the years 1881–99, and commanded the Boer force which compelled the surrender of the Jameson raiders at Doornkop (Jan. 2, 1896). In the war of 1899 Cronje was general commanding in the western theatre of war, and began the siege of Kimberley. He opposed the advance of the British division under Lord Methuen, and fought, though without success, three general actions at Belmont, Graspan and Modder river. At Magersfontein, early in Dec. 1899, he completely repulsed a general attack made upon his position, and thereby checked for two months the northward advance of the British column. In the campaign of Feb. 1900, Cronje opposed Lord Roberts's army on the Magersfontein battleground, but he was unable to prevent the relief of Kimberley; retreating westward, he was surrounded near Paardeberg, and, after a most obstinate resistance, was forced to surrender with the remnant of his army (Feb. 27, 1900). As a prisoner of war Cronje was sent to St. Helena, where he remained until released after the conclusion of peace. He died at Klerksdorp, Transvaal, Feb. 4, 1911. (*See* South African War, 1899–1902.)

CRONUS, an ancient deity, not much worshipped in Greece, probably belonging to the pre-Hellenic population (etymology unknown; ancient explanation = χρόνος, Time, impossible; probably not Greek). His functions are connected with agriculture; in Attica his festival (*Kronia, Hekatombaion 12, i.e.*, harvest-time) resembled the Saturnalia (Accius *ap.* Macrob., *Saturn.*, 1, 7, 37; *cf.* Saturn). In art, he is shown as an old man holding a curved implement, probably originally a sickle, but interpreted as the *harpe* (*see* below).

In mythology, he is son of Uranus and Ge (Heaven and Earth). Uranus, when his children were born, hid them in the body of Ge, who, unable to bear the pressure longer, begged them to deliver her. Cronus alone consented; Ge gave him a curved sword (*harpe*) wherewith he castrated Uranus. Thus (like similar heroes in Maori, Indian and Chinese myth) he separated earth and heaven. He now became the lord of his brothers, the Titans, and shut up the most dangerous (the *Hekatoncheires* or Hundred-handed Ones) in Tartarus. His consort was his sister Rhea. Ge and Uranus warned him that his own child should overthrow him; so he swallowed Hestia, Demeter, Hera, Hades, and Poseidon when they were born. But Rhea hid away the infant Zeus in Crete, and tricked Cronus into swallowing a stone instead, which afterwards was shown and venerated at Delphi. Zeus grew up, made Cronus disgorge his brethren, rebelled, and was victorious. Cronus was imprisoned in Tartarus, or (*see* the late story in Plutarch, *De Defect. Orac.*, 18) on an island near Britain, and guarded by the *Hekatoncheires;* or he became lord of Elysium (*q.v.*). The swallowing myth has savage parallels.

Under the rule of Cronus, men lived in a state of Paradisal innocence (ὁ ἐπὶ Κρόνου βίος, *Saturnia regna*), and the earth bore all things untilled. It was the Golden Age. Cronus in time was rationalized into a great and beneficent western king. Hence the late and artificial Italian tale that he came to the future site of Rome, was welcomed there by Janus (also euhemerized into a king), founded a city there, and taught the people navigation, coinage, and other useful things. (*See* Saturn.)

On account of his swallowing of his children, Cronus is frequently identified with foreign gods, notably the Semitic Ba'al (Baal Saturnus on numerous inscriptions of Roman Africa) and Moloch, to whom human sacrifices, particularly of children, were made.

See Preller-Robert, *Griech. Mythologie*, i., p. 46 *et seq.;* L. R. Farnell, *Cults of the Greek States*, i., chap. i.; M. Meyer in Roscher's *Lexikon, s.v.*

CROOKES, SIR WILLIAM (1832–1919), English chemist and physicist, was born in London on June 17, 1832. He studied chemistry at the Royal College of Chemistry and became an assistant under A. W. von Hofmann. In 1854 he became assistant in the meteorological department of the Radcliffe observatory, Oxford, and in 1855 he obtained a chemical post at Chester. From the time of his marriage in 1856 to Ellen Humphrey he lived in London, devoting himself uninterruptedly to scientific work of various kinds. He founded and conducted the *Chemical News,* and had a private laboratory at his house in Kensington Park gardens. He was knighted in 1897 and received the Order of Merit in 1910. He was president at different times of many learned societies; from 1913–15 he was president of the Royal Society. He died in London on April 4, 1919.

In 1861 spectroscopic observations on the residue from the manufacture of sulphuric acid led Crookes to the discovery and isolation of thallium, a specimen of which was shown in public for the first time at the exhibition of 1862. In the course of investigations on the properties of thallium he observed the curious behaviour of the hot element while being weighed in vacuo. This led Crookes to construct the radiometer (*q.v.*).

His researches on the electrical discharge through a rarefied gas led to the observation of the dark space which bears his name, and Crookes developed his theory of "radiant matter" or matter in a "fourth state." (*See* Electricity, Conduction of: *Gases.*) In 1883 Crookes began an enquiry into the nature and constitution of the rare earths, his observations on yttrium led him to the theory that all elements have been produced by evolution from one primordial stuff. He succeeded in artificially making minute diamonds; and on the discovery of radium he took up the study of its properties. He invented the spinthariscope which shows the presence of traces of radium salt by the production of phosphorescence on a zinc sulphide screen. Crookes was constantly consulted by the Government on chemical questions, and one of his many practical contributions to the public welfare was his production of a glass which would effectively shield the eyes of the workers from the deleterious rays emitted from molten glass. Crookes wrote or edited various books on chemistry and chemical technology, including *Select Methods of Chemical Analysis*, which went through a number of editions. He was a keen student of psychic phenomena and sought to effect some correlation between them and ordinary physical laws.

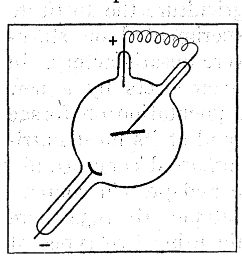

Fig. 1.—The X-ray tube invented by Sir W. Crookes

See E. E. Fournier d'Albe, *Life of Sir William Crookes* (1923).

CROOKES' TUBE: *see* Electricity, Conduction of; X-Rays, Nature of.

CROOKSTON, a city of northwestern Minnesota, on the Red Lake river, 18 mi. from the North Dakota border; the county seat of Polk county. It is on federal highways 2 and 75; is served by the Great Northern and the Northern Pacific railways; and has an airport. Dams on the river provide fine water power, and the city has varied manufactures, notably flour and tow. It has a large jobbing business, and is an important distributing point for wheat, dairy products and livestock. The North-west School of Agriculture of the University of Minnesota, and its North-west Agricultural Experiment station, are located there. The Red River valley winter show (of livestock and agricultural products) is held at Crookston annually. Crookston was settled about 1872, and was chartered as a city in 1883. It was named after an early settler, William Crooks. Pop. (1940) 7,161.

CROP, the *ingluvies,* or pouched expansion of a bird's oesophagus, in which the food remains to undergo a preparatory process of digestion before being passed into the true stomach; the produce of cereals or other cultivated plants. The term "white-crop" is used for such grain crops as barley or wheat, which whiten as they grow ripe; "green-crop" for such as roots or potatoes which do not, and also for those which are cut in a green state, like clover (*see* AGRICULTURE: A GENERAL SURVEY). Other uses of the word are, in leather dressing, for the whole untrimmed hide; in mining and geology, for the "outcrop" or appearance at the surface of a vein or stratum, and particularly in tin mining, for the best part of the ore produced after dressing. A "hunting crop" is a short thick stock for a whip, with a small leather loop at one end, to which a thong may be attached. From the verb "to crop," *i.e.,* to take off the top of anything, comes "crop" meaning a closely-cut head of hair.

CROP-DRYING. The special handling or use of machines to remove the amount of moisture necessary to prevent spoilage of crops in climates where natural drying is precarious has long been attempted. The Romans gave attention to proper stacking and ventilation but relied solely on the natural agents, sun and wind. Apparently Jethro Tull's description of an Oxfordshire farmer's success in drying grain in a malt kiln about 1700 is the earliest account of artificial drying (see *Horse-Hoeing Husbandry,* 1733).

In 1866, George Dyson patented a stack drier consisting of a hollow vertical cylinder through which air was blown or removed by a fan. Both James Paxman and W. A. Gibbs exhibited driers at the Royal Agricultural society's show in 1869. When Martin J. Sutton offered a prize of £100 in 1882 "for the most efficient and economical method of drying hay or corn crops artificially either before or after being stacked," Gibbs was one of the eight contestants. His hay-making machine agitated the unstacked hay while hot air was driven through it; six others used exhaust fans in the stack, and one forced ventilation into the stack through perforated drums.

Various types of motor-driven fans continued to be developed, but in 1919 Charles Tinker of Kilmartin patented a stack drier consisting of a cone-shaped coil of steam-heated pipes around which the crop was stacked, the drying being done in a Dutch barn. At the request of the ministry of agriculture the Institute of Agricultural Engineering at Oxford experimented on stack-drying from 1923 to 1925, but the results were unsatisfactory. In 1927 the institute succeeded in drying sugar beets by a new process employing a conveyor drier. Experimentation on forage crops proved that grass dried while young and at its most nutritious stage could provide a substitute for imported concentrates. Artificially dried hay was high in carotene and protein content, remained green and sweet, and was very palatable. By 1938 there were 96 centres for drying in Great Britain using five types of commercial driers.

In the United States experimentation on artificial drying did not begin until 1910, but as early as 1875 the department of agriculture published a notice of Gibbs' machine in the *Annual Report.* The design of the first drier for forage crops was inspired by lumber kilns. The department experimented from 1910 to 1912 with a drier built at Hayti, Mo. By 1915, several commercial companies had produced various types of driers, but the federal government withdrew its support and interest lagged until 1925, when the emphasis on hay and forage crops as substitutes for cotton in the southern states, where the heavy rainfall made the production of hay extremely difficult, revived the interest of the department of agriculture, the various state experiment stations, commercial companies, and individuals in artificial drying. Independently, Arthur J. Mason, an engineer interested in preserving alfalfa, built an experimental plant at West Point, Miss., in 1911, patented a conveyor drier in 1916, and by 1926 made installations at the Walker-Gordon farm at Plainsboro, New Jersey.

The artificial drying of grass and alfalfa was also tried in Holland and Switzerland where the main emphasis was on small, farm-size driers. Germany and Scandinavia experimented largely with factory-size plants capable of drying both root and forage crops. However, as late as 1939 the process had not advanced very far into commercial farming on the continent.

The standard types of driers in Great Britain and the United States are apron-conveyor, revolving drum, tray, and pneumatic, using oil, gas, and coal for heating. In the tray and apron-conveyor types the material is dried whole at low temperature over a long period, whereas in the revolving drum and pneumatic types the forage is chopped into small pieces and dried at high temperature for a short period. An important contribution of U.S. designers was the use of straight furnace gases for drying, a procedure that increased thermal efficiency and lowered costs. Special cutting and loading equipment was developed simultaneously to cut down on labour requirements and speed delivery of the crop to the drier. A mower-crusher for large stemmed legumes such as soybeans reduced the drying time and enabled the mass to be more evenly dried.

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(H. L. E.)

CROPS. In face of the immense variety of crops throughout the world, it is surprising how uniform are the cultivated farms of Europe. Flying across the country you look down on a succession of rough rectangles of ground, some of permanent grass, some sown with one of the four cereals, some with rotation grasses or leguminous crops and with roots. This trim mosaic, as it seems from above, is broken chiefly by woodland and by vineyards, some cut out of the riverside hills, as along the Rhine and Moselle, some covering spacious plains, as the valley of the Garonne; and on a smaller scale by orchards of fruit and hops.

A similar flight over tropical or semitropical countries reveals a very different pattern. The variety of crops may be greater, but at the same time very wide areas may be covered by one crop —by sugar, tea, cocoa, coffee or cotton. In some places, as in a famous view in Honolulu from the Pali heights, rice and pineapples, though more vivid in hue, resemble the trim familiar fields of temperate climes. When we take an historical view of the cultivated crops we shall see a steady increase in variety due to discovery, to selection, of late years to hybridization, and to inventions that enable man to extract the essential virtues from plants, as linen from flax, sugar from cane and beetroot, opium from poppies, cotton from a seed covering, fibre from coco-nut; to the discovery of the qualities of dried or infused parts of plants, such as the coffee bean or tea leaf or tobacco leaf. But this multiplication of plants found useful for cultivation involves from time to time the rejection of others, driven out by discovery of better substitutes or a change of taste. Lord Ernle, in his admirable history of "English Farming Past and Present," wrote on this head.

"As the linen trade became more concentrated in particular localities, flax was more rarely cultivated. The hemp-yards which were once attached to many cottages and farmhouses were similarly abandoned. The use of teasels by clothiers was displaced by machinery, and the crop no longer cultivated. Woad, madder, and saffron found cheaper substitutes. Liquorice disappeared from Nottinghamshire, camomile from Derbyshire, canary seed from Kent, caraway from Essex."

New Crops.—But with a few exceptions the history of practical agriculture is divided into chapters by the discovery of the value of additional crops. Potatoes, sainfoin and lucerne, turnips and sugar-beet, have all produced crucial changes on the farms of Europe. In British official statistics of the 20th century the crops are now grouped together under the following heads (not perfectly accurate linguistically). The two largest divisions are: corn crops, so called, and green crops. Under corn crops are included: wheat, barley, oats, rye, beans and peas. Under green crops: potatoes, swedes and turnips, mangolds, cabbage, kohl-rabi and rape, carrots, vetches or tares and lucerne, beetroot, sugar-beet. After these two great divisions come clover, sainfoin and artificial grasses. Then pasture grasses, and finally a miscellaneous group consisting of hops, flax and small fruit.

The turnip, introduced chiefly through Sir Richard Weston in 1650, introduced a crucial change in British farming. At a later date few if any crops have made so much difference to the agriculture of a continent as the sugar-beet, which owed its early vogue largely to Napoleon. Throughout Europe the standard farm relies on some rotation of grain, clovers and roots; and this need has been forced upon farmers even in the most exclusively grain-bearing districts, such as the Prairie Provinces of Canada, by the need of clearing ground of weeds. The intervention of a root crop is almost as useful for clearing the ground as for increasing its production. In no country have the relative proportions of the different crops been so nearly standardized as in Denmark. A characteristic small farm in the dairying districts of that country, which is of all countries the most vitally dependent on its farm crops, consists of a small patch of permanent grass, a rather bigger patch of lucerne and a root and grain crop. The essential virtue of the famous Norfolk rotation prevails: roots, barley, clover, wheat. With many additions and qualifications and substitutes of like genera, these remain the master crops of the farms of temperate climes. Only in wide pastoral countries, given up to great ranches or stations, such as some South American republics or Queensland or the more northern parts of Western Australia, is the percentage of grass to arable bigger.

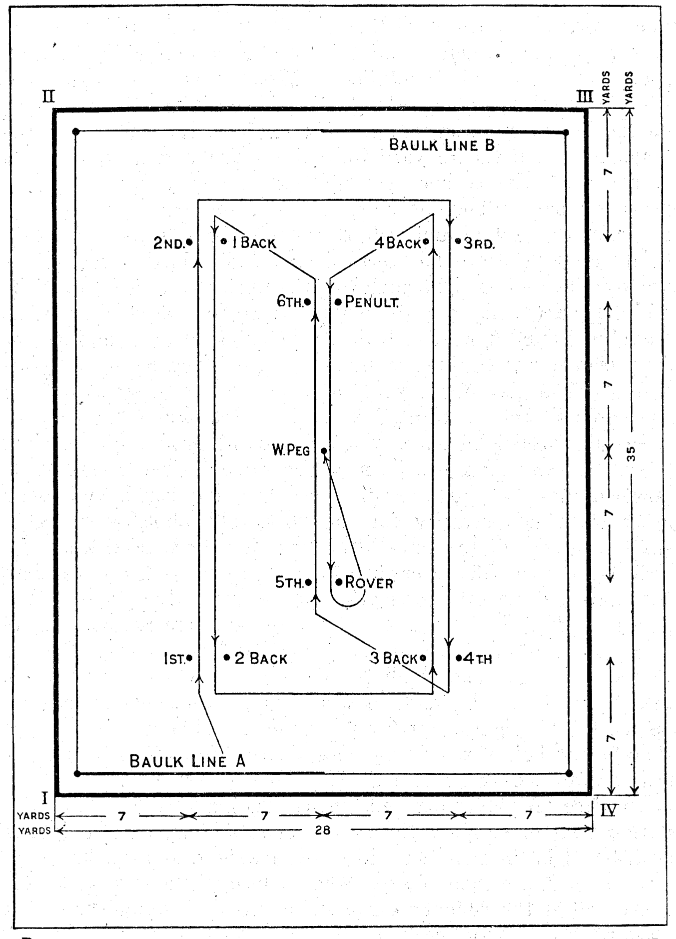
Suiting Crops to Areas.—Areas especially suited for particular crops may be very sharply defined; and curious examples are to be seen within most countries. For example in Canada the deep silt of the southern end of the Okanagan valley was found to be of especial virtue for fruit. Apple trees yielded a heavy crop every year without intermission. In spite of the need of expensive irrigation this valley in a most mountainous country quickly became an almost continuous orchard; and in spite of its remoteness planted orchards reached a value of £250 an acre. Artificial irrigation as an influence on production—of which of course the valley of the Nile is the classical example—is well seen in previously barren areas in Australia (especially on the borders of New South Wales and South Australia) converted into small farms for the production of all sorts of fruits: citrus fruits, stone fruits and grapes, grown chiefly for raisins.

The relative importance of the crops of a country cannot, of course, be gauged merely by area. The distinction between intensive and extensive crops, though not everywhere applicable, holds good in general. Permanent grass is the thinnest and most extensive and scarcely deserves the name of crop, compared with the production of hops on which as much as £150 an acre may be spent in a year with prospects of a good profit, or of the garden of a French market gardener who may sell £500 or £600 worth a year from a single acre.

Even more intensive than such so-called French gardens as are found near Paris or at Rouen, or the Dutch gardens that multiply round Delft and The Hague, are the crops grown under glass—in Guernsey, for example, or on the edge of London. No less than £900 worth of tomatoes and cucumbers has been sold from an acre of glass in Essex. Many examples of such a movement may be found; but contrary tendencies are not less obvious. (W. B. T.)

(For list of agricultural objects, *see* AGRICULTURAL ARTICLES.)

CROQUET, a lawn game played with balls, mallets, hoops and one peg (from Fr. *croc,* a crook, or crooked stick). The game has been evolved, according to some writers, from the *paille-maille* which was played in Languedoc at least as early as the 13th century. However that may be, croquet was played in England in 1856, or perhaps a few years earlier, and soon became popular. In 1868 the first all-comers' meeting was held at Moreton-in-the-Marsh. In the same year the All England Croquet club was formed, the annual contest for the championship taking place on the grounds of this club at Wimbledon. After being for ten years or so the most popular game for the country house and garden party, croquet was practically ousted by lawn tennis, until, with improved implements and a more scientific form of play, it was revived about 1894–95. In 1896–97 was formed the United All England Croquet association, now known as the Croquet association. There are 111 clubs affiliated to the association. There



PLAN OF CROQUET COURT SHOWING SETTING OF HOOPS AND PEGS, AND ORDER OF PLAY IN ACCORDANCE WITH THE OFFICIAL LAWS (1928) OF THE CROQUET ASSOCIATION

Only those portions in heavy outline need be marked on the ground. The order of making the points is indicated by the arrows

were by 1935 approximately 1,500 associates whose nominal subscription entitles them to a copy of the *Gazette* and entry to the ground during tournaments controlled by the association. Its headquarters are at the Roehampton club and the chief events of the year are played on the club croquet lawns, including the final rounds of the All England handicap, a competition attracting more than 500 competitors. The tournaments at Hurlingham, Ranelagh, Eastbourne, Brighton, Cheltenham, Lewes and Buxton are specially popular. Croquet flourishes throughout the British empire and there are 15 affiliated associations in Melbourne, Adelaide, Sydney, Auckland, Queensland and Tasmania. Some of these associations have many clubs affiliated to them, amounting to about 300 in all. A team from Australia visited England in 1925 and the test matches were won by the home country. Further test matches were played in 1928 and 1935 (won by Australia) and in 1937 (won by England). Croquet players were also catered for in the south of France during the winter. The game is very popular in the U.S. and is usually played in rural districts wherever grass plots are large enough and level enough for a court. The rules and court dimensions differ in Great Britain and the U.S., the following regulations governing croquet in Great Britain.

The Game.—The game of croquet is played between two sides, playing alternate "turns," each side consisting either of one or of two players. Four balls are used, one side playing blue and black, and the other side red and yellow. Any ordinary turn may be played with either ball of the side, provided that no ordinary turn may be played with the same ball again until all the balls are in play. When a side consists of two players, one partner plays throughout with one ball of the side, and the other partner with the other. The game is won by the side which first scores all its "points" in order. The court is rectangular, 35 yd. long by 28 yd. wide, within a boundary defined by a continuous line. Portions of the yard line 13 yd. long, measured from the corner spots at corners I and III, towards corners IV and II respectively, are called "Baulk lines." Eight white pegs, not exceeding $\frac{3}{4}$ in. in diameter or 3 in. in height above the ground are placed on the boundary, at distances of 3 ft. from the corners of the boundary. The square yard formed at each corner by the two corner pegs, the corner spot and the corner flag, is called a "corner square." The hoops are of round iron, from $\frac{5}{8}$ in. to $\frac{3}{4}$ in. in diameter, and of uniform thickness. They stand 12 in. in height above the ground, vertical and firmly fixed. The crowns are straight and at right angles to the uprights, which should be $3\frac{3}{4}$ in. apart (inside measurement), $3\frac{11}{16}$ in. for the championship, from the ground upwards. The winning peg is of wood and of uniform diameter above the ground of $1\frac{1}{2}$ in. The setting of the hoops and peg is in accordance with the diagram, the order of making the "points" being indicated by the arrows. Each hoop is run twice and the peg hit once, which may be hit from any direction.

The above setting has been in general use since 1922. It is, however, not well adapted for "peeling," and has largely done away with the necessity for the "pass-roll" shot, both highly skilful features of the game. "Peeling" is a term used when the striker causes a ball, other than his own, to run a hoop in order; that ball is then said to have been "peeled." Like most other games croquet is subject to alteration and amendment in its rules and laws and no absolute finality has been reached in regard to the setting. Mallets may be of any size and weight, but the head must be made of wood only, except that metal may be used for weighting or strengthening it. The two end faces shall be parallel, of wood only, and identical in every respect, and each face may have a rounded edge which shall be considered part of the face. A player may not change his mallet more than once during a game, except in the case of *bona fide* damage. The balls shall be $3\frac{5}{8}$ in. in diameter and of even weight, and not less than $15\frac{3}{4}$ oz. nor more than $16\frac{1}{4}$ oz. The hoop or peg next in order for every ball at the commencement of a turn is distinguished by a clip of the colour of the ball.

The object of the player is to score the points of the game by striking his ball through each of the hoops and the peg in a fixed order; and the side wins which first succeeds in scoring all the points with both the balls of the side. No point is scored by passing through a hoop or hitting the peg except in the proper order. Each player starts in turn from either of the baulk lines. If he fails either to make a point or to "roquet"[1] (*i.e.*, drive his ball against) another ball in play, his turn is at an end and the next player in order takes his turn in like manner. If he succeeds in scoring a point, he is entitled (as in billiards) to another stroke; he may then either attempt to score another point, or he may roquet a ball. Having roqueted a ball (provided he has not already roqueted the same ball in the same turn without having scored a point in the interval) he is entitled to two further strokes: first he must "take croquet," *i.e.*, he places his own ball (which from the moment of the roquet is "dead" or "in hand") in contact with the roqueted ball on any side of it, and then strikes his own ball with his mallet, being bound to move or shake both balls perceptibly. If at the beginning of a turn the striker's ball is in contact with another ball, a "roquet" is held to have been made and "croquet" must be taken at once. After taking croquet the striker is entitled to another stroke, with which he may score another point, or roquet another ball not previously roqueted in the same turn since a point was scored, or he may play for safety. Thus, by skilful alternation of making points and roqueting balls, a "break" may be made in which point after point, and even all the points in the game (for the ball in play) may be scored in a single turn, in addition to three or four points for the partner ball. The chief skill in the game perhaps consists in playing the stroke called "taking croquet" (but *see* below on the "rush"). Expert players can drive both balls together from one end of the ground to the other, or send one to a distance while retaining the other, or place each with accuracy in different directions as desired, the player obtaining position for scoring a point or roqueting another ball according to the strategical requirements of his position. Care has, however, to be taken in playing the croquet stroke that both balls are absolutely moved or perceptibly shaken, and that neither of them be driven over the boundary line, for in either event the player's next stroke is forfeited and his turn brought summarily to an end.

There are two main styles in playing croquet and it being impossible to dogmatize as to the better, either generally or for the individual, players would be well advised to give both an exhaustive trial. The essential features of all styles, whether to make a roquet or run a hoop is that the eye, the ball and the object aimed at should form a vertical right angle. The "upright" style is played with a long mallet of about 39 in. The player faces the object to be hit, holding the top of the mallet with his left hand, the arm being close to the side. The right hand grasps the shaft lower down and is solely responsible for the necessary power of the strike, the left hand merely acting as the fulcrum of the swing. Either the right or the left foot may be in advance, and should be parallel to the line of aim, the player's weight being mainly on the front foot. For the other style, commonly known as "front play" or Irish, a much shorter mallet of about 33 in. is used. The mallet is swung between the feet and the grip employed is similar to the Vardon grip in golf, the hands being close together and often overlapping. The former has advantage over the other in two important points, viz., ability to stop shot and power. It is apt, however, to fail in two important shots, a six-yard roquet and the long rush, and fails for the same reason in both cases; the player being further from the ball there is a larger margin of error, or, in other words a greater liability to be slightly inaccurate. The Irish style is undoubtedly more tiring and the strain on wrists very great; whereas in the upright method the fingers do practically no work and owing to its being less fatiguing is far easier to maintain, especially on a slow lawn.

In making a shot the ball should be hit in the centre and as low down as possible with the exact middle of the mallet. The eyes must be concentrated on the spot and the head of the mallet drawn back slowly. This is the secret of all successful shots, either for roquets or hoop running; the more difficult the angle of the hoop the slower the back swing—any jerking is fatal. The "rush stroke" is a roquet and used to drive the pilot ball some distance; this must be hit full in the face for a straight rush. The hands and mallet should be kept down and follow well through. True hitting should be aimed at, not force. When it is desired to drive a ball in an angular direction the pilot ball must be aimed at off the centre, when the angle required is extremely oblique the outer and opposite side of the pilot should be hit. The "roll" is a croquet stroke in which both balls are rolled along the same distance and is attained by standing well forward with the hands in front of the head of the mallet. The stroke is not a hit, but a sweep. The "pass roll" is the most difficult of all as unless it is played firmly and with deliberation the mallet will hit the ball twice and the stroke is a foul. The stance is similar to that for the "roll," but the ball is hit higher up and the curtailed back swing is more vertical, resulting, if the stroke is smooth, in the player's ball passing the pilot ball. The "split shot" is utilized when two balls are to be driven in opposite directions. Line the balls so that they point in the direction that the pilot ball is to travel, then play the stroke facing the midway between that point and where the striker's ball is being directed. The angles are the same as in billiards, though it is difficult to obtain an absolute right angle. The "stop shot" is also analogous to billiards, the object being to drive the pilot ball a long distance and to keep the striker's ball back. Stand farther behind than usual, hitting the ball very near the

[1]The words "roquet" and "croquet" are pronounced as in French, with the *t* mute.

bottom of the face of the mallet with a short, sharp hit. The proportion of a good "stop shot" is one in six, *i.e.,* that the player's ball goes one yard while the pilot ball travels six yards. "Taking off" is a croquet shot and consists in taking off from a ball which is to be left behind and merely shaken to another ball or given spot on the lawn.

A first-class croquet lawn should be as level as possible with a true and consistent surface; no obstacle to an all-round break is therefore present other than the player's lack of skill. If games were won by all-round breaks much of the interest would be missing. The picking up and assembling of the balls and the laying of a break at the conclusion of a turn generally require infinitely more skill and thought than the somewhat automatic execution of a three- or four-ball break. Once the balls have been assembled no difficult shot is required throughout the break, provided the player has acquired a certain degree of proficiency in the standard shots. The main principle in either three- or four-ball breaks is always to keep the pilot balls straight in front and sweep them, as it were, along the path of direction. The whole secret of break-making is correctly rushing the pilot ball to the right spot after running a hoop; by doing so the next shot is made easy and the approach to the following hoop will become a short straight stop shot, ensuring a good position for hoop running. This positioning is the hallmark of first-class players and it is noteworthy that it is the incompetent player who gives himself during a break difficult and oblique approaches to hoops, ultimately leading to long and angular hoops to run and eventually to a breakdown with the balls adjacent and to the advantage of the opponent. During a three-ball break the player must keep in mind the earliest and safest opportunity for bringing the fourth ball into play, for though it may be quite simple to continue with only three balls it is impossible to finish the break satisfactorily unless all four balls are in command. The usual method is to leave the opponent's balls wired from one another across whichever hoop the player's backward ball requires, and retire with the remaining balls as far away as possible, taking care that both the opponent's balls have an absolutely open shot. If the opponent misses the long roquet his ball is at once brought into play; should he retire into a corner the earliest opportunity of digging him out must be taken. A four-ball break is easier to play, but as some 90 continuous strokes are required to complete the round, the demand on patience and concentration is very great, and unless a player is in good practice, the hand and eye tire with the simplest shots.

Peeling, though adding considerable risk to the successful completion of a break, may have to be essayed where bisques have to be given. The break for a double peel (the last two hoops) is played in the usual way, care being taken that the ball to be peeled (the peelee) and another are sent to the sixth hoop, and immediately after making that hoop the peelee is sent through the penultimate and the break continued. On the way up to two back the peelee must be positioned for the rover hoop, and opportunities will occur before making three back and the penultimate, or even at the time when making the rover hoop, to complete the peel. A triple peel is played in like manner, four back being peeled immediately after running the third hoop and the ball positioned before making the sixth hoop, when play becomes similar to that for a double peel. Tactics play an important part in the game and must be guided by the knowledge of your own skill and by what you know of your opponent's strength or weakness. Broadly speaking, two points must be considered before shooting: what will be gained if the roquet is successful and how will it affect the opponent's next turn if unsuccessful. If, for instance, by going into a corner the opponent will be left with a difficult start for a three-ball break, and if by shooting and failing to roquet a four-ball break is presented, the course of action is obvious. When bisques have to be conceded, the balls at the end of the break should not be left less than eight yards from the boundary, thus compelling the opponent either to roll up gently, when the chances of making the roquet are minimized, or else if he shoots hard and misses, he is faced with a seven-yard return roquet should he elect to take a bisque. Although either ball of a side may be played much can be done to compel the opponent to shoot with his forward ball. It can be left near the hoop of the player's backward ball and in many ways it is possible to influence the progress of the adversary.

The problem of devising a game between two experts in which each player should have an equal chance still awaits solution. Execution on a good lawn has become so accurate that the result of a match too often depends on the spin of a coin. For instance, J. Tuckett, meeting C. Corbally in a round of the open championship (1913), played blue, the first ball, to the left-hand boundary. Corbally hit with red and progressed to four back on a two-ball break. His opponent missed the long shot with black and Corbally finished the game with a triple peel with the fourth ball in play. As an exhibition of perfect croquet it will rarely be equalled and yet can scarcely be called a match. It is a frequent occurrence in first-class croquet for the third ball in play to go to the peg and finish the game with the fifth ball. On the other hand, the wide range of handicapping (from minus four to plus 18) gives the less talented players fair chances of being on the court; more especially is this the case as there is no limit regarding the number of possible bisques a player may take in succession in any game.

Winners of the Open Croquet Championship of England after 1907

1907 R. C. J. Beaton, 1908 C. Corbally, 1909 G. Ashmore, 1910 C. L. O'Callaghan, 1911 E. Whitaker, 1912 C. L. O'Callaghan, 1913 C. Corbally, 1914 P. D. Mathews, 1915 to 1918 no competition, 1919 P. D. Mathews, 1920 P. D. Mathews, 1921 Capt. C. L. O'Callaghan, 1922 C. E. Pepper, 1923 Capt. H. W. J. Snell, 1924 D. L. G. Joseph, 1925 Miss D. D. Steel, 1926 Ben C. Apps, 1927 E. Whitaker, 1928 Capt. K. H. Coxe, 1929 Lt.-Col. W. B. du Pre, 1930 Ben C. Apps, 1931 Ben C. Apps, 1932 H. O. Hicks, 1933 Miss D. D. Steel, 1934 Lt.-Col. W. B. du Pre, 1935 Miss D. D. Steel, 1936 Miss D. D. Steel, 1937 C. F. Colman, 1938 D. J. V. Hamilton-Miller, 1939 H. O. Hicks.

GLOSSARY

Roquet: when the striker's ball in play hits another ball in play.

Croquet: when a ball has been roqueted, croquet is taken by placing the striker's ball in contact with the ball roqueted, and the striker's ball is then hit.

Bisque: an extra turn, given in a game played under handicap.

Half Bisque: a restricted extra turn, no point can be scored for any ball.

A Point: when a ball runs a hoop or hits the peg in order.

Rover: a ball that has run all the hoops.

Pilot Ball: the ball aimed at.

Object Ball: the ball from which croquet is taken.

Peelee: ball to be peeled.

Tice: one of the opening shots of the game played to such a spot as will tempt the opponent to shoot.

Wire: a ball is wired from another ball when (1) any part of the peg or an upright would impede the direct course of any part of it towards any part of the other ball; or (2) any part of the peg or hoop so interferes with any part of the swing of the mallet that the striker cannot drive his ball freely towards any part of the other ball.

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UNITED STATES

In the U.S., croquet is usually played on a court 30 ft. by 60 ft., or 25 ft. by 60 ft., surrounded by boundary lines formed by strong cord fastened to the four corners. (*See* Spalding's *Lawn Sports,* No. 43 R.) The arrangement of the arches or wickets (oval shaped) and stakes should be similar to that shown in the diagram.

Stakes are set just outside the playing line, half way between the end corners, the first arch 8 ft. from the boundary line and the second 7 ft. from the first; the side arches in line across the field with the second arch, and 5 ft. 9 in. from the boundary line, and so on according to the diagram.

The so-called "pendulum stroke," done by swinging the mallet between the legs, made with two hands, is most reliable in directing the ball, but ladies find the outside stroke less awkward. The first object of the game is to strike the ball to a certain distance and no further in its position near another ball; to be near the front of its arch; to wire it so that there can be no direct shot on the ball; to put a ball beyond the open shot of a ball already wired. The greatest skill is required to drive the object ball to a desired position, and especially to make a ball pass to the right or left. Making a ball jump over another or over one or more arches is also difficult but can be accomplished with some practice.

The balls are of wood or hard rubber; the stakes of hard wood $1\frac{1}{4}$ in. in diameter, set at the middle of the court just outside the playing line and projecting above the court only $1\frac{1}{2}$ in., so as to allow a ball to be shot from in front of it in any direction. The handles of the mallets are made in various lengths to conform to the size of the player; the size and weight of the wood in the head also varies. Balls should have coloured painted bands to distinguish them.

Grounds are laid out in America in various ways, some being elliptical in form; arches are often placed at widely different points, although in America uniformity generally prevails. This game is one in which there should be an international uniformity, if possible, as a basis for possible international competition for honours in this attractive outdoor pastime. The terms used in America for croquet as well as the definitions are different from those in Great Britain. The following terms and definitions are used in America:—

Ball in hand, a ball that has roqueted another ball. *Ball in play,* after a ball in hand has taken croquet it is a ball in play. *Bisque,* an extra stroke allowed at any time during a game.

Bombard, to drive one ball by croquet so as to displace another. *Boundary line,* the outside limits of the court.

Carom, a rebounding of a ball from stake, arch or another ball.

Combination, the using of two or more balls to effect some particular play. *Croquet,* to place one ball against another and play from it or with it any way. This is imperative after a roquet.

Danger ball, that ball of the adversary which is to be played next—the "guilty ball."

Dead ball, a ball from which or upon which the player has taken his turn since making a point. It is then dead to all direct shots till he makes another point, or has another turn or play.

Direct shot, when the ball struck with the mallet directly passes to another ball, or makes carom thereon from a stake or an arch.

Drive shot, a shot made so as to send the object ball to some desired position. *Finesse,* to play a ball where it will be of least use to adversary.

Follow shot, when the playing ball in taking croquet is made to follow the object ball in nearly or quite the same direction.

Foul strike, a false one—one at variance with the rules.

Innocent ball, the last-played ball of adversary.

Jump shot, striking a ball so as to make it jump over any obstacle between it and the object aimed at.

Live ball, a ball upon which the playing ball has a right to play. *Object ball,* the ball at which the player aims.

Odds, extra stroke or strokes allowed by superior players to equalize playing. (*See* BISQUE.)

Playing line, real or imaginary line 30 in. inside of boundary line, on which balls are placed for playing when they have passed beyond it or outside the boundary line.

Run, the making of a number of points in one turn of play.

Split shot, any croquet from a ball upon which a ball has counted. *Set-up,* a position of advantage secured by a player in the interests of his partner ball.

Wiring, to wire a ball is to place it so that it will be behind a wire (or arch), thus preventing an open or direct shot.

"Tight Croquet," another variety of the sport, is really considered a giant game of pool or billiards, requiring strategy and great skill. It is played on a court 38 ft. by 44 ft. with hard rubber balls $3\frac{3}{8}$ in. in diameter, weighing about 1 lb. each. The mallets weigh from 2 to 5 lb. each, and the heads are bound at either end with heavy brass bands. The mallets are swung with one hand instead of two. One wicket is placed in the middle of the court, facing the ends and in line with the other four, instead of two placed in the centre facing the sides as in the original game. "Tight Croquet" was originated by C. L. Rice in 1876. J. H. Welsh started the Union Croquet Club in Central park, New York, in 1890; this club meets every day, except in exceptionally stormy weather, on the sheep meadow near the mall in the park.

The Brooklyn Croquet Club meets in Prospect park, and this organization includes many expert players among its members.

"Hun Croquet," another version, is played in Central park by an exclusive gathering. This game, too, is slightly different from the others. (J. B. P.)

CRORE: *see* RUPEE.

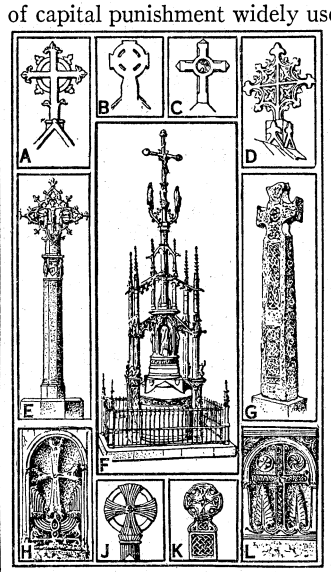
CROSBY, FANNY (Mrs. Frances Jane Crosby Van Alstyne (1820–1915), American hymn writer, was born in Southeast, Putnam county, N.Y., on March 24, 1820. As a result of an illness at the age of six weeks, she lost her sight. In March 1835, she entered the Institution for the Blind in New York city, remaining 12 years as a pupil and 13 years as an instructor, and devoting much time to the study of poetry. On March 5, 1858, she married Alexander Van Alstyne. She was interested in religious work, being closely associated with Dwight Moody, George C. Stebbins, Ira D. Sankey and William H. Doane. Her first hymn to attract attention and to be translated into many languages was "Pass Me Not, O Gentle Saviour," written in 1868. Among the best known of her many hymns are: "Safe in the Arms of Jesus"; "Saved by Grace"; "Rescue the Perishing"; "Blessed Assurance"; "Saviour, More Than Life to Me"; "Some Day the Silver Cord Will Break."

See S. Trevana Jackson, *Fanny Crosby's Story of Ninety-four Years* (1915).

CROSBY, a municipal borough in the Bootle and Ormskirk parliamentary divisions of Lancashire, England, at the mouth of the Mersey between Liverpool, from which it is 5 mi. N.W., and Southport, being a residential district for both.

Population (est. 1938) 55,780. Area (including foreshore) 10.7 sq.mi. The borough was incorporated in 1937 and consists of the former urban districts of Great Crosby and Waterloo-with-Seaforth.

CROSS and **CRUCIFIXION,** an instrument, and method, of capital punishment widely used in ancient times. It is doubtful whether crucifixion was employed by the Greeks; the Romans, who inflicted it only on slaves and criminals of the lowest class, probably borrowed it from the Carthaginians, among whom its use was frequent. Hints of its use among the Jews have been seen in Deut. xxi. 22–23; Josh. viii. 29, x. 26.



BY PERMISSION (D.) SIR B. FLETCHER, "HISTORY OF ARCHITECTURE," 1928 (BATSFORD); (E., F.) VIOLLET-LE-DUC, "DICTIONNAIRE"
A, B. SIMPLE ENGLISH GOTHIC; C. MODERN FRENCH; D, J. COMPLEX ENGLISH FORMS; E, F. FRENCH GOTHIC; G, K. CELTIC; H. ARMENIAN; L. 9TH CENTURY ROMAN

The victim of this cruel punishment was either impaled on, or bound to, an upright stake (*crux simplex*); or else fastened, by cords or by nails through his hands and feet, to an upright post (*stipes*) with a cross-bar (*patibulum*). In either case he was then left to die of exhaustion, thirst and wounds (under the Romans crucifixion was always preceded by scourging). Besides the simple stake, the Romans used three kinds of cross: the *crux commissa,* or tau cross (T), sometimes called St. Anthony's cross; *c. immissa,* or Latin cross (✝); *c. decussata,* or St. Andrew's cross (X). By general tradition, it was on a *crux immissa* that Christ died; but some hold it was the *tau* cross. After the scourging, the criminal was made to carry his cross to the place of execution; he was then stripped naked, and nailed or bound to the cross as it lay on the ground, or after it had been set up in position. The former method is most frequently found in representations of the crucifixion of Christ; but a few miniatures and other paintings depict Him as mounting a ladder placed against the cross, and the ladder is not infrequently found among the mediaeval "Emblems of the Passion."

Pre-Christian Crosses.—The cross has been used both as a religious symbol and as an ornament from the dawn of man's civilization. Various objects, dating from periods long anterior to the Christian era, have been found, marked with crosses of different designs, in almost every part of the old world. India, Syria, Persia and Egypt have all yielded numberless examples, while numerous instances, dating from the later Stone age to Christian times, have been found in nearly every part of Europe. The use of the cross as a religious symbol in pre-Christian times and among non-Christian peoples may probably be regarded as almost universal, and in very many cases it was connected with some form of nature worship. Two of the most frequent forms of pre-Christian cross are the tau cross, so named from its resemblance to the Greek capital letter Τ, and the *swastika* or *fylfot* 卐 also called *"Gammadion"* or *crux gammata,* owing to its form being that of four Greek capital letters *gamma* Γ placed together. The tau cross with a handle (☥ *crux ansata*) often occurs in Egyptian and Assyrian sculptures as a symbol of divinity. The *swastika* has a very wide range of distribution and is found on all kinds of objects. It was used as a religious emblem in India and China many centuries before the Christian era, and is met with on prehistoric monuments from various parts of Europe, Asia and America. It is, in fact, a device of such common occurrence on objects of pre-Christian origin that it is hardly necessary to specify individual instances. The cross, as a device in different forms and often enclosed in a circle, is of frequent occurrence on coins and medals of pre-Christian date in France and elsewhere. Indeed, objects marked with pre-Christian crosses are to be seen in every important museum.

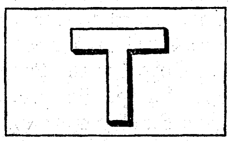


FIG. 1.—PRE-CHRISTIAN CROSS CALLED "TAU" FROM ITS RESEMBLANCE TO GREEK LETTER "T"

Early Christian Crosses.—The death of Christ on a cross necessarily conferred a new significance on the figure, which had hitherto been associated with a conception of religion not merely non-Christian, but in essence often directly opposed to it. It was not, however, till the time of Constantine that the cross was publicly used as the symbol of the Christian religion. Till then its employment had been restricted and private among the Christians themselves. Under Constantine it became the acknowledged symbol of Christianity, just as long afterwards the crescent was adopted as the symbol of the Mohammedan religion. Constantine's conversion to Christianity is attributed to his vision of the cross in the sky with the accompanying words ἐν τούτῳ νίκα ("in this conquer"), on the eve of his victory over Maxentius in 312. The finding of the holy cross by his mother, St. Helena, in 326, is commemorated by a festival, on May 3, called the "Invention of the Holy Cross." The legend is that when visiting in Palestine, she was guided to the site of the crucifixion by an aged Jew, who had inherited traditional knowledge as to its position. After the ground had been dug to a considerable depth three crosses were found, together with the superscription placed over the Saviour's head and the nails with which He was crucified. His cross was identified by the miraculous cure of a sick woman who was stretched upon it. This legend is related by writers such as St. Ambrose, Rufinus, Sulpicius Severus and others, but it is discounted by the silence of Eusebius and by the existence of an older legend, according to which the true cross was found by Protonice, the wife of the emperor Claudius. It is clear, however, that before the end of the 4th century there was at Jerusalem what was believed to be a relic of the true cross; and it seems probable that this was found during the excavations conducted by Macarius, bishop of Jerusalem, *c.* 327.

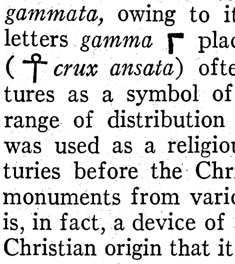


FIG. 2.—FYLFOT PRE-CHRISTIAN CROSS, COMPOSED OF FOUR CAPITAL GAMMAS, Γ, WITH BASES SET. IT IS ALSO CALLED "SWASTIKA"

Another festival of the holy cross is kept on Sept. 14 and is known as the "Exaltation of the Holy Cross." It seems to have originated at Jerusalem, to commemorate first the dedication, in the year 335, of the churches built on the sites of the crucifixion and the holy sepulchre and afterwards the restoration by Heraclius, in 629, of the relic which had been carried off by the Persians in 614. It came into observance at Rome before the end of the 7th century and has long been one of the principal feasts of the Roman Catholic Church.

The superscription placed over the Saviour's head, which St. Helena is said to have found with the cross, seems to have been sent by Constantine to Rome, where it is now preserved in the church of S. Croce in Gerusalemme. As regards the nails, a question has arisen as to their number. In most of the early pictures of the Crucifixion the feet are shown as separately nailed to the cross, but at a later period they are crossed, and a single nail fixes them. In the former case there would be four nails, in the latter only three; and it has been argued that there were probably only two, one for each hand. Four is the number generally accepted: one is said to have been cast by St. Helena into the sea, during a storm, in order to subdue the waves; another is said to have been beaten out into the iron circlet of the crown of Lombardy, now preserved at Monza. Some 30 more "holy nails" are preserved among the relics at Milan, Carpentras and other places.

The employment of the cross as the Christian symbol has been so manifold in its variety and application, and the different forms to which the figure has been adapted and elaborated are so complex, that it is only possible to deal with the outline of the subject.

We learn from Tertullian and other early Christian writers of the constant use which the Christians of those days made of the sign of the cross. Tertullian (*De Cor. Mil.* cap. iii.) says: "At each journey and progress, at each coming in and going out, at the putting on of shoes, at the bath, at meals, at the kindling of lights, at bedtime, at sitting down, whatsoever occupation engages us, we mark the brow with the sign of the cross." We should naturally expect, therefore, to find it very frequently used in the public worship of the Church. The earliest liturgical forms are comparatively late, and are without rubrics, but allusions by early writers to the ceremonial use of the sign of the cross in the public services are so numerous, and lay such stress upon it, that we are left in no doubt on the point. St. Augustine, indeed, speaks of the sacraments as not duly ministered if the use of the sign of the cross were absent from their ministration (*Hom. cxviii. in St. Joan*). As to its later liturgical use we need only refer to the service books of the Greek and Latin churches, which plainly indicate the frequency of, and the importance attached to, its employment. Its occasional use is retained by the Lutherans, and in the Church of England it is authoritatively used at baptism, and at the "sacring" or anointing of the sovereign at the coronation.

Besides the forms of cross already described, the equilateral or Greek cross (+) should be mentioned. It appears, though rarely, on early Christian monuments, and from the 4th century onwards has been of frequent use, especially in the Eastern Churches.

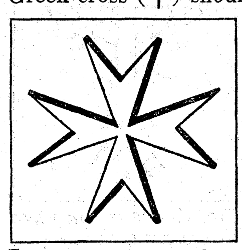


FIG. 3.—MALTESE CROSS, BADGE OF THE KNIGHTS OF MALTA

Heraldic Crosses.—The cross in one form or other appears on the flags and ensigns of many Christian countries. The English cross of St. George is a plain red cross on a white ground; the Scottish cross of St. Andrew is a plain diagonal white cross (heraldically termed a saltire) on a blue ground, and the Irish cross of St. Patrick is a plain diagonal red cross on a white ground. These three crosses are combined in the Union Jack. (*See* FLAG.)

The cross has also been adopted by many orders of knighthood. Perhaps the best known of these is the cross of the knights of Malta. It is a white cross of eight points on a black ground (fig. 3) and is the proper Maltese cross, a name which is often wrongly applied to the cross *patée* (fig. 4). The knights of the Garter use the cross of St. George, as do those of the order of St. Michael and St. George; the knights of the Thistle use St. Andrew's cross, and those of St. Patrick the cross of St. Patrick charged with a shamrock leaf.

Akin to the crosses of knightly orders are those which figure as charges on coats of arms. The science of heraldry evolved a wonderful variety of cross-forms during the period it held sway in the middle ages. The different forms of cross used in heraldry are, in fact, so numerous that it is only the larger works on that subject, which attempt to record them all. (For such crosses *see* HERALDRY.)

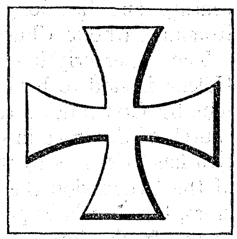


FIG. 4.—CROSS PATÉE

Church Crosses.—In the middle ages the cross-form, in one way or another, was predominant everywhere, and was introduced whenever opportunity offered itself for doing so. The larger churches were planned on its outline, so that the ridge line of their roofs proclaimed it far and wide. This was more particularly followed in north Europe, but when it was first introduced is not quite certain. Practically all the ancient cathedral churches of England and Wales are cruciform in plan; Llandaff is an exception.

The artistic skill and ingenuity of the mediaeval designer have produced cross designs of endless variety and of singular elegance and beauty. Some of the most beautiful of these designs are the gable crosses of the old churches. Fig. 5 shows the west gable cross of Washburn church, Worcestershire; fig. 6 that of the nave of Castle Acre church, Norfolk; and fig. 7 the east gable cross of Hethersett church in that county. They may be taken as good examples of a type of cross which is often of great beauty, but it is overlooked owing to its bad position for observation.

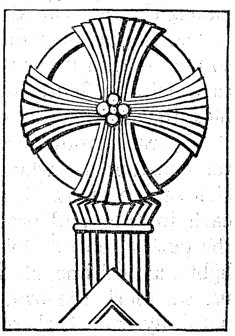


FIG. 5.—WEST GABLE CROSS OF WASHBURN CHURCH, WORCESTERSHIRE

Other architectural crosses, of great beauty of design, are those which occur on the grave slabs of the middle ages. Instances of a plainer type occur in Saxon times, but after the 11th century they were fashioned after the intricate and beautiful designs with which ancient churches are, as a rule, so plentifully supplied. Sometimes these crosses are incised in the slab, sometimes they are executed in low relief. The long shaft of the cross is most commonly plain, but in many instances branches, with leaf designs, are thrown out at intervals down the entire length of the shaft. The Calvary cross (Latin cross on steps) is sometimes found. Fig. 8 from Stradsett church, Norfolk, and fig. 9 from Bosbury church, Herefordshire, are good examples of the designs at the head of sepulchral crosses. Of upright standing crosses the Irish and Iona types are well known, and their great artistic beauty and elaboration and excellence of sculpture are universally recognized. These crosses are sometimes spoken of as "Runic Crosses," some of them bearing inscriptions in Runic characters. Standing crosses, of different kinds, were commonly set up in every suitable place during the middle ages, as the mutilated bases and shafts still remaining readily testify. Such crosses were erected in the centre of the market place, in the churchyard, on the village green, or as boundary stones, or marks to guide the traveller. Some, like the Black Friars cross at Hereford, were preaching stations, others, like the beautiful Eleanor crosses at Northampton, Geddington and Waltham, were commemorative in character. Of these latter crosses, which marked the places where the funeral procession of Queen Eleanor halted on its way from Nottinghamshire to Westminster, there were originally ten or more, erected between 1291 and 1294. These crosses, like the Black Friars cross at Hereford, are elaborate architectural erections, and very similar to them in this respect are the beautiful market crosses at Winchester, Chichester, Salisbury, Devizes, Shepton Mallet, Leighton Buzzard, etc. Of churchyard crosses, as distinguished from memorial crosses in churchyards, one of the most perfect now remaining stands in the churchyard of Somerby, in Lincolnshire (Tennyson's birthplace), a tall shaft surmounted by a pedimented tabernacle, on one side of which is the Crucifixion, on the other the Virgin and Child. Churchyard crosses may have been used as occasional preaching stations, for reading the Gospel in the Palm Sunday procession, and for public proclamations after the chief Sunday morning service, much in the same way that market crosses were used for proclamations on market days.

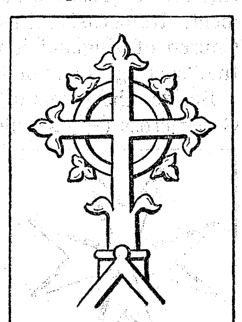


FIG. 6.—CROSS ON NAVE OF CASTLE ACRE CHURCH, NORFOLK

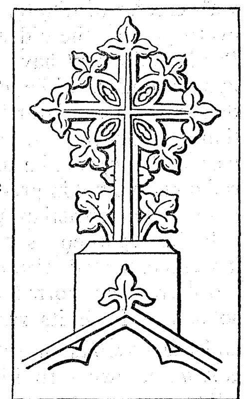


FIG. 7.—EAST GABLE CROSS OF HETHERSETT CHURCH, NORFOLK

Bishops' Crosses.—Mention should be made of ecclesiastical crosses and their ceremonial use. From a fairly early period it has been the prerogative of an archbishop or metropolitan to have a cross borne before him within the limits of his province. The archiepiscopal cross must not be confused with the crozier or pastoral staff. The latter, which is formed with a crook at the end, is quite distinct, and is used by archbishops and bishops alike, who bear it with the left hand in processions, and when blessing the people. The archiepiscopal cross, on the contrary, is always borne before the archbishop or during the vacancy of the archiepiscopal see before the guardian of the spiritualities *sede vacante*. Good illustrations of the archiepiscopal cross occur on the monumental brasses of Archbishop Waldeby, of York (1398), at Westminster Abbey, and of Archbishop Cranley, of Dublin (1417), in New College chapel, Oxford.

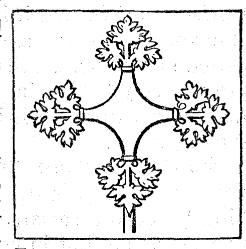


FIG. 8.—SEPULCHRAL CROSS FROM STRADSETT CHURCH, NORFOLK

The custom of carrying a cross at the head of an ecclesiastical procession seems to have been general in early times. The long shaft was sometimes removable, so that the cross or crucifix at the top could be set in a stand and kept on the altar. This was perhaps the origin of the altar-cross, of whose use there seems no indisputable evidence before the 11th century. (*See* H. Thurston, *Cath. Encyl.*, iv. 533.)

As a personal ornament the cross came into common use, and was usually worn over the chest (and so called a pectoral cross), suspended by a chain from the neck. A cross of this kind, of very great interest and beauty, was found about 1690 on the breast of Queen Dagmar, the wife of Waldemar II., king of Denmark (d. 1213). It is of Byzantine design and workmanship, and is of enamelled gold (fig. 10 shows both sides of it); on one side is the Crucifixion, on the other the half-figure of our Lord in the centre, with the Virgin and St. John the Evangelist on either side, and St. Chrysostom and St. Basil above and below. At the present day a pectoral cross forms part of the recognized insignia of a Roman Catholic bishop, and is worn by him over his robes, but this official use of the pectoral cross is quite modern. The custom appears to have taken rise in the 17th century on the Continent. A cruciform reliquary was found on the body of St. Cuthbert when his tomb was opened in 1827, but it was evidently worn as an object of devotion, not as part of his episcopal attire. The custom of wearing a pectoral cross over ecclesiastical robes has, curiously enough, been copied from the comparatively modern Roman Catholic usage by the Lutheran bishops and superintendents of Scandinavia and Prussia; and in Sweden the cross is now

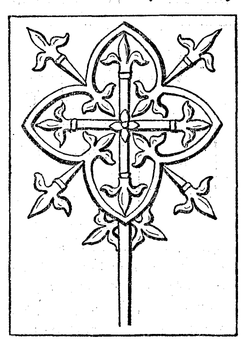
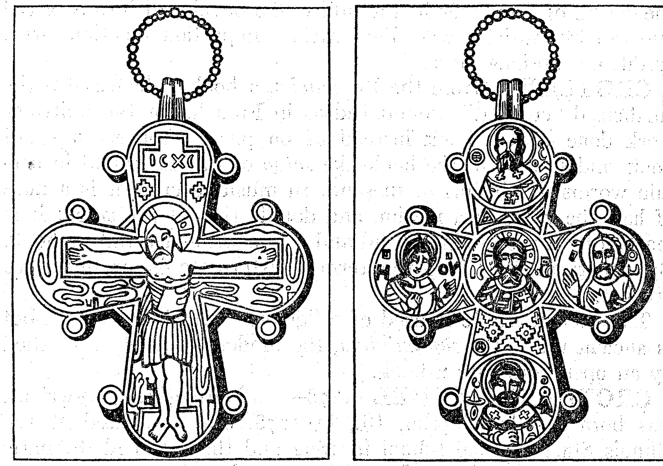


FIG. 9.—SEPULCHRAL CROSS FROM BOSBURY CHURCH, HEREFORDSHIRE

delivered to the new bishop, on his installation in office, by the archbishop of Uppsala, together with the mitre and crozier. Within the last generation the use of a pectoral cross, worn over their robes as part of the insignia of the episcopal office, has been adopted by some bishops of the Church of England, but it has no ancient sanction or authority.



FIGS. 10 AND 11.—THE OBVERSE AND REVERSE OF AN ENAMELLED GOLD CROSS OF BYZANTINE DESIGN AND WORKMANSHIP FOUND IN 1690 ON THE BREAST OF QUEEN DAGMAR, WIFE OF WALDEMAR II., KING OF DENMARK (D. 1213). ONE SIDE SHOWS THE CRUCIFIXION: THE OTHER, CHRIST WITH THE VIRGIN AND ST. JOHN ON EITHER SIDE, ST. CHRYSOSTOM ABOVE, AND ST. BASIL BELOW

BIBLIOGRAPHY.—J. Lipsius, *De Cruce libri III.* (1593); J. Bingham, *Antiquities of the Christian Church* (1708); E. L. Cutts, *Manual of Sepulchral Slabs and Crosses* (1849); J. P. Bergeau, *History of the Holy Cross* (1863); C. de Mortillet, *La Signe de la croix avant le Christianisme* (1866); H. Leclerc in F. Cabrol, *Dictionnaire d'archéologie chrétienne, et de liturgie,* iii. (1903); F. Cabrol and H. Thurston in *Catholic Encyclopaedia,* iv. (1907).

CROSSBILL, the common name of a genus (*Loxia*) of the finch family (*Fringillidae*), remarkable in that the upper and lower sheaths of the bill cross one another obliquely. This is correlated with the bird's habit of feeding on pine seeds, the formation of the bill enabling it to hold apart the scales while extracting the seed with its tongue. (*See* Yarrell, *Zool. Journ.,* iv. pp. 457–465, Pl. xiv., figs. 91–7.) The common crossbill (*L. curvirostra*) is about the size of a skylark, but more stoutly built. The plumage of the adult cock is a rich crimson, with patches of flame-colour; these are replaced in captivity by dull orange or bright golden yellow. The female is yellowish green; the young, before the first moult, a dull olive. Crossbills live in small flocks and are great wanderers. The nest is rudely constructed and the eggs resemble those of the greenfinch, but are larger. This species is distributed throughout Europe and Northern Asia and in the woods of the Atlas mountains. The larger parrot-crossbill (*L. pityopsittacus*) inhabits Scandinavia. Two species are found in America; *L. curvirostra minor* differs from the British species in its smaller bill; the second form, *L. leucoptera,* is smaller, rose-coloured, and with white wing-bars.

BY COURTESY OF AMERICAN MUSEUM OF NATURAL HISTORY

AMERICAN RED CROSSBILL ON THE BRANCH OF A FIR TREE, THE CONES OF WHICH IT OPENS WITH ITS PLIER-LIKE BILL

CROSS-BOW. An ancient missile-throwing weapon consisting of a bow fixed transversely upon a stock that contains a groove to guide the missile, a notch to hold the string of the bow, and a trigger to release it. There were several varieties of cross-bows, viz.—goat's-foot, windlass, catch, German, cross-bow à galet, ramrod, the Chinese and the arbalest, which usually fired quarrels or square-headed bolts, and was so stiff that a mechanical contrivance was required to bend it. Those of the cavalry were lighter than those of the infantry.

CROSSED CHEQUE: *see* CHEQUE.

CROSSEN, a town of Germany, in the Prussian province of Brandenburg, on the Oder, 31 mi. S.E. of Frankfort-on-Oder by rail. Pop. (1939) 10,584.

It was founded in 1005 and was important during the middle ages as a point of passage across the Oder. It attained civic rights in 1232 and was for a time the capital of a Silesian duchy, which passed to Brandenburg in 1482.

There are manufactories of copper and brass ware, while in the surrounding country fruit growing is important. Trade is mainly in wine, fruit and fish.

CROSS-HEAD, the joint between a piston rod and a connecting rod (*q.v.*) constrained to move so that the piston rod travels to and fro in a straight line and the connecting rod oscillates about the junction.

(*See* STEAM ENGINE.)

CROSSING, in architecture, the intersection of the nave and transept.

CROSSKEY, HENRY WILLIAM (1826–1893), English geologist and Unitarian minister, was born at Lewes in Sussex, on Dec. 7, 1826. He became an authority on glacial geology, and in conjunction with David Robertson wrote many papers on the post-tertiary fossiliferous beds of Scotland (*Trans. Geol. Soc. Glasgow*). He also prepared for the British Association a valuable series of reports (1873–92) on the erratic blocks of England, Wales, and Ireland. With David Robertson and G. S. Brady he wrote the *Monograph of the post-tertiary Entomostraca of Scotland,* etc., for the Palaeontographical Society (1874). He died at Edgbaston, Birmingham, on Oct. 1, 1893.

See R. A. Armstrong, *H. W. Crosskey: his Life and Work* (1895).

CROSS RIVER, a river of West Africa, over 500m. long. It rises in 6° N., 10° 30′ E. in the mountains of the Cameroons and flows at first north-west. In 8° 48′ E., 5° 50′ N. are a series of rapids; below this point the river is navigable for shallow-draught boats. At 8° 20′ E., 6° 10′ N., its most northern point, the river turns south-west, and then south, entering the Gulf of Guinea through the Calabar estuary. The Calabar river, which rises about 5° 30′ N., 8° 30′ E., has a course parallel to, and 10 to 20m. E. of, the Cross river. Near its mouth, on its east bank, is the town of Calabar (*q.v.*). It enters the estuary in 4° 45′ N. The Cross, Calabar, Kwa and other streams farther east, which rise on the flanks of the Cameroon mountains, form a large delta.

CROSS-ROADS, BURIAL AT, in former times the method of disposing of executed criminals and suicides. The explanation is that the ancient Teutonic peoples often built their altars at the cross-roads, and as human sacrifices, especially of criminals, formed part of the ritual, these spots came to be regarded as execution grounds. After the introduction of Christianity, criminals and suicides were buried at the cross-roads during the night, in order to assimilate their funeral to that of the pagans. An example of a cross-road execution-ground was the famous Tyburn in London, which stood on the spot where the Oxford, Edgware and London roads met.

CROSS SPRINGER, in architecture, the block from which the diagonal ribs of a vault spring or start.

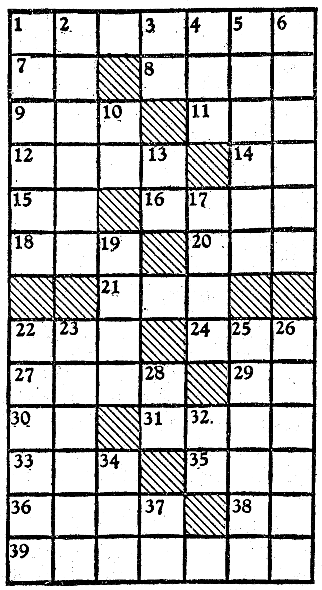
CROSSWORD. A word-guessing puzzle, consisting of a diagram, usually rectangular, divided into squares, into each of which, when not cancelled, a certain letter of the alphabet is to be inserted.

In properly keyed puzzles, each letter forms a part of two words, one running downward and one across. Accompanying the diagram are numbered definitions for the horizontal and vertical columns of squares. These correspond to identical numbers in the puzzle so that when the proper solution is fitted, the words of the puzzle interlock perfectly.

The first crosswords seem to have been printed in England during the 19th century. These were of an elementary kind, apparently derived from the word square, and printed in various periodicals and in books of general puzzles for the nursery. However, it was in the United States that the puzzle developed into

Horizontal

1. Cigar-shaped submarine projectile
7. Teutonic deity
8. Seaport in N. Algeria, Africa
9. Pastry
11. Collection of facts
12. Elongated fish (pl.)
14. Coast guard (abbr.)
15. Printer's measure
16. Opposed to aweather
18. In music; as it is written
20. To mistake
21. Babylonian war god
22. 1150 (Roman numerals)
24. Garden vegetable
27. Either one of the bears (astron.)
29. Aloft
30. A compass point
31. Musical instrument
33. Foster brother of King Arthur
35. Pedal digit
36. A weight of Denmark (pl.)
38. New Zealand native fort
39. Army officer



T	O	R	P	E	D	O
E	R		O	R	A	N
P	I	E		A	N	A
E	E	L	S		C	G
E	N		A	L	E	E
S	T	A		E	R	R
		I	R	A		
M	C	L		P	E	A
U	R	S	A		U	P
S	E		H	A	R	P
K	A	Y		T	O	E
E	S	E	R		P	A
G	E	N	E	R	A	L

Vertical

1. Indian tents
2. To cause to face toward the east
3. Italian river
4. A period of time
5. One who moves in time with music
6. A wild ass of Asia
10. A north Syrian deity
13. Symbol for samarium
17. To jump
19. Troubles
22. A sphagnum bog
23. Wrinkle
25. Mother of Minos
26. A plea
28. Exclamation expressing relief
32. Siamese coin
34. A longing (slang)
37. Note of scale

a serious adult pastime. In 1913 the *New York World* began publishing crossword puzzles in its Sunday supplement, *Fun.* Gradually the desire for them spread, and in 1923 they became the most talked-of form of entertainment in the United States, being published by most of the popular newspapers, and in a few months had returned to take England by storm. Though American enthusiasm for them has diminished somewhat, and though they have failed to become firmly established in other European countries, England has remained faithful to these puzzles for many years, and there seems to be no sign of waning in their popularity.

Though the majority of puzzles are confined to (*a*) symmetrical patterns of shaded or blacked out squares (*see* fig.) within the rectangle, variations have by no means been an exception. These include (*b*) an asymmetrical scattering of squares, (*c*) a plain diagram with no squares cancelled and the ends of words marked simply by a thick line, (*d*) isolated but quite successful examples of pictorial designs, either in outline containing the diagram, or in line inside the diagram, or a combination of both, and (*e*) diagramless puzzles with no clue given to the position or length of the words.

The "general" type of crossword has also been subject to changes. A number of words in one puzzle may bear upon some announced theme such as music, sports, literature or geography. Many of the puzzles in this category are difficult and serve as the medium for a generally recondite examination. Again, some clues will be omitted altogether, but a direction be given that the words thus neglected belong to a particular class: jewels, for example, or the words in a quotation. Or every word will have some given prefix, suffix, or part in common, and only the rest of the word will actually fill the spaces in the diagram: (cat)alepsy, (Cat)hay, etc.; unc(tion), cap(tion), etc.; qu(it)e, cr(it)ic, etc. (G. E. Lr.)

CROTCH, WILLIAM (1775–1847), English musician, born at Norwich, who was a musical prodigy at the age of two. At the age of four he went to London and gave daily organ recitals in the rooms of a milliner in Piccadilly. He developed into a sound and worthy musician who filled various important positions with credit, but nothing more.

CROTCHET (from the Fr. *croche,* a hook; whence also the Anglicized "crochet," pronounced as in French, for the knitting-work done with a hook instead of on pins), properly a small hook, and so used of the hook-like *setae* or bristles found in certain worms which burrow in sand. In music, a crochet is a note of half the value of a minim, and double that of a quaver; it is marked by a round black head and a line without a tail or hook. By American musicians the term quarter-note is preferred to crochet.

The French *croche* is used of a "quaver" which has a tail, but in ancient music the *semiminima,* the modern crochet, is marked by an open note with a hook.

CROTHERS, RACHEL (1878–), American playwright, was born in Bloomington, Ill., in 1878. She graduated at the Illinois State Normal school in 1892 and then studied dramatic art in Boston and New York. She made her first stage appearance as a member of Felix Morris' company in New York city, and was afterwards a member of Madame Rhea's company. Her first play to be professionally produced was *The Rector* at the Madison Square theatre, N.Y., on April 3, 1903. She has produced and directed her own plays, the most representative of them dealing with the general question of woman's rights, the most popular of them being *A Man's World,* produced in 1909 (published in Boston, 1915); *He and She,* produced in 1911 (published in A. H. Quinn's *Representative American Plays,* 1917); *Old Lady 31,* produced in 1916 (published with *Mary the Third* and *A Little Journey* in *Three Plays* by Rachel Crothers, 1923); *Nice People,* produced in 1921 (published in M. J. Moses' *Representative American Dramas,* Boston, 1925, in A. H. Quinn's *Contemporary American Plays,* 1923, and also with *Expressing Willie,* produced 1924, and *39 East,* produced 1919, in *Three Plays* by Rachel Crothers, 1924).

Her one-act plays were published in London in *One-Act Plays for Stage and Study,* and in *Six One-Act Plays,* Boston, 1925. Later plays were *When Ladies Meet* (1932) and *Susan and God* (1937).

CROTONA, CROTO or **CROTON** (Gr. Κρότων, mod. Crotone), a Greek town in southern Italy on the east coast of the territory of the Bruttii (mod. *Calabria*), 7 mi. N.W. of the Lacinian promontory. It was founded by a colony of Achaeans led by Myscellus in 710 B.C. Like Sybaris, it soon became a city of power and wealth. It was especially celebrated for its successes in the Olympic games from 588 B.C. onwards, Milo being the most famous of its athletes. Pythagoras established himself there between 540 and 530 B.C. and formed a society of 300 disciples (among whom was Milo). In 510 B.C. Crotona was strong enough to defeat the Sybarites, and raze their city to the ground. Shortly afterwards, however, the disciples of Pythagoras were driven out, and a democracy established. The victory of the Locrians and Phlegians over Crotona in 480 B.C. marked the beginning of its decline. It suffered after this from the attacks of Dionysius I, who became its master for 12 years, of the Bruttii and of Agathocles, and even more from the invasion of Pyrrhus, after which in 277 the Romans obtained possession of it. Livy states that the walls had a length of 12 mi. and that about half the area within them had at that time ceased to be inhabited.

After the battle of Cannae, Crotona revolted from Rome, and Hannibal made it his winter quarters for three years.

The importance of the city was mainly due to its harbour, which, though not a good one, was the only port between Tarentum and Rhegium. Remains of a ship loaded with a cargo of classical marbles were found in it. The original settlement occupied the hill above it (143 ft.) and later became the acropolis. Its healthy situation was famous in antiquity, and to this was ascribed its superiority in athletics; it was the seat also of a famous medical school. Of the exact site of the ancient city and its remains practically nothing is known. On the Lacinian promontory was the famous temple of Hera Lacinia of which only one column is standing. It was approached by a processional way from Croton, which, in front of the gate into the enclosure wall, was some 20 yards wide.

CROTONALDEHYDE is formed from aldol (*see* ALDEHYDES: *Aldolization*) when the latter loses water. Its chemical formula is $CH_3{\cdot}CH{:}CH{\cdot}CHO$, and on oxidation it passes into crotonic acid, $C_4H_6O_2$. It is of importance in the manufacture of rubber (*see* RUBBER: PRODUCTION AND MANUFACTURE).

CROTON OIL, an oil prepared from the seeds of *Croton Tiglium,* a tree belonging to the family Euphorbiaceae, and native or cultivated in India and the Malay Islands. The seeds resemble those of the castor-oil plant, but have not their polished and mottled surface. The kernels contain from 50 to 60% of oil, which is obtained by pressing them, when bruised to a pulp, between hot plates. Croton oil is a transparent and viscid liquid of a brownish or pale-yellow tinge, and acrid, peculiar and persistent taste, a disagreeable odour and acid reactions. It is soluble in volatile oils, carbon disulphide and ether, and to some extent in alcohol. It contains acetic, butyric and valeric acids, with glycerides of acids of the same series, and a volatile body. $C_5H_8O_2$, tiglic acid, metameric with angelic acid, and identical with methyl-crotonic acid, $CH_3{\cdot}CH{:}C\ (CH_3)\ (CO_2H)$. The odour is due to various volatile acids, which are present to the extent of about 1%. A substance called crotonal appears to be responsible for its external, but not its internal, action. The latter is probably due to crotolinic acid, $C_9H_{14}O_2$, which has active purgative properties. The maximum dose of croton oil is two minims, one-fourth of that quantity being usually ample.

Applied to the skin, croton oil acts as a powerful irritant, inducing so much inflammation that definite pustules are formed. Taken internally, even in minute doses, croton oil very soon causes much colic and a fluid diarrhoea. In larger doses it produces severe gastroenteritis. The same result may follow absorption of croton oil by the skin.

The minuteness of the dose, the certainty of the action, and the large amount of fluid drained away constitute this the best drug for administration to an unconscious patient, especially in apoplexy, or to insane patients refusing to take any drug. One drop of the oil, placed on the back of the tongue, must inevitably be swallowed by reflex action. A dose should never be repeated. The characters of this drug obviously contra-indicate its use in all cases of organic disease or obstruction of the bowel, in pregnancy, or in cases of constipation in children or the aged.

CROTUS, RUBIANUS (JOHANNES JÄGER) (*c.* 1480–*c.* 1539), German humanist, born at Dornheim and educated at Erfurt, later becoming professor of theology at Cologne. In 1515 he contributed to the collection, *Epistolae Obscurorum Virorum,* his satirical letters on scholasticism and monasticism. After four years in Italy, Crotus became rector of Erfurt university (1520) and there entertained Luther. Three years later he went to Fulda, but finally settled in Halle, where he reverted to his old religion (*c.* 1530) and became a canon. His *Apologia* appeared at Leipzig 1531.

See Kampschulte, *De J. Croto Rubiano Commentatio* (Bonn, 1862); Einert, *Johann Jäger aus Dornheim* (1883); and Brecht, *Die Verfasser der Epistolae obscurorum virorum* (1904).

CROUP, a name formerly given to diseases characterized by distress in breathing accompanied by a metallic cough and some hoarseness of speech. It is now known that these symptoms are often associated with diphtheria (*q.v.*), spasmodic laryngitis (*q.v.*), and a third disease, spasmodic croup, to which the term is now alone applied. This occurs most frequently in children above two years of age; the child goes to bed quite well, and a few hours later suddenly awakes with great difficulty in inspiration, the chest wall becomes markedly retracted, and there is a metallic cough. He becomes cyanosed, and seems moribund. In the course of four or five minutes normal respiration starts again, and the attack is over for the time being; but it may recur several times a day. The seizure may be accompanied by convulsions. The best treatment is to plunge the child into a warm bath, and sponge the back and chest with cold water. Subsequently this can be done two or three times a day. Should the cyanosis become very severe, respiration can be restarted by vomiting induced by ipecacuanha wine, or other means. Rickets, enlarged tonsils or adenoids if present should be treated.

CROUSAZ, JEAN PIERRE DE (1663–1748), Swiss writer, was born at Lausanne. In 1700 he became professor of philosophy and mathematics there, and in 1724 theological disputes about the *Consensus* (a document drawn up as a test of Protestant orthodoxy as to the doctrine of grace) led to his going to a similar chair at Groningen. In 1726 he went as governor to the young prince Frederick of Hesse-Cassel, and in 1737 was reinstated at Lausanne. He introduced the philosophy of Descartes and Locke to Lausanne, and was a violent opponent of Leibnitz and Bayle.

The most important of his works are *Nouvel Essai de logique* (1712); *Géométrie des lignes et des surfaces rectilignes et circulaires* (1712); *Traité du beau* (1714); *Examen du traité de la liberté de penser d'Antoine Collins* (1718); *De l'éducation des enfants,* dedicated to the then Princess of Wales (1722); *Examen du pyrrhonisme ancien et moderne,* an attack chiefly on Bayle (1733); *Examen de l'essai de M. Pope sur l'homme,* an attack on the Leibnitzian theory of that poem (1737); *Logique* (1741); *De l'esprit humain* (1741); *Réflexions sur l'ouvrage intitulé: La Belle Wolfienne* (1743).

CROW, a Siouan Plains Indian tribe, also known as Absaroka. They formerly lived in the drainage of Yellowstone river and numbered 3,000–4,000. In 1922 there remained 1,800 on their reservation in Montana. Their speech resembles the Hidatsa (*q.v.*), from whom their separation is probably not ancient. *See* Frank B. Linderman, *American* (Life Story of a Crow Chief, 1930).

See Lowie in *Anthr. Pap. Am. Nat. Hist.,* vols. xi., xvi., xxi., xxv. (1913–22).

CROW, a general name for several birds of the genus *Corvus,* of the family *Corvidae.* It is applied particularly in England to the carrion crow (*C. corone*) and hooded crow (*C. cornix*) and in America to the American crow (*C. brachyrhynchos*). The *Corvidae* are the most highly developed family of birds, and include, besides the crows proper, the magpies, jays, choughs, the rook and the raven (*qq.v.*).

Of the true crows, the black or carrion crow is resident in Britain. It shares its range with a second species, the grey or hooded crow. Both forms migrate south in winter, a line from the Firth of Clyde to the head of the Adriatic dividing, roughly, their summer homes; the carrion crow occurs to the south-west of this, the hooded crow to the north-east. Where the ranges overlap, the two species appear to inter-breed freely, sometimes producing intermediate types. The "hoodie" differs from its congener in possessing a grey instead of a black body. Both species feed on carrion, small birds, eggs, etc.; they are some 18 or 19 in. in length and build isolated nests in which they lay four to six bluish-green eggs blotched with brown.

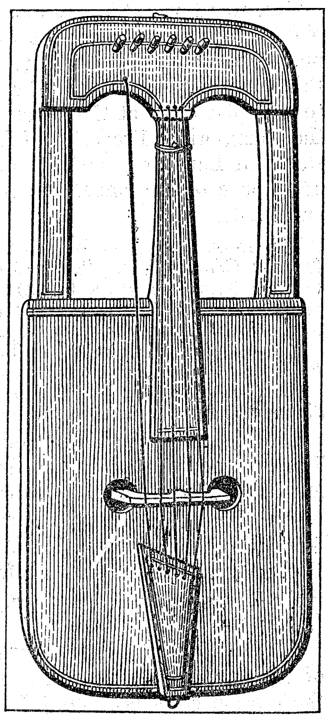
The American crow is, unlike the preceding, gregarious and feeds largely on grain; hence it is very unpopular with farmers. It is smaller than the European species. The fish crow (*C. ossifragus*) is also American and lives largely on fish, molluscs and garbage cast up by the sea. The Indian house crow (*C. splendens*) is abundant in India, where it is very tame and useful as a scavenger. The so-called carrion crow of the United States of America is the black vulture.

CROWBERRY or **CRAKEBERRY** (*Empetrum nigrum*), the English name for a low-growing heath-like shrub belonging to the family Empetraceae, found on heaths and rocks in the British Isles and across northern Europe, Asia and North America and also in the Andes. It has slender, wiry, spreading branches covered with short, narrow, stiff leaves, the margins of which are recurved to form a hollow cylinder concealing the hairy under surface. The minute flowers are succeeded by black, edible, berry-like fruits, one-fourth to one-third of an inch in diameter, which are much eaten by birds.

CROWD, Crouth, Crowth (Welsh *crwth;* Fr. *crout;* Ger. *Chrotta, Hrotta*), a mediaeval stringed instrument derived from the lyre, characterized by a sound-chest having a vaulted back and an open space left at each side of the strings to allow the hand to pass through in order to stop the strings on the finger-board. The Welsh crwth, which survived until the end of the 18th century, is represented by a specimen of that date preserved in the Victoria and Albert Museum.

The earliest representation of the crwth yet discovered dates from the Carolingian period. In the miniatures of the Bible of Charles the Bald, in the Bibliothèque Nationale, Paris, one of the musicians of King David is seen stopping strings on the fingerboard with his left hand and plucking them with the right; this crwth has only three strings, and may be the crwth *trîthant* of Wales. It will be understood that the crwth was not an exclusively Welsh instrument, but only a late survival in Wales of an archaic instrument once generally popular in Europe but long obsolete elsewhere than in Wales.

(K. S.)



BY COURTESY OF THE DIRECTOR OF THE VICTORIA AND ALBERT MUSEUM

THE WELSH CRWTH (CROWD), WHICH WAS USED IN WALES UNTIL THE 18TH CENTURY

CROWDER, ENOCH HERBERT (1859–1932), American soldier, was born in Missouri on April 11, 1859. He graduated at the U.S. military academy in 1881, and was commissioned in the cavalry. After serving four years in campaigns against the Apache and Sioux Indians, he was detailed as commandant at the University of Missouri, where he also studied law and received his graduate degree in law in 1886. From 1891–95 he was acting judge advocate of the military department of the Platte. Upon the outbreak of the Spanish-American War he was appointed judge advocate of the American troops sent to the Philippine Islands. While in the Philippines he served as secretary to the military governor and as associate justice of the supreme court of the Philippines for two years (1899–1901). Returning to the United States in Aug. 1903, he was chief of the 1st Division of the general staff (1903–07). During the Russo-Japanese War, he went to Manchuria as American military observer with the Japanese army (1904–05). From 1906–08, he was in Cuba as secretary of State and justice, in which position he devised the first electoral laws of the island. In July 1910 he was a member of the fourth Pan-American Conference in Argentina, and in September of the same year visited Chile on a special mission. He became advocate general of the army in February 1911 and in this position made sweeping changes. When the United States entered the World War, he was directed to draft the selective service bill. From May 1917 to July 1919, he was provost marshal, charged with the duties of administering the new act, and in 1919 he was reappointed judge advocate general. Crowder was recognized as an expert in military law. In his book, *The Spirit of Selective Service* (1920), he describes the method whereby within 18 months after America had entered the World War, 2,000,000 men were in France, almost as many more were in cantonments, and altogether no fewer than 24,000,000 had been registered and classified. He visited Cuba in March, 1919, upon the invitation of the Cuban Government to assist in the revision of the Cuban electoral laws, and on the completion of his work, received the thanks of the Cuban Congress. He served as personal representative of Presidents Wilson and Harding in Cuba from Dec. 31, 1920, to March 5, 1923, when he became U.S. ambassador to Cuba. On Sept. 1, 1927, he retired from the diplomatic service by resignation, having completed 50 years of public service. He died May 7, 1932.

CROWE, SIR EYRE ALEXANDER (1864–1925), British civil servant, was born at Leipzig, July 30, 1864. Educated at Düsseldorf, Berlin and Paris, he entered the Foreign Office in 1885, became counsellor of embassy in 1907, and assistant under-secretary of State in 1912. He was a British delegate at the second Hague Conference of 1907 and at the International Naval Conference held in London in 1908. He conducted the British case in the arbitration of 1911 regarding the recapture in France of the Indian agitator Savarkar, and was created K.C.M.G. Though his mother and wife were German, he was a vigilant critic of German foreign policy, and before the World War prepared an impressive memorandum for the Cabinet on the subject, whilst his scheme for seizing German shipping in British ports was adopted when the crisis came. He was one of the committee of six who drew up for Great Britain a draft convention of the League of Nations, and he took part in the Paris Peace Conference. In 1920 he was promoted G.C.M.G. and became permanent under-secretary for foreign affairs. He died April 28, 1925.

See his correspondence and memoranda in *British Documents on the Origins of the War, 1898–1914,* ed. G. P. Gooch and H. W. V. Temperley (1926).

CROWE, SIR JOSEPH ARCHER (1825–1896), English consular official and art critic, son of Eyre Crowe, was born in London on Oct. 25, 1825. He studied painting under Delaroche in Paris, where his father was correspondent of the *Morning Chronicle.* During the Crimean War he was the correspondent of the *Illustrated London News,* and during the Austro-Italian War represented *The Times* in Vienna. He was British consul-general in Leipzig from 1860 to 1872, and in Düsseldorf from 1872 to 1880, when he was appointed commercial attaché in Berlin, being transferred to Paris in 1882. In 1883 he was secretary to the Danube conference in London; in 1889 plenipotentiary at the Samoa conference in Berlin; and in 1890 British envoy at the Telegraph congress in Paris, in which year he was made K.C.M.G. During a sojourn in Italy, 1846–47, he cemented a lifelong friendship with the Italian critic Giovanni Battista Cavalcaselle (1820–97), and together they produced several historical works on art of classic importance, notably *Early Flemish Painters* (London, 1857); *A New History of Painting in Italy from the Second to the Sixteenth Century* (London, 1864–71, 5 vols.). In 1895 Crowe published *Reminiscences of Thirty-Five Years of My Life.* He died at Schloss Gamburg in Bavaria on Sept. 6, 1896.

Crowe and Cavalcaselle's great *History of Painting* was under revision by Crowe up to the time of his death, and subsequently by S. A. Strong (d. 1904) and Langton Douglas.

CROWFOOT, the name applied to several species of *Ranunculus,* most of which are better known as buttercups (*q.v.*). The water crowfoot (*R. aquatilis*) has a floating stem bearing finely-divided submerged leaves and lobed floating leaves. The flowers are white. (*See* also Ranunculus, Ranunculaceae.)

CROWLAND or **CROYLAND,** town in Holland, Lincolnshire, England; in a low fen district, on the river Welland, 8 mi. N.N.E. of Peterborough, served by branches of the L.N.E.R. Pop. (1931) 2,809. The origin of the monastery, which existed here in 1051, is very obscure. Its traditions were put together by Ordericus Vitalis, but the history supposedly written by Ingulf, the first Norman abbot (1085–86) was shown to be a forgery and probably the work of prior Richard Upton, who became abbot in 1417. His object in writing it seems to have been to supply evidence showing the rights of the monastery for lawsuits in which it was involved with the people of Moulton, Weston, Spalding and Pinchbeck. These suits were decided in the abbey's favour in 1415. However, religious life may have begun at Crowland in 699, when Guthlac, a celebrated hermit, settled on the then island with two followers, and it is not improbable that King Aethelbald founded the monastery following Guthlac's death in 714. By the time of Domesday it was well established and then held properties valued at £57 1*s.* 4*d.* In 1091 fire destroyed part of the church, but a new building was begun by Abbot Geoffrey (1110–

24). The west front is of early English date, with Penpendicular restoration. The north aisle is restored and used as the parish church. A curious triangular bridge spanned three streams, now covered, and affords three footways, which meet at an apex in the middle. The town suffered from fire (1469–76), but the abbey tenants were given money to rebuild it. The annual fair of St. Bartholomew, which originally lasted 12 days, was first mentioned in Henry III's charter of 1227. The fair is now held on Sept. 4. With the dissolution of the monastery the prosperity of the town rapidly decreased.

See *Victoria County History,* Lincolnshire, ii, 105–118.

CROWLEY, ROBERT (1518?–1588), English religious and social reformer, was educated at Magdalen college, Oxford, where he was a foundation scholar and a fellow. He set up a printing-office in Ely Rents, Holborn, where he printed many of his own writings.

As a typographer, his most notable production was an edition of *Pierce Plowman* in 1550, and some of the earliest Welsh printed books came from his press. His "Information and Petition against the Oppressors of the poor Commons of this realm," addressed to the parliament of 1547, is remarkable for its attack on the "more than Turkish tyranny" of the landlords and capitalists of that day. While repudiating communism, Crowley was a Christian Socialist, and warmly approved the efforts of Protector Somerset to stop enclosures.

In his *Way to Wealth* (1550), he attributes the failure of the Protector's policy to the organized resistance of the richer classes. His *Voice of the Last Trumpet Blown by the Seventh Angel* (1550), his *One-and-Thirty Epigrams* (1550) and *Pleasure and Pain* (1551) were edited for the Early English Text society in 1872 (Extra Ser. xv). Crowley was ordained deacon by Ridley on Sept. 29, 1551.

During Mary's reign he was among the exiles at Frankfort. At Elizabeth's accession he was made archdeacon of Hereford in 1559, and prebendary of St. Paul's in 1563, and was incumbent first of St. Peter the Poor in London, and then of St. Giles's Without, Cripplegate.

He refused to minister in the "conjuring garments of popery," and in 1566 was deprived and imprisoned for resisting the use of the surplice by his choir. His "A Brief Discourse against the Outward Apparel and Ministering Garments of the Popish Church," is "memorable," says Canon Dixon, "as the first distinct utterance of Nonconformity."

In 1576 he was presented to the living of St. Lawrence Jewry. Nor had he abandoned his connection with the book trade, and in 1578 he was admitted a freeman of the Stationers' company.

He died on June 18, 1588. The most important of his works not hitherto mentioned is his continuation of Languet and Cooper's *Epitome of Chronicles* (1559).

See J. M. Cowper's *Pref. to the Select Works of Crowley* (1872); Strype's *Works;* Gough's *General Index to Parker Soc. Publ.;* Machyn's *Diary;* Macray's *Reg. Magdalen College;* Newcourt's *Rep. Eccles. Lond.;* Hennessy's *Nov. Rep. Eccl.* (1898); Le Neve's *Fasti Eccl. Angl.;* Pocock's *Burnet;* Pollard's *England Under Somerset;* R. W. Dixon's *Church History.*

CROWLEY, a city in southwestern Louisiana, U.S.A.; the capital of Acadia parish. It is on federal highway 90, and is served by the Missouri Pacific, the Southern Pacific and the Texas and Pacific railways.

The population in 1920 was 6,108; in 1930, 7,656; and in 1940, 9,523 by the federal census. It is the centre of a rice-growing district.

The city has a large trade in tractors and other agricultural machinery. Crowley was settled in 1887, and was incorporated in 1889.

CROWN, an English silver coin of the value of five shillings; hence used to express the sum of five shillings. It was originally of gold and was first coined in 1526, in imitation of the French "Crown of the Sun" period. Edward VI introduced silver crowns and half-crowns, and down to the reign of Charles II crowns and half-crowns and sometimes double crowns were struck both in gold and silver. In the reign of Edward VI also was introduced the practice of dating coins and marking them with their current value.

The "Oxford crown" struck in Oxford in 1644, was designed by Thomas Rawlins and included a view of that city on the obverse. Since the reign of Charles II the crown has been struck in silver only. At one time during the 19th century it was proposed to abandon the issue of the crown, and from 1861 until 1887 none was struck. From the latter year until 1902 it was in limited circulation.

Between 1902 and 1927 no crowns were minted, but small quantities were struck in the years 1928–37, the largest coined being 714,769 in 1935 on the occasion of King George V's jubilee. The half-crown continued to be minted in large quantities.

The figure of St. George first appeared on the obverse side of the crown in 1818. The design of the reverse was altered in 1937 and after that consisted of the ensign's armorial of the United Kingdom contained in a shield surmounted by the royal crown with supporters both standing on a mount with the royal motto, and an inscription. (*See* also NUMISMATICS.)

(W. D. C.)

CROWN and **CORONET,** an official or symbolical ornament worn on or round the head. The crown at first had no regal significance. It was a garland, or wreath, of leaves or flowers, conferred on the winners in the athletic games. Afterwards it was often made of gold, and among the Romans was bestowed for honourable service performed. The *corona obsidionalis,* of grass and flowers plucked on the spot, was given to the general who conquered a city. The *corona civica,* of oak leaves with acorns, was bestowed on the soldier who in battle saved the life of a Roman citizen.

The mural crown (*corona muralis*) was for the soldier who was the first to scale the walls of a besieged city, and was usually a circlet of gold adorned with turrets. The naval crown (*corona navalis*), decorated with a series of prows of ships, was the reward of a notable victory at sea.

Many other forms of crown were used by the Romans, as the conqueror's triumphal crown of laurel, the myrtle crown, and the convivial, bridal, funeral and other crowns. Some of the emperors wore crowns on occasion, as Caligula and Domitian, at the games, and stellate or spike crowns are depicted on the heads of several of the emperors on their coins, but no idea of imperial sovereignty was indicated thereby. The Roman people, who had accepted imperial rule as a fact, were very jealous of the employment of its emblem on the part of their rulers. That emblem was the diadem, and although the diadem and crown are frequently confused with each other they were quite distinct. The diadem, of eastern origin, was a band of linen or silk, richly embroidered, worn tied round the forehead. Selden says that the diadem and crown "have been from ancient times confounded, yet the diadem strictly was a very different thing from what a crown now is or was, and it was no other then than only a fillet of silk, linen or some such thing." The confusion between them has, perhaps, come about from the fact that the modern crown seems to be rather an evolution from the diadem than the descendant of the older crowns. The linen or silk diadem was eventually exchanged for a flexible band of gold, worn in its place round the forehead. The further development of the crown from this was effected by the addition of an upper row of ornament. Thus the mediaeval and modern crowns may be considered as radiated diadems, and so the diadem and crown have become, as it were, merged in one another.

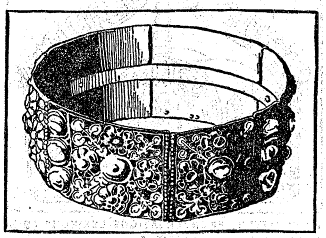


FIG. 1.—IRON CROWN OF LOMBARDY

Among the historical crowns of Europe, the Iron Crown of Lombardy (fig. 1), preserved at Monza, claims notice. It is a band of iron, enclosed in a circlet formed of six plates of gold, hinged one to the other, and richly jewelled and enamelled. It is regarded with great reverence, owing to a legend that the inner band of iron has been hammered out of one of the nails of the true cross. The crown is so small, the diameter being only 6in., and the circlet only $2\frac{1}{2}$in. in width, that doubts have been felt as to whether it was originally intended to be worn on the head or was merely meant to be a votive crown. The legend as to the iron being that of one of the nails of the cross is rejected by Muratori and others, and cannot be traced far back. Another historical crown is that of Charlemagne, preserved at Vienna. It is a series of four larger and four smaller plaques of gold, rounded at the tops and set together alternately. The larger plaques are set with emeralds and sapphires, and the smaller plaques have each an enamelled figure of Our Lord, David, Solomon, and Hezekiah respectively. A jewelled cross rises from the large front plaque, and an arch bearing the name of the emperor Conrad springs across from the back of this cross to the back of the crown.

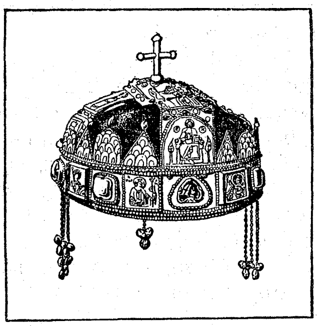
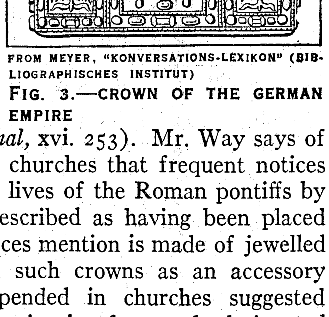


FIG. 2.—CROWN OF ST. STEPHEN OF HUNGARY

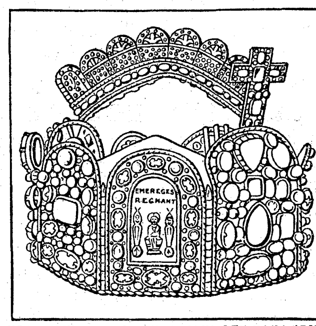
At Madrid is the crown of Svintilla, king of the Visigoths (621–631), a circlet of thick gold set with pearls, sapphires and other stones. It has been given as a votive offering at some period to a church, as was often the custom. Attached to its upper rim are the chains whereby to suspend it, and from the lower rim hang letters of red-coloured glass or paste which read +Svintilanvs Rex Offeret. Two other Visigothic crowns are preserved with it in the Almeria Real.

In 1858 a most remarkable discovery was made, near Toledo, of eight gold crowns of the 7th century, fashioned lavishly with barbaric splendour. They are now in the Cluny Museum, at Paris, having been purchased for £4,000, the intrinsic value of the gold, without reckoning that of the jewels and precious stones, being not less than £600. The largest and most magnificent is the crown of Reccesvinto, king of the Visigoths from 653 to 675, a circlet of pure gold set with pearls and precious stones in great profusion. It is 9in. in diameter and more than $\frac{1}{2}$in. in thickness, the width of the circlet being four inches. It has also been given as a votive offering to a church, and has the chains to hang it by attached to the upper rim, while from the lower rim depend pearls, sapphires, and a series of richly jewelled letters 2in. each in depth, which read +Reccesvinthvs Rex Offeret. The second of these crowns in size is generally thought to be that of the queen of Reccesvinto. It has no legend, but merely a cross hanging from it. The six others are smaller; they are believed to have been the crowns of Reccesvinto's children. From one of them hangs a legend which relates that they were an offering to a church, which has been identified with much probability as that of Sorbas, a small town in the province of Almeria. It has been surmised that in the disturbances which soon afterwards followed they were buried for safety. For a detailed description of these most remarkable crowns the reader must be referred to a paper by Albert Way (*Archaeological Journal,* xvi. 253). Mr. Way says of the custom of offering crowns to churches that frequent notices of the usage may be found in the lives of the Roman pontiffs by Anastasius. "They are usually described as having been placed over the altar, and in many instances mention is made of jewelled crosses of gold appended within such crowns as an accessory ornament. . . . The crowns suspended in churches suggested doubtless the sumptuous pensile luminaries, frequently designated from a very early period as *coronae,* in which the form of the royal circlet was preserved in much larger proportions, as exemplified by the remarkable *corona* still to be seen suspended in the cathedral at Aix-la-Chapelle over the crypt in which the body of Charlemagne was deposited."



FROM MEYER, "KONVERSATIONS-LEXIKON" (BIBLIOGRAPHISCHES INSTITUT)
FIG. 3.—CROWN OF THE GERMAN EMPIRE

Of modern Continental crowns the imperial crown of Austria (fig. 5) may be mentioned. It is composed of a circlet of gold, adorned with precious stones and pearls, heightened with fleurs-de-lys, and is raised above the circlet in the form of a cap which is opened in the middle, so that the lower part is crescent-shaped; across this opening from front to back rises an arched fillet, enriched with pearls and surmounted by a cross, above which is a jewel of pearls.

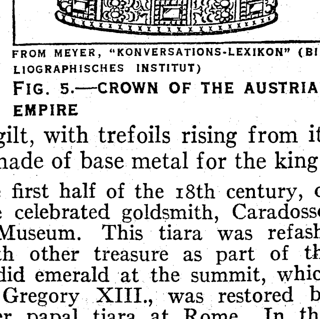


FROM MEYER, "KONVERSATIONS-LEXIKON" (BIBLIOGRAPHISCHES INSTITUT)
FIG. 4.—CROWN OF THE HOLY ROMAN EMPIRE

The papal *tiara* (a Greek word, of Persian origin, for a form of ancient Persian popular head-dress, standing high erect, and worn encircled by a diadem by the kings), the triple crown worn by the popes, has taken various forms since the 9th century. It is important to remember that the tiaras in old Italian pictures are inventions of the artists and not copied from actual examples. In its present shape, dating substantially from the Renaissance, it is a peaked head-covering not unlike a closed mitre (*q.v.*), round which are placed one above the other three open crowns.[1] Two bands, or *infulae,* as they are called, hang from it as in the case of a mitre. The tiara (*q.v.*) is the crown of the pope as a temporal sovereign.

Pictorial representations in early manuscripts and the rude effigies on their coins are not very helpful in deciding as to the form of crown worn by the Anglo-Saxon and Danish kings of England before the Norman Conquest. In some cases it would appear as if the diadem studded with pearls had been worn, and in others something more of the character of a crown. After the Conquest the great seals, monumental effigies, and coins become more and more serviceable in determining the forms the crown took.

The crown of William the Conqueror and his immediate successors seems to have been a plain circlet with four uprights, which terminated in trefoils (fig. 7), but Henry I. enriched the circlet with pearls or gems (fig. 8), and on his great seal the trefoils have something of the character of fleurs-de-lys. The effigy of Richard I. at Fontevrault shows a development of the crown; the trefoil heads are expanded, chased and jewelled. The crown of John is shown on his effigy at Worcester, though unfortunately it is rather badly mutilated. It shows, however, that the upper ornament was of fleurons set with jewels. Fig. 9 shows generally this development of the crown in a restored form. The crown on the effigy of Henry III. at Westminster had a beaded row below the circlet, which is narrow and plain, and from it rises a series of plain trefoils with slightly raised points between them. The tomb was opened in 1774, and on the king's head was found an imitation crown of tin or latten gilt, with trefoils rising from its upper edge. This, although only made of base metal for the king's



FROM MEYER, "KONVERSATIONS-LEXIKON" (BIBLIOGRAPHISCHES INSTITUT)
FIG. 5.—CROWN OF THE AUSTRIAN EMPIRE

[1]A coloured drawing, done in the first half of the 18th century, of the magnificent tiara made by the celebrated goldsmith, Caradosso, for Julius II. is in the British Museum. This tiara was refashioned by Pius VI., but went with other treasure as part of the indemnity to Napoleon. The splendid emerald at the summit, which was engraved with the arms of Gregory XIII., was restored by Napoleon and now adorns another papal tiara at Rome. In this drawing the three crowns (a feature introduced at the beginning of the 14th century) are represented by three bands of X-shaped ornament in enamelled gold.

burial, may nevertheless be taken as exhibiting the form of the royal crown at the time, and it may be usefully compared with that on the effigy of the king, which was made in Edward I.'s reign (fig. 10). Edward I. used a crown of very similar design. In the crown of Edward II. we have perhaps the most graceful and elegant of all the forms which the English mediaeval crown assumed, and this form seems to have continued without any marked alteration during the reigns of Edward III. and Richard II. The crown on the head of the effigy of Henry IV. at Canterbury evidently represents one of great magnificence, both of design and ornament. What is perhaps lost of the grace of form of the crown of Edward II. is made up for by a profusion of adornment and ornamentation unsurpassed at any subsequent period. The circlet is much wider and is richly chased and jewelled, and from it rise eight large leaves, the intervening spaces being filled with fleurs-de-lys of definite outline. It will be noted that this crown is, like its predecessors, what is known as an open crown, without any arches rising from the circlet, but in the accounts of the coronation of Henry IV. by Froissart and Waurin it is distinctly stated that the crown was arched in the form of a cross. This is the earliest mention of an arched crown, which is not represented on the great seal till that of Edward IV. in 1461. The crown, as shown on Henry IV.'s effigy, very probably represents the celebrated "Harry crown" which was afterwards broken up and employed as surety for the loan required by Henry V. when he was about to embark on his expedition to France. Fig. 11 shows the crown of Henry V. The crown of Henry VI. seems to have had three arches, and there is the same number shown on the crown of Henry VII., which ensigns the hawthorn bush badge of that king. The crown of Edward IV. (fig. 12) shows two arches, and a crown similarly arched appears on the great seal of Richard III. Crowns, both open and arched, are represented in sculpture and paintings until the end of the reign of Edward IV., and the royal arms are occasionally ensigned by an open crown as late as the reign of Henry VIII. The crown of Henry VII. on his effigy in Westminster Abbey shows a circlet surmounted by four crosses and four fleurs-de-lys alternately, and has two arches rising from it. A similar crown appears on the great seal of Henry VIII. The crown of Henry VII. (fig. 13), which ensigns the royal arms above the south door of King's college chapel, Cambridge, has the motto of the order of the Garter round the circlet. Fig. 11 shows the form of crown used by Edward VI., but a tendency (not shown in the illustration) began of flattening the arches of the crown, and on some of the coins of Elizabeth the arches are not merely flattened, but are depressed in the centre, much after the character of the arches of the crown on many of the silver coins of the 19th century prior to 1887. The crowns of James I. and Charles I. had four arches, springing from the alternate crosses and fleurs-de-lys of the circlet. The royal crown which, strangely enough, surmounts the shield with the arms of the Commonwealth on the coins of Oliver Cromwell (as distinguished from those of the Commonwealth itself, which have no crown) is a royal crown with alternate crosses and fleurs-de-lys round the circlet, and is surmounted by three arches, which, though somewhat flattened, are not bent. On them rest the orb and cross. The crown used by Charles II. shows the arches somewhat depressed in the centre, a feature of the royal crown which seems to have been continued henceforward till 1887, when the pointed form of the arches was resumed, in consonance with an idea that such a form indicated an imperial rather than a regal crown, Queen Victoria having been proclaimed empress of India in 1877. In the foregoing account the changes of the form of the crowns of the kings have been briefly noticed. Those crowns were the personal crowns, worn by the different kings on various state occasions, but they were all crowned before the Commonwealth with the ancient crown of St. Edward, and the queens consort with that of Queen Edith. There were, in fact, two sets of regalia, the one used for the coronations and kept at Westminster, and the other used on other occasions by the kings and kept in the Tower. The crowns of this latter set were the personal crowns made to fit the different wearers, and are those which have been briefly described. The crown of St. Edward, with which the sovereigns were crowned, had a narrow circlet from which rose alternately four crosses and four fleurs-de-lys, and from the crosses sprang two arches, which at their crossing supported an orb and cross. These arches must have been a later addition, and possibly were first added for the coronation of Henry IV. (*vide supra*). Queen Edith's crown had a plain circlet with, so far as can be determined, four crosses of pearls or gems on it, and a large cross rising from it in front, and arches of jewels or pearls terminating in a large pearl at the top. A valuation of these ancient crowns was made at the time of the Commonwealth prior to their destruction. From this valuation we learn that St. Edward's crown was of gold filigree or "wirework" as it is called, and was set with stones, and was valued at £248. Queen Edith's crown was found to be only of silver-gilt, with counterfeit pearls, sapphires, and other stones, and was only valued at £16. At the Restoration an endeavour was made to reproduce as well as possible the old crowns and regalia according to their ancient form, and a new crown of St. Edward was made on the lines of the old one for the coronation of Charles II. The framework of this crown, bereft of its jewels, is in the possession of Lady Amherst of Hackney. The crowns of James II., William III. and Queen Anne generally resembled it in form. Although the marginal note in the coronation order of Queen Victoria indicates "K. Edward's crown" as that with which the late queen was to be crowned, it was actually the State or imperial crown worn by the sovereign when leaving the church after the ceremony that was used. It had been altered for the coronation, and the arches were formed of oak leaves. Fig. 14 shows Queen Victoria's crown with raised arches and without the inner cap of estate, which since the reign of Henry VII. has been degraded into forming a lining to the crowns of the sovereigns and the coronets of the peers. Fig. 15 shows the coronation crown of King Edward VII. The crown of Scotland, preserved with the Scottish regalia at Edinburgh, is believed to be composed of the original circlet worn by King Robert the Bruce. James V. made additions to it in 1535, and in general characteristics it much resembles an English crown of that date.

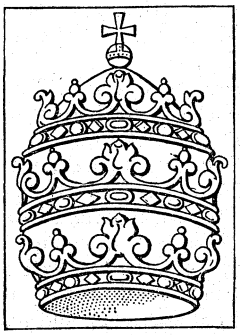
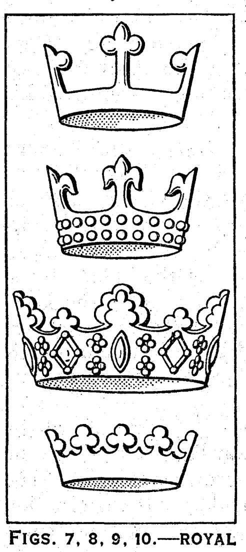
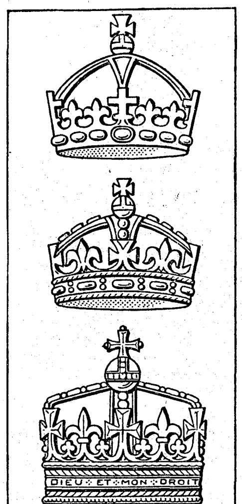


FIG. 6.—PAPAL TIARA (WITHOUT THE INFULAE)


FIGS. 7, 8, 9, 10.—ROYAL CROWNS OF ENGLAND, WILLIAM I. TO HENRY IV.



FIGS. 11, 12, 13.—ROYAL CROWNS OF ENGLAND, HENRY V. TO CHARLES I.

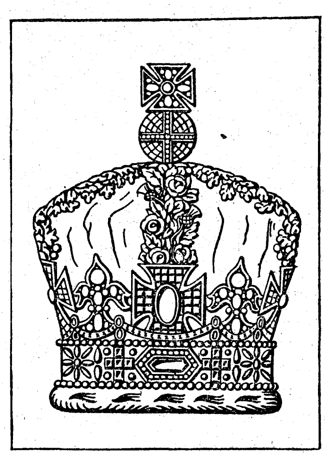


FIG. 14.—CORONATION CROWN OF QUEEN VICTORIA

The kings of arms in England, Scotland, and Ireland wear crowns, the ornamentation of which round the upper rim of the circlet is composed of a row of acanthus or oak leaves. Round the circlet is the singularly inappropriate text from Psalm. li., *Miserere mei Deus secundum magnam misericordiam tuam.* The form of these crowns seems to have been settled in the reign of Charles II. Before that period they varied at different times, according to representations given of them in grants of arms, etc.

This brings us to the crowns of lesser dignity, known for that reason as coronets, and worn by the five orders of peers.

The use of crowns by dukes originated in 1362, when Edward III. created his sons Lionel and John dukes of Clarence and Lancaster respectively. This was done by investing them with a sword, a cap of maintenance or estate, and with a circlet of gold set with precious stones, which was imposed on the head. Previous to this dukes had been invested at their creation by the girding on of a sword only. In 1387 Richard II. created Richard de Vere marquess of Dublin, and invested him by girding on a sword, and by placing a golden circlet on his head. The golden circlet was confined to dukes and marquesses till 1444, when Henry VI. created Henry Beauchamp, earl of Warwick, premier earl, and the letters patent effecting this concede that the earl and his heirs shall wear a golden circlet on the head on feast days, even in the royal presence. As to the form of these circlets we have no clear knowledge. The dignity of a viscount was first created by Henry VI. in 1439, but nothing is said of any insignia pertaining to that dignity. It is believed that a circlet of gold with an upper rim of pearls was first conferred on a viscount by James I., who conceded it to Robert Cecil, Viscount Cranborne. However, in 1625–26 it is definitely recorded that the viscounts carried their coronets in their hands in the coronation procession from Westminster Hall to the Abbey church. The use of a coronet by the barons dates from the coronation of Charles II., and by letters patent of Aug. 7, 1661, their coronet is described as a circle of gold with six pearls on it.

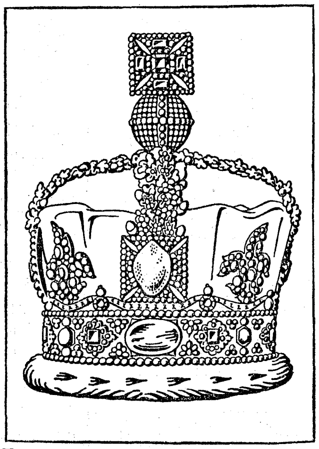
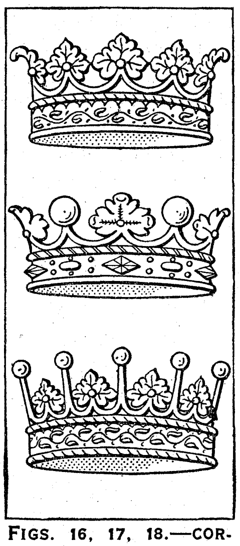


FIG. 15.—CORONATION CROWN OF KING EDWARD VII.

At the present day the coronet of a duke (fig. 16) is formed of a circlet of gold, from which rise eight strawberry leaves. The coronet of a marquess (fig. 17) differs from that of a duke in having only four strawberry leaves, the intervening spaces being occupied by four low points which are surmounted by pearls. The coronet of an earl (fig. 18) differs again by having eight tall rays on each of which is set a pearl, the intervening spaces being occupied by strawberry leaves one-fourth of the height of the rays. The coronet of a viscount has 16 small pearls fixed to the golden circlet, and the coronet of a baron has six large pearls similarly arranged.



FIGS. 16, 17, 18.—CORONETS OF DUKES, MARQUESSES AND EARLS

See Stothard, *The Monumental Effigies of Great Britain* (1817); L. G. Wickham Legg, *English Coronation Records* (1901); *The Ancestor,* Nos. i. and ii. (1902). (T. M. F.)

CROWN DEBT, in English law, a debt due to the Crown. By various statutes—the first dating from the reign of Henry VIII. (1541)—the Crown has priority for its debts before all other creditors even in bankruptcy proceedings. At common law the Crown always had a lien on the lands and goods of debtors by record, which could be enforced even when they had passed into the hands of other persons. By the Act of 1541 specialty debts were put practically on the same footing as debts by record. Simple contract debts due to the Crown also became specialty debts, and the rights of the Crown are enforced by a summary process called an *extent.* (*See* WRIT.) The difficulty of ascertaining whether lands were subject to a Crown lien or not was often very great, and a remedy was provided by the Judgments Act, 1839, and the Crown Suits Act, 1865. Later, by the Land Charges Act, 1900, no debt due the Crown operated as a charge on land until a writ of execution for the purpose of enforcing it has been registered under the Land Charges Registration and Searches Act, 1888. Both Acts were repealed and substantially re-enacted by the Land Charges Act, 1925.

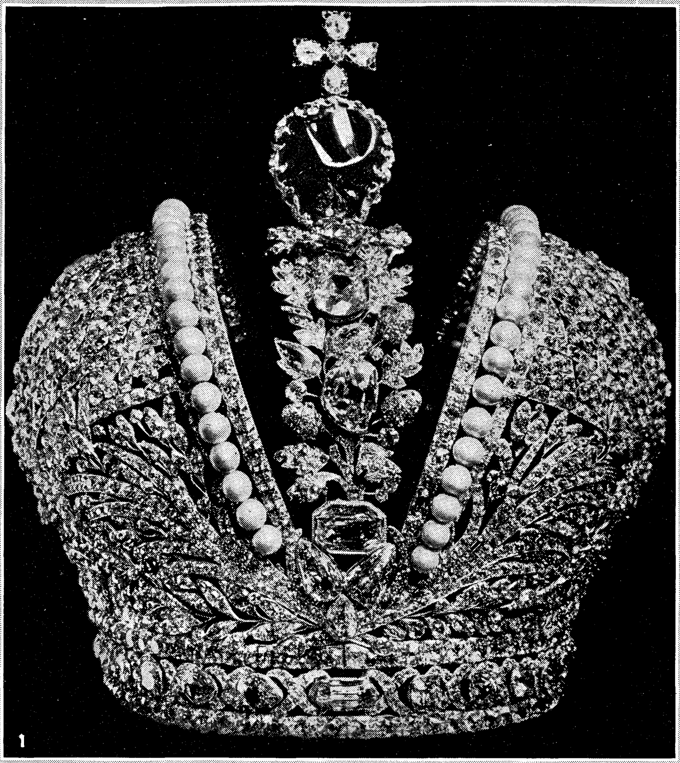
The preference for debts due to the Crown, the duchy of Lancaster and the duke of Cornwall was abolished in the case of insolvent estates by the Administration of Estates Act, 1925.

CROWNE, JOHN (*c.* 1640–1703), British dramatist, was a native of Nova Scotia and was born about 1640. His father "Colonel" William Crowne, accompanied the earl of Arundel on a diplomatic mission to Vienna in 1637, and wrote an account of his journey. He emigrated to Nova Scotia, where he received a grant of land from Cromwell, but the French took possession of his property, and the home government did nothing to uphold his rights. Crowne came to England, and began his literary career with a romance, *Pandion and Amphigenia, or the History of the coy Lady of Thessalia* (1665). In 1671 he produced a dull play, *Juliana, or the Princess of Poland.* The earl of Rochester procured for him a commission to supply a masque, *Calisto,* which gained him the favour of Charles II. Crowne's heroic play, *The Destruction of Jerusalem by Titus Vespasian* (1677), contained a thinly disguised satire on the Puritan party, and *c.* 1683 he produced *The City Politiques,* satirizing the Whig party and containing characters which were readily recognized as portraits of Titus Oates and others. This made him many enemies, and he petitioned the king for a small place that would release him from the necessity of writing for the stage. The king exacted one more comedy, which should, he suggested, be based on the *No puede ser guardar una mujer* of Moreto. This had already been unsuccessfully adapted, as Crowne discovered later, by Sir Thomas St. Serfe, but in Crowne's hands it developed into *Sir Courtly Nice, It Cannot Be* (1685), an entertaining comedy which kept its place as a stock piece for nearly a century. Of his many other pieces the best are the two comedies, *The English Friar* (1690), which owes something to Molière's *Tartuffe,* and *The Married Beau* (1694) based on the "Curioso Impertinente" in *Don Quixote.* It is stated that Crowne was still living in 1703, but nothing is known of his later life.

See *The Dramatic Works of John Crowne* (1873), edited by James Maidment and W. H. Logan for the *Dramatists of the Restoration.*

CROWN JEWELS or **REGALIA** are the visible emblems of royalty which pertain to a monarch. They vary greatly in different countries both in significance and value, but in European countries a crown, generally richly jewelled, is the chief of the insignia of sovereignty. The only crown jewels, except the Danish, that are on view are the crown jewels of England, which are kept in the Tower of London and guarded by a battalion of His Majesty's Guards. Upwards of 350,000 people of all nations annually view the crown jewels.

The king of England has three crowns:—(1) King Edward the Confessor's crown, also known as St. Edward's crown; (2) The imperial State crown; (3) The imperial crown of India. The crown known as St. Edward's crown was made for the coronation of Charles II. in 1662 after the pattern of the ancient crown destroyed by the Commonwealth. It consists of a circlet of gold adorned with rosettes of precious stones, surrounded by diamonds. The centre gems of these rosettes are rubies, emeralds and sapphires. From the circlet rise four crosses-paté, and four fleurs-de-lys alternately, adorned with diamonds and other gems. From the tops of the crosses rise two complete arches of gold crossing each other. These arches are considered to be the mark of independent sovereignty. They are edged with rows of silver pearls, and have gems and clusters of gems upon them. On the top of the arches is a mound of gold surmounted by a cross, all richly jewelled. This is the crown of England and is the one used at English coronation ceremonies.



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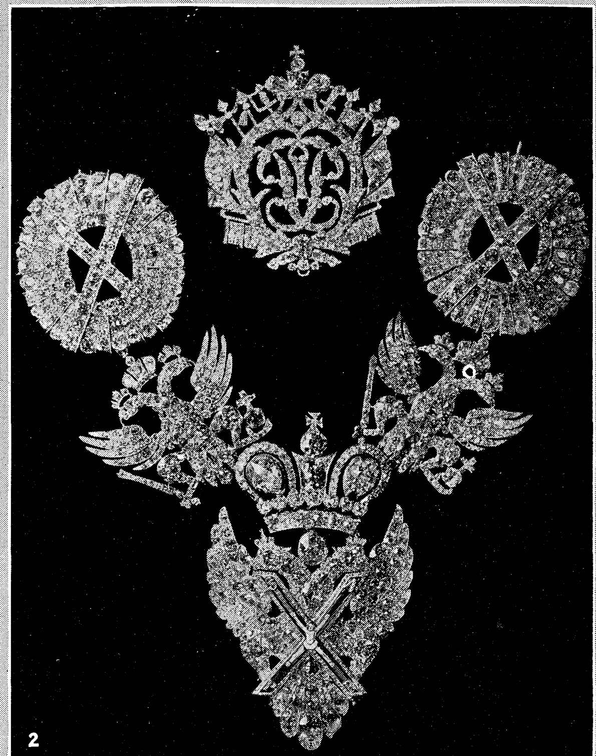

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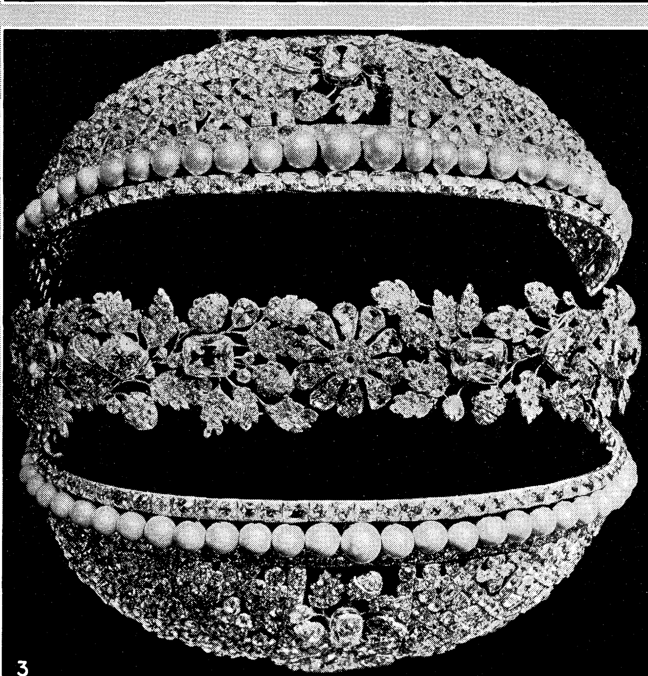

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RUSSIAN CROWN JEWELS

1. The Great Imperial Crown, made by Posier, jeweller to the court of Catherine II., in St. Petersburg, 1762. The crown, in the shape of a mitre, has on its summit a cross of five magnificent diamonds supported by a large uncut but polished ruby. A foliated arch containing 11 diamonds rises from the front and back to support the ruby and cross, and on either side of this arch is a hoop of 38 perfect pearls in mitre formation. The spaces on the side of the arches are filled with ornamental silver work studded with diamonds and underlaid with purple velvet. The band encircling the head contains 28 diamonds

3. Top view of the Great Imperial Crown, with the ruby and cross detached, showing foliated arch which supports them

2. Part of chain of Order of St. Andrew, probably executed in 1795, which contains 20 detachable pieces of different designs, each of which may be used as an independent jewel. Top jewel is accessory piece bearing the personal emblem of Paul I. Bottom jewel is insigne of the Order of St. Andrew. The crowned eagle is ornamented with two pear-shaped diamonds and 51 diamonds of medium cut. Between crown and eagle is a large blue diamond. The cross of St. Andrew, on a base of blue enamel, is surrounded by small rose diamonds

4. Imperial diadem of pearls and diamonds, probably of the 19th century, containing 13 large ancient pearls, 113 additional pearls of various sizes but of very fine quality, 84 brilliants and 500 rose diamonds

The imperial State crown was made for Queen Victoria in 1838. Many of the gems in this crown are of very ancient origin. Amongst these are the Black Prince's ruby, which is as large as a small hen's egg, and was owned first by the Black Prince, and later worn by Henry V. at the battle of Agincourt; the great sapphire from the crown of Charles II., known as the Stuart sapphire; the second largest portion of the Star of Africa diamond weighing 309 carats; Queen Elizabeth's pearl ear-drops; and the sapphire from the coronation ring of Edward the Confessor. There are altogether in this crown, exclusive of the larger stones, four rubies, 11 emeralds, 16 sapphires, 277 pearls and 2,783 diamonds. It is the most valuable and beautiful crown in the world.

The imperial crown of India owes its origin to the law which forbids the crown of England being taken out of England. When, therefore, George V. was crowned in Delhi emperor of India, a new crown had to be made for him and his successors to the throne. This crown is finely designed on the English pattern, with four crosses-paté and four fleurs-de-lys set alternately on the upper rim of the circlet. From this spring eight half-arches which in their turn support a rich mound and cross at the top, all thick set with diamonds. There are several very fine emeralds, rubies, and sapphires in this crown. It cost £60,000.

Next in importance are the queen's crowns or diadems:—(1) the crown of Queen Mary of Modena, consort of James II.; (2) the diadem of the same queen; (3) the State crown of Queen Mary, consort of George V. The crown of Queen Mary of Modena is of the usual formal shape and studded throughout with diamonds and pearls, no coloured stones being used. Queen Anne, in her statue outside St. Paul's cathedral, may be seen wearing this crown. The diadem of Queen Mary of Modena has along its upper edge a row of large pearls rising to a point in the front, with a single diamond at its highest point. Beneath this is a rich floral spray, in thick gold open-work, having large diamonds as leaves and flowers. On each side of the spray are a succession of large rosettes with large diamonds in their centres and small diamonds set all round them. This diadem cost £110,000. The State crown of Queen Mary is a beautiful and light diamond crown, having in the centre of the circlet one of the lesser portions of the Star of Africa weighing 96 carats. In a cross-paté above this is the Koh-i-Noor the most renowned diamond in the world. It weighs in its present condition $106\frac{1}{16}$ carats (having originally weighed 800 carats). After a tragic history of many centuries, the diamond was captured by the British and presented by the Army of the Punjab to Queen Victoria after the Sikh Wars. The cross that surmounts the mound at the top of the crown is set with yet another lesser portion of the Star of Africa weighing 64 carats. The prince of Wales's crown is of gold without jewels and has one arch to distinguish it from a coronet. The arch was introduced by Charles II.

There are five sceptres:—(1) the king's royal sceptre with the cross; (2) the king's sceptre with the dove; (3) the queen's sceptre with the cross; (4) the queen's sceptre with the dove; (5) the queen's ivory rod. At the head of the king's royal sceptre is the greatest diamond in the world, known as the principal Star of Africa. It weighs $516\frac{1}{2}$ carats, more than four times the weight of any other known diamond. This sceptre dates from Charles II. and is carried in the king's right hand at the coronation. The Star of Africa diamond was introduced by Edward VII.

There are two orbs:—(1) the king's orb; (2) the queen's orb. The orb is a golden ball, surmounted by a beautiful jewelled cross. The orb and cross are held to signify the domination of the Christian religion over the world. It is placed in the king's left hand at the coronation. The reason for there being two orbs is that William and Mary were jointly crowned king and queen of England, a second orb being made for the occasion.

St. Edward's staff, known also as the Rod of Justice and Equity, is of gold 4 ft. $7\frac{1}{2}$ in. in length and is supposed to guide the king's footsteps. It was re-made for Charles II. after the pattern of the old staff destroyed during the Commonwealth.

The Ampulla or Golden Eagle, and the Anointing Spoon are used at the coronation for the anointing of the king. These were both overlooked and escaped destruction during the Commonwealth. They are very ancient indeed, and may well be of Byzantine origin.

There are five swords:—(1) the sword of State; (2) the jewelled sword of State; (3) the swords named (*a*) Curtana or the sword of Mercy, (*b*) sword of Justice, spiritual, (*c*) sword of Justice, temporal. The sword of State, a long two-handled sword, is carried before the king on all State occasions such as the opening of parliament. The jewelled sword of State is used only at the coronation, when the king lays it on the altar to demonstrate that he places his military power at the service of the Church. This is very richly jewelled and is the most valuable in the world. The three swords, Curtana, the Sword Spiritual, and the Sword Temporal, are alike except that the point of Curtana has been broken off as a token of mercy.

The Golden Spurs of St. George are, as in the case of the jewelled sword, placed on the altar by the king at his coronation, with a like significance.

The bracelets, another very ancient token of royalty, may be seen with the rest of the regalia at the Tower of London. As far back as ancient Hebrew days a bracelet was one of the insignia of a king.

Some portions of the Scottish regalia have been preserved and are kept in Edinburgh Castle. The chief of these is the Scottish crown, which is among the most ancient pieces of State jewellery in the kingdom. This crown seems to have been made for Robert Bruce in 1314, and, with some reconstruction by French workmen, was worn by James V. about 1540; Mary Queen of Scots was crowned with it when nine months old. Another interesting item is the coronation ring of Charles I. which was bequeathed to George III. by Cardinal York together with other Stuart relics.

The Irish crown jewels were stolen from Dublin Castle some years ago and have never been recovered. There was nothing of historic or of great intrinsic value amongst them.

See G. J. Younghusband and C. Davenport, *The Crown Jewels of England* (1919). (G. Yo.)

EUROPEAN STATES

Although examples of Merovingian (*c.* 450–650) jewels have come down to us, it is not until the Carlovingian period (750–980) that we find authentic evidence of crown jewels. Of Charlemagne we have his crown, his sword, *La Joyeuse,* and his spurs. The crown is composed of eight gold plates, arched at the top, four incrusted with precious stones, four enamelled with the figures of Solomon, David, Hezekiah and Christ, to which Conrad II. (11th century) added a Latin cross with a single arch. The sword has a scabbard of gold with insertions of cloisonné enamel and incrustations of precious stones; the hilt was added in 1804 by Napoleon I. who brought it back from Vienna. It is at the Louvre, Paris, where are also to be seen the great Emperor's gold spurs with repousée ornament; a hand of Justice in gold and ivory of the 10th century, the sceptre of Charles V. (14th century), tipped with a statuette of Charlemagne springing from a lily; a beautiful chased gold clasp from the cloak of Louis IX.; the finger ring of Louis X. bearing for bezel a sapphire engraved with the effigy of St. Louis; a statuette reliquary in rock crystal, mounted in silver gilt and enamel, and enclosing "deux chevaux de Notre Dame," besides much else. The Valois, Bourbons and Bonapartes were all great collectors of gems and patrons of jewellers, but their treasures were often remounted and dispersed. The typical Bourbon crown, as introduced by Louis XIV. was a mass of diamonds, the jewelled band surmounted by eight fleur-de-lis, whence sprang arches supporting a large double fleur-de-lis. The Orleans branch placed a wreath of laurels round the band and substituted a mound for the double fleur-de-lis. Napoleon I. used for his coronation a fillet of gold incrusted with flowers in precious stones, surmounted by eight arches supporting a mound and cross, but a later crown had eight eagles with uplifted wings and eight palms supporting the mound and cross. The French crown diamonds and gems were constantly re-set for each succeeding monarch, who added to the collection or alienated much of the treasure. Famous jewels and stones were lost during the Revolution, among these being the famous Regent diamond and the Dragon or Côte de Bretagne ruby, both of which were subsequently recovered. The Regent or Pitt diamond originally weighed 410 carats, but was reduced to $186\frac{1}{16}$ carats after cutting. It was sold by Thomas Pitt, Governor of Fort St. George, to Philip of Orleans, and was at various times mounted in the crown, on the mound, and on the hilt of the state sword (by Napoleon I.). In 1848 the crown jewels of France were scheduled for sale, a scheme which was not carried out, but by a law of 1887 they were dispersed at auction (only a few, such as the Regent and those mentioned as preserved in the Louvre being kept). The sale (which included the famous eight Mazarin diamonds, a legacy from the great Cardinal) realized 7,207,252 francs.

The most precious item of the crown jewels of Italy is the iron crown of Lombardy, made to the order of Princess Theodolinda, widow of Authoris, king of Lombardy, and presented, A.D. 594, to the duke of Turin. It consists of a broad band of gold incrusted with rosettes in enamel and precious stones, with an inner circlet of iron, said to be forged from a nail from the True Cross. The modern crown is of gold and precious stones with 18 arches.

The crown of the German Empire, dating from 1871, is designed on the lines of that of Charlemagne, but four of the gold plates have a Latin cross between four small crosses in precious stones, and the four others have spread eagles with a star above; it has, however, four arches supporting a mound and cross, and is lined with a high cap in gold brocade. The Prince Imperial's coronet is of gold, jewelled, and consists of a broad band surmounted by four crosses pattée and four displayed eagles, the arches supporting a mound and cross. Each of the States of the former German Empire had its crowns and jewels, the most famous of which are the White Diamond of Saxony, $48\frac{1}{4}$ carats, acquired by Augustus the Strong (16th century), and the Green Diamond of Dresden, 40 carats, which has belonged to the Saxon crown since 1743.

The crown jewels of Portugal were amassed over a long period and contained a wonderful assortment of great value, among which is the Braganza diamond, claimed to be the largest known diamond. It is a Brazilian stone of 1,680 carats, but is probably a topaz.

Vienna was once the repository of priceless crown jewels, though some of these Napoleon I. took back to Paris, but Vienna is still very rich, the regalia being a mass of diamonds and rubies. The Imperial crown, made for Rudolph II. consists of a head-band from which spring four small and four large lily-shaped ornaments in diamonds and rubies, tipped by large pearls, and within the circle is a globular cap in two sections, bordered by enamelled bands and pearls, representing the coronation ceremonies, and between these sections are two hoops supporting a large sapphire. Far older, and more interesting, is the crown of Hungary or St. Stephen (10th century). It consists of a broad band of gold ornamented with panels of saints in enamel and precious stones, and an upper part (given by Pope Silvester II. when he bestowed the title of Apostolic King on Stephen, *c.* 1071), of square and pointed enamelled panels and four hoops supporting a cross, while from the sides and back jewelled trefoils hang from small chains.

Probably the most splendid collection of crown jewels belonged to the Romanoffs and were mostly preserved at the Winter palace, though now apparently dispersed. The imperial crown, begun for Catherine II. and finished for Paul I., is a superb piece of goldsmith's work, incrusted with diamonds, pearls and rubies. It consists of a broad head band, and above this a high globular cap in two sections, in front laurel leaves and palms and between the sections two half hoops of large stones, supporting a huge uncut ruby surrounded with brilliants and tipped with a cross. The Empress's crown was only slightly less magnificent. There were also a number of diadems, tiaras and nuptial crowns in diamonds, rubies and other precious stones. One of these nuptial crowns, a diamond tiara designed as wheat-ears and foliage, the jewelled sword of Paul I., with many other jewels were sold at auction in London in 1927. Among the other treasures in the white saloon of the Winter Palace is the imperial orb surmounted by diamond cross, the sceptre tipped with the Orloff diamond, the uncut diamonds known as the Moon of the Mountain, 120 carats bought by Catharine II., the Shah, 85 carats, and a pale red ruby the Polar star, 40 carats. The Orloff is one of the famous diamonds of the world. It weighs $194\frac{3}{4}$ carats, is said to have been the eye of an idol in Mysore, was purchased by count Orloff at Amsterdam in 1776, and was presented by him to the crown. There were also a large number of Russian and foreign orders, with stars and collars in diamonds and other precious stones. A miniature set of the imperial insignia in gold and brilliants was preserved in the Hermitage palace.

The Rumanian crown is unique in Europe, being of bronze and steel, made from Turkish guns captured at Plevna.

CROWN LAND, in Great Britain, land belonging to the Crown, the hereditary revenues of which were surrendered to parliament in the reign of George III.

In Anglo-Saxon times the property of the king consisted of (*a*) his private estate, (*b*) the demesne of the Crown, comprising palaces, etc., and (*c*) rights in the folkland of the kingdom. By the time of the Norman Conquest the three became merged into the estate of the Crown, that is, land annexed to the Crown, held by the king as king. The king, also, ceased to hold as a private owner, but he had full power of disposal by grant of the crown lands, which were increased from time to time by confiscation, escheat, forfeiture, etc. The history of the crown lands of the reign of William III. was one of continuous alienation to favourites. Their wholesale distribution by William III. necessitated the intervention of parliament, and in the reign of Queen Anne an act was passed limiting the right of alienation of crown lands to a period of not more than 31 years or three lives. The revenue from the crown lands was also made to constitute part of the civil list. At the beginning of his reign George III. surrendered his interest in the crown lands in return for a fixed "civil list" (*q.v.*). The control and management of the crown lands is now regulated by the Crown Lands Act, 1829, and various amending acts. Under these acts their management is entrusted to the commissioners of woods, forests and land revenues, who have certain statutory powers as to leasing, selling, exchanging, etc.

State lands in the British colonies are vested in the Crown, and they are called crown lands; actually, however, the various colonial legislatures have full control over them and power of disposal. Acts dealing with crown lands are usually called "land acts."

CROWN POINT, a village of Essex county, New York, U.S.A., in a township of the same name, about 90m. N.E. of Albany and about 9 mi. N. of Ticonderoga, on the west shore of Lake Champlain. The population of the township in 1930 was 1,468; in 1940 by the federal census it was 1,661. Among the manufactures are lumber and woodenware. One of the chief sources of income in the vicinity is dairy farming. In 1609 Champlain fought the Iroquois Indians there and began the enmity between the Five (later Six) Nations and the French. Subsequently Dutch and English traders trafficked in the vicinity. Realizing the town's strategic importance, the French in 1731 built Fort Frédéric, the first military post at Crown Point. Despite English and colonial expeditions sent against it, Crown Point remained in French hands until 1759. Crown Point was then occupied by Lord Jeffrey Amherst, who began the construction, near old Fort Frédéric, of a large fort, which was garrisoned but was never completed. At the outbreak of the War of Independence the fort was captured by Col. Seth Warner and a force of "Green Mountain Boys," and it remained in American hands save for a brief period in 1777, when it was occupied by a detachment of Burgoyne's invading army.

CROWTHER, SAMUEL ADJAI (1809?–1891), African missionary-bishop, was born in Ochugu in the Yoruba country, West Africa, and was sold into slavery in 1821. Next year he was rescued, with many other captives, by H.M. ship "Myrmidon," and was landed at Sierra Leone. Educated there in a missionary school, he became a teacher and afterwards missionary on the Niger. In 1842 he entered the Church Missionary College in London, and in June 1843 was ordained by Bishop Blomfield. Returning to Africa, he worked amongst his own people and afterwards at Abeokuta. Here he devoted himself to the preparation of schoolbooks, and the translation of the Bible and Prayer-Book into Yoruba and other dialects. In 1864 he was consecrated first bishop of the Niger territories. Crowther died of paralysis on Dec. 31, 1891.

CROYDON, a municipal, county and parliamentary borough of northeast Surrey, England, suburban to London. Pop. (1891), 102,695; (1938), 243,400. Area 19.7 sq.mi. The borough embraces a great residential district. It has ten stations on the main and branch lines of the Southern railway. The original site was farther west than the present town and is mentioned in Domesday. Still earlier settlement is indicated by the prehistoric remains near Addington Park. There are a number of springs in the neighbourhood which are important determinants of settlement in a chalk country. The manor of Croydon was presented by William I to Archbishop Lanfranc, founder of the archiepiscopal palace in which his successors lived occasionally till 1750, and of which the chapel and hall remain. The church associated with the archiepiscopal residence is Norman and Early English in style. Croydon is a bishopric suffragan in the diocese of Canterbury. In 1596 Archbishop Whitgift founded the hospital or almshouse which bears his name. It was saved from destruction in connection with a road-widening scheme in 1925 after a long dispute. His grammar-school was housed in new buildings in 1871 and again in 1931. At Addiscombe was formerly a mansion dating from 1702, and acquired by the East India company in 1809 for a military college, which on the abolition of the company became the Royal Military college for the East Indian army, and was closed in 1862. The government civil customs aerodrome, operated by the civil aviation department of the Air Ministry, is at Waddon, 2 mi. S.W. of Croydon town hall. It is officially known as the London Terminal Aerodrome, Croydon, and is one of the busiest air ports in the world (*see* AERODROME), normally with direct regular services to several continental capitals, air connections to more distant European cities being obtained by special interworking. It was the first place bombed during the heavy "blitz" on London in 1940. Croydon was formed into a municipal borough in 1883, a parliamentary borough, returning one member, in 1885 and a county borough in 1888. It has returned two members since 1918. There are 220 mi. of roads in the borough, which controls 1,338 ac. of open spaces.

CROZAT, PIERRE (1661–1740), French art collector, was born at Toulouse. He became treasurer to the king in Paris, and acquired a magnificent collection of pictures and *objets d'art,* which descended to his nephews, Louis François (d. 1750), Joseph Antoine (d. 1750), and Louis Antoine (d. 1770), and were dispersed after their deaths; the collection of Louis Antoine Crozat went to St. Petersburg (Leningrad).

CROZET ISLANDS, an uninhabited group in the Indian ocean, in 46°–47° S. and 51° E., belonging to France. They are mountainous, with summits from 4,000–5,000 ft. high and include two groups—Penguin or Inaccessible, Hog, Possession and East islands; and the Twelve Apostles. Like other islands in these waters, they appear to be of igneous formation; but owing to the bleak climate and inaccessibility they are seldom visited. They were discovered in 1772 by Marion-Dufresne and are named after one of his officers. Possession, the loftiest, has a snow-clad peak said to exceed 5,000 ft.

The hogs released on Hog island by an English captain have disappeared; the rabbits survive.

CROZIER, JOHN BEATTIE (1849–1921), British philosopher, was born at Galt, Canada, of Scottish parentage, on April 23, 1849. After graduating in medicine at Toronto University in 1872, he bought a practice in London, England, and then began a systematic study of philosophy and economics. His first publication *The Religion of the Future* (1880), attracted little attention; but *Civilisation and Progress* (1885) reached a fourth edition and was translated into Japanese. His *History of Intellectual Development* (1897–1901) was followed by the grant of a Civil List pension, some compensation for failing eyesight and the loss of his medical practice. His further publications include *My Inner Life,* an autobiography (1898), *The Wheel of Wealth* (1906); *Sociology Applied to Practical Politics* (1911) and *Last Words on Great Issues* (1917). He died Jan. 8, 1921.

CROZIER, WILLIAM (1855–1942). U.S. artillerist and inventor, was born at Carrollton, O., Feb. 19, 1855. He graduated at West Point in 1876 and served on the western frontier for three years thereafter against the Sioux and Bannock Indians. In 1888 he was sent by the war department to study artillery in Europe, and upon his return he was placed in full charge of the construction of gun carriages for the army. With Gen. Adelbert R. Buffington (1837–1922), the chief of ordnance, he invented the Buffington-Crozier disappearing gun carriage (1896). He also invented a wire-wound gun and perfected many appliances connected with heavy and field ordnance. During the Spanish-American War he was inspector-general for the Atlantic and Gulf coast defenses. In 1899 he was one of the American delegates to the Hague Peace conference. He later served in the Philippines and in 1900 was chief of ordnance of the U.S. army. During 1912–13 he was president of the army war college. In 1917, he was made major general and chief of ordnance and in 1918 major general of the line. As a member of the war council he was in France and Italy during the first half of 1918. His *Notes on the Construction of Ordnance* was adopted as a textbook in the schools for officers. He died Nov. 10, 1942.

CROZIER or **PASTORAL STAFF,** in the Christian Church, an ensign of office or dignity. It is some 5 ft. long, ending at the top in a crook (*volute*) bent inward, and made of metal, ivory or wood. If of metal, it is hollow; if of wood, it usually is covered with metal. The crook is usually richly ornamented and is divided from the shaft by a boss; the shaft is commonly separated into sections, so that it can be taken to pieces.

"Crozier" is probably derived from the *lituus* of the Roman augurs, and so called from O.Fr. *crocier,* Med. Lat. *crociarius,* crook-bearer. The "crook" was formerly called "crozier's staff," afterward abridged to "crozier." It is conferred on bishops at consecration and on mitred abbots at investiture and is the ensign proper of cardinals (except cardinal-deacons) and bishops; but the former are entitled to use it only in the churches from which they derive their titles, the latter only in their dioceses. The popes, as early as the time of Innocent III, did not carry the pastoral staff, and it would seem never to have been the custom. Abbots carry the pastoral staff only when specially empowered by the pope to do so, and then only in the territory under the jurisdiction of their monastery and in the churches subordinated to it. With certain restrictions, it is also sometimes conceded to dignitaries of cathedral and collegiate churches.

CRUCIAL, having the form of a cross, as the "crucial ligaments" of the knee-joint, which cross each other, connecting the femur and the tibia (Lat. *crux,* a cross); from Francis Bacon's expression *instantia crucis* (from the finger-post or *crux* at cross-roads), decisive, finally choosing between two alternatives, hence, generally, a synonym for "critical."

CRUCIBLE CAST STEEL. The crucible process, the oldest of the four leading methods for the manufacture of steel, and one which holds the premier position for quality, came into use in 1870 as the result of experiments by Benjamin Huntsman, who attempted to modify the irregularity of the imported blister steel or converted bar, and ultimately succeeded by melting the steel in crucibles. Huntsman made his discovery about 1740 in Sheffield, England.

The furnace used for melting, a sketch of which is given in fig. 1, is of very simple construction, and consists of a more or less elliptical melting chamber about 3 ft. 6 in. deep, 2 ft. 6 in. from front to back and 1 ft. 6 in. wide, lined with fire-brick and rammed ganister, and large enough to hold two crucibles. The top of the furnace is level with the melting-house floor, and is closed by a loose fire-brick cover. Under the melting-house is a vaulted cellar through which access is gained to the fire-bars and ash-pit of the furnace. The upper part of the furnace is connected by a short horizontal flue with a tall chimney about 40 ft. high. The melting-house is so arranged that the furnaces occupy two sides of the building leaving the centre free for the casting operation.

The Crucibles.—Either clay or plumbago crucibles may be used; for the production of castings the latter are preferred on account of their somewhat greater durability, but in the case of tool steel, where the content in carbon must lie between narrow limits, clay crucibles are almost exclusively employed.

Before lighting up, any clinker adhering to the furnace walls must be removed. These precautions having been completed, fireclay stands, slightly less in diameter than the bottoms of the crucibles and about 3in. thick, are placed on the fire-bars, and crucibles, which have been gradually heated up overnight in an annealing furnace, are placed on them. Ignited coke from the annealing furnace is now spread over the fire-bars, and, when the fire is well alight, coke is added until it is level with the tops of the crucibles.

By the time this fire has burnt down, the crucibles will be at a white heat; in the case of handmade crucibles a handful of sand must be thrown into the crucible to fill up the hole in the bottom. The charge is now introduced through a charger—a wrought iron funnel long enough to reach from the mouth of the crucible to the top of the furnace-lids placed in the crucibles, and the furnace filled with coke to a point well above the covers of the crucibles. When this fire, which is known as the first or steeling fire, has burnt down, which takes from 40 to 50 minutes, the furnace is again filled with coke and allowed to burn down a second time. The melter then examines the charge in the crucible to ascertain whether the whole of the charge is melted; if so, the third or killing fire is added. The fire is necessary to expel dissolved gases from the steel, which, if not removed would give rise to cavities, technically known as blowholes, in the ingots. When everything is deemed satisfactory by the melter, he instructs his assistant, "the puller out," to get ready for casting. The crucible lids are taken off, the slag removed from the surface of the metal, the crucibles withdrawn from the furnace, and their contents poured into ingot moulds; these are rectangular in section, and are generally made of cast-iron, in two separate halves, held together by wrought iron rings and wedges, to facilitate the removal of the ingot. Immediately after casting the crucibles are cleared of adhering clinker and returned to the furnace ready for the next charge. The first charge generally takes from five to six hours, and succeeding charges from two and a half to three hours.

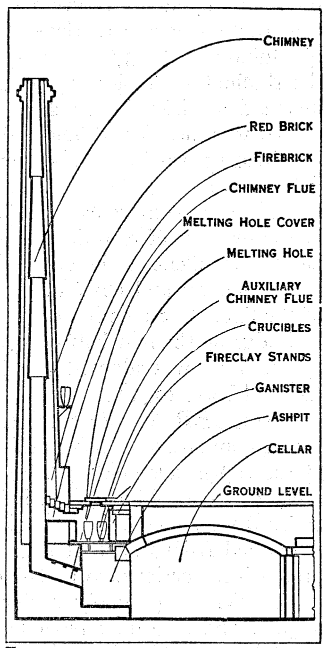

FIG. 1.—SECTIONAL VIEW OF THE HUNTSMAN COKE-FIRED CRUCIBLE FURNACE. FIREBRICK IS USED IN ALL FLUES

Such is the method as originally devised by Huntsman; later it was found that the third or killing fire did not remove entirely the dissolved gases from the steel, and that chemical aid was necessary; this was provided by the addition of ferro-manganese—an alloy of iron and manganese containing about 80% of manganese—to the charge before applying the third fire. Aluminium may also be used for this purpose, but although somewhat more active in removing the dissolved gases (the third fire in many cases not being necessary), it is held by many that the ingots are not so clean as when manganese is used, and that they are more difficult to weld. Most often a combination of the two methods is employed, manganese additions being made with the third fire, and a chip of aluminium added just before casting.

Nature of Process.—The process is not essentially a chemical one, but slight changes in composition do take place. The silicon in the steel will be about double, and the manganese half, of what would be expected from the mean composition of the charge. This arises from the fact that part of the manganese is oxidized to manganous oxide, and this reacts with the silica in the walls of the crucible, forming a manganous silicate slag from which silicon is reduced by the carbon in the steel. The sulphur will also tend to increase, due to absorption from the furnace gases, the amount of such absorption depending on the purity of the coke with regard to this element. With a sulphur content of 2% in the coke, the increase of this element in the steel will amount to ·01%.

Modifications of the method are used extensively. Instead of starting with blister steel, advantage may be taken of the affinity of molten iron for carbon, by melting bar iron in contact with sufficient carbon to give steel of the required hardness; or wrought iron and white cast-iron may be melted together. Whatever method is employed, however, it is of the greatest importance to see that the proportions of silicon and sulphur in the raw materials are sufficiently low to allow for the increases in these elements which occur during the process.

The desire to obtain more rapid melting and a lower consumption of fuel than is possible in the natural draught furnace, has led to the application of forced draught to the ordinary coke-fired furnace, and to the use of furnaces specially designed for the use of producer gas, water gas, natural gas or oil. These furnaces generally possess a greater capacity than the Huntsman type, and may contain from four to 50 crucibles at one time. Although the quantity of steel contained in a single crucible is only small (50 to 100lbs.), it is possible to utilize the process as a step in the manufacture of quite large forgings, by combining the contents of several crucibles in a common ladle prior to casting. By this means ingots weighing as much as 80 tons have been produced.

As the process is simply a means of obtaining a steel with the average composition of the materials charged into the crucible, practically any grade of steel can be produced, but it is in the manufacture of high grade tool and cutlery steels that it finds its chief application. Of late years, especially in countries where electric power is cheap, it has found a serious rival in the electric furnace.

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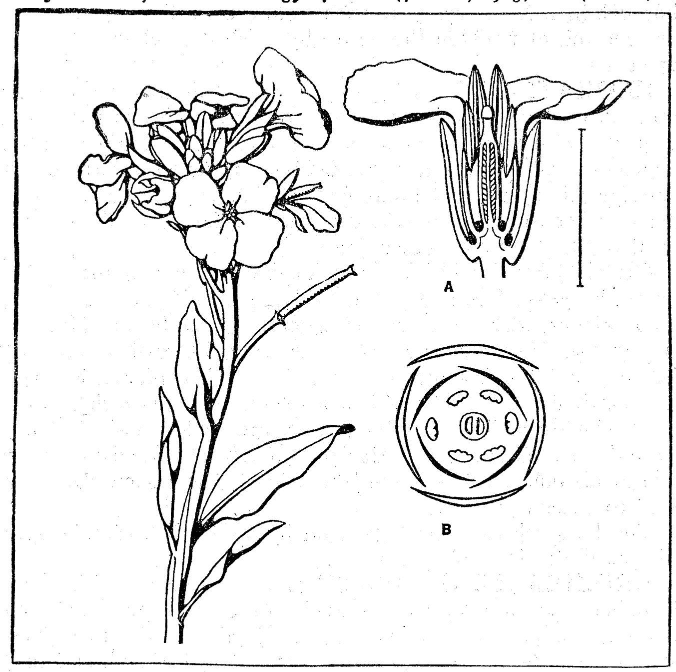
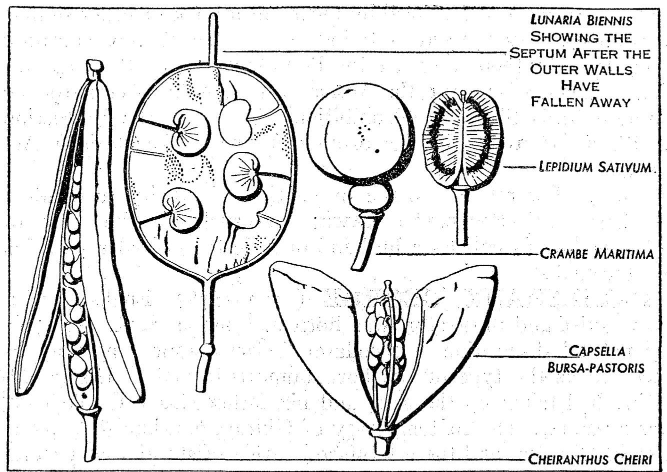


FIG. 1.—WALLFLOWER (CHEIRANTHUS CHEIRI), A HARDY PERENNIAL NATIVE TO SOUTHERN EUROPE, LONG A GARDEN FAVOURITE. A. FLOWER OF THE WALL-FLOWER IN VERTICAL SECTION. B. FLORAL DIAGRAM OF WINTER CRESS (BARBAREA VULGARIS)

CRUCIFERAE, a family of flowering plants, which derives its name from the cruciform arrangement of the four petals of the flower. It is a family of herbaceous dicotyledons, many of which, such as wallflower, stock, mustard, cabbage, radish and others, are well-known garden or field-plants. Many are annuals; among these



AFTER BAILLON, "HISTOIRE DES PLANTES"

FIG. 2.—DETAILS OF THE FRUITS PRODUCED BY CRUCIFEROUS PLANTS
The Cruciferae include among other members the radish, turnip, cauliflower, watercress, wallflower, sweet alyssum, wild mustard and pepper grass

are some of the commonest weeds of cultivation, shepherd's purse (*Capsella Bursa-pastoris*), charlock (*Brassica Sinapis*), hedge mustard (*Sisymbrium officinale*), Jack-by-the-hedge (*S. Alliaria*). Others are biennials producing a number of leaves on a short stem in the first year, and in the second sending up a flowering shoot at the expense of the nourishment stored in the thick tap-root during the previous season. Under cultivation this root becomes much enlarged, as in turnip, swede and others. Wallflower (*Cheiranthus Cheiri*), however, is a perennial. The leaves when borne on an elongated stem are arranged alternately and have no stipules. The flowers are in racemes without bracts; during the life of the flower its stalk continues to grow so that the open flowers of an inflorescence stand on a level (that is, are corymbose). The flowers are regular, with four free sepals arranged in two pairs at right angles, four petals arranged crosswise in one series, and two sets of stamens, an outer with two members and an inner with four, in two pairs placed in the middle line of the flower and at right angles to the outer series. The four inner stamens are longer than the two outer; and the stamens are hence collectively described as tetradynamous. The pistil, which is above the rest of the members of the flower, consists of two carpels joined at their edges to form the ovary which becomes two-celled by subsequent ingrowth of a septum from these united edges; a row of ovules springs from each edge. The fruit is a pod or siliqua splitting by two valves from below upwards and leaving the placentas with the seeds attached to the *replum* or framework of the septum. The seeds are filled with the large embryo, the two cotyledons of which are variously folded. In germination the cotyledons come above ground and form the first green leaves of the plant.

AFTER BAILLON, "HISTOIRE DES PLANTES"

FIG. 3.—CRUCIFERAE
A. Floral diagram (Brassica)
B. Cardamine pratensis. Flower with the perianth removed

Pollination is effected by insects. The petals are generally white or yellow, more rarely lilac or some other colour, and between the bases of the stamens are honey-glands.

Cruciferae is a large family containing 350 genera and about 3,000 species. It has a world-wide distribution, but finds its chief development in the temperate and frigid zones, especially of the northern hemisphere, and as Alpine plants. In the subdivision of the family into tribes use is made of differences in the form of the fruit and the manner of folding of the embryo. When the fruit is several times longer than broad it is known as a siliqua, as in stock; when about as long as broad, a silicula, as in shepherd's purse.

The family is well represented in Britain—among others by *Nasturtium* (*N. officinale*, water-cress), *Arabis* (rock-cress), *Cardamine* (bitter-cress), *Sisymbrium* (hedge mustard), etc.; *S. Irio* is London rocket (so-called because it sprang up after the fire of London in 1666), *Brassica* (cabbage and mustard), *Diplotaxis* (rocket), *Cochlearia* (scurvy-grass), *Capsella* (shepherd's purse), *Lepidium* (cress), *Thlaspi* (penny-cress), *Cakile* (sea rocket), *Raphanus* (radish), and others. Of economic importance are species of *Brassica*, including mustard (*B. nigra*), white mustard, used when young in salads (*B. alba*), cabbage (*q.v.*) and its numerous forms derived from *B. oleracea*, turnip (*B. campestris*), and swede (*B. Napus*), Chinese cabbage or Pakchoi (*B. chinensis*), *Raphanus sativus* (radish), *Cochlearia Armoracia* (horse-radish), *Nasturtium officinale* (water-cress), *Lepidium sativum* (garden cress). *Isatis* affords a blue dye, woad. Many of the genera are known as ornamental garden plants; such are *Cheiranthus* (wallflower), *Matthiola* (stock), *Iberis* (candytuft), *Alyssum* (Alison), *Hesperis* (dame's violet), *Lunaria* (honesty), *Aubrietia* and others. In North America the family is represented by about 50 genera, many of the species having been introduced from Europe as weeds, which have become distributed over a wide territory. In the eastern region the largest genera are rock cress (*Arabis*) and bitter cress (*Cardamine*); while in the western mountain region the largest genus is Whitlow-grass (*Draba*).

For a treatment of the genera *see* O. E. Schulz, *Cruciferae;* Engler and Prantl, *Die Natürlichen Pflanzenfamilien* 17b:227–658, fig. 121–426 (1936).

CRUDEN, ALEXANDER (1701–1770), author of the well-known Biblical concordance (*q.v.*), was born at Aberdeen on May 31, 1701, and educated at Marischal college. After a term of confinement for insanity he removed to London, where he became a tutor, and afterwards opened a bookseller's shop in the Royal Exchange. In 1735, he obtained the unremunerative post of bookseller to the queen, and then in 1737 he finished his concordance. Cruden's piety and exceptional intellectual powers were marred by periods of insanity. After a brief confinement in a madhouse at Bethnal Green, he published a pamphlet dedicated to Lord H. (probably Harrington, secretary of state) entitled *The London Citizen Exceedingly Injured, or a British Inquisition Displayed,* and dedicated an account of his trial to the king. About 1740 he became a proofreader, and several editions of Greek and Latin classics are said to have owed their accuracy to his care. In 1750, he published a small *Compendium of the Holy Bible,* and also a larger edition of the *Concordance.*

Adopting the title of "Alexander the Corrector," he assumed the office of correcting the morals of the nation, especially with regard to swearing and Sunday observance, and petitioned parliament for an appointment in this capacity. On being released from a third confinement for insanity, he published *The Adventures of Alexander the Corrector* (1755). *The Corrector's Earnest Address to the Inhabitants of Great Britain* (1756) was occasioned by the Lisbon earthquake. The *Scripture Dictionary* was printed in Aberdeen in two volumes shortly after his death. His biographer, Alexander Chalmers, says that a verbal index to Milton (edition of Thomas Newton, bishop of Bristol, in 1769) was Cruden's.

Cruden died in London on Nov. 1, 1770.

CRUDEN, village and civil parish on the east coast of Aberdeenshire, Scotland. Pop. (1931) 2,554. It is situated at the head of Cruden bay, $29\frac{3}{4}$ mi. N.N.E. of Aberdeen by the L.N.E.R. branch line from Ellon to Boddam. There is a fine golf course, good bathing and a large hotel. The district has been promoted as a holiday resort by the L.N.E.R. There is good fishing at Port Erroll, called Ward of Cruden, at the north end of the sands. Near Ardendraught, not far from the shore, Malcolm II is said to have defeated Canute in 1014. The Water of Cruden, which rises a few miles to the west, flows through the village into the North sea. Slains castle, a former seat of the earl of Erroll, lies to the north of Cruden, but the old castle of Slains is about 5 mi. to the southwest, near the point where, according to tradition, the "St. Catherine" of the Spanish Armada foundered in 1588.

CRUELTY is the disposition to inflict unnecessary pain or the actual infliction of it. It would appear at the first blush that some human beings, even children, have such a disposition. Dr. Pfister (*The Psycho-analytic Method,* 1915) reports the case of a boy whom the sight of a charming kitten promptly filled with the desire to ill-treat it. "A fearful interest seized him until he had procured a stick and struck the sleeping animal on the nose with all his strength. The young cat was half dead from pain and fright, but the boy had a strong feeling of pleasure." The same boy, we are told, enjoyed putting flies to death as slowly as possible. Nevertheless, the independent existence of such a disposition cannot be said to be established. It is remarkable that no such disposition has been observed among the lower animals; and lovers of animals rather resent the common identification of cruelty with brutality as an insult to the innocent brutes. The fact is that manifestations of cruelty among human beings are usually accompanied by such emotional attitudes as anger or masterfulness, and it is not altogether easy to disentangle the moment of cruelty in the total disposition from the element of masterfulness or of anger and its multifarious causes. It is noteworthy that cruelty is sometimes found together with a spirit of destructiveness, as was the case with the above-mentioned boy. And destructiveness is frequently merely a manifestation of instinctive self-assertion or masterfulness, or just an expression of superfluous energy uncontrolled by imagination or intelligence. When acts of cruelty are carried out in a fit of anger or wrath, it seems clear that they are not the result of a cruel disposition but of an emotion which notoriously blinds the agent so that he does not realize the results of his conduct adequately, much less sympathetically. Now anger arises whenever a strong impulse is thwarted, and so it is not surprising that some cases of cruelty arise in connection with the repression of sexual impulses.

The view that cruelty is not a primary tendency or disposition but rather the result of other tendencies and deficiencies, is borne out to some extent by cases in which cruelty has a definite range. That the sympathy of most people is limited to certain spheres is a familiar fact; and, something similar happens in some cases with the disposition to cruelty. Prof. G. Stanley Hall (*Adolescence,* 1905) has drawn attention to such cases. Presumably in such cases cruelty begins where the limited sympathy and insight end. "Many youthful murderers (writes Stanley Hall), callous to the sufferings of their victims, have had the keenest sympathy with pets and even with children. . . . The juvenile torturers often seem to have specialized psychic zones, where tenderness is excessive, as if to compensate for their defect. They weep over the pain, actual or imaginary, of their pets while utterly hardened to the normal sentiments of kindness and help for suffering."

On the whole, it would appear that cruelty is not an independent instinct or disposition but rather a derivative phenomenon resulting positively from self-assertion or masterfulness, and negatively from the blindness caused by anger or by limitations of sympathy.

The English common law has never taken cognizance of the commission of acts of cruelty upon animals, and direct legislation upon the subject, dating from the 19th century, was due in a great measure to public agitation, supported by the Royal Society for the Prevention of Cruelty to Animals (founded in 1824). Various acts were passed in 1822 (known as Martin's Act), 1835, 1837, 1849 and 1854, and the law relating to domestic and captive animals is now to be found in the Protection of Animals Act 1911 and the amending Act of 1912 together with various minor amendment acts down to 1927. These statutes replace the acts of 1849 and 1854. The Cruelty to Animals Act 1876 was passed for the purpose of regulating the practice of vivisection (*q.v.*). The Ground Game Act 1880 prohibits night shooting, or the use of spring traps above ground, or poison. The Diseases of Animals Acts and orders thereunder are for the purpose of securing animals from unnecessary suffering, as well as from disease. Finally, the Wild Birds Protection Acts 1880 to 1908, with various game acts (*see* GAME LAWS), extend the protection of the law to wild birds and their eggs, and impose penalties for the setting of pole traps and the taking of a wild bird by means of a hook or other similar instrument. Other statutes relating to the subject, whose purpose is disclosed by their titles, are the Poultry Act 1911, the Exportation of Horses Act 1914, the Animals Anaesthetics Act 1919, the Captive Birds Shooting (Prohibition) Act 1921, the Protection of Birds Act 1925, the Performing Animals (Regulation) Act 1925.

For the law relating to the prevention of cruelty to children *see* CHILDREN, PROTECTIVE LAWS; for cruelty in the sense of such conduct as entitles a husband or wife to judicial separation *see* DIVORCE.

CRUIKSHANK, GEORGE (1792–1878), English artist, caricaturist and illustrator, was born in London, Sept. 27, 1792. By natural disposition and collateral circumstances he may be accepted as the type of the born humoristic artist. His grandfather had taken up the arts, and his father, Isaac Cruikshank, was a painter. The contemporary of Gillray, Rowlandson, Alken, Heath, Dighton, and the established caricaturists of that generation, George developed great proficiency as an etcher. Gillray's matured and trained skill had some influence upon his executive powers. Prolific and dexterous beyond his competitors, for a generation Cruikshank delineated Tories, Whigs and Radicals with fine impartiality. Satirical capital came to him from every public event—wars abroad, the enemies of England (for he was always fervidly patriotic), the camp, the court, the senate, the church; low life, high life; the humours of the people, the follies of the great. George Cruikshank's technical and manipulative skill as an etcher was such that Ruskin placed his productions in the foremost rank. He died at 263, Hampstead road, London, on Feb. 1, 1878, and was buried in St. Paul's cathedral.

A vast number of Cruikshank's spirited cartoons were published as separate caricatures, all coloured by hand; others formed series, or were contributed to satirical magazines, the *Satirist, Town Talk, The Scourge* (1811–16) and the like ephemeral publications. In conjunction with William Hone, G. Cruikshank produced political satires, *The Political House that Jack Built* (1819), and others, re-issued by Hone in 1827 under the general title, *Facetiae and Miscellanies.*

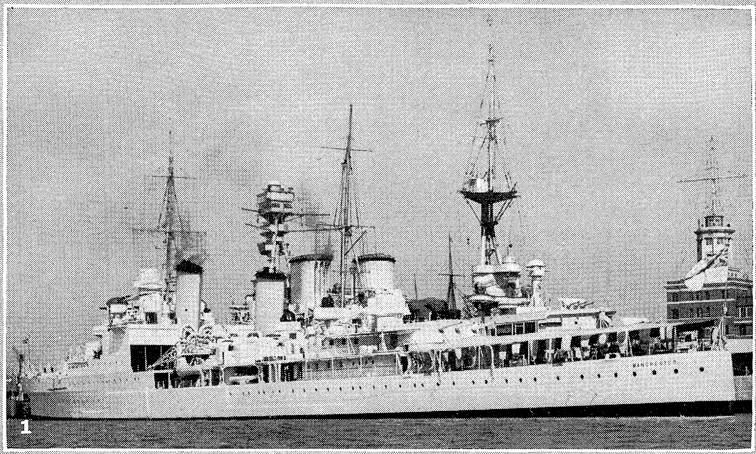
Of a more genially humoristic order are his famed book illustrations. Early in this series came *The Humorist* (1819–21) and *Life in Paris* (1822), the well-known series of *Life in London,* conjointly produced by the brothers I. R. and G. Cruikshank, and Grimm's *Collection of German Popular Stories* (1824–26), in two series, with 22 inimitable etchings. To the first 14 volumes (1837–43) of *Bentley's Miscellany,* Cruikshank contributed 126 of his best plates, etched on steel, including the famous illustrations to *Oliver Twist, Jack Sheppard, Guy Fawkes* and *The Ingoldsby Legends.* For W. Harrison Ainsworth, Cruikshank illustrated *Rookwood* (1836), and *The Tower of London* (1840). For C. Lever's *Arthur O'Leary* he supplied ten full-page etchings (1844), and 20 spirited graphic etchings for Maxwell's lurid *History of the Irish Rebellion in 1798* (1845). The best known of the pictures and illustrations produced by Cruikshank as an enthusiastic advocate of abstinence are *The Bottles,* 8 plates (1847), with its sequel, *The Drunkard's Children,* 8 plates (1848), with the ambitious work, *The Worship of Bacchus,* published by subscription after the artist's oil painting, now in the National Gallery, London, to which it was presented by his numerous admirers.

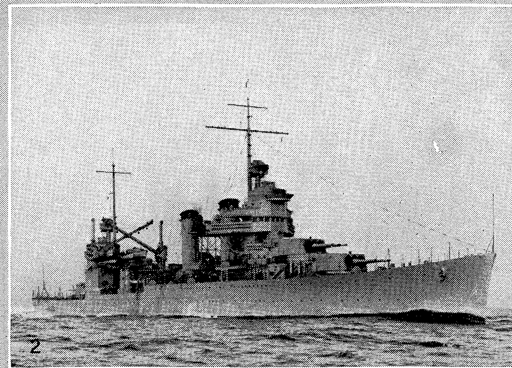
See *Cruikshank's Water-Colours,* with introduction by Joseph Grego (1903).

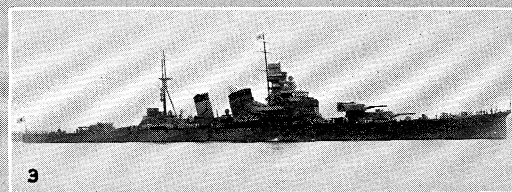
CRUISER. A fast and well-armed warship, specially designed for two main functions: (a) to guard the sea routes, (b) to act as an advance guard or scouting force for the battle fleet.

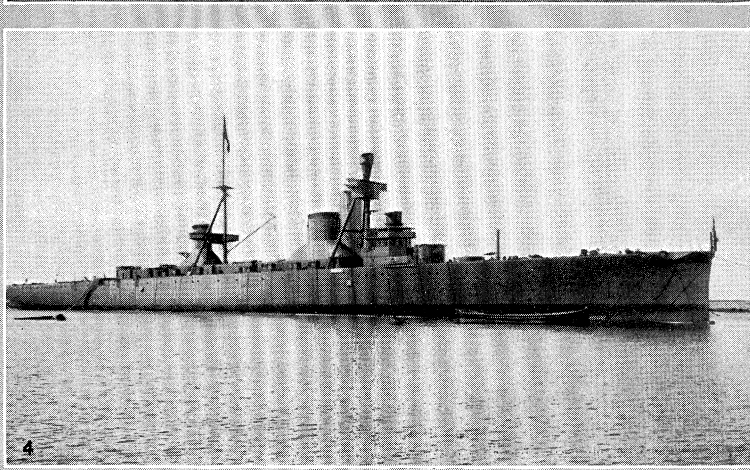
GENERAL PRINCIPLES

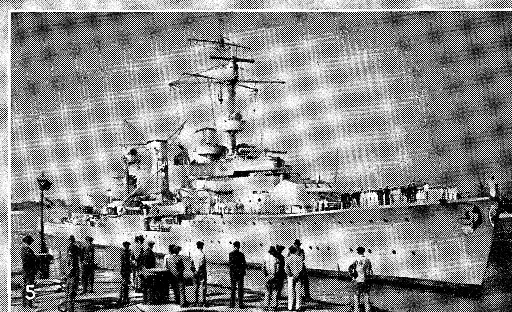
The first traces of that elaborate classification of warships into types with distinctive functions which is characteristic of the modern fleet can be discovered in the second half of the 17th century. Before that time fleets were not formed for action upon any generally accepted principle; warships of all types and sizes took part at the same time and the action resolved itself into a series of isolated combats as the separate units found oppor-

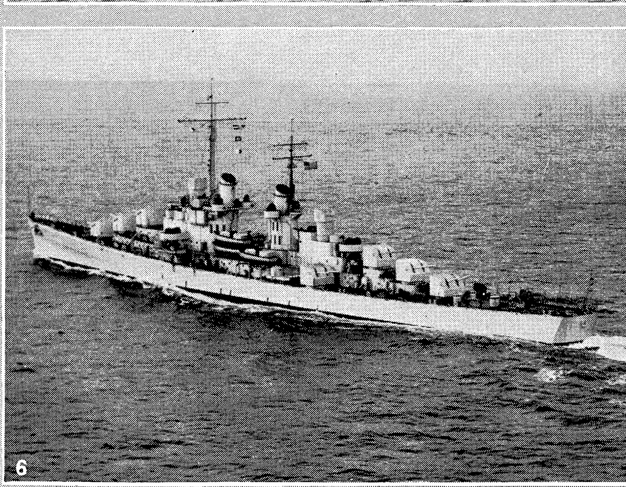


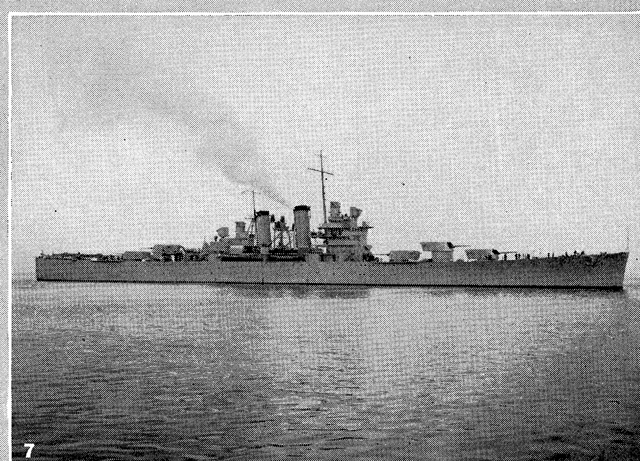












BY COURTESY OF (2, 7) THE UNITED STATES NAVY DEPARTMENT, (4) NAVAL ATTACHÉ, ITALIAN EMBASSY, LONDON; PHOTOGRAPHS (1) FROM EUROPEAN, (3) FROM "JANE'S FIGHTING SHIPS," (5) BRITISH COMBINE, (6) INTERNATIONAL

CRUISERS OF FIVE NAVIES

1. H.M.S. "Manchester," Southampton class cruiser. Displacement, 9,400 tons. Armament: twelve 6-in. guns, eight 4-in. anti-aircraft guns, 21 other; six 21-in. torpedo tubes; carries 3 aircraft. Armour: 1-2-in. turrets, 4-3-in. side, 4-in. conning tower. Speed, 32.3 knots
2. U.S.S. "Vincennes," heavy cruiser. Displacement, 9,950 tons. Armament: nine 8-in., 55-calibre; eight 5-in. guns. Carries 2 catapults and 4 aircraft. Armour: 5-in. vertical side, two 3-in. decks, 5-6-in. gunhouses, 8-in. conning tower. Speed, 32 knots. Sunk Aug. 9, 1942
3. Japanese cruiser "Aoba." Displacement, 7,100 tons. Carries six 8-in. guns, four 4.7-in. anti-aircraft, twelve 21-in. torpedo tubes (above water), and 2 seaplanes. Speed, 33 knots
4. Italian cruiser "Trento." Displacement, 10,000 tons. Armament: sixteen 3.9-in. anti-aircraft, eight 8-in. guns, eight 21-in. torpedo tubes, in pairs (above water); carries 2 planes. Armour: 2¾-in. side, amidships and turrets, 2-in. deck. Speed, 36 knots
5. German light cruiser "Königsberg," 6,000 tons, sunk by British naval dive-bombers at Bergen, Norway, April 9, 1940
6. U.S.S. "Atlanta," light cruiser. Displacement, 6,000 tons. Armament: twelve 5-in., 38-calibre dual purpose guns; 12 others; six 21-in. torpedo tubes; carries 2 or 3 planes. Armour: 3½-in. side, 2-in. deck. Speed, at least 38 knots
7. U.S.S. "St. Louis," light cruiser. Displacement (estimated), 10,000 tons. Armament: fifteen 6-in. guns, eight 5-in. anti-aircraft guns, 12 other; carries 4 aircraft. Armour (unofficial): 1½-4-in. side, 3 in. + 2-in. decks, 3-5-in. gunhouses, 8-in. conning tower. Speed, 32.5 knots

tunity. The Queen's ships under the command of the Lord High Admiral operating against the Spanish Armada ranged from the "Triumph" of 1,100 tons to the "Signet" of 30 tons.

In the naval war of 1652 the Dutch fleet fought to protect convoys or to clear the seas for merchant traffic. It was as if the German battle fleet had made its way out of Kiel during the World War to engage the British fleet, so that a vast convoy of German merchantmen might slip safely away with their cargoes. Dutch trade suffered to so great an extent that in subsequent wars of the period the Dutch merchant ships were withdrawn to port, while the Dutch fleet endeavoured to secure permanent command of the seas. Thus the primary duty of a fleet came to be regarded as that of seeking out and destroying the enemy.

About the same time, the growing use of the fireship (there were 87 such ships working with the British Navy of 123 warships in 1690–1700) formed a pressing reason for developing the "line of battle": that formation by means of which, by opening their intervals, the fleet could best avoid fireship attack. The line of battle necessitated uniformity of sailing and gun power in order to be effective, and large offensive power per vessel so that the line should not be too long. These requirements precluded the employment of the smaller warships of the day in the line. On the other hand, the breaking up of convoys into smaller and less valuable groups, withdrew from the capital ship the temptation to make the capture of these her objective and opened opportunities both of attack and defence for the smaller fighting ships.

Developments were of slow growth, but by the middle of the 18th century the line of battleship, the frigate, a faster and more lightly armed vessel to act as observer for the line of battleship, but not to occupy a place in the line, and the light cruiser, a still more lightly armed vessel for commerce protection, were accepted types. The principles of sea warfare, which brought these types into being, have not always been clearly recognized, but war has inevitably brought them into prominence.

At the beginning of the Napoleonic wars there was considerable heterogeneity of type both among battleships and frigates, but by the closing years the main battle fleet was composed almost entirely of 74-gun ships (85 out of 99 capital ships), the many classes of frigates were in course of replacement by a uniform type of 38 and 36-gun ships, and there were 403 ships of below 20 guns out of the 550 cruising ships of the Navy required for convoy and look-out duties, and this notwithstanding the unchallenged command of the sea which the main fleet had obtained.

It is also possible to trace the gradual standardization of types after the wooden and sailing Navy had given way to more modern construction. Cruisers, to use the general term, gradually came to be grouped into four fairly well defined classes:—the battle cruiser; the armoured cruiser; the protected cruiser, and the light cruiser. The first of these may be regarded as the culminating point of cruiser design.

Battle Cruiser.—The development of the armoured cruiser with 9-in., or, in the case of Japan, even 12-in. guns, seemed to call for a new type of warship, one faster than any class afloat except the destroyer, and with an armament second only to that of the battleship. This resulted in the battle cruiser, the first example of which was the "Invincible" class, contemporaries of the improved "Dreadnought" class of battleship. (*See* Technical section of this article.)

It was conceived that a squadron of such ships would be able to drive in the enemy's cruiser forces, unmask his battle fleet and harry the latter's van and rear during the main action.

Battle cruisers were not originally intended to engage in prolonged duels with ships of their own class, as they actually did in the Dogger Bank action and in the preliminary stages of the battle of Jutland (*q.v.*). For such "hammer and tongs" fighting they, as a class, and the British design in particular, were not well suited and the latter suffered accordingly; but the fact that the World War found Germany with a powerful battle cruiser fleet, made such engagements almost inevitable, particularly in the low visibility which so often prevails in the North Sea.

The most striking success of the battle cruiser as a type was that achieved by the two British ships at the battle of the Falkland Islands (*q.v.*), but there they were overwhelmingly superior to their opponents in speed and in the range and calibre of their guns; moreover, the weather conditions gave them every opportunity to make the most of their advantages. There, too, they filled a rôle which was unforeseen when they were designed; viz., that of making a sudden descent on an enemy cruiser force in distant seas. Nevertheless, they were most effective in it, thanks to the master-hand of the man who was chiefly responsible for their conception—the veteran First Sea Lord, Admiral of the Fleet Lord Fisher. The secrecy and promptness with which they were despatched, the timely arrival of a force so powerful that it left nothing to chance, formed a striking example of correct and vigorous strategy.

The Washington Treaty (*q.v.*) having limited the amount of capital ship tonnage, it seems probable that the sea powers will prefer to make use of their respective quotas for battleship construction only; in which case the battle cruiser as a type will gradually die out; in fact, with the extinction of the German battle cruiser fleet, Britain and Japan are the only two nations whose navies include this type of warship, which was not adopted by any of the other great sea powers.

Armoured Cruisers.—The heavy armoured cruiser, such as the "Defence" class, has become practically extinct. It did not prove of much value in the World War. Too slow, as compared with the modern battleship, it was not a useful auxiliary to the battle fleet, it could not face the enemy battle cruisers, while it was needlessly costly and unsuitable in other ways for guarding the trade routes. At Jutland the British armoured cruisers suffered heavily and could be of very little service.

Protected Cruisers.—The term has now died out, but ships of this type, such as the "Amphitrite" class, were representative of the ocean-going, commerce-protecting cruiser of their time, and the forerunners of the 10,000-ton cruiser of to-day.

Light Cruisers.—As the place of the big cruiser was taken by the armoured cruiser and eventually by the battle cruiser, and with the growing size and power of the destroyer, there came an ever-increasing demand for light, fast cruisers to act as fleet auxiliaries. As the World War went on, this type became more and more numerous and produced a more or less standard design of "fleet cruiser"—ships of about 3,500 to 5,000 tons, armed with six-in. guns. The type was chiefly intended for work in the North Sea and since the War has not proved adequate to replace older and much larger ships required for high-sea work, but long since worn out and scrapped.

Some years after the War, the British Admiralty decreed that, in future, there would be only two categories of cruisers—the "battle cruiser" and the "cruiser"; but, in fact, the latter category was still in 1928 divided into the large cruiser and the small cruiser, known as "A" and "B" classes, heavy and light cruisers.

The names "light cruiser" and "heavy cruiser" are actually misnomers. It is the common conception that the former ship is lighter in tonnage than the latter while this is not necessarily the case. Both types of ship have been built up to a tonnage of 10,000 tons; in fact, most of the later light cruisers are listed at 10,000 tons, while the so-called heavy cruisers are listed as low as 8,250 tons. The difference in designation is made according to the size of the largest guns, the heavy cruisers carrying 8 in. guns while the light cruisers carry 6 inch. The British heavy cruisers run from 8,250 tons with 6 8 in. guns to 10,000 tons with 8 8 in. guns while the U.S.A. ships go from 9,050 tons to 10,000 tons carrying either 9 or 10 8 in. guns.

The British light cruisers run from 4,580 tons with 6 6 in. guns to 10,000 tons with 12 6 in. guns while the U.S.A. has vessels of this class ranging from 7,500 tons with 10 6 in. guns to 10,000 tons with 15 6 in. guns.

A new development in naval shipbuilding is the anti-aircraft cruiser. This vessel is one built on the same lines as the light cruiser displacing about 5,000 tons and carrying armament guns whose primary function is defence against aircraft.

To the British Empire, scattered all over the world and knit together by the long sea routes, the question of cruisers is a vital one. The very life and sustenance of the inhabitants of the British Isles depend on these sea arteries being secure throughout their entire length. This can only be ensured by a sufficiently large number of cruisers to police them; but such a force, with its units widely distributed, as they always are and must be, does not constitute a menace or challenge to other nations; for it could only be concentrated into one large fleet at the risk of exposing the sea arteries to being severed at many distant points. This would cause the dismemberment of some parts of the Empire, while the heart would be starved of some vital commodity.

Nelson and many another old-time sea commander complained bitterly of the lack of frigates. At the beginning of the World War, Britain had more than double the number of cruisers she possessed in 1928, yet the Admiralty were at their wits' end for ships of this class.

To-day the cruiser, as a type, stands for security for those of all nations who "pass on the seas on their lawful occasions"; they are the safeguards of civilization lest it should be assailed by the many wild and uncontrolled forces which still abound in and around the waters of the world. But for the cruisers of the various sea Powers, piracy, gun-running and slavery would be rampant again. In fact, the cruiser should be respected and maintained as a powerful factor in preserving peace and tranquillity the world over. (E. A.; X.)

TECHNICAL

The progress in technical science, which marked the opening years of the 19th century and has continued without pause for more than a hundred years, gave to the naval constructor iron for wood (1850–60), steel for iron (1877), the screw (1845), the turbine (1902), the geared turbine (1914), the rifled gun (1865), the breech loader (1880), barbettes securing extensive arcs of fire (1880), wrought iron armour (1860), and cemented armour (1900). Corresponding changes took place in the character and construction of warships, but the broad principles of the functions of the cruising type, as of the battleship (*q.v.*), remained unaffected.

During the interval within which these scientific developments were becoming accessible there was naturally considerable diversity in design, and among the cruising vessels on active service were frigates, corvettes, 2nd class cruisers, despatch vessels and torpedo cruisers, sloops and gun vessels. It was not until the British Naval Defence Act of 1889 that types of present-day cruisers came into being; when the ships built under this Act were completed in 1892, cruisers were arranged in first, second and third classes; type ships being "Blenheim" (1890) of 9,000 tons displacement, speed 20½ knots, armed with 2 9·2in. and 10 6in. guns, with a protective deck 3 inches thick; "Apollo" class (1891), of 3,400 tons displacement, speed 20 knots, armed with 2 6in. and 6 4·7in. guns with a protective deck 1 in. thick; and "Philomel" (1890), of 2,575 tons, 19 knots, armed with 8 4·7in. guns, with a protective deck 1 in. thick.

The "Blenheim" type continued till 1898, when the "Diadem" class of 11,000 tons and 21 knots were the last of the large cruisers protected only by a thick deck. The "Apollo" type continued until they were displaced by the armoured cruiser and the light cruiser, the last class being "Chatham" (1911) of 5,400 tons displacement, speed 25½ knots, which ship had a 3in. nickel steel belt amidships, in addition to the protective deck. The "Philomel" type ended with the "Amphion" class (1911), of 3,440 tons displacement and speed 25½ knots, after which they merged into the light cruiser type.

The Armoured Cruiser.—The introduction of Harveyised armour, enabled armour only 6in. thick to provide very substantial protection to the sides of cruisers, which was first taken advantage of in the "Cressy" class (1901), which vessels were the forerunners of both the armoured and battle cruisers. The ships were of 12,000 tons displacement, speed 21½ knots, armed with 2 9·2in. and 12 6in. guns and two submerged torpedo tubes. They had a protective deck of 2–3in. thick and side armour 6in. thick. The types passed through several stages until the "Minotaur" (1905) of 14,000 tons, 23 knots, armed with 4 9·2in. and 10 7·5in. guns and five torpedo tubes.

The Light Cruiser.—The "Arethusa" class were the first vessels of this new type of fast lightly armoured cruisers. Their displacement was 3,500 tons and speed 29 knots. The machinery was of 40,000 s.h.p. and was the same as in the L class destroyers. They were the first cruisers to burn oil fuel only. The armament was 2 6in. and 6 4in. guns, and the side had protective plating 3–2in. thick. The following classes, "Calliope" and "Danae," were similar in many respects but embodied important improvements, geared turbines in "Champion" and later vessels, while in the later "C" class vessels and in the "D" class, a uniform armament of 6in. guns all mounted on the middle line, gave each vessel a powerful broadside. The "Emerald" class followed in 1917, the speed being increased to match the high speed of the German cruisers then building. Machinery of 80,000 s.h.p. was fitted. The displacement was 7,500 tons, speed 33 knots, and they were armed with 7 6in. guns and 12 21in. torpedo tubes.

The Ocean Cruiser.—The cruisers of the war period were of a type suitable for service in the North Sea, but in 1915 designs were prepared for the "Raleigh" class, more especially suited for ocean work in any part of the world. They have a speed of 30 knots and are armed with 7 7·5in. guns, five of which are on the middle line and two, one on either side, amidships. They are adapted for burning coal and oil. The 3in. belt of earlier vessels is repeated and in addition they are bulged against torpedo attack.

The Battle Cruiser.—The 1904 Committee on Designs, which produced the "Dreadnought" also recommended a new type of cruiser which has been designated a battle cruiser, the same calibre of guns being mounted as in battleships. The overruling consideration was speed, therefore it was necessary to surrender a certain number of guns and a great deal of armour as compared with the battleships.

The first ships of this type were "Invincible," "Inflexible" and "Indomitable," 530ft. in length, 17,250 tons, 41,000 h.p., turbine machinery, quadruple screws and 25 knots speed. Eight 12in. guns were fitted in four turrets. The armour protection was on a 6-in. basis only.

Successive improvements were made in "Indefatigable," "Australia" and "New Zealand" with increased displacement, and then the 28-knot ships "Lion" and "Princess Royal" were laid down in 1909–10. The horse power rose to 70,000 and 8 13·5in. guns were provided, the displacement rising to 26,350 tons. The armour protection was on a 9in. basis. The "Queen Mary" (1911) was generally similar. Further improvement was made in the "Tiger" (1912), of 28,500 tons, in which ship 12 6in. guns were fitted in addition to the main armament of 8 13·5in. guns.

The success of the battle cruisers "Invincible" and "Inflexible" at the Falkland Islands battle led to the building of two fast cruisers, "Renown" and "Repulse," in lieu of two battleships of the "Royal Sovereign" class which had been laid down. These vessels had 6 15in. guns and 17 4in. guns and an armour belt of 6in. thickness. The machinery was virtually a repeat of that of "Tiger," and with 112,000 h.p. the "Repulse" obtained 32·6 knots on the measured mile trial. They were 750 ft. long, with a displacement of 26,500 tons and they carried 4,250 tons of oil fuel. The construction of these vessels in about 20 months from the initiation of the design constitutes a record in design and construction.

The "Hood" was designed as a battle cruiser in 1916 and during building the lessons of the Battle of Jutland were incorporated in the ship. The protection was brought up to battleship standard, the belt being 8–12in. and barbettes 9–12in., and the thickness of the protective deck was also considerably increased over previous ships. A bulge to provide protection against torpedo attack was also a part of the design. She was armed with 8 15in. guns and 12 6in. guns. Geared turbines were adopted for the machinery, giving a total power of 144,000 s.h.p., and the ship attained 32 knots on her trials.

Germany in 1906 passed an act authorizing an extensive building program of war vessels to be completed by 1917, which beside battleships and torpedo craft, included twenty large and thirty-eight small cruisers. A series of armoured and battle cruisers was started, "Blücher," of 15,500 tons displacement, speed 24 knots, armed with 12 8·2in. and 8 5·9in. guns and 4 18in. torpedo tubes, being the first, followed by "Von Der Tann," "Moltke," "Goeben," "Seydlitz," "Derfflinger," "Lützow" and "Hindenburg." They were all fast powerful vessels, and the last-named had a displacement of 27,000 tons, speed 28 knots (85,000 s.h.p.), armed with 8 12in. and 14 5·9in. guns and 4 19·7in. torpedo tubes, armour 7in. thick on side, 10in. on barbettes. For light cruisers, a continuous building programme of about 3 vessels per year took place, the vessels varying from "Dresden" class, 3,500 tons displacement, 24 knots, armed with 4·1in. guns and 4 torpedo tubes, to "Köln" of 5,600 tons, 27½ knots, armed with 8 5·9in. and 3 8·8cm. guns, and 4 torpedo tubes.

Japan was the only other nation to complete battle cruisers before the World War, with the "Kongo" class (4), 27,500 tons displacement, speed 28 knots, armed with 8 14in. and 16 6in. guns and 8 21in. torpedo tubes, completed in 1913. Her armoured cruisers completed after 1906 are the "Tsukuba" class (2) and "Kurama" class (2), the latter of 14,600 tons displacement and 21½ knots, completed in 1910. The last light cruisers completed before the war were the "Yahagi" class (3) of 4,950 tons and 26 knots, armed with 8 6in. and 4 3in. guns and 3 18in. torpedo tubes. Since the World War about 14 fast light cruisers have been built of about 5,500 tons displacement, 33 knots, armed generally with 7 5·5in. guns and 6 or 8 21in. torpedo tubes. Also the "Furutaka" class (4), which vessels are of 7,500 tons displacement, 33 knots (100,000 s.h.p.), armed with 6 8in. and 4 4·7in. guns and 12 21in. torpedo tubes.

The United States did not complete any battle cruisers, and in 1914 the latest armoured cruisers in the American navy were the vessels of the "Tennessee" class (4), completed about 1908, of 14,500 tons displacement, speed 22½ knots, armed with 4 10in. and 16 6in. guns, and 4 21in. torpedo tubes, and the "Pennsylvania" class (6), of 13,680 tons, 22 knots, armed with 4 8in. and 14 6in. guns and 2 18in. torpedo tubes. Prior to the World War the "Chester" class (3), completed in 1908, were the newest light cruisers, but in 1916 the 10 vessels of the "Omaha" class were authorised. These ships are of 7,500 tons displacement, 33½ knots (90,000 s.h.p.), armed with 12 6in. and 4 3in. guns and 6 21in. torpedo tubes.

France and Italy also did not build battle cruisers, but each had several classes of armoured cruisers completed after 1905. These were, for France, the "Waldeck Rousseau" class (2), the "Ernest Renan" (2), and the "Léon Gambetta" (2), the first-named ships being of 14,000 tons displacement, 23 knots, with a main armament of 7 6in. guns; and for Italy, the "San Giorgio" class (2) and "Pisa" class (2). These vessels were of 10,000 tons displacement, 23 knots, and with a main armament of 2 or 4 10in. guns, 8 7·5in. guns and 3 18in. torpedo tubes.

The Washington Agreement of 1921 fixed a limit of 10,000 tons displacement for war vessels other than capital ships, and of 8in. for the gun mounted in such vessels. Since this conference, the five Powers concerned have each started building cruisers up to the limits allowed. Great Britain has completed the vessels of "Kent" class (5) and "London" class (4), and has two vessels of "Dorsetshire" class under construction. The U.S.A. has completed 18 heavy cruisers with 8-in. guns, nine light cruisers with 6-in. guns and has under construction 48 cruisers of various types. Japan has completed the "Nachi" class (5) and has under construction five vessels of "Takao" class. France has completed the "Duquesne" class (2) and "Suffren." Two more vessels of "Suffren" class were under construction in 1930. Italy has completed "Trento" class (2), and has under construction four vessels of "Zara" type.

These vessels are all designed to obtain speeds of more than 30 knots, and in some cases, by the deletion of any protective plating, very high speeds have been obtained. In general, they carry a main armament of 8 or 10 8in. guns with anti-aircraft guns and torpedo tubes. The weakness of the type is the insufficiency of protection that can be provided on the limited displacement, but it is too soon to state what will be the ultimate influence exercised by this important type of ship upon cruiser design.

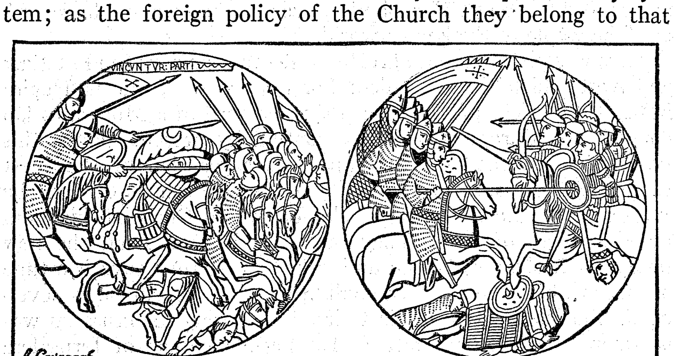
By the Treaty of Versailles, Germany was not allowed to exceed a cruiser displacement of 6,000 tons, and she has produced the "Emden," "Karlsruhe" class (3) and "Leipzig." The last ship has a speed of 32 knots and a main armament of 9 5·9in. guns in triple turrets. (W. J. B.; X.)

Note: Particulars regarding the cruisers of other nations as well as additional particulars regarding the navies of the different countries of the world will be found in the section headed *Defence* in the articles on the various countries, as United States, France, Japan, Italy, etc. To these the reader is referred.

CRUNDEN, JOHN (d. 1828) English architectural and decorative designer. Most of his early inspiration was drawn from Chippendale and his school; later the influence was a bastard classicism. He produced and published many designs.

CRUSADES, the name given to the series of campaigns undertaken by the Christians of western Europe from 1096 to 1291 for the recovery of the Holy Land from the Mohammedans, so called from the cross worn as a badge by the Crusaders. By analogy the term "crusade" is also given to any campaign undertaken in the same spirit.

Significance of the Crusades.—The crusades may be regarded partly as the *decumanus fluctus* in the surge of religious revival, which had begun in western Europe during the 10th, and had mounted high during the 11th century; partly as a chapter, and a most important chapter, in the history of the interaction of East and West. Contemporaries regarded them in the former of these two aspects, as "holy wars" and "pilgrims' progresses" towards Christ's Sepulchre; the reflective eye of history must perhaps regard them more especially from the latter point of view. Considered as holy wars the crusades must be interpreted by the ideas of an age which was dominated by the spirit of otherworldliness, and accordingly ruled by the clerical power which represented the other world. They are a *novum salutis genus,* a new path to Heaven, to tread which counted "for full and complete satisfaction" (*pro omni poenitentia*) and gave "forgiveness of sins" (*peccaminum remissio*); they are, again, the "foreign policy" of the papacy, directing its faithful subjects to the great war of Christianity against the infidel. As such a *novum salutis genus,* the crusades connect themselves with the history of the penitentiary system; as the foreign policy of the Church they belong to that



FROM LAVISSE & PARMENTIER, "ALBUM HISTORIQUE"

FIG. 1.—COMBATS BETWEEN CRUSADERS AND SARACENS, FROM STAINED GLASS WINDOWS (NOW DESTROYED) IN THE ABBEY OF ST. DENIS, PARIS

clerical purification and direction of feudal society and its instincts, which appears in the institution of "God's Truce" and in chivalry itself. The penitentiary system, according to which the priest enforced a code of moral law in the confessional by the sanction of penance—penance which must be performed as a condition of admission to the sacrament of the Eucharist—had been from early times a great instrument in the civilization of the raw Germanic races. Penance might consist in fasting; it might consist in flagellation; it might consist in pilgrimage. The penitentiary pilgrimage, which seems to have been practised as early as A.D. 700, was twice blessed; not only was it an act of atonement in itself, like fasting and flagellation; it also gained for the pilgrim the merit of having stood on holy ground. Under the influence of the Cluniac revival, which began in the 10th century, pilgrimages became increasingly frequent; and the goal of pilgrimage was often Jerusalem. Pilgrims who were travelling to Jerusalem joined themselves in companies for security, and marched under arms; the pilgrims of 1064, who were headed by the archbishop of Mainz, numbered some 7,000 men. When the first crusade finally came, what was it but a penitentiary pilgrimage under arms—with the one additional object of conquering the goal of pilgrimage? That the Pilgrims' Progress should thus have turned into a Holy War is a fact readily explicable, when we turn to consider the attempts made by the Church, during the 11th century, to purify, or at any rate to direct, the feudal instinct for private war (*guerra*). Since the close of the 10th century diocesan councils in France had been busily acting as legislatures, and enacting "forms of peace" for the maintenance of God's Peace or Truce (*Pax Dei* or *Treuga Dei*). In each diocese there had arisen a judicature (*judices pacis*) to decide when the form had been broken; and an executive, or *communitas pacis*, had been formed to enforce the decisions of the judicature. But it was an easier thing to consecrate the fighting instinct than to curb it; and the institution of chivalry represents such a clerical consecration, for ideal ends and noble purposes, of the martial impulses which the Church had hitherto endeavoured to check. In the same way the crusades themselves may be regarded as a stage in the clerical reformation of the fighting laymen. As chivalry directed the layman to defend what was right, so the preaching of the crusades directed him to attack what was wrong—the possession by "infidels" of the Sepulchre of Christ. The crusades are the offensive side of chivalry: chivalry is their parent—as it is also their child. The knight who joined the crusades might thus still indulge the bellicose side of his genius—under the aegis and at the bidding of the Church; and in so doing he would also attain what the spiritual side of his nature ardently sought—a perfect salvation and remission of sins. He might butcher all day, till he waded ankle-deep in blood, and then at nightfall kneel, sobbing for very joy, at the altar of the Sepulchre—for was he not red from the winepress of the Lord? One can readily understand the popularity of the crusades, when one reflects that they permitted men to get to the other world by fighting hard on earth, and allowed them to gain the fruits of asceticism by the way of obedience to natural instincts. Nor was the Church merely able, through the crusades, to direct the martial instincts of a feudal society; it was also able to pursue the object of its own immediate policy, and to attempt the universal diffusion of Christianity, even at the edge of the sword, over the whole of the known world.

Thus was renewed, on a greater scale, that ancient feud of East and West, which has never died. For 1,000 years, from the Hegira in 622 to the siege of Vienna in 1683, the peril of a Mohammedan conquest of Europe was almost continually present. From this point of view, the crusades appear as a reaction of the West against the pressure of the East—a reaction which carried the West into the East, and founded a Latin and Christian kingdom on the shores of Asia. They protected Europe from the new revival of Mohammedanism under the Turks; they gave it a time of rest in which the Western civilization of the middle ages developed. But the relation of East and West during the crusades was not merely hostile or negative. The Latin kingdom of Jerusalem was the meeting-place of two civilizations: on its soil the East learned from the West, and—perhaps still more—the West learned from the East. The culture developed in the West during the 13th century was not only permitted to develop by the protection of the crusades; it grew upon materials which the crusades enabled it to import from the East. Yet the debt of Europe to the crusades in this last respect has perhaps been unduly emphasized. Sicily was still more the meeting-place of East and West than the kingdom of Jerusalem; and the Arabs of Spain gave more to the culture of Europe than the Arabs of Syria.

Historical Causes of the Crusades.—Within 15 years of the Hegira, Jerusalem fell before the arms of Omar (637), and it continued to remain in the hands of Mohammedan rulers till the end of the first crusade. For centuries, however, a lively intercourse was maintained between the Latin Church in Jerusalem, which the clemency of the Arab conquerors tolerated, and the Christians of the West. Charlemagne in particular was closely connected with Jerusalem: the patriarch sent him the keys of the city and a standard in 800; and in 807 Harun Al-Rashid recognized this symbolical cession, and acknowledged Charlemagne as protector of Jerusalem and owner of the church of the Sepulchre. Charlemagne founded a hospital and a library in the Holy City; and later legend, when it made him the first of crusaders and the conqueror of the Holy Land, was not without some basis of fact. The connection lasted during the 9th century; kings like Alfred of England and Louis of Germany sent contributions to Jerusalem, while the church of Jerusalem acquired estates in the West. During the 10th century this intercourse still continued; but in the 11th century interruptions began to come. The fanaticism of the caliph Hakim destroyed the church of the Sepulchre and ended the Frankish protectorate (1010); and the patronage of the Holy Places, a source of strife between the Greek and the Latin Churches as late as the beginning of the Crimean War, passed to the Byzantine empire in 1021. This latter change in itself made pilgrimages from the West increasingly difficult: the Byzantines, especially after the schism of 1054, did not seek to smooth the way of the pilgrim, and Victor II. had to complain to the empress Theodora of the exactions practised by her officials. But still worse for the Latins was the capture of Jerusalem by the Seljuk Turks in 1071. Without being intolerant, the Turks were a rougher and ruder race than the Arabs of Egypt whom they displaced; while the wars between the Fatimites of Egypt and the Abbasids of Baghdad, whose cause was represented by the Seljuks, made Syria (one of the natural battle-grounds of history) into a troubled and unquiet region. The native Christians suffered; the pilgrims of the West found their way made still more difficult, and that at a time when greater numbers than ever were thronging to the East. Western Christians could not but feel hampered and checked in their natural movement towards the fountain-head of their religion, and it was natural that they should ultimately endeavour to clear the way. In much the same way, at a later date and in a lesser sphere, the closing of the trade-routes by the advance of the Ottoman Turks led traders to endeavour to find new channels, and issued in the rounding of the Cape of Good Hope and the discovery of America. Nor, indeed, must it be forgotten that the search for new and more direct connections with the routes of oriental trade is one of the motives underlying the crusades themselves, and leading to what may be called the 13th-century discovery of Asia.

It was thus natural, for these reasons, that the conquest of the Holy Land should gradually become an object for the ambition of Western Christianity—an object which the papacy, eager to realize its dream of a universal church subject to its sway, would naturally cherish and attempt to advance. Two causes combined to make this object still more natural and more definite. On the one hand, the reconquest of lost territories from the Mohammedans by Christian Powers had been proceeding steadily for more than 100 years before the first crusade; on the other hand, the position of the Eastern empire after 1071 was a clear and definite summons to the Christian West, and proved, in the event, the immediate occasion of the holy war. As early as 970 the recovery of the territories lost to Mohammedanism in the East had been begun by emperors like Nicephorus Phocas and John Zimisces: they had pushed their conquests, if only for a time, as far as Antioch and Edessa, and the temporary occupation of Jerusalem is attributed to the East Roman arms. At the opposite end of the Mediterranean, in Spain, the Omayyad caliphate was verging to its fall: the long Spanish crusade against the Moor had begun; and in 1018 Roger de Toeni was already leading Normans into Catalonia to the aid of the native Spaniard. In the centre of the Mediterranean the fight between Christian and Mohammedan had been long, but was finally inclining in favour of the Christian. The Arabs had begun the conquest of Sicily from the East Roman empire in 827, and they had attacked the mainland of Italy as early as 840. The popes had put themselves at the head of Italian resistance: in 848 Leo IV. is already promising a sure and certain hope of salvation to those who die in defence of the cross; and by 916, with the capture of the Arab fortress on the Garigliano, Italy was safe. Then came the reconquest of the Mediterranean islands near Italy. The Pisans conquered Sardinia at the instigation of Benedict VIII. about 1016; and, in a 30 years' war which lasted from 1060 to 1090, the Normans, under a banner blessed by Pope Alexander II., wrested Sicily from the Arabs. The Norman conquest of Sicily may with justice be called a crusade before the crusades; and it cannot but have given some impulse to that later attempt to wrest Syria from the Mohammedans, in which the virtual leader was Bohemund, a scion of the same house which had conquered Sicily. But while the Christians of the West were thus winning fresh ground from the Mohammedans, in the course of the 11th century, the East Roman empire had now to bear the brunt of a Mohammedan revival under the Seljuks—a revival which, while it crushed for a time the Greeks, only acted as a new incentive to the Latins to carry their arms to the East. The Seljuk Turks, first the mercenaries and then the masters of the caliph, had given new life to the decadent caliphate of Baghdad. Under the rule of their sultans, who assumed the rôle of mayors of the palace in Baghdad about the middle of the 11th century, they pushed westwards towards the caliphate of Egypt and the East Roman empire. While they wrested Jerusalem from the former (1071), in the same year they inflicted a crushing defeat on the Eastern emperor at Manzikert. The result of the defeat was the loss of almost the whole of Asia Minor; the dominions of the Turks extended to the Sea of Marmora. An appeal for assistance, such as was often to be heard again in succeeding centuries, was sent by Michael VII. of Constantinople to Gregory VII. in 1073. Gregory listened to the appeal; he projected—not, indeed, as has often been said, a crusade[1], but a great expedition, which should recover Asia Minor for the Eastern empire, in return for a union of the Eastern with the Western Church. In 1074 Gregory actually assembled a considerable army; but his disagreement with Robert Guiscard, followed by the outbreak of the war of investitures, hindered the realization of his plans, and the only result was a precedent and a suggestion for the events of 1095. The appeal of Michael VII. was re-echoed by Alexius Comnenus himself. Brave and sage as he was, he could hardly cope at one and the same time with the hostility of the Normans on the west, of the Petchenegs (Patzinaks) on the north, and of the Seljuks on the east and south. Already in 1087 and 1088 he had appealed to Baldwin of Flanders, verbally and by letter[2], for troops; and Baldwin had answered the appeal. The same appeal was made more than once, to Urban II.; and the answer was the first crusade. The first crusade was not, indeed, what Alexius had asked or expected to receive. He had appealed for reinforcements to recover Asia Minor; he received hundreds of thousands of troops, independent of him, and intending to conquer Jerusalem for themselves, though they might incidentally recover Asia Minor for the Eastern empire on their way. Alexius may almost be compared to a magician, who has uttered a charm to summon a ministering spirit, and is surrounded on the instant by legions of demons. In truth the appeal of Alexius had set free forces in the West which were independent of, and even ultimately hostile to, the interests of the Eastern empire.

Mixture of Motives.—The primary force, which thus transmuted an appeal for reinforcements into a holy war for the conquest of Palestine, was the Church. The creative thought of the middle ages is clerical thought. It is the Church which creates the Carolingian empire, because the clergy think in terms of empire. It is the Church which creates the first crusade, because the clergy believe in penitentiary pilgrimages, and the war against the Seljuks can be turned into a pilgrimage to the Sepulchre; because, again, it wishes to direct the fighting instinct of the laity, and the consecrating name of Jerusalem provides an unimpeachable channel; above all, because the papacy desires a perfect and universal church, and perfect and universal church must rule in the Holy Land. But it would be a mistake to regard the crusades (as it would be a mistake to regard the Carolingian empire) as a pure creation of the Church, or as merely due to the policy of a theocracy directing men to the holy war which is the only war possible for a theocracy. It would be almost truer, though only half the truth, to say that the clergy gave the name of crusade to sanctify interests and ambitions which, while set on ends other than those of the Church, happened to coincide in their choice of means. There was, for instance, the ambition of the adventurer prince, the younger son, eager to carve a principality in the far East, of whom Bohemund is the type; there was the interest of Italian towns, anxious to acquire the products of the East more directly and cheaply, by erecting their own emporia in the eastern Mediterranean. The former was the driving force which made the first crusade successful, where later crusades, without its stimulus, for the most part failed; the latter was the one staunch ally which alone enabled Baldwin I. and Baldwin II. to create the kingdom of Jerusalem. So far as the crusades led to permanent material results in the East, they did so in virtue of these two forces. Unregulated enthusiasm might of itself have achieved little or nothing; enthusiasm caught and guided by the astute Norman, and the no less astute Venetian or Genoese, could not but achieve tangible results. The principality or the emporium, it is true, would supply motives to the prince and the merchant only; and it may be urged that to the mass of the crusaders the religious motive was all in all. In this way we may return to the view that the first crusade, at any rate, was *un fait ecclésiastique*. It is indeed true that to thousands the hope of acquiring spiritual merit must have been a great motive; it is also true, as the records of crusading sermons show, that there was a strong element of "revivalism" in the crusades, and that thousands were hurried into taking the cross by a gust of that uncontrollable enthusiasm which is excited by revivalist meetings to-day. But it must also be admitted that there were motives of this world to attract the masses to the crusades. Famine and pestilence at home drove men to emigrate hopefully to the golden East. In 1094 there was pestilence from Flanders to Bohemia: in 1095 there was famine in Lorraine. *Francigenis occidentalibus facile persuaderi poterat sua rura relinquere; nam Gallias per annos aliquot nunc seditio civilis, nunc fames, nunc mortalitas nimis afflixerat* (Ekkehard, *Chronica*, p. 213). No wonder that a stream of emigration set towards the East, such as would in modern times flow towards a newly discovered gold-field—a stream carrying in its turbid waters much refuse, tramps and bankrupts, camp-followers and hucksters, fugitive monks and escaped villeins, and marked by the same motley grouping, the same fever of life, the same alternations of affluence and beggary, which mark the rush for a gold-field to-day.

Such were the forces set in movement by Urban II., when, after holding a synod at Piacenza (March, 1095), and receiving there fresh appeals from Alexius, he moved to Clermont, in the south-east of France, and there on Nov. 26 delivered the great speech which was followed by the first crusade. In this speech he appealed, indeed, for help for the Greeks, *auxilio . . . saepe acclamato indigis* (Fulcher i. c. i.); but the gist of his speech was the peril of Christianity. Let the truce of God be observed at home; and let the arms of Christians be directed to conquering the infidel in an expedition which should count for full and complete penance. Like Gregory VII., Urban had thus sought for aid for the Eastern empire; unlike Gregory, who had only mentioned the Holy Sepulchre in a single letter, and then casually, he had struck the note of Jerusalem. The instant cries of *Deus vult* which answered the note showed that Urban had struck aright. Thousands at once took the cross; the first was Bishop Adhemar of Puy, whom Urban named his legate and made leader of the first crusade (for the holy war, according to Urban's original conception, must needs be led by a clerk). Fixing Aug. 15, 1096, as the time for the depar-

[1]Tradition credits a pope still earlier than Gregory VII. with the idea of a crusade. Silvester II. is said to have preached a general expedition for the recovery of Jerusalem, and the same preaching is attributed to Sergius IV. in 1011. But the supposed letter of Silvester is a later forgery; and in 1000 the way of the Christian to Jerusalem was still free and open.

[2]The Count de Riant impugned the authenticity of Alexius's letter to the Count of Flanders. It is very probable that the versions of this letter which we possess, and which are to be found only in later writings like Guibert de Nogent, are apocryphal; Alexius can hardly have held out the bait of the beauty of Greek women or have written that he preferred to fall under the yoke of the Latins rather than that of the Turks. But it is also probable that these apocryphal versions are based on a genuine original.

ture of the crusaders, and Constantinople as the general rendezvous, Urban returned from France to Italy. It is noticeable that it was on French soil that the seed had been sown[1]. Preached in France by a pope of French descent, the crusades began—and they continued—as essentially a French (we may almost say a Norman-French) enterprise; and the kingdom which they established in the East was essentially a French kingdom, in its speech and its customs, its virtues and its vices. It was natural that France should be the home of the crusades. She was already the home of the Cluniac movement, the centre from which radiated the truce of God, the chosen place of chivalry; she could supply a host of feudal nobles, somewhat loosely tied to their place in society, and ready to break loose for a great enterprise; she had suffered from battle and murder, pestilence and famine, from which any escape was welcome. To the Normans particularly the crusades had an intimate appeal. They appealed to the old Norse instinct for wandering—an instinct which, as it had long before sent the Norseman eastward to find his El Dorado in Micklegarth, could now find a natural outlet in the expedition to Jerusalem: they appealed to the Norman religiosity, which had made them a people of pilgrims, the allies of the papacy, and, in England and Sicily, crusaders before the crusades: finally, they appealed to that desire to gain fresh territory, upon which Malaterra remarks as characteristic of Norman princes. No wonder, then, that the crusading armies were recruited in France, or that they were led by men of the stock of the d'Hautevilles. Meanwhile newly conquered England had its own problems to solve; and Germany, torn by civil war, and not naturally quick to kindle, could only deride the "delirium" of the crusader (Ekkehard, *Chronica,* p. 214).

THE FIRST CRUSADE

The first crusade falls naturally into two parts. One of these may be called the crusade of the people: the other may be termed the crusade of the princes. Of these the people's crusade—prior in order of time, if only secondary in point of importance—may naturally be studied first. The sermon of Urban II. at Clermont became the staple for wandering preachers, among whom Peter the Hermit (*q.v.*) distinguished himself by his fiery zeal[2]. He has been described as riding on an ass from place to place through France and along the Rhine, carrying away by his eloquence thousands of the poor. Some three or four months before the term fixed by Urban II., in April and May 1096, five divisions of *pauperes* had already collected. Three of these, led by Fulcher of Orleans, Gottschalk and William the Carpenter respectively, failed to reach even Constantinople. The armies of Fulcher and Gottschalk were destroyed by the Hungarians in just revenge for their excesses (June); the third, after joining in a wild *Judenhetze* in the towns of the valley of the Rhine, during which some 10,000 Jews perished as the first-fruits of crusading zeal, was scattered to the winds in Hungary (August). Two other divisions, however, reached Constantinople in safety. The first of these, under Walter the Penniless, passed through Hungary in May, and reached Constantinople, where it halted to wait for the Hermit, in the middle of July. The second, led by Peter himself, passed safely through Hungary, but suffered severely in Bulgaria, and only attained Constantinople with sadly diminished numbers at the end of July. These two divisions (which in spite of good treatment by Alexius began to commit excesses against the Greeks) united and crossed the Bosporus in August, Peter himself remaining in Constantinople. By the end of October they had perished utterly at the hands of the Seljuks; a heap of whitening bones alone remained to testify to the later crusaders, when they passed in the spring of 1097, of the fate of the people's crusade.

Meanwhile the knights had already begun to assemble in March 1096. In small bands, and by divers ways, they streamed gradually southward and eastward, in a steady flow, throughout 1096. But three large divisions, under three considerable leaders, were pre-eminent among the rest. Godfrey of Bouillon, with his brother Baldwin, led the crusaders of Lorraine along "the road of Charles the Great," through Hungary, to Constantinople, where he arrived on Dec. 23. Raymund of Toulouse (the first prince to join the crusading movement) along with Bishop Adhemar, the papal commissary, led the Provençals down the coast of Illyria, and then due east to Constantinople, arriving towards the end of April 1097. Bohemund of Otranto, the destined leader of the crusade, with his nephew Tancred, led a fine force of Normans by sea to Durazzo, and thence by land to Constantinople, which he reached about the same time as Raymund. To the same great rendezvous other leaders also gathered, some of higher rank than Godfrey or Raymund or Bohemund, but none destined to exercise an equal influence on the fate of the crusade. Hugh of Vermandois, younger brother of Philip I. of France, had reached Constantinople in Nov. 1096, in a species of honourable captivity, and had done Alexius homage; Robert of Normandy and Stephen of Blois, to whom Urban II. had given St. Peter's banner at Lucca, only arrived—the last of the crusaders—in May 1097 (their original companion in arms, Count Robert of Flanders, having left them to winter at Bari, and crossed to Constantinople before the end of 1096).

The Rival Princes.—Thus was gathered at Constantinople, in the spring of 1097, a great host, which Fulcher computes at 600,000 men (I. c. iv.), Urban II. at 300,000, and which was probably some 150,000 strong[1]. Before we follow this host into Asia, we may pause to enquire into the various factors which would determine its course, or condition its activity. On the Western side, and among the crusaders themselves, there were two factors of importance, already mentioned above—the aims of the adventurer prince, and the interests of the Italian merchant; while on the Eastern side there are again two—the policy of the Greeks, and the condition of the Mohammedan East. We have already seen that among the princes who joined the first crusade there were some who were rather *politiques* than *dévots,* and who aimed at the acquisition of temporal profit as well as of spiritual merit. Of these the type—and, it may almost be said, the inspirer of the rest—was Bohemund. From the first he had an Eastern principality in his mind's eye; and if we may judge from the follower of Bohemund who wrote the *Gesta Francorum,* there had already been some talk at Constantinople of Antioch as the seat of this principality. Bohemund's policy seems to have inspired Baldwin, the brother of Godfrey of Bouillon to emulation; on the one hand he strove to thwart the endeavours of Tancred, the nephew of Bohemund, to begin the foundation of the Eastern principality for his uncle by conquering Cilicia, and, on the other, he founded a principality for himself in Edessa. Raymund of Provence, the third and last of the great *politiques* of the first crusade, was, like Baldwin, envious of Bohemund; and jealousy drove him first to attempt to wrest Antioch from Bohemund, and then to found a principality of Tripoli to the south of Antioch, which would check the growth of his power. The political motives of these three princes, and the interaction of their different policies, were thus a great factor in determining the course and the results of the first crusade. The influence of the Italian towns did not make itself greatly felt till after the end of the first crusade, when it made possible the foundation of a kingdom in Jerusalem, in addition to the three principalities established by Bohemund, Baldwin and Raymund; but during the course of the crusade itself the Italian ships which hugged the shores of Syria were able to supply the crusaders with provisions and munitions of war, and to render help in the sieges of Antioch and Jerusalem[2]. Sea-power had thus some influence in determining the victory of the crusaders.

The Eastern Empire.—In the East the conditions were mainly

[1]The *Chanson de Roland,* which cannot be posterior to the first crusade—for the poem never alludes to it—already contains the idea of the holy war against Islam. The idea of the crusade had thus already ripened in French poetry, before Urban preached his sermon.

[2]Later legend ascribed the origin of the first crusade to his preaching, and the legend has been followed by modern historians; but in point of fact Peter is a figure of secondary importance. (*See* F. Duncalf, "The Peasants' Crusade," in the *American Historical Review* for 1921, pp. 440–53.)

[1]Godfrey's army numbered some 30,000 infantry and 10,000 cavalry (Röhricht, *Erst. Kreuzz.* 61); Urban II. reckons Bohemund's knights as 7,000 in number (*ibid.* 71, n. 7).

[2]The Genoese had been invited by Urban II. in Sept. 1096 "to go with their gallies to Eastern parts in order to set free the path to the Lord's Sepulchre."

favourable. The one difficulty—and it was serious—was the attitude adopted by Alexius. Confronted by crusaders where he had asked for auxiliaries, Alexius had two alternative policies presented to his choice. He might, in the first place, have frankly admitted that the crusaders were independent allies, and treating them as equals, he might have waged war in concert with them, and divided the conquests achieved in the war. A boundary line might have been drawn somewhere to the north-west of Antioch; and the crusaders might have been left to acquire what they could to the south and east of that line. Unhappily, clinging to the conviction that all the lands which the crusaders would traverse were the "lost provinces" of his empire, he induced the crusaders to do him homage, so that, whatever they conquered, they would conquer in his name, and whatever they held, they would hold by his grant and as his vassals. Thus Hugh of Vermandois became the man of Alexius in Nov. 1096; Godfrey of Bouillon was induced, not without difficulty, to do homage in Jan. 1097; and in April and May the other leaders, including Bohemund and the obstinate Raymund himself, followed his example. The policy of Alexius was destined to produce evil results, both for the Eastern empire and for the crusading movement. The West had already its grievances against the East: the Greek emperors had taken advantage of their protectorate of the Holy Places to lay charges on the pilgrims, against which the papacy had already been forced to remonstrate; nor were the Italian towns, with the exception of favoured Venice, disposed to be friendly to the great monopolist city of Constantinople. The old dissension of the Eastern and Western Churches had blazed out afresh in 1054; and the policy of Alexius only added new rancours to an old grudge, which culminated in the Latin conquest of Constantinople in 1204. On the other hand, the success of the crusading movement was imperilled, both now and afterwards, by the jealousy of the Comneni. Always hostile to the principality, which Bohemund established in spite of his oath, they helped by their hostility to cause the loss of Edessa in 1144, and they hastened the disintegration of the Latin kingdom of Jerusalem. Yet one must remember, in justice to Alexius, the gravity of the problem by which he was confronted; nor was the conduct of the crusaders themselves such that he could readily make them his brethren in arms.

Mohammedan Dissensions.—The condition of Asia Minor and Syria in 1097 was in many respects calculated to favour the success of the crusaders. The Seljuk sultans had only achieved a military occupation of the country which they had conquered. There were Seljuk garrisons in towns like Nicaea and Antioch, ready to offer an obstinate resistance to the crusaders; and here and there in the country there were Seljuk armies, either cantoned or nomadic. But the inhabitants of the towns were often hostile to the garrisons, and over wide tracts of country there were no forces at all. Accordingly, when the crusaders had captured the town of Nicaea, and defeated the Seljuk field-army at Dorylaeum their way lay clear before them through Asia Minor. Not only so, but they could count, at the very least, on a benevolent neutrality from the native population; while from the Armenian principalities in the south-east of Asia Minor, which survived unsubdued in the general deluge of Seljuk conquest, they could expect active assistance (the hope of which will explain the north-easterly line of march which they followed after leaving Heraclea). But the purely military character of the Seljuk occupation helped the crusaders in yet another way. Strong generals were needed in the separate divisions of the empire, and these, as has always been the case in Eastern empires, made themselves independent in their spheres of command, because there was no organization to keep them together under a single control. On the death of Malik Shah, the last of the great Seljuk emperors (1092), the empire dissolved. A new sultan, Barkiyāroq or Barkiarok, ruled in Baghdad (1094–1104); but in Asia Minor Kilij Arslan held sway as the independent sultan of Konia (Iconium), while the whole of Syria was also practically independent. Not only was Syria thus weakened by being detached from the body of the Seljuk empire; it was divided by dissensions within, and assailed by the Fatimite caliph of Egypt from without. In 1095 two brothers, Ridwan and Dekak, ruled in Aleppo and Damascus respectively; but they were at war with one another, and Yagi-sian, the ruler of Antioch, was a party to their dissensions. Ridwan and Yagi-sian were only stopped in an attack on Damascus by news of the approach of the crusaders, which led the latter to throw himself hastily into Antioch, in the autumn of 1097. Meanwhile the Fatimites were not slow to take advantage of these dissensions. A great religious difference divided the Fatimite caliph of Cairo, the head of the Shiite sect, from the Abbasid caliph of Baghdad, who was the head of the Sunnites. The difference may be compared to the dissension between the Greek and the Latin Churches; but it had perhaps more of the nature of a political difference. In any case, it hampered the Mohammedans as much as the jealousy between Alexius and the Latins hampered the progress of the crusade. The crusading princes were well enough aware of the gulf which divided the caliph of Cairo from the Sunnite princes of Syria; and they sought by envoys to put themselves into connection with him, hoping by his aid to gain Jerusalem (which was then ruled for the Turks by Sokman, the son of the amir Ortok)[1]. But the caliph preferred to act for himself, and took advantage of the wars of the Syrian princes, and of the terror inspired by the advance of the crusaders to conquer Jerusalem (Aug. 1098). But though the leaders of the first crusade thus failed to utilize the dissensions of the Mohammedans as fully as they desired, it still remains true that these dissensions very largely explain their success. It was the disunion of the Syrian amirs, and the division between the Abbasids and the Fatimites, that made possible the conquest of the Holy City and the foundation of the kingdom of Jerusalem. When a power arose in Mosul, about 1130, which was able to unify Syria—when, again, in the hands of Saladin, unified Syria was in turn united to Egypt—the cause of Latin Christianity in the East was doomed.

Siege of Antioch.—We are now in a position to follow the history of the first crusade. By the beginning of May 1097 the crusaders were crossing the Bosporus, and entering the dominions of Kilij Arslan. Their first operation was the siege of Nicaea, defended by a Seljuk garrison, but eventually captured, with the aid of Alexius, after a month's siege (June 18). Alexius took possession of the town; and though he rewarded the crusading princes richly, some discontent was excited by his action. After the capture of Nicaea, the field-army of Kilij Arslan had to be met. In a long and obstinate encounter, it was defeated at Dorylaeum (July 1); and the crusaders marched unmolested in a south-easterly direction to Heraclea. Here Tancred, followed by Baldwin, turned into Cilicia, and began to take possession of the Cilician towns, and especially of Tarsus—thus beginning, it would seem, the creation of the Norman principality of Antioch. The main army turned to the north-east, in the direction of Caesarea (in order to bring itself into touch with the Armenian princes of this district), and then marched southward again to Antioch. At Marash, half way between Caesarea and Antioch, Baldwin, who had meanwhile wrested Tarsus from Tancred, rejoined the ranks; but he soon left the main body again, and struck eastward towards Edessa, to found a principality there. At the end of October the crusaders came into position before Antioch, which was held by Yagi-sian, and began the siege of the city, which lasted from Oct. 21, 1097 to June 3, 1098. The great figure in the siege was naturally Bohemund (who had also been the hero of Dorylaeum). He repelled attempts at relief made by Dekak (Dec. 31, 1097) and Ridwan (Feb. 9, 1098); he put the besiegers in touch with the Genoese ships lying in the harbour of St. Simeon, the port of Antioch (March 1098)—a move which at once served to remedy the want of provisions from which the crusaders suffered, and secured materials for the building of castles, with which Bohemund sought—in the Norman fashion—to overawe the besieged city. But it was finally by the

[1]Thus already on the first crusade the path of negotiation is attempted simultaneously with the holy war. On the third crusade and above all on the sixth, this path was still more seriously attempted. It is interesting, too, to notice the part which the laity already plays in directing the course of the crusade. From the first the crusade, however clerical in its conception, was largely secular in its conduct; and thus, somewhat paradoxically, a religious enterprise aided the growth of the secular motive and contributed to the escape of the laity from that tendency towards a papal theocracy, which was evident in the pontificate of Gregory VII.

treachery of one of Yagi-sian's commanders, the amir Firuz, that Bohemund was able to effect its capture. The other leaders had, however, to promise him possession of the city, before he would bring his negotiations with Firuz to a conclusion; and the matter was so long protracted that an army of relief under Kerbogha of Mosul was only at a distance of three days' march, when the city was taken (June 3, 1098). The besiegers were no sooner in the city, than they were besieged in their turn by Kerbogha; and the 25 days which followed were the worst period of stress and strain which the crusaders had to encounter. Under the pressure of this strain "spiritualistic" phenomena began to appear. It was in the ranks of the Provençals, where the religiosity of Count Raymund seems to have extended to his followers, that these phenomena appeared; and they culminated in the supposed discovery of the Holy Lance, which had pierced the side of the Saviour. The excitement communicated itself to the whole army; and the nervous strength which it gave enabled the crusaders to meet and defeat Kerbogha in the open (June 28), but not before many of their number, including even Count Stephen of Blois, had deserted and fled.

Capture of Jerusalem.—With the discovery of the Lance, which became as it were a Provençal asset, Count Raymund assumes a new importance. Mingled with the religiosity of his nature there was much obstinacy and self-seeking; and when Kerbogha was finally repelled, he began to dispute the possession of Antioch with Bohemund, pleading in excuse his oath to Alexius. The struggle lasted for some months, and helped to delay the further progress of the crusaders. Raymund, indeed, left Antioch in November, and moved south-east to Marra; but his men still held to positions in Antioch, from which they were not dislodged by Bohemund till Jan. 1099. Expelled from Antioch, the obstinate Raymund endeavoured to recompense himself in the south (where indeed he subsequently created the county of Tripoli); and from Feb. to May 1099 he occupied himself with the siege of Arca, to the north-east of Tripoli. It was during the siege of Arca that Peter Bartholomew, to whom the vision of the Holy Lance had first appeared, was subjected, with no definite result, to the ordeal of fire—the hard-headed Normans doubting the genuine character of any Provençal vision, the more when, as in this case, it turned to the political advantage of the Provençals. The siege was long protracted; the mass of the pilgrims were anxious to proceed to Jerusalem, and, as the altered tone of the author of the *Gesta* sufficiently indicates, thoroughly weary of the obstinate political bickerings of Raymund and Bohemund. Here Godfrey of Bouillon finally came to the front, and placing himself at the head of the discontented pilgrims, he forced Raymund to accept the offers of the amir of Tripoli, to desist from the siege, and to march to Jerusalem (in the middle of May 1099). Bohemund remained in Antioch: the other leaders pressed forward, and following the coast route, arrived before Jerusalem in the beginning of June. After a little more than a month's siege, the city was finally captured (July 15). The slaughter was terrible; the blood of the conquered ran down the streets, until men splashed in blood as they rode. At nightfall, "sobbing for excess of joy," the crusaders came to the church of the Sepulchre from their treading of the winepress, and put their blood-stained hands together in prayer. So, on that day of July, the first crusade came to an end.

It remained to determine the future government of Jerusalem; and here the eternal problem of the relations of Church and State emerged. It might seem natural that the Holy City, conquered in a holy war by an army of which the pope had made a churchman, Bishop Adhemar, the leader, should be left to the government of the Church. But Adhemar had died in Aug. 1098 (whence, in large part, the confusion and bickerings which followed at the end of 1098 and the beginning of 1099); nor were there any churchmen left of sufficient dignity or weight to secure the triumph of the ecclesiastical cause. In the meeting of the crusaders on July 22, some few voices were raised in support of the view that a "spiritual vicar" should first be chosen in the place of the late patriarch of Jerusalem (who had just died in Cyprus), before the election of any lay ruler was taken in hand. But the voices were not heard; and the princes proceeded at once to elect a lay ruler. Raymund of Provence refused to accept their nomination, nominally on the pious ground that he did not wish to reign where Christ had suffered on the cross; though one may suspect that the establishment of a principality in Tripoli—in which he had been interrupted by the pressure of the pilgrims—was still the first object of his ambition. The refusal of Raymund meant the choice of Godfrey of Bouillon, who had, as we have seen, become prominent since the siege of Arca; and Godfrey accordingly became—not king, but "advocate of the Holy Sepulchre." A few days afterwards Arnulf, the chaplain of Robert of Normandy, and one of the sceptics in the matter of the Holy Lance, became "vicar" of the vacant patriarchate. Godfrey's first business was to repel an Egyptian attack, which he accomplished successfully at Ascalon, with the aid of the other crusaders (Aug. 12). At the end of August the other crusaders returned, and Godfrey was left with a small army of 2,000 men, and the support of Tancred, now prince of Galilee, to rule in some four isolated districts—Jaffa, Jerusalem, Ramlah and Haifa. At the end of the year came Bohemund and Godfrey's brother Baldwin (now count of Edessa) on a pilgrimage to Jerusalem. The result of Bohemund's visit was new trouble for Godfrey. Bohemund procured the election of Dagobert, the archbishop of Pisa, to the vacant patriarchate, disliking Arnulf, and perhaps hoping to find in the new patriarch a political supporter. Bohemund and Godfrey together became Dagobert's vassals; and in the spring Godfrey even seems to have entered into an agreement with the patriarch to cede Jerusalem and Jaffa into his hands, in the event of acquiring other lands or towns, especially Cairo, or dying without direct heirs. When Godfrey died in July 1100 (after successful forays against the Mohammedans which took him as far as Damascus), it might seem as if a theocracy were after all to be established in Jerusalem, in spite of the events of 1099.

THE LATIN KINGDOM OF JERUSALEM

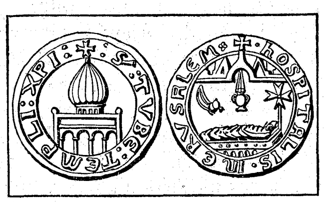
The First Three Kings (1100–1143).—The theocracy, however, was not destined to be established. Godfrey had died without direct heirs. Dagobert had at first consented to the dying Godfrey's wish that his brother, Baldwin, in far Edessa, should be his successor; but when Godfrey died he saw an opportunity too precious to be missed, and opposed Baldwin, counting on the support of Bohemund, to whom he sent an appeal for assistance[1]. But a party in Jerusalem, headed by the late "vicar" Arnulf, opposed itself to the hierarchical pretensions of Dagobert and the Norman influence by which they were backed; and this party, representing the Lotharingian laity, carried the day. Baldwin was summoned from Edessa; and when he arrived, towards the end of the year, he was crowned king by Dagobert himself. Thus was founded, on Christmas day 1100, the Latin kingdom of Jerusalem; and thus was the possibility of a theocracy finally annihilated. A feudal kingdom of Frankish seigneurs was to be planted on the soil of Palestine, instead of a *dominium temporale* of the patriarch like that of the pope in central Italy. Nor were there great difficulties with the Church to hamper the growth of this kingdom. For two years, indeed, a struggle raged between Baldwin I. and Dagobert: Baldwin accused the patriarch of treachery, and attempted to force him to contribute to the defence of the kingdom. But in 1102 the struggle ceased with the deposition of the patriarch and the victory of the king. The contention was renewed for a time by the patriarch Stephen in the reign of Baldwin II. The new struggle was of short duration (1128–30) and was soon ended by Stephen's death.

The establishment of a kingdom in Jerusalem in 1100 was a blow, not only to the Church but to the Normans of Antioch. At the end of 1099 any contemporary observer must have believed that the capital of Latin Christianity in the East was destined to be Antioch. Antioch lay in one of the most fertile regions of the East; Bohemund was almost, if not quite, the greatest genius of his generation; and when he visited Jerusalem at the end of 1099, he led an army of 25,000 men—and those men, at any rate in

[1]The genuineness of the letter (on which, by the way, depends the story of Godfrey's agreement with Dagobert) has been impeached by Prutz and Kugler, and doubted by Röhricht. It is accepted by von Sybel and Hagenmeyer.

large part, Normans. What could Godfrey avail against such a force? Yet the principality of Godfrey was destined to higher things than that of Bohemund. Jerusalem, like Rome, had the shadow of a mighty name to lend prestige to its ruler; and as residence in Rome was one great reason of the strength of the mediaeval papacy, so was residence in Jerusalem a reason for the ultimate supremacy of the Lotharingian kings. Jerusalem attracted the flow of pilgrims from the West as Antioch never could; and though the great majority of the pilgrims were only birds of passage, there were always many who stayed in the East. There was thus a steady immigration into the kingdom, to strengthen its armies and recruit with new blood the vigour of its inhabitants. Still more important, perhaps, was the fact that the ports of the kingdom attracted the Italian towns; and it was therefore to the kingdom that they lent the strength of their armies and the skill of their siege-artillery—in return, it is true, for concessions of privileges so considerable as to weaken the resources of the kingdom they helped to create. While Jerusalem possessed these advantages, Antioch was not without its defects. It had to meet—or perhaps it would be more true to say, it brought upon itself—the hostility of strong Mohammedan powers in the vicinity. As early as 1100 Bohemund was captured in battle by Danishmend of Sivas; and it was his captivity, depriving the patriarch as it did of Norman assistance, which allowed the uncontested accession of Baldwin I. Again, in 1104, the Normans, while attempting to capture Harran, were badly defeated on the river Balikh, near Rakka; and this defeat may be said to have been fatal to the chance of a great Norman principality[1]. But the hostility of Alexius, aided and abetted by the jealousy of Raymund of Toulouse, was almost equally fatal. Alexius claimed Antioch; was it not the old possession of his empire, and had not Bohemund done him homage? Raymund was ready to defend the claims of Alexius; was not Bohemund a successful rival? Thus it came about that Alexius and Raymund became allies; and by the aid of Alexius Raymund established, from 1102 onwards, the principality which, with the capture of Tripoli in 1109, became the principality of Tripoli, and barred the advance of Antioch to the south. Meanwhile the armies of Alexius not only prevented any further advance to the northwest, but conquered the Cilician towns (1104). No wonder that Bohemund flung himself in revenge on the Eastern empire in 1108 —only, however, to meet with a humiliating defeat at Durazzo.

Expansion of the Kingdom.—Thus it was that Baldwin waxed while Bohemund waned. The growth of Baldwin's kingdom, as it was suggested above, owed more to the interests of Italian traders than it did to crusading zeal. In 1100, indeed, it might appear that a new crusade from the West, which the capture of Antioch in 1098 had begun, and the conquest of Jerusalem in 1099 had finally set in motion, was destined to achieve great things for the nascent kingdom. Thousands had joined this new crusade, which should deal the final blow to Mohammedanism: among the rest came the first of the troubadours, William IX., count of Poitiers, to gather copy for his muse, and even some, like Stephen of Blois and Hugh of Vermandois, who had joined the first crusade, but had failed to reach Jerusalem. The new crusaders cherished high plans; they would free Bohemund and capture Baghdad. But each of the three sections of their army was routed in turn in Asia Minor by the princes of Sivas, Aleppo and Harran, in the middle of 1101; and only a few escaped to report the crushing disaster. Edward I. had thus no assistance to expect from the West, save that of the Italian towns. From an early date Italian ships had followed the



FROM LAVISSE & PARMENTIER, "ALBUM HISTORIQUE"

FIG. 2.—SEALS OF KNIGHTLY ORDERS

Left, the seal of the Knights Templars. Right, that of the Knights of St. John of Jerusalem

[1]Yet the north always continued to be more populous than the south; and the Latins maintained themselves in Antioch and Tripoli a century after the loss of Jerusalem. The land was richer in the north: it was protected by its connection with Cyprus and Armenia: it was more remote from Egypt—the basis of Mohammedan power from the reign of Saladin onwards.

crusaders. There were Genoese ships in St. Simeon's harbour in the spring of 1098 and at Jaffa in 1099; in 1099 Dagobert, the archbishop of Pisa, led a fleet from his city to the Holy Land; and in 1100 there came to Jaffa a Venetian fleet of 200 sail, whose leaders promised Venetian assistance in return for freedom from tolls and a third of each town they helped to conquer. But it was the Genoese who helped Baldwin I. most. The Venetians already enjoyed, since 1080, a favoured position in Constantinople, and had the less reason to find a new emporium in the East; while Pisa connected itself, through Dagobert, with Antioch[1], rather than with Jerusalem, and was further, in 1111, invested by Alexius with privileges, which made an outlet in the Holy Land no longer necessary. But the Genoese, who had helped with provisions and siege-tackle in the capture of Antioch and of Jerusalem, had both a stronger claim on the crusaders, and a greater interest in acquiring an eastern emporium. An alliance was accordingly struck in 1101 (Fulcher II. c. vii.), by which the Genoese promised their assistance, in return for a third of all booty, a quarter in each town captured, and a grant of freedom from tolls. In this way Baldwin I. was able to take Arsuf and Caesarea in 1101 and Acre in 1104. But Genoese aid was given to others beside Baldwin (it enabled Raymund to capture Byblus in 1104, and his successor, William, to win Tripoli in 1109); while, on the other hand, Baldwin enjoyed other aid besides that of the Genoese. In 1110, for example, he was enabled to capture Sidon by the aid of Sigurd of Norway, the Jorsalafari, who came to the Holy Land with a fleet of 55 ships, starting in 1107, and in a three years' "wandering," after the old Norse fashion, fighting the Moors in Spain, and fraternizing with the Normans in Sicily. At a later date, in the reign of Baldwin II., Venice also gave her aid to the kings of Jerusalem. Irritated by the concessions made by Alexius to the Pisans in 1111, and furious at the revocation of her own privileges by John Comnenus in 1118, the republic naturally sought a new outlet in the Holy Land. A Venetian fleet of 120 sail came in 1123, and after aiding in the repulse of an attack, which the Egyptians had taken advantage of Baldwin II.'s captivity to deliver, they helped the regent Eustace to capture Tyre (1124), in return for considerable privileges—freedom from tolls throughout the kingdom, a quarter in Jerusalem, baths and ovens in Acre, and in Tyre one-third of the city and its suburbs, with their own court of justice and their own church. After thus gaining a new footing in Tyre, the Venetians could afford to attack the islands of the Aegean as they returned, in revenge for the loss of their privileges in Constantinople; but the hostility between Venice and the Eastern empire was soon afterwards appeased, when John Comnenus restored the old privileges of the Venetians. The Venetians, however, maintained their position in Palestine; and their quarters remained, along with those of the Genoese, as privileged commercial franchises in an otherwise feudal State.

In this way the kingdom of Jerusalem expanded until it came to embrace a territory stretching along the coast from Beirut (captured in 1110[2]) to el-Arish on the confines of Egypt—a territory whose strength lay not in Judaea, like the ancient kingdom of David, but, somewhat paradoxically (though commercial motives explain the paradox), in Phoenicia and the land of the Philistines. With all its length, the territory had but little breadth: towards the north it was bounded by the amirate of Damascus; in the centre, it spread little, if at all, beyond the Jordan; and it was only in the south that it had any real extension. Here there were two considerable annexes. To the south of the Dead sea stretched a tongue of land, reaching to Aila, at the head of the eastern arm of the Red sea. This had been won by Baldwin I., by way of revenge for the attacks of the Egyptians on his kingdom; and here, as early as 1116, he had built the fort of Monreal, half way be-

[1]Pisa naturally connected itself with Antioch, because Antioch was hostile to Constantinople, and Pisa cherished the same hostility, since Alexius I. had in 1080 given preferential treatment to Venice, the enemy of Pisa.

[2]This is the year in which the kingdom may be regarded as definitely founded. The period of conquest practically ends at this date, though isolated gains were afterwards made. The year 1110 is additionally important by reason of the accession of Maudud al Mosul, which marks the beginning of a Muslim reaction.

tween Aila and the Dead sea. To the east of the Dead sea, again, lay a second strip of territory, in which the great fortress was Krak (Kerak) of the Desert, planted somewhere about 1140 by the royal butler, Paganus, in the reign of Fulk of Jerusalem. These extensions in the south and east had also, it is easy to see, a commercial motive. They gave the kingdom a connection of its own with the Red sea and its shipping; and they enabled the Franks to control the routes of the caravans, especially the route from Damascus to Egypt and the Red sea. Thus, it would appear, the whole of the expansion of the Latin kingdom (which may be said to have attained its height in 1131, at the death of Baldwin II.) may be shown to have been dictated, at any rate in large part, by economic motives; and thus, too, it would seem that two of the most powerful motives which sway the mind of man—the religious motive and the desire for gain—conspired to elevate the kingdom of Jerusalem (at once the country of Christ, and a natural centre of trade) to a position of supremacy in Latin Syria. During this process of growth the kingdom stood in relation to two sets of powers—the three Frankish principalities in northern Syria, and the Mohammedan powers both of the Euphrates and the Nile—whose action affected its growth and character.

Of the three Frankish principalities, Edessa, founded in 1098 by Baldwin I. himself, was a natural fief of Jerusalem. Baldwin de Burg, the future Baldwin II., ruled in Edessa as the vassal of Baldwin I. from 1100 to 1118; and thereafter the county was held in succession by the two Joscelins of Tell-bashir until the conquest of Edessa by Zengi in 1144. Lying to the east of the Euphrates, at once in close contact with the Armenians, and in near proximity to the great route of trade which came up the Euphrates to Rakka, and thence diverged to Antioch and Damascus, the county of Edessa had an eventful if brief life. The county of Tripoli, the second of these principalities, had also come under the aegis of Jerusalem at an early date. Founded by Raymund of Toulouse, between 1102 and 1105, with the favour of Alexius and the alliance of the Genoese, it did not acquire its capital of Tripoli till 1109. Even before the conquest of Tripoli, there had been dissensions between William, the nephew and successor of Raymund, and Bertrand, Raymund's eldest son, which it had needed the interference of Baldwin I. to compose; and it was only by the aid of the king that the town of Tripoli had been taken. At an early date, therefore, the county of Tripoli had already come under the influence of the kingdom. Meanwhile the principality of Antioch, ruled by Tancred, after the departure of Bohemund (1104–12), and then by Roger his kinsman (1112–19), was, during the reign of Baldwin I., busily engaged in disputes both with its Christian neighbours at Edessa and Tripoli, and with the Mohammedan princes of Mardin and Mosul. On the death of Roger in 1119, the principality came under the regency of Baldwin II. of Jerusalem, until 1126, when Bohemund II. came of age. Bohemund had married a daughter of Baldwin; and on his death in 1130 Baldwin II. once more became the guardian of Antioch. From this time, therefore, Antioch may be regarded as a dependency of Jerusalem; and thus the end of Baldwin's reign (1131) may be said to mark the time when the Latin kingdom of Jerusalem stands complete, with its own boundaries stretching from Beirut in the north to el-Arish and Aila in the south, and with the three Frankish Powers of the north admitting its suzerainty.

Muslim Reaction.—The Latin power thus established and organized in Syria had to face in the north a number of Mohammedan amirs, in the south the caliph of Egypt. The disunion between the Mohammedans of northern Syria and the Fatimites of Egypt, and the political disintegration of the former, were both favourable to the success of the Franks; but they had nevertheless to maintain their ground vigorously both in the north and the south against almost incessant attacks. The hostility of the decadent caliphate of Cairo was the less dangerous; and though Baldwin I. had at the beginning of his reign to meet annual attacks from Egypt, by the end he had pushed his power to the Red sea, and in the very year of his death (1118) he had penetrated along the north coast of Egypt as far as Farama (Pelusium). The plan of conquering Egypt had indeed presented itself to the Franks from the first, as it continued to attract them to the end; and it is significant that Godfrey himself, in 1100, promised Jerusalem to the patriarch, "as soon as he should have conquered some other great city, and especially Cairo." But the real menace to the Latin kingdom lay in northern Syria; and here a power was eventually destined to rise, which outstripped the kings of Jerusalem in the race for Cairo, and then—with the northern and southern boundaries of Jerusalem in its control—was able to crush the kingdom as it were between the two jaws of a vice. Until 1127, however, the Mohammedans of northern Syria were disunited among themselves. The beginning of the 12th century was the age of the atabegs (regents or stadtholders). The atabegs formed a number of dynasties, which displaced the descendants of the Seljuk amirs in their various principalities. These dynasties were founded by emancipated mamelukes, who had held high office at court and in camp under powerful amirs, and who, on their death, first became stadtholders for their descendants, and then usurped the throne of their masters. There was an atabeg dynasty in Damascus founded by Tughtigin (1103–28): there was another to the north-east, that of the Ortokids, represented by Sokman, who established himself at Kaifa in Diarbekr about 1101, and by his brother Ilghazi, who received Mardin from Sokman about 1108, and added to it Aleppo in 1117[1]. But the greatest of the atabegs were those of Mosul on the Tigris—Maudud, who died in 1113; Aksunkur, his successor; and finally, greatest of all, the atabeg Zengi, who ruled in Mosul from 1127 onwards.

Before the accession of Zengi, there had been constant fighting, which had led, however, to no definite result between the various Mohammedan princes and the Franks of northern Syria. The constant pressure of Tancred of Antioch and Baldwin de Burg of Edessa led to a series of retaliations between 1110 and 1115; Edessa was attacked in 1110, 1111, 1112 and 1114; and in 1113 Maudud of Mosul, who may be regarded as the first to begin the *jihad,* or counter-crusade, had even penetrated as far as the vicinity of Acre and Jerusalem. But the dissensions of the Mohammedans made their attacks unavailing; in 1115, for instance, we find Antioch actually aided by Ilghazi and Tughtigin against Aksunkur of Mosul. Again, in the reign of Baldwin II., there was steady fighting in the north; Roger of Antioch was defeated by Ilghazi at Balat in 1119, and Baldwin II. himself was captured by Balak, the successor of Ilghazi, in 1123, but on the whole the Franks held the upper hand. Baldwin conquered part of the territory of Aleppo in 1121 and the following years, and extorted a tribute from Damascus (1126). But when Zengi established himself in Mosul in 1127, the tide gradually began to turn. He created for himself a great and united principality, comprising not only Mosul, but also Aleppo, Harran, Nisibin and other districts; and in 1130, Alice, the widow of Bohemund II., sought his alliance in order to maintain herself in power at Antioch. In the beginning of the reign of Fulk of Jerusalem (1131–43) the progress of Zengi was steady. He conquered in 1135 several fortresses in the east of the principality of Antioch, and in this year and the next pressed the count of Tripoli hard; while in 1137 he defeated Fulk at Barin, and forced the king to capitulate and surrender the town. If Fulk had been left alone to wage the struggle against Zengi, and if Zengi had enjoyed a clear field against the Franks, the fall of the kingdom of Jerusalem might have come far sooner than it did[2]. But there were two powers which aided Fulk, and impeded the progress of Zengi—the amirate of Damascus and the emperors of Constantinople. The position of Damascus is a position of crucial importance from 1130 to 1154. Lying between Mosul and

[1]Ilghazi died in 1122. His successor was Balak, who ruled from 1122 to 1124, and succeeded in capturing in 1123 Baldwin II. of Jerusalem. The union of Mardin and Aleppo under the sway of these two amirs, connecting as it did Mesopotamia with Syria, marks an important stage in the revival of Mohammedan power (Stevenson, *Crusades in the East,* p. 109).

[2]Stevenson, however, believes that Zengi was *not* animated by the idea of recovering Jerusalem. He thinks that his principal aim was simply the formation of a compact Mohammedan State, which was, indeed, in the issue destined to be the instrument of the *jihad,* but was not so intended by Zengi (*op. cit.* pp. 123–124).

Jerusalem, and important both strategically and from its position on the great route of commerce from the Euphrates to Egypt, Damascus became the arbiter of Syrian politics. During the greater part of the period between 1130 and 1154 the policy of Damascus was guided by the vizier Muin eddin Anar, who ruled on behalf of the descendants of the atabeg Tughtigin. He saw the importance of finding an ally against the ambition of Zengi, who had already attacked Damascus in 1130. The natural ally was Jerusalem. As early as 1133 the alliance of the two Powers had been concluded; and in 1140 the alliance was solemnly renewed between Fulk and the vizier. Henceforth this alliance was a dominant factor in politics. One of the great mistakes made by the Franks was the breach of the alliance in 1147—a breach which was widened by the attack directed against Damascus during the second crusade; and the conquest of Damascus by Nureddin in 1154 was ultimately fatal to the Latin kingdom, removing as it did the one possible ally of the Franks, and opening the way to Egypt for the atabegs of Mosul.

The Eastern Empire.—The alliance of the emperors of Constantinople was of far more dubious value. We have already seen that it was the theory of the Eastern emperors—a theory which logically followed from the homage of the crusaders to Alexius—that the conquests of the crusaders belonged to their empire, and were held by the crusading princes as fiefs. We have seen that the action of Bohemund at Antioch was the negation of this theory, and that Alexius in consequence helped Raymund to establish himself in Tripoli as a thorn in the side of Bohemund, and sent an army and a fleet which wrested from the Normans the towns of Cilicia (1104). The defeat of Bohemund at Durazzo in 1108 had resulted in a treaty, which made Antioch a fief of Alexius; but Tancred (who in 1107 had recovered Cilicia from the Greeks) refused to fulfil the terms of the treaty, and Alexius (who attempted—but in vain—to induce Baldwin I. to join an alliance against Tancred in 1112) was forced to leave Antioch independent. Thus, although Alexius had been able, in the wake of the crusading armies, to recover a large belt of land round the whole coast of Asia Minor—the interior remaining subject to the sultans of Konia (Iconium) and the princes of Sivas—he left the territories to the east of Cilicia in the hands of the Latins when he died in 1118. Not for 20 years after his death did the Eastern empire make any attempt to gain Cilicia or exact the homage of Antioch. But in 1137 John Comnenus appeared, instigated by the opportunity of dissensions in Antioch, and received its long-denied homage, as well as that of Tripoli; and in the following year he entered into hostilities with Zengi, without, however, achieving any considerable result. In 1142 he returned again, anxious to create a principality in Cilicia and Antioch for his younger son Manuel. The people of Antioch refused to submit; a projected visit to Jerusalem, during which John was to unite with Fulk in a great alliance against the Muslim, fell through; and in the spring of 1143 the emperor died in Cilicia, with nothing accomplished. On the whole, the interference of the Comneni, if it checked Zengi for the moment in 1138, may be said to have ultimately weakened and distracted the Franks, and to have helped to cause the loss of Edessa (1144), which marks the turning-point in the history of the kingdom of Jerusalem.

THE ORGANIZATION OF THE KINGDOM

Before we turn to describe the second crusade, which the loss of Edessa provoked, and to trace the fall of the kingdom, which the second crusade rather hastened than hindered, we may pause at this point to consider the organization of the Frankish colonies in Syria. The first question which arises is that of the relation of the kingdom of Jerusalem to the three counties or principalities of Antioch, Tripoli and Edessa, which acknowledged their dependence upon it. The degree of this dependence was always a matter of dispute. The rights of the king of Jerusalem chiefly appear when there is a vacancy or a minority in one of the principalities, or when there is dissension either inside one of the principalities or between two of the princes. On the death of one of the princes without heirs of full age, the kings of Jerusalem were entitled to act as regents, as Baldwin II. did twice at Antioch, in 1110 and 1130; but the kings regarded this right of regency as a burden rather than a privilege, and it is indeed characteristic of the relation of the king to the three princes, that it imposes upon him duties without any corresponding rights. It is his duty to act as regent; it is his duty to compose the dissensions in the principality of Antioch, and to repress the violences of the prince towards his patriarch (1154); it is his duty to reconcile Antioch with Edessa, when the two fall to fighting. The princes on their side acted independently: if they joined the king with their armies, it was as equals doing a favour; and they sometimes refused to join until they were coerced. They made their own treaties with the Mohammedans, or attacked them in spite of the king's treaties; they dated their documents by the year of their own reign, and they had each their separate laws or assizes. There was, in a word, co-ordination rather than subordination; nor did the kings ever attempt to embark on a policy of centralization.

The relation of the king to his own barons within his immediate kingdom of Jerusalem is not unlike the relation of the king to the three princes. In Norman England the king insisted on his rights; in Frankish Jerusalem the barons insisted on his duties. The circumstances of the foundation of the kingdom explain its characteristics. As the crusaders advanced to Jerusalem, says Raymund of Agiles (c. xxxiii.), it was their rule that the first-comer had the right to each castle or town, provided that he hoisted his standard and planted a garrison there. The feudal nobility was thus the first to establish itself, and the king only came after its institution—the reverse of Norman England, where the king first conquered the country, and then plotted it out among his nobles. The predominance of the nobility in this way became as characteristic of feudalism in the Latin kingdom of Jerusalem as the supremacy of the Crown was of contemporary feudalism in England; and that predominance expressed itself in the position and powers of the high court, in which the ultimate sovereignty resided. The kingdom of Jerusalem consisted of a society of peers, in which the king might be *primus*, but in which he was none the less subject to a punctilious law, regulating his position equally with that of every member of the society. In such a society the election of the head by the members may seem natural; and Godfrey and the first two Baldwins were elected in this way. But the conception of the equality of the king and his peers in the long run led to hereditary monarchy; for if the king held his kingdom as a fief, like other nobles, the laws of descent which applied to a fief applied to the kingdom, and those laws demanded heredity. Yet the high court, which decided all problems of descent, would naturally intervene if a problem of descent arose, as it frequently did, in the kingdom; and thus the barons had the right of deciding between different claimants, and also of formally "approving" each new successor to the throne. The conception of the kingdom as a fief not only subjected it to the jurisdiction of the high court; it involved the more disastrous result that the kingdom, like other fiefs, might be carried by an heiress to her husband; and the proximate causes of the collapse of the kingdom in 1187 may be found in this fact and the dissensions which it occasioned.

Thus conceived as the holder of a great fief, the king had only the rights of *suzerain* over the four great baronies and the 12 minor fiefs of his kingdom. He had not those rights of *sovereign* which the Norman kings of England inherited from their Anglo-Saxon predecessors, or the Capetian kings of France from the Carolings; nor was he able, therefore, to come into direct touch with each of his subjects, which William I., in virtue of his sovereign rights, was able to attain by the Salisbury oath of 1086. Amalric I. indeed, by his *assise sur la ligèce,* attempted to reach the vassals of his vassals; he admitted *arrière-vassaux* to the *haute cour,* and encouraged them to carry their cases to it in the first instance. But this is the only attempt at that policy of *immédiatisation* which in contemporary England was carried to far greater lengths; and even this attempt was unsuccessful. No real alliance was actually formed between the king and the mesne nobility against the immediate baronage. The body of the tenants-in-chief continued to limit the power of the Crown: their consent was necessary to legislation, and grants of fiefs could not be made without their permission. Nor was the Crown only limited in this way. The duties of the king towards his tenants are prominent in the assizes. The king's oath to his men binds him to respect and maintain their rights, which are as prominent as are his duties; and if the men feel that the royal oath has not been kept, they may lawfully refuse military service (*gager le roi*), and may even rise in authorized and legal rebellion. The system of military service and the organization of justice corresponded to the part which the monarchy was thus constrained to play. The vassal was bound to pay military service, not, as in western Europe, for a limited period of 40 days, but for the whole year—the Holy Land being, as it were, in a perpetual state of siege. On the other hand, the vassal was not bound to render service, unless he were paid for his service; and it was only famine, or Saracen devastation, which freed the king from the obligation of paying his men. The king was also bound to insure the horses of his men by a system called the *restor:* if a vassal lost his horse otherwise than by his own fault, it must be replaced by the Treasury (which was termed, as it also was in Norman Sicily, the *secretum*)[1]. But the king had another force in addition to the feudal levy—a force of *soudoyers,* holding fiefs, not of land, but of pay (*fiefs de soudée*)[2]. Along with these *soudoyers* went another branch of the army, the Turcopuli, a body of light cavalry, recruited from the Syrians and Mohammedans, and using the tactics of the Arabs; and an infantry was found among the Armenians, the best soldiers of the East, and the Maronites, who furnished the kingdom with archers. To all these various forces must be added the knights and native levies of the great orders, whose masters were practically independent sovereigns like the princes of Antioch and Tripoli; and with these the total levy of the kingdom may be reckoned at some 25,000 men. (For the history of the orders *see* the articles on the TEMPLARS; ST. JOHN OF JERUSALEM, KNIGHTS OF; KNIGHTHOOD AND CHIVALRY.) But the strength of the kingdom lay less, perhaps, in the army than in the magnificent fortresses which the nobility, and especially the two orders, had built; and the most visible relic of the crusades to-day is the towering ruins of a fortress like Krak (Kerak) des Chevaliers, the fortress of the Knights of St. John in the principality of Tripoli. These fortresses, garrisoned not by the king, as in Norman England, but by their possessors, could only strengthen the power of the feudatories, and help to dissipate the kingdom into a number of local units.

Judicial System.—In the organization of its system of justice the kingdom showed its most characteristic features. Two great central courts sat in Jerusalem to do justice—the high court of the nobles, and the court of burgesses for the rest of the Franks. (1) The high court was the supreme source of justice for the military class; and in its composition and procedure the same limitation of the Crown, which appears in regard to military service, is again evident. The high court is not a *curia regis,* but a *curia baronum,* in which the theory of *judicium parium* is fully realized. If the king presides in the court, the motive of its action is none the less the preservation of the rights of the nobles, and not, as in England, the extension of the rights of the Crown. It is a court of the king's peers: it tries cases of dispute between the king and his peers—with regard, for instance, to military service—and it settles the descent of the title of king. (2) The court of burgesses was almost equally sovereign within its sphere. While the body of the noblesse formed the high court, the court of the burgesses was composed of 12 legists (probably named by the king) under the presidency of the *vicomte*—a knight named by the king, who was a great financial as well as a judicial officer. The province of the court included all acts and contracts between burgesses, and extended to criminal cases in which burgesses were involved. Like the high court, the court of burgesses also had its assizes—a body of unwritten legal custom[1].

[1]There are certain connections and analogies between the kingdom of Sicily and that of Jerusalem during the 12th century. In either case there is an importation of Western feudalism into a country originally possessed of Byzantine institutions, but affected by an Arabic occupation. The subject deserves investigation.

[2]The holders of fiefs both held fiefs of land and received pay; the paid force received pay only. An instance of the latter is furnished by John of Margat, a vassal of the seignory of Arsuf. He has 200 bezants along with a quantity of wheat, barley, lentils and oil; and in return he must march with four horses (Rey, *Les Colonies franques en Syrie* p. 24).

The independent position of the burgesses, who assumed a position of equality by the side of the feudal class, is one of the peculiarities of the kingdom of Jerusalem. It may be explained by reference to the peculiar conditions of the kingdom. Burgesses and nobles, however different in status, were both of the same Frankish stock, and both occupied the same superior position with regard to the native Syrians. The commercial motive, again, had been one of the great motives of the crusade; and the class which was impelled by that motive would be both large and, in view of the quality of the Eastern goods in which it dealt, exceptionally

[1]As was noticed above, there were apparently separate assizes for the three principalities, in addition to the assizes of the kingdom. The assizes of Antioch have been discovered and published. The assizes of the kingdom itself are twofold—the assizes of the high court and the assizes of the court of burgesses. (1) The assizes of the high court are preserved for us in works by legists—John of Ibelin, Philip of Novara and Geoffrey of Tort—composed in the 13th century. We possess, in other words, *law-books* (like Bracton's treatise *De legibus*), but not *laws*—and law-books made after the loss of the kingdom to which the laws belonged. There are two vexed questions with regard to these law-books. (*a*) The first concerns the origin and character of the laws which the law-books profess to expound. According to the story of the legists who wrote these books—*e.g.,* John of Ibelin—the laws of the kingdom were laid down by Godfrey, who is thus regarded as the great νομοθέτης of the kingdom. These laws (progressively modified, it is admitted) were kept in Jerusalem, under the name of "Letters of the Sepulchre," until 1187. In that year they were lost; and the legists tell us that they are attempting to reconstruct *par oir dire* the gist of the lost archetype. The story of the legists is now generally rejected. Godfrey never legislated: the customs of the kingdom gradually grew, and were gradually defined, especially under kings like Baldwin III. and Amalric I. If there was thus only a customary and unwritten law (and William of Tyre definitely speaks of a *jus consuetudinarium* under Baldwin III., *quo regnum regebatur*), then the "Letters of the Sepulchre" are a myth—or rather, if they ever existed, they existed not as a code of written law, but, perhaps, as a register of fiefs, like the Sicilian *Defetarii.* Thus the story of the legists shrinks down to the regular myth of the primitive legislator, used to give an air of respectability to law-books, which really record an unwritten custom. The fact is that until the 13th century the Franks lived *consuetudinibus antiquis et jure non scripto.* They preferred an unwritten law, as Prutz suggests, partly because it suited the barristers (who often belonged to the baronage, for the Frankish nobles were "great pleaders in court and out of court"), and partly because the high court was left unbound so long as there was no written code. In the 13th century it became necessary for the legists to codify, as it were, the unwritten law, because the upheavals of the times necessitated the fixing of some rules in writing, and especially because it was necessary to oppose a definite custom of the kingdom to Frederick II., who sought, as king of Jerusalem, to take advantage of the want of a written law, to substitute his own conceptions of law in the teeth of the high court. (*b*) The second difficulty concerns the text of the law-books themselves. The text of Ibelin became a *textus receptus*—but it also became overlaid by glosses, for it was used as authoritative in the kingdom of Cyprus after the loss of the kingdom of Jerusalem, and it needed expounding. Recensions and revisions were twice made, in 1368 and 1531; but how far the true Ibelin was recovered, and what additions or alterations were made at these two dates, we cannot tell. We can only say that we have the text of Ibelin which was used in Cyprus in the later middle ages. At the same time, if our text is thus late, it must be remembered that its content gives us the earliest and purest exposition of French feudalism, and describes for us the organization of a kingdom where all rights and duties were connected with the fief, and the monarch was only a suzerain of feudatories. (2) The assizes of the court of burgesses became the basis of a treatise at an earlier date than the assizes of the high court. The date of the redaction (which was probably made by some learned burgess) may well have been the reign of Baldwin III., as Kugler suggests: he was the first native king, and a king learned in the law; but Beugnot would refer the assizes to the years immediately preceding Saladin's capture of Jerusalem. These assizes do not, of course, appear in Ibelin, who was only concerned with the feudal law of the high court. They were used, like the assizes of the high court, in Cyprus; and, like the other assizes, they were made the subject of investigation in 1531, with the object of discovering a good text. The law which is expounded in these assizes is a mixture of Frankish law with the Graeco-Roman law of the Eastern empire which prevailed among the native population of Syria.

In regard to both assizes, it is most important to bear in mind that we possess not laws, but law-books or custumals—records made by lawyers for their fellows of what they conceived to be the law, and supported by legal arguments and citations of cases. But, as Prutz remarks, Phillip of Novara *lehrt nicht die Wissenschaft des Rechts, sondern die des Unrechts:* he does not explain the law so much as the ways of getting round it.

prosperous. Finally, when one remembers how, during the first crusade, the *pedites* had marched side by side with the *principes*, and how, from the beginning of 1099, they had practically risen in revolt against the selfish ambitions of princes like Count Raymund, it becomes easy to understand the independent position which the burgesses assumed in the organization of the kingdom. Burgesses could buy and possess property in towns, which knights were forbidden to acquire; and though they could not intermarry with the feudal classes, it was easy and regular for a burgess to thrive to knighthood. Like the nobles, again, the burgesses had the right of confirming royal grants and of taking part in legislation; and they may be said to have formed—socially, politically and judicially—an independent and powerful estate. Yet (with the exception of Antioch, Tripoli and Acre in the course of the 13th century) the Frankish towns never developed a communal government: the domain of their development was private law and commercial life.

Fiefs and Immunities.—Locally, the consideration of the system of justice administered in the kingdom involves some account of three things—the organization of the fiefs, the position of the Italian traders in their quarters and the privileges of the Church. Each fief was organized like the kingdom. In each there was a court for the noblesse, and a court (or courts) for the bourgeoisie. There were some 37 *cours de bourgeoisie* (several of the fiefs having more than one), each of which was under the presidency of a *vicomte*, while all were independent of the court of burgesses at Jerusalem. Of the feudal courts there were some 22. Each of these followed the procedure and the law of the high court; but each was independent of the high court, and formed a sovereign court without any appeal. On the other hand, the revolution wrought by Amalric I. in the status of the *arrière vassaux*, which made them members of the high court, allowed them to carry their cases to Jerusalem in the first instance, if they desired. Apart from this, the characteristic of seignorial justice is its independence and its freedom from the central court; though, when we reflect that the central court is a court of seigneurs, this characteristic is seen to be the logical result of the whole system. Midway between the seignorial *cours de bourgeoisie* and tne privileged jurisdictions of the Italian quarter, there were two kinds of courts of a commercial character—the *cours de la fonde* in towns where trade was busy, and the *cours de la chaîne* in the sea-ports. The former courts, under their bailiffs, gradually absorbed the separate courts which the Syrians had at first been permitted to enjoy under their own *reïs;* and the bailiff with his 6 assessors (4 Syrians and 2 Franks) thus came to judge all commercial cases in which Syrians were involved. The *cours de la chaîne*, whose institution is assigned to Amalric I. (1162–74), had a civil jurisdiction in admiralty cases, and, like the *cours de la fonde*, they were composed of a bailiff and his assessors. Distinct from all these courts, if similar in its sphere, was the court which the Italian quarter generally enjoyed in each town under its own consuls—a court privileged to try all but the graver cases, such as murder, theft and forgery. The court was part of the general immunity which made these quarters *imperia in imperio:* their exemptions from tolls and from financial contributions is parallel to their judicial privileges. Regulated by their mother-town, both in their trade and their government, these Italian quarters outlasted the collapse of the kingdom, and continued to exist under Mohammedan rulers. The Church had its separate courts, as in the West; but their province was perhaps greater than elsewhere. The Church courts could not indeed decide cases of perjury; but, on the other hand, they tried all matters in which clerical property was concerned, and all cases of dispute between husband and wife. In other spheres the immunities and exemptions of the Church offered a far more serious problem, and especially in the sphere of finance. Perhaps the supreme defect of the kingdom of Jerusalem was its want of any financial basis. It is true that the king had a revenue, collected by the vicomte and paid into the *secretum* or Treasury—a revenue composed of tolls on the caravans and customs from the ports, of the profits of monopolies and the proceeds of justice, of poll-taxes on Jews and Mohammedans, and of the tributes paid by Mohammedan powers. But his expenditure was large: he had to pay his feudatories; and he had to provide fiefs in money and kind to those who had not fiefs of land. The contributions sent to the Holy Land by the monarchs of western Europe, as commutations in lieu of personal participation in crusades, might help; the fatal policy of razzias against the neighbouring Mohammedan powers might procure temporary resources; but what was really necessary was a wide measure of native taxation such as was once, and once only, attempted in 1183. To any such measure the privileges of the Italian quarters, and still more those of the Church, were inimical. In spite of provisions somewhat parallel to those of the English statute of mortmain, the clergy continued to acquire fresh lands at the same time that they refused to contribute to the defence of the kingdom, and rigorously exacted the full quota of tithe from every source which they could tap, and even from booty captured in war. The richest proprietor in the Holy Land[1], but practically immune from any charges on its property, the Church helped, unconsciously, to ruin the kingdom which it should have supported above all others. It refused to throw its weight into the scale, and to strengthen the hands of the king against an over-mighty nobility. On the other hand, it must be admitted that the Church did not, after the first struggle between Dagobert and Baldwin I., actively oppose by any hierarchical pretensions the authority of the Crown. The assizes may speak of patriarch and king as conjoint seigneurs in Jerusalem; but as a matter of fact the king could secure the nomination of his own patriarch, and after Dagobert the patriarchs are, with the temporary exception of Stephen in 1128, the confidants and supporters of the kings. It was the two great orders of the Templars and the Hospitallers which were, in reality, most dangerous to the kingdom. Honeycombed as it was by immunities—of seigneurs, of Italian quarters, of the clergy—the kingdom was most seriously impaired by these overweening immunists, who, half-lay and half-clerical, took advantage of their ambiguous position to escape from the duties of either character. They built up great estates, especially in the principality of Tripoli; they quarrelled with one another, until their dissensions prevented any vigorous action; they struggled against the claims of the clergy to tithes and to rights of jurisdiction; they negotiated with the Mohammedans as separate Powers; they conducted themselves towards the kings as independent sovereigns. Yet their aid was as necessary as their influence was noxious. Continually recruited from the West, they retained the vigour which the native Franks of Palestine gradually lost; and their corporate strength gave a weight to their arms which made them indispensable, while their great wealth and vast estates made them at the same time an object of fear and envy.

Degeneration of the Franks.—In describing the organization of the kingdom, we have also been describing the causes of its fall. It fell because it had not the financial or political strength to survive. "Les vices du gouvernement avaient été plus puissants que les vertus des gouvernants." But the vices were not only vices of the Government: they were also vices, partly inevitable, partly moral, in the governing race itself. The climate was no doubt responsible for much. The Franks of northern Europe attempted to live a life that suited a northern climate under a southern sun. They rode incessantly to battle over burning sands, in full armour—chain mail, long shield and heavy casque—as if they were on their native French soil. The ruling population was already spread too thin for the work which it had to do; and exhausted by its efforts, it gradually became extinct. A constant immigration from the West, bringing new blood and recruiting the stock, could alone have maintained its vigour; and such immigration never came. Little driblets of men might indeed be added to the numbers of the Franks; but the mass of crusaders either perished in Asia Minor, as in 1101 and 1147, or found themselves thwarted and distrusted by the native Franks. It was indeed one of the misfortunes of the kingdom that its inhabitants could

[1]For instance, the abbey of Mount Sion had large possessions, not only in the Holy Land (at Ascalon, Jaffa, Acre, Tyre, Caesarea and Tarsus) but also in Sicily, Calabria, Lombardy, Spain and France (at Orleans, Bourges and Poitiers).

never welcome the reinforcements which came to their aid[1]. The barons suspected the crusaders of ulterior motives, and of designing to get new principalities for themselves. In any case the native Frank, accustomed to commercial intercourse and diplomatic negotiations with the Mohammedans, could hardly share the unreasoning passion to make a dash for the "infidel." As with the barons, so with the burgesses: they profited too much by their intercourse with the Mohammedans to abandon readily the way of peaceful commerce, and they were far more ready to hinder than to help any martial enterprise. Left to itself, the native population lost physical and moral vigour. The barons alternated between the extravagances of Western chivalry and the attractions of Eastern luxury: they returned from the field to divans with frescoed walls and floors of mosaic, Persian rugs and embroidered silk hangings. Their houses, at any rate those in the towns, had thus the characteristics of Moorish villas; and in them they lived a Moorish life. Their sideboards were covered with the copper and silver work of Eastern smiths and the confectioneries of Damascus. They dressed in flowing robes of silk, and their women wore oriental gauzes covered with sequins. Into these divans where figures of this kind moved to the music of Saracen instruments, there entered an inevitable voluptuousness and corruption of manners. The hardships of war and the excesses of peace shortened the lives of the men; the kingdom of Jerusalem had 11 kings within a century. While the men died, the women, living in comparative indolence, lived longer lives. They became regents to their young children; and the experience of all mediaeval minorities reiterates the lesson—woe to the land where the king is a child and the regent a woman. Still worse were the frequent remarriages of widowed princesses and heiresses. By the assizes of the high court, the widow, on the death of her husband, took half of the estate for herself, and half in guardianship for her children. *Liberae ire cum terra,* widows carried their estates or titles to three or four husbands; and as in 15th-century England, the influence of the heiress was fatal to the peace of the country. (*See* A. Herzog, *Die Frau auf den Fürstenthronen der Kreuzfahrstaaten,* 1919.) At Antioch, for instance, after the death of Bohemund II. in 1130, his widow Alice headed a party in favour of the marriage of the heiress Constance to Manuel of Constantinople, and did not scruple to enter into negotiations with Zengi of Mosul. Her policy failed; and Constance successively married Raymund of Antioch and Raynald of Chatillon. The result was the renewed enmity of the Greek empire, while the French adventurers who won the prize ruined the prospects of the Franks by their conduct. In the kingdom matters were almost worse. There was hardly any regular succession to the throne; and Jerusalem, as Stubbs writes, "suffered from the weakness of hereditary right and the jealousies of the elective system" at one and the same time. With the frequent remarriages of the heiresses of the kingdom, relationships grew confused and family quarrels frequent; and when Sibylla carried the crown to Guy de Lusignan, a newcomer disliked by all the relatives of the Crown, she sealed the fate of the kingdom.

FROM LAVISSE-PARMENTIER, "ALBUM HISTORIQUE," AFTER SCHLUMBERGER

FIG. 3.—SARACEN ARMY ON THE MARCH AGAINST THE CRUSADERS. REPRODUCED FROM AN ILLUMINATION ON A 13TH-CENTURY ARABIC MANUSCRIPT

[1]One must remember that these reinforcements would often consist of desperate characters. It was one of the misfortunes of Palestine that it served as a Botany Bay, to which the criminals of the West were transported for penance. The natives, already prone to the immorality which must infect a mixed population living under a hot sun, the immorality which still infects a place like Aden, were not improved by the addition of convicts.

It may be doubted—though it seems a harsh verdict to pass on a kingdom founded by religious zeal on holy soil—whether the kingdom possessed that moral basis which alone can give a right of survival to any institution or organization. The crusading States had been founded by adventurers who thirsted for gain; and the primitive appetite did not lose its edge with the progress of time. We cannot be certain, indeed, how far the Frankish lords oppressed their Syrian tenants: the stories of such oppression have been discredited; and if we may trust the evidence of a Mohammedan traveller, Ibn Jubair, the lot of the Mohammedans who lived on Frankish manors was better than it had been under their native lords[1]. But the habits of the Franks were none the less habits of lawless greed: they swooped down from their castles, as Raynald of Chatillon did from Krak of the Desert, to capture Saracens and hold them to ransom or to plunder caravans. The lust of unlawful gain had infected the Frankish blood, as it also infected England during the Hundred Years' War; and in either case Nemesis infallibly came. The Muslims might have endured a State of "infidels"; they could not endure a State of brigands.

THE SECOND CRUSADE

We speak of first, second and third crusades, but, more exactly, the crusades were one continuous process. Scarcely a year passed in which new bands did not come to the Holy Land. We have already noticed the great if disastrous crusade of 1100–01 and the Venetian crusade of 1123–24, and reference is made to the crusade of Henry the Lion in 1172 and that of Edward I. in 1271–72—all famous crusades which are not reckoned in the usual numbering. Crusades appear to have been dignified by numbers when they followed some crushing disaster—the loss of Edessa in 1144, or the fall of Jerusalem in 1187—and were led by kings and emperors; or when, like the fourth and fifth crusades, they achieved some conspicuous success or failure. But it is important to bear in mind the continuity of the crusades—the constant flow of new forces eastward and back again westward; for this alone explains why the crusades formed a great epoch in civilization, familiarizing, as they did, the West with the East.

The years 1143–44 are in many ways the turning point in the history of the Latin East. In 1143 began the reign of the first

[1]The manorial system in the Latin kingdom of Jerusalem was a continuation of the village system as it had existed under the Arabs. In each village (*casale*) the *rustici* were grouped in families (*foci*); the tenants paid from $\frac{1}{4}$ to $\frac{1}{2}$ of the crop, besides a poll-tax and labour-dues. The villages were mostly inhabited by Syrians: it was rarely that Franks settled down as tillers of the soil. Prutz regards the manorial system as oppressive. Absentee landlords, he thinks, rack-rented the soil (p. 167), while the "inhuman severity" of their treatment of villeins led to a progressive decay of agriculture, destroyed the economic basis of the Latin kingdom, and led the natives to welcome the invasion of Saladin (pp. 327–331).

The French writers Rey and Dodu are more kind to the Franks; and the testimony of contemporary Arabic writers, who seem favourably impressed by the treatment of their subjects by the Franks, bears out their view, while the tone of the assizes is admittedly favourable to the Syrians. One must not forget that there was a brisk native manufacture of carpets, pottery, ironwork, gold-work and soap; or that the Syrians of the towns had a definite legal position.

native king[1]; and about this date may be placed the final organization of the kingdom, witnessed by the completion of its body of customary law. At the same date, however, the decline of the kingdom also begins; the fall of Edessa is the beginning of the end. In 1143 John Comnenus and Fulk had just died, and Zengi, seeing his way clear, was able to throw himself on the great Christian outpost, and finally entered on Christmas day 1144. Two years later Zengi died; but he left an able successor in his son, Nureddin, and an attempt to recover Edessa was successfully repelled in Nov. 1146. Not only so, but in the spring of 1147 the Franks were unwise enough to allow the hope of gaining two small towns to induce them to break the vital alliance with Damascus. Thus, in itself, the position of affairs in the Holy Land in 1147 was certainly ominous; aid from the West seemed a necessity.

Early in 1145 news had come from Antioch to Eugenius III. of the fall of Edessa, and at the end of the year he had sent an encyclical to France—the natural soil, as we have seen, of crusading zeal. The response was instantaneous: Louis VII. of France himself, who bore on his conscience the burden of an unpunished massacre by his troops at Vitry in 1142[2], took the crusading vow on Christmas Day of 1145. But the greatest success was attained when St. Bernard—no great believer in pilgrimages, and naturally disposed to doubt the policy of a second crusade—was induced by the pope to become the preacher of the new movement. To the crusading king of France St. Bernard added the king of Germany, when, in Christmas week of 1146, he induced Conrad III. to take the vow by his sermon in the cathedral of Spires. Thus was begun the second crusade, under auspices still more favourable than those which attended the beginning of the first, seeing that kings now took the place of knights, while the new crusaders would no longer be penetrating into the wilds, but would find a friendly basis of operations ready to their hands in Frankish Syria. But the more favourable the auspices, the greater proved the failure. Already at the final meeting at Étampes, in 1147, difficulties arose. Manuel Comnenus demanded that all conquests made by the crusaders should be his fiefs; and the question was debated whether the crusaders should follow the land route through Hungary, along the old road of Charlemagne, or should go by sea to the Holy Land. On this question the envoys of Manuel and of Roger of Sicily, who were engaged in hostilities with one another, took opposite sides. Conrad, related by marriage to Manuel, decided in favour of the land route, which Manuel desired because it brought the crusade more under his direction, and because, if the route by sea were followed, Roger of Sicily might be able to divert the crusading ships against Constantinople. As it was, a struggle raged between Roger and Manuel during the whole progress of the crusade, which greatly contributed towards its failure, preventing, as it did, any assistance from the Eastern empire. Nor was there any real unity among the crusaders themselves. The crusaders of northern Germany never went to the Holy Land at all; they were allowed the crusaders' privileges for attacking the Wends to the east of the Elbe—a fact which at once attests the cleavage between northern and southern Germany (intensified of late years by the war of investitures), and anticipates the age of the Teutonic knights and their long crusade on the Baltic. The crusaders of the Low Countries and of England took the sea route, and attacked and captured Lisbon on their way, thus helping to found the kingdom of Portugal, and achieving the one real success which was gained by the second crusade[3].

[1] After 1143 one may therefore speak of the period of the Epigom—the native Franks, ready to view the Muslims as joint occupants of Syria, and to imitate the dress and habits of their neighbours.

[2] Doubt has been cast on the view that a troubled conscience drove Louis to take the cross; and his action has been ascribed to simple religious zeal (*cf.* Lavisse, *Histoire de France,* iii. 12).

[3] This body of crusaders ultimately reached the Holy Land, where it joined Conrad (who had lost his own original forces), and helped in the fruitless siege of Damascus. The services which it rendered to Portugal were repeated by later crusaders. Crusaders from the Low Countries, England and the Scandinavian north took the coast route round western Europe; and it was natural that, landing for provisions and water, they should be asked, and should consent, to lend their aid to the natives against the Moors. Such aid is recorded to have been given on the third and fifth crusades.

Among the great army of crusaders who actually marched to Jerusalem there was little real unity. Conrad and Louis VII. started separately, and at different times, in order to avoid dissensions between their armies; and when they reached Asia Minor (after encountering some difficulties in Greek territory) they still acted separately. Eager to win the first spoils, the German crusaders, who were in advance of the French, attempted a raid into the sultanate of Iconium; but after a stern fight at Dorylaeum they were forced to retreat (Oct. 1147), and for the most part perished by the way. Louis VII., who now appeared, was induced by this failure to take the long and circuitous route by the west coast of Asia Minor; but even so he had lost the majority of his troops when he reached the Holy Land in 1148. Here he joined Conrad (who had come by sea from Constantinople) and Baldwin III., and after some deliberation the three sovereigns resolved to attack Damascus. The attack was impolitic: Damascus was the one ally which could help the Franks to stem the advance of Nureddin. It proved as futile as it was impolitic; for the vizier of Damascus, Muin-eddin-Anar, was able to sow dissension between the native Franks and the crusaders; and by bribes and promises of tribute he succeeded in inducing the former to make the siege an absolute failure, at the end of only four days (July 28, 1148). The second crusade now collapsed. Conrad returned to Constantinople in the autumn of 1148, and Louis VII. returned by sea to France in the spring of 1149. The only effects of this great movement were effects prejudicial to the ends towards which it was directed. The position of the Franks in the Holy Land was not improved by the attack on Damascus; while the ignominious failure of a crusade led by two kings brought the whole crusading movement into discredit in western Europe, and it was utterly in vain that Suger and St. Bernard attempted to gather a fresh crusade in 1150.

Consequences of Failure.—The result of the failure of the second crusade was the renewal of Nureddin's attacks. The rest of the county of Edessa, including Tell-bashir on the west, was now conquered (1150); while Raymund of Antioch was defeated and killed (in 1149), and several towns in the east of his principality were captured. Baldwin III. attempted to make head against these troubles, partly by renewing the old alliance with Damascus, partly by drawing closer to Manuel of Constantinople. For the next 20 years, during the reigns of Baldwin and his brother Amalric I., there was a close connection between the kingdom of Jerusalem and the East Roman empire. Baldwin and Amalric both married into the Comnenian house, while Manuel married Mary of Antioch, the daughter of Raymund. In the north Manuel enjoyed the homage of Antioch, which his father had gained in 1137, and the nominal possession of Tell-bashir, which had been ceded to him by Baldwin III.: in the south he joined with Amalric I. in the attempt to acquire Egypt (1168–71). In this way he acquired a certain ascendancy over the Latin kings: Baldwin III. rode behind him at Antioch in 1159 without any of the insignia of royalty, and in an inscription at Bethlehem of 1172 Amalric I. had the name of the emperor written above his own[1]. The patronage of Constantinople, to which Jerusalem was thus practically surrendered, contributed to some slight extent in maintaining the kingdom against Nureddin. But there were dissensions within, both between Baldwin and his mother, Melisinda, who sought to protract her regency unduly, and between contending parties in Antioch, where the hand of Constance, Raymund's widow, was a desirable prize; and from without the horns of the crescent were slowly closing in on the kingdom. Nureddin pursued in his policy the tactics which the Mohammedans used against the Franks in battle: he sought to envelop their territories on every side. In 1154 fell Damascus, and the crescent closed perceptibly in the north: the most valuable ally of the kingdom was lost, and the way seemed clear from Aleppo (the peculiar seat of

[1] Manuel was an ambitious sovereign, apparently aiming at a world-monarchy, such as was afterwards attempted from the other side by Henry VI. As Henry VI. had designs on Constantinople and the Eastern empire, so Manuel cherished the ambition of acquiring Italy and the Western empire, and he negotiated with Alexander III. to that end in 1167 and 1169: *cf.* the life of Alexander III. in Muratori, *S.R.I.* iii. 460.

Nureddin's power) into Egypt. On the other hand, in 1153 Baldwin III. had taken Ascalon, which for 50 years had mocked the efforts of successive kings, and by this stroke he might appear to have closed for Nureddin the route to Egypt, and to have opened a path for its conquest by the Franks. For the future, events hinged on the situation of affairs in Egypt, and in Egypt the fate of the kingdom of Jerusalem was finally decided (*see* EGYPT: *History,* "Mohammedan Period"). There was a race for the possession of the country between Nureddin's lieutenant Shīrgūh or Shīrkūh and Amalric I., the brother and successor of Baldwin III.; and in the race Shīrkūh proved the winner.

Since the days of Godfrey and Baldwin I., Egypt had been a goal of Latin ambition, and the capture of Ascalon must obviously have given form and strength to the projects for its conquest. Plans of attack were sketched; routes were traced; distances were measured; and finally in 1163 there came the impulse from within which turned these plans into action. The Shiite caliphs of Egypt were by this time the playthings of contending viziers, as the Sunnite caliphs of Baghdad had long been the puppets of Turkish sultans and amirs; and in 1164 Amalric I. and Nureddin were fighting in Egypt in support of two rival viziers, Dirgham and Shawar. For Nureddin the fight meant the acquisition of an heretical country for the true faith of the Sunnite, and the final enveloping of the Latin kingdom[1]: for Amalric it meant the escape from Nureddin's net, and a more direct and lucrative contact with Eastern trade. Into the vicissitudes of the fight it is not necessary here to enter; but in the issue Nureddin won, in spite of the support which Manuel gave to Amalric. Nureddin's Kurdish lieutenant, Shīrgūh, succeeded in establishing in power the vizier whom he favoured, and finally in becoming vizier himself (Jan. 1169); and when he died, his nephew Saladin (Sala-ed-din) succeeded to his position (March 1169), and made himself, on the death of the caliph in 1171, sole ruler in Egypt. Thus the Shiite caliphate became extinct: in the mosques of Cairo the name of the caliph of Baghdad was now used; and the long-disunited Mohammedans at last faced the Christians as a solid body. But nevertheless the kingdom of Jerusalem continued almost unmenaced, and practically undiminished, for the next 16 years. If a religious union had been effected between Egypt and northern Syria, political disunion still remained; and the Franks were safe as long as it lasted. Saladin acted as the peer of Nureddin rather than as his subject; and the jealousy between the two kept both inactive till the death of Nureddin in 1174. Nureddin left only a minor in his place: Amalric, who died in the same year, left a son (Baldwin IV.) who was not only a minor but also a leper; and thus the stage seemed cleared for Saladin. He was confronted, however, by Raymund, count of Tripoli, the one man of ability among the decadent Franks, who acted as guardian of the kingdom; and he was also occupied in trying to win for himself the Syrian possessions of Nureddin. The task engaged his attention for nine years. Damascus he acquired as early as 1174; but Raymund supported the heir of Nureddin in his capital at Aleppo, and it was not until 1183 that Saladin entered the city, and finally brought Egypt and northern Syria under a single rule.

Loss of Jerusalem.—The hour of peril for the Latin kingdom had now at last struck. It had done little to prepare itself for that hour. Repeated appeals had been sent to the West from the beginning of the Egyptian affair (1163) onwards; and in 1184–85 a great mission, in which the patriarch of Jerusalem and the masters of the Templars and the Hospitallers were associated, came to France and England, and offered the crown of Jerusalem to Philip Augustus and Henry II.[2] in turn, in order to secure their presence in the Holy Land. The only result of these appeals was the rise of a regular system of taxation in France and England, *ad sustentationem Hierosolimitanae terrae,* which starts about 1185 (though there had already been isolated instances in 1147 and 1166), and may almost be described as the beginning of modern taxation. In the East itself, with the exception of the tax of 1183[1], nothing was done that was good, and two things were done which were evil. Sibylla married her second husband, Guy de Lusignan, in 1180—a marriage destined to be the cause of many dissensions; for Sibylla, the eldest daughter of Amalric I., carried to her husband—a French adventurer—a presumptive title to the Crown, which would never be admitted without dispute.

In 1186 Guy eventually became king, following the death of Baldwin V. (Sibylla's son by her first marriage); but his coronation was in violation of the promise given to Raymund of Tripoli (that in the event of the death of Baldwin V. without issue the succession should be determined by the pope, the emperor and the kings of France and England), and Guy, with a weak title, was unable to exercise any real control over the kingdom. At this point another French adventurer, who had already made himself somewhat of a name in Antioch, gave the final blow to the kingdom. Raynald of Chatillon, the second husband of Constance of Antioch, after languishing in captivity from 1159 to 1176, had been granted the seignory of Krak, to the east and south of the Dead sea. From this point of vantage he began depredations on the Red sea (1182), building a fleet, and seeking to attack Medina and Mecca—a policy which may be interpreted either as mere buccaneering, or as a calculated attempt to deal a blow at Mohammedanism in its very centre. Driven from the Red sea by Saladin, he turned from buccaneering to brigandage, and infested the great trade-route from Damascus to Egypt, which passed close by his seignory. In 1186 he attacked a caravan in which the sister of Saladin was travelling, thus violating a four years' truce, which, after some two years' skirmishing, Saladin and Raymund of Tripoli had made in the previous year owing to the general prevalence of famine. The coronation of one French adventurer and the conduct of another, whom the first was unable to control, meant the ruin of the kingdom; and Saladin at last delivered in full force his long-deferred attack. The crusade was now at last answered by the counter-crusade—the *jihad;* for though for many years past Saladin had, in his attempt to acquire all the inheritance of Nureddin, left Palestine unmenaced and intact, his ultimate aim was always the holy war and the recovery of Jerusalem. The acquisition of Aleppo could only make that supreme object more readily attainable; and he had therefore spent his time in acquiring Aleppo, but only in order that he might ultimately "attain the goal of his desires, and set the mosque of Aksa free, to which Allah once led in the night his servant Mohammed." Thus it was on a kingdom of crusaders who had lost the crusading spirit that a new crusade swept down; and Saladin's army in 1187 had the spirit and the fire of the Latin crusaders of 1099. The tables were turned; and fighting on their own soil for the recovery of what was to them too a holy place, the Mohammedans easily carried the day. At Tiberias a little squadron of the brethren of the two Orders went down before Saladin's cavalry in May; at Hattin the levy *en masse* of the kingdom, some 20,000 strong, foolishly marching over a sandy plain under the heat of a July sun, was utterly defeated; and after a fortnight's siege Jerusalem capitulated (Oct. 2, 1187). In the kingdom itself nothing was left to the Latins by the end of 1189 except the city of Tyre; and to the north of the kingdom they held only Antioch and Tripoli, with the Hospitallers' fortress at Margat. The fingers of the clock had been pushed back; once more things were as they had been at the time of the first crusade; once more the West must arm itself for the holy war and the recovery of Jerusalem—but now it must face a united Mohammedan world, where in 1096 it had found political and religious dissension, and it must attempt its vastly heavier task without the morning freshness of a new religious impulse, and with something of the weariness of 100 years of struggle upon its shoulders.

[1]Nureddin, unlike his father, was definitely animated by a religious motive: he fought first and foremost against the Latins (and not, like his father, against Muslim States), and he did so as a matter of religious duty.

[2]Henry II., as an Angevin, was the natural heir of the kingdom of Jerusalem on the extinction of the line descended from Fulk of Anjou. This explains the part played by Richard I. in deciding the question of the succession during the third crusade.

[1]The taxation levied in the West was also attempted in the East, and in 1183 a universal tax was levied in the kingdom of Jerusalem, at the rate of 1% on movables and 2% on rents and revenues. *Cf.* Dr. A. Cartellieri, *Philippe II. August,* ii. pp. 3–18 and p. 85.

THE THIRD CRUSADE (1189–1192)

The 40 years from 1189 to 1229 form a period of incessant crusading, occupied by crusades of every kind. There are the third, fifth and sixth crusades against the "infidel" Mohammedans encamped in the Holy Land; there is the Albigensian crusade against the heretic Cathars; there is the fourth crusade, directed in the issue against the schismatic Greeks; lastly, there are the crusades waged by the papacy against revolted Christians—John of England and Frederick II. Our concern lies with the first kind of crusade, and with the other three only so far as they bear on the first, and as they illustrate the immense widening which the term "crusade" now underwent—a widening accompanied by its inevitable corollary of shallowness of motive and degradation of impulse.

It was Conrad, the marquis of Montferrat, who as much as any one man was responsible for the third crusade. Compelled to leave the court of Constantinople, which he had been serving, he had sailed for the Holy Land and reached Tyre about three weeks after the battle of Hattin. He had saved Tyre; and from it he sent his appeals to the West. Not the least effective of these appeals was a great poster which he had circulated in Europe, and which represented the Holy Sepulchre defiled by the horses of the Mohammedans. Meanwhile the papacy, as soon as the news reached Rome, despatched encyclicals throughout Europe; and soon a new crusade was in full swing. But the third crusade, unlike the first, does not spring from the papacy, which was passing through one of its epochs of depression; it springs from the lay power, which, represented by the three strong monarchies of Germany, England and France, was at this time dominant in Europe. In Germany it was the solemn national Diet of Mainz (Easter 1188) which "swore the expedition" to the Holy Land; in France and England the agreement of the two kings decided upon a joint crusade. The very means which Philip Augustus and Henry II. took, in order to further the crusade, show its lay aspect. A scheme of taxation—the Saladin tithe—was imposed on all who did not take the cross; and this taxation, while on the one hand it drove many to take the cross in order to escape its incidence, on the other hand provided a necessary financial basis for military operations. The "economic" motive for taking the cross was strengthened by the regulations made in favour of debtors who joined the crusade. Thousands must have joined the third crusade in order to escape paying either their taxes or the interest on their debts; and the atmosphere of the gold-digger's camp (or of the cave of Adullam) must have begun more than ever to characterize the crusading armies. The lay basis of the third crusade made it, in one sense, the greatest of all crusades, in which all the three great monarchs of western Europe participated; but it also made it a failure, for the kings of France and England carried their political rivalries into the movement, in which it had been agreed that they should be sunk. Spiritually, therefore, the third crusade is inferior to the first, however imposing it may be in its material aspects. Yet it must be admitted that the idea of a spiritual regeneration accompanied the crusading movement of 1188. Europe had sinned in the face of God; otherwise Jerusalem would never have fallen; and the idea of a spiritual reform from within, as the necessary corollary and accompaniment of the expedition of Christianity without, breathes in some of the papal letters.

We may conceive of the third crusade under the figure of a number of converging lines, all seeking to reach a common centre. That centre is Acre. The siege of Acre, as arduous and heroic in many of its episodes as the siege of Troy, had been begun in the summer of 1189 by Guy de Lusignan, who, captured by Saladin at the battle of Hattin, and released on parole, had at once broken his word and returned to the attack. The army which was besieging Acre was soon joined by various contingents; for Acre, after all, was the vital point, and its capture would open the way to Jerusalem. Two of these contingents alone concern us here—the German and the Anglo-French. Frederick I. of Germany, using a diplomacy which corresponds to the lay character of the third crusade, had sought to prepare his way by embassies to the king of Hungary, the Eastern emperor and the sultan of Iconium. Starting from Regensburg in May 1189, the German army marched quietly through Hungary; but difficulties arose, as they had arisen in 1147, as soon as the frontiers of the Eastern empire were reached. The emperor Isaac Angelus had not only the old grudge of all Eastern emperors against the "upstart" emperor of the West; he had also allied himself with Saladin, in order to acquire for his empire the patronage of the Holy Places and religious supremacy in the Levant. The difficulties between Frederick and Isaac Angelus became acute: in Nov. 1189 Frederick wrote to his son Henry, asking him to induce the pope to preach a crusade against the schismatic Greeks. But terms were at last arranged, and by the end of March 1190 the Germans had all crossed to the shores of Asia Minor. Taking a route midway between the eastern route of the crusaders of 1097 and the western route of Louis VII. in 1148, Frederick marched by Philadelphia and Iconium, not without dust and heat, until he reached the river Salef, in Armenian territory. Here, with the burden of the day now past, the fine old crusader—he had joined before in the second crusade, 40 years ago—perished by accident in the river; and of all his fine army only 1,000 men won their way through, under his son, Frederick of Swabia, to join the ranks before Acre (Oct. 1190). The Anglo-French detachment gained a greater immediate success. War had indeed disturbed the original agreement of Gisors between Philip Augustus and Henry II., but a new agreement was made by Henry's successor, Richard I., and the French king at Nonancourt (Dec. 1189), by which the two monarchs were to meet at Vezelay next year, and then follow the sea route to the Holy Land together. They met, and by different routes they both reached Sicily, where they wintered together (1190–91). The enforced inactivity of a whole winter was the mother of disputes and bad blood; and when Philip sailed for the Holy Land, at the end of March 1191, the failure of the crusade was already decided. Richard soon followed; but while Philip sailed straight for Acre, Richard occupied himself by the way in conquering Cyprus—partly out of knight-errantry, and in order to avenge an insult offered to his betrothed wife Berengaria by the despot of the island, partly perhaps out of policy, and in order to provide a basis of supplies and of operations for the armies attempting to recover Palestine. In any case, he is the founder of the Latin kingdom of Cyprus (for he afterwards sold his new acquisition to Guy de Lusignan, who established a dynasty in the island); and thereby he made possible the survival of the institutions and assizes of Jerusalem, which were continued in Cyprus until it was conquered by the Ottoman Turks. From Cyprus Richard sailed to Acre, arriving on the 8th of June, and in little more than a month he was able, in virtue of the large reinforcements he brought, and in spite of dissensions in the Christian camp which he helped to foment, to bring the two years' siege to a successful issue (July 12, 1191). It was indeed time; the privations of the besiegers during the previous winter had been terrible; and the position of affairs had only been made worse by the dissensions between Guy de Lusignan and Conrad of Montferrat, who had begun to claim the Crown in return for his services, and had, on the death of Sibylla, the wife of Guy, reinforced his claim by a marriage with her younger sister, Isabella. In these dissensions it was inevitable that Philip Augustus and Richard I., already discordant, should take contrary sides; and while Richard naturally sided with Guy de Lusignan, who came from his own county of Poitou, Philip as naturally sided with Conrad. At the end of July it was decided that Guy should remain king for his life, and Conrad should be his successor; but as three days afterwards Philip Augustus began his return to France (pleading ill-health, but in reality eager to gain possession of Flanders), the settlement availed little for the success of the crusade. Richard stayed in the Holy Land for another year, during which he won a battle at Arsuf and refortified Jaffa. But far more important than any hostilities are the negotiations which, for the whole year, Richard conducted with Saladin. They show the lay aspect of the third crusade; they anticipate the crusade of Frederick II.—for Richard was attempting to secure the same concessions which Frederick secured by the same means which he used. They show again the closer approximation and better understanding with the Mohammedans, which marks this crusade. Nothing is more striking in these respects than Richard's proposal that Saladin's brother should marry his own sister Johanna and receive Jerusalem and the contiguous towns on the coast. In the event, a peace was made for three years (Sept. 2, 1192), by which Lydda and Ramlah were to be equally divided, Ascalon was to be destroyed, and small bodies of crusaders were to be allowed to visit the Holy Sepulchre. Meanwhile Conrad of Montferrat, at the very instant when his superior ability had finally forced Richard to recognize him as king, had been assassinated (April 1192): Guy de Lusignan had bought Cyprus from Richard, and had sailed away to establish himself there[1]; and Henry of Champagne, Richard's nephew, had been called to the throne of Jerusalem, and had given himself a title by marrying Conrad's widow, Isabella. In this condition Richard left the Holy Land, when he began his eventful return, in Oct. 1192. The crusade had failed—failed because a leaderless army, torn by political dissensions and fighting on a foreign soil, could not succeed against forces united by religious zeal under the banner of a leader like Saladin. Yet it had at any rate saved for the Christians the principality of Antioch, the county of Tripoli, and some of the coast towns of the kingdom[2]; and if it had failed to accomplish its object, it had left behind, none the less, many important results. The difficulties which had arisen between Isaac Angelus and Frederick Barbarossa contain the germs of the fourth crusade; the negotiations between Richard and Saladin contain the germs of the sixth. National rivalries had been accentuated and national differences brought into prominence by the meeting of the nations in a common enterprise; while, on the other hand, Mohammedans and Christians had fraternized as they had never done before during the progress of a crusade. But what the third crusade showed most clearly was that the crusading movement was being lost to the papacy, and becoming part of the domain of the secular State—organized by the State on its own basis of taxation, and conducted by the State according to its own method of negotiation. This after all is the great change; and even the genius of an Innocent III. "could not make undone what had once been done." On the contrary, the thing once done would go further; and the State would take up the name of crusade in order to cover, and under such cover to achieve, its own objects and ambitions.

[1]The crusades in their course established a number of new States or kingdoms. The first crusade established the kingdom of Jerusalem (1100); the third, the kingdom of Cyprus (1195); the fourth, the Latin empire of Constantinople (1204); while the long crusade of the Teutonic knights on the coast of the Baltic led to the rise of a new State east of the Vistula. The kingdom of Lesser Armenia, established in 1195, may also be regarded as a result of the crusades. The history of the kingdom of Jerusalem is part of the history of the crusades: the history of the other kingdoms or States touches the history of the crusades less vitally. But the history of Cyprus is particularly important—and for two reasons. In the first place, Cyprus was a natural and excellent basis of operations; it sent provisions to the crusaders in 1191, and again at the siege of Damietta in 1219, while its advantages as a strategic basis were proved by the exploits of Peter of Cyprus in the 14th century. In the second place, as the Latin kingdom of Jerusalem fell, its institutions and assizes were transplanted bodily to Cyprus, where they survived until the island was conquered by the Ottoman Turks. But the monarchy was stronger in Cyprus than in Jerusalem; the fiefs were distributed by the monarch, and were smaller in extent; while the feudatories had neither the collective powers of the *haute cour* of Jerusalem, nor the individual privileges (such as jurisdiction over the bourgeoisie), which had been enjoyed by the feudatories of the old kingdom. Till 1489 the kingdom of Cyprus survived as an independent monarchy, and its capital, Famagusta, was an important centre of trade after the loss of the coast-towns in the kingdom of Jerusalem. In 1489 it was acquired by Venice, which claimed the island on the death of the last king, having adopted his widow (a Venetian lady named Catarina Cornaro) as a daughter of the republic. On the history of Cyprus, *see* Stubbs, *Lectures on Medieval and Modern History,* 156–208. The history of the kingdom of Armenia is closely connected with that of Cyprus. The Armenians in the south-east of Asia Minor borrowed feudal institutions from the Franks and the feudal vocabulary itself. The kingdom was involved in a struggle with Antioch in the early part of the 13th century. Later, it allied itself with the Mongols and fought against the Mamelukes, to whom, however, it finally succumbed in 1375.

[2]The kingdom of Jerusalem is thus from 1192 to its final fall, a strip of coast, to which it is the object of kings and crusades to annex Jerusalem and a line of communication connecting it with the coast. This was practically the aim of Richard I.'s negotiations; and this was what Frederick II. for a time secured.

THE FOURTH CRUSADE (1202–1204)

The history of the fourth crusade is a history of the predominance of the lay motive, of the attempt of the papacy to escape from that predominance, and to establish its old direction of the crusade, and of the complete failure of its attempt. Until the accession of Innocent III. in 1198 the lay motive was supreme; and its representative was Henry VI.—the greatest politician of his day, and in many ways the greatest emperor since Charlemagne. In 1195 Amalric, the brother of Guy de Lusignan, and his successor in Cyprus, sought the title of king from Henry and did homage; and at the same time Leo of Lesser Armenia, in order to escape from dependence on the Eastern empire, took the same course. Henry thus gained a basis in the Levant; and the death of Saladin in 1193, followed by a civil war between his brother, Malik-al-Adil, and his sons for the possession of his dominions, weakened the position of the Mohammedans. As emperor, Henry was eager to resume the imperial crusade which had been stopped by his father's death; and both as Frederick's successor and as heir to the Norman kings of Sicily, who had again and again waged war against the Eastern empire, he had an account to settle with the rulers of Constantinople. The project of a crusade and of an attack on Constantinople wove themselves into a single thread, in a way which very definitely anticipates the fourth crusade of 1202–04. In 1195 Henry took the cross; some time before, he had already sent to Isaac Angelus to demand compensation for the injuries done to Frederick I., along with the cession of all territories ever conquered by the Norman kings of Sicily, and a fleet to co-operate in the new crusade. In the same year, however, Isaac was dethroned by his brother, Alexius III.; but Henry married Isaac's daughter Irene to his brother, Philip of Swabia, and thus attempted to give the Hohenstaufen a new title and a valid claim against the usurper Alexius. Thus armed he pushed forward the preparations for the crusade in Germany—a crusade whose first object would have been an attack on Alexius III.; but in the middle of his preparations he died in Sicily in the autumn of 1197, and the crusade collapsed. Some results were, however, achieved by a body of German crusaders which had sailed in advance of Henry; by its influence Amalric of Cyprus succeeded Henry of Champagne, who died in 1197, as king of Jerusalem, and a vassal of the emperor thus became ruler in the Holy Land; and the Teutonic order, which had begun as a hospital during the siege of Acre (1190–91), now received its organization. Some of the coast towns, too, were recovered by the German crusaders, especially Beirut; and in 1198 the new king Amalric II. was able to make a truce with Malik-al-Adil for the next five years.

"The true heir of Henry VI.," Ranke has said, "is Innocent III.," and nowhere is this more true than in respect of the crusading movement. Throughout the course of his crowded and magnificent pontificate, Innocent III. made the crusade his ultimate object, and attempted to bring it back to its old religious basis and under the papal direction. By the spring of 1200, owing to Innocent's exertions, a new crusade was in full progress, especially in France, where Fulk of Neuilly played the part once played by Peter the Hermit. Like the first crusade, the fourth crusade—in its personnel, but not its direction—was a French enterprise; and its leading members were French feudatories like Theobald of Champagne (who was chosen leader of the crusade), Baldwin of Flanders (the future emperor of Constantinople), and the count of Blois. The objective, which these three original chiefs of the fourth crusade proposed to themselves, was Egypt[1]. Since 1163 the importance of acquiring Egypt had been definitely understood; in the summer of 1192 Richard I. had been advised by his counsellors that Cairo and not Jerusalem was the true point of attack; and in 1200 there was the additional reason for preferring an

[1]M. Luchaire, in the volume of his biography of Innocent III. called *La Question d'Orient,* shows how, in spite of the pope, the fourth crusade was in its very beginnings a lay enterprise. The crusading barons of France chose their own leader and determined their own route, without consulting Innocent.

attack on Egypt, that the truce in the Holy Land between Amalric II. and Malik-al-Adil had still three years to run. It is Egypt therefore—to which, it must be remembered, the centre of Mohammedan power had now been virtually shifted, and to which motives of trade impelled the Italian towns (since from it they could easily reach the Red sea, and the commerce of the Indian ocean)—which is henceforth the normal goal of the crusades. This is one of the many facts which differentiate the crusades of the 13th from those of the preceding century. But, with Syria in the hands of the Mohammedans, the attack on Egypt must necessarily be directed by sea; and thus the crusade henceforth becomes—what the third crusade, here as elsewhere the turning-point in crusading history, had already in part been—a maritime enterprise. Accordingly, early in 1201, envoys from each of the three chiefs of the fourth crusade (among whom was Villehardouin, the historian of the crusade) came to Venice to negotiate for a passage to Egypt. An agreement was made between the doge and the envoys, by which transport and active help were to be given by Venice in return for 85,000 marks and the cession of half of the conquests made by the crusaders.

Diversion to Constantinople.—But the fourth crusade was not to be plain sailing to Egypt. It became involved in a maelstrom of conflicting political motives, by which it was swept to Constantinople. Here we must distinguish between cause and occasion. There were three great causes which made for an attack on Constantinople by the West. There was first of all the old crusading grudge against the Eastern empire, and its fatal policy of regarding the whole of the Levant as its lost provinces, to be restored as soon as conquered, or at any rate held in fee, by the Western crusaders—a policy which led the Eastern emperors either to give niggardly aid or to pursue obstructive tactics, and caused them to be blamed for the failure of the crusades of 1101, of 1149 and of 1190. It is significant of the final result of these things that already in 1147 Roger of Sicily, engaged in war with Manuel, had proposed the sea-route for the second crusade, perhaps with some intention of diverting it against Constantinople; and in the winter of 1189–90 Barbarossa, as we have seen, had actually thought and spoken of an attack on Constantinople. In the second place, there was the commercial grudge of Venice, which had only been given large privileges by the Eastern empire to desire still larger, and had, moreover, been annoyed not only by alterations or revocations of those privileges, such as the usurper Alexius III. had but recently attempted, but also by the temporary destruction of its quarter in Constantinople in 1171. Lastly, and perhaps most of all, there is the old Norman blood-feud with Constantinople, as old as the old Norse seeking for Micklegarth, and keen and deadly ever since the Norman conquest of the Greek themes in south Italy (1041 onwards). The heirs of the Norman kings were the Hohenstaufen; and we have already seen Henry VI. planning a crusade which would primarily have been directed against Constantinople. It is this Hohenstaufen policy which becomes the primary occasion of the diversion of the fourth crusade. Philip of Swabia, engaged in a struggle with the papacy, found Innocent III. planning a Guelph crusade, which should be under the direction of the Church; and to this Guelph project he opposed the Ghibelline plan of Henry VI., with such success that he transmuted the fourth crusade into a political expedition against Constantinople. To such a policy of transmutation he was urged by two things. On the one hand, the death of the count of Champagne (May 1201) had induced the crusaders to elect as their leader Boniface of Montferrat, the brother of Conrad; and Boniface was the cousin of Philip, and interested in Constantinople, where not only Conrad, but another brother as well, had served, and suffered for their service at the hands of their masters. On the other hand Alexius, the son of the dethroned Isaac Angelus, was related to Philip through his marriage with Irene; and Alexius had escaped to the German court to urge the restoration of his father. On Christmas Day 1201, Philip, Alexius and Boniface all met at Hagenau[1] and formulated (one may suppose) a plan for the diversion of the crusade. Events played into their hands. When the crusaders gathered at Venice in the autumn of 1202, it was found impossible to get together the 85,000 marks promised to Venice. The Venetians—already, perhaps, indoctrinated in the Hohenstaufen plan—indicated to the leaders a way of meeting the difficulty: they had only to lend their services to the republic for certain ends which it desired to compass, and the debt was settled. The conquest of Zara, a port on the Adriatic claimed by the Venetians from the king of Hungary, was the only object overtly mentioned; but the idea of the expedition to Constantinople was in the air, and the crusaders knew what was ultimately expected. It took time and effort to bring them round to the diversion: the pope—naturally enough—set his face sternly against the project, the more as the usurper, Alexius III., was in negotiation with him in order to win his support against the Hohenstaufen, and Innocent hoped to find, as Alexius promised, a support and a reinforcement for the crusade in an alliance with the Greek empire. But they came round none the less, in spite of Innocent's renewed prohibitions. In Nov. 1202 Zara was taken; and at Zara the fatal decision was made. The young Alexius joined the army; and in spite of the opposition of stern crusaders like Simon de Montfort, who sailed away ultimately to Palestine, he succeeded by large promises in inducing the army to follow in his train to Constantinople. By the middle of July 1203 Constantinople was reached, the usurper was in flight, and Isaac Angelus was restored to his throne. But when the time came for Alexius to fulfil his promises, the difficulty which had arisen at Venice in the autumn of 1202 repeated itself. Alexius's resources were insufficient, and he had to beg the crusaders to wait at Constantinople for a year in order that he might have time. They waited; but the closer contact of a prolonged stay only brought into fuller play the essential antipathy of the Greek and the Latin. Continual friction developed at last into the open fire of war; and in March 1204 the crusaders resolved to storm Constantinople, and to divide among themselves the Eastern empire. In April Constantinople was captured; in May Baldwin of Flanders became the first Latin emperor of Constantinople. Venice had her own reward; a Venetian, Thomas Morosini, became patriarch; and the doge of Venice added "a quarter and a half" of the Eastern empire—chiefly the coasts and the islands—to the sphere of his sway. If Venetian cupidity had not originally deflected the crusade (and it was the view of contemporary writers that Venice had committed her first treason against Christianity by diverting the crusade from Egypt in order to get commercial concessions from Malik-al-Adil[1], yet it had at any rate profited exceedingly from that diversion; and the Hohenstaufen and their protégé Alexius only reaped dust and ashes. For, however Ghibelline might be the original intention, the result was not commensurate with the subtlety of the design, and the power of the pope was rather increased than diminished by the event of the crusade. The crusaders appealed to Innocent to ratify the subjugation of a schismatic people, and the union of the Eastern and Western Churches; and Innocent, dazzled by the magic of the *fait accompli*, not unwillingly acquiesced. He might soothe himself by reflecting that the basis for the crusade, which he had hoped to find in Alexius III., was still more securely offered by Baldwin; he could not but feel with pride that he had become "as it were pope and apostolicus of a second world." Yet the result of the fourth crusade was on the whole disastrous both for the papacy and for the crusading movement. The pope had been forced to see the helm of the crusades wrenched from his grasp; and the Albigensian crusade against the heretics of southern France was soon afterwards to show that the example could be followed, and that the land-hunger of the north French baronage could exploit a crusade as successfully as ever did Hohenstaufen policy leagued with Venetian cupidity. The crusade lost its *élan* when it became a move in a political game. If the third crusade had been directed by the lay power towards the true spiritual end of all crusades, the fourth was directed by the lay power to its

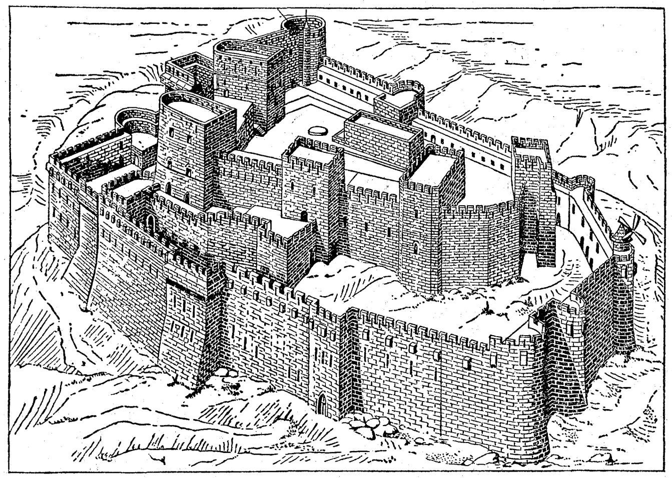
[1]There seems to be little doubt of Philip's complicity in the diversion of the fourth crusade to Constantinople (*cf.* M. Luchaire, *La Question d'Orient*, pp. 84–86).

[1]It is true that in 1208 Venice received commercial concessions from the court of Cairo. But this *ex post facto* argument is the sole proof of this view; and it is quite insufficient to prove the accusation.

own lay ends; and the political and commercial motives, which were deeply implicit even in the first crusade, had now become dominantly explicit. In a simpler and more immediate sense, the capture of Constantinople was detrimental to the movement from which it sprang. The precarious empire which had been founded in 1204 drained away all the vigorous adventurers of the West for its support for many years to come, and the Holy Land was starved to feed a land less holy, but equally greedy of men. No basis for the crusades was ever to be found in the Latin empire of the East; and Innocent, after vainly hoping for the new crusade which was to emerge from Constantinople, was by 1208 compelled to return to the old idea of a crusade proceeding simply and immediately from the West to the East.

THE FIFTH CRUSADE (1218–1221)

The glow and glamour of the crusades disappear save for the pathetic sunset splendours of St. Louis, as Dandolo dies, and gallant Villehardouin drops his pen. But before St. Louis sailed for Damietta there intervened the failure of one crusade, and the secular and diplomatic success of another. The fifth crusade is the last started in that pontificate of crusades—the pontificate of Innocent III. It owed its origin to his feverish zeal for the recovery of Jerusalem, rather than to any pressing need in the Holy Land. Here reigned, during the 40 years of the loss of Jerusalem, an almost unbroken peace. Malik-al-Adil, the brother of Saladin, had by 1200 succeeded to his brother's possessions not only in Egypt but also in Syria, and he granted the Christians a series of truces (1198–1203, 1204–10, 1211–17). While the Holy Land was thus at peace, crusaders were also being drawn elsewhere by the needs of the Latin empire of Constantinople, or the attractions of the Albigensian crusade (*see* ALBIGENSES). But Innocent could never consent to forget Jerusalem, as long as his right hand retained its cunning. The pathos of the Children's crusade of 1212 only nerved him to fresh efforts. A shepherd boy named Stephen had appeared in France, and had induced thousands to follow his guidance: with his boyish army he rode on a wagon southward to Marseille, promising to lead his followers dry-shod through the seas. In Germany a child from Cologne, named Nicolas, gathered some 20,000 young crusaders by like promises, and led them into Italy. Stephen's army was kidnapped by slave-dealers and sold into Egypt; while Nicolas's expedition left nothing behind it but an after-echo in the legend of the Pied Piper of Hamelin. But for Innocent these outbursts of the revivalist element, which always accompanied the crusades, had their moral: "the very children put us to shame," he wrote; "while we sleep they go forth gladly to conquer the Holy Land." In the fourth Lateran Council of 1215 Innocent found his opportunity to rekindle the flickering fires. Before this great gathering of all Christian Europe he proclaimed a crusade for the year 1217, and in common deliberation it was resolved that a truce of God should reign for the next four years, and for the same period all trade with the Levant should cease. Here two things were attempted—neither, indeed, for the first time[1]—which 14th-century pamphleteers on the subject of the crusades unanimously advocate as the necessary conditions of success; there was to be peace in Europe and a commercial war with Egypt. This statesmanlike beginning of a crusade, preached, as no crusade had ever been preached before, in a general council of all Europe, presaged well for its success. In Germany (where Frederick II. himself took the cross in this same year) a large body of crusaders gathered together: in 1217 the south-east sent the duke of Austria and the king of Hungary to the Holy Land; while in 1218 an army from the north-west joined at Acre the forces of the previous year. Egypt had already been indicated by Innocent III. in 1215 as the goal of attack, and it was accordingly resolved to begin the crusade by the siege of Damietta, on the eastern delta of the Nile. The original leader of the crusade was John of Brienne, king of Jerusalem (who had succeeded Amalric II., marrying Maria, the daughter of Amalric's wife Isabella by her former husband, Conrad of Montferrat); but after the end of 1218 the cardinal legate Pelagius, fortified by papal letters, claimed the command. In spite of dissensions between the cardinal and the king, and in spite of the offers of Malik-al-Kamil (who succeeded Malik-al-Adil at the end of 1218), the crusaders finally carried the siege to a successful conclusion by the end of 1219. The capture of Damietta was a considerable feat of arms, but nothing was done to clinch the advantage which had been



FROM LAVISSE & PARMENTIER, "ALBUM HISTORIQUE"

FIG. 4.—KRAK DES CHEVALIERS

This fortress was constructed about the beginning of the 13th century by the Knights of St. John of Jerusalem. It stands on a height in the county of Tripoli, north of the old kingdom of Jerusalem, and was captured by Bibars, Sultan of Egypt, in 1271

won, and the whole of the year 1220 was spent by the crusaders in Damietta, partly in consolidating their immediate position, and partly in waiting for the arrival of Frederick II., who had promised to appear in 1221. In 1221 Hermann of Salza, the master of the Teutonic order, along with the duke of Bavaria, appeared in the camp before Damietta; and as it seemed useless to wait any longer for Frederick II., the cardinal, in spite of the opposition of King John, gave the signal for the march on Cairo[1]. The army reached a fortress (erected by the sultan in 1219, afterwards, from 1221, the town of Mansura), and encamped there at the end of July. Here the sultan reiterated terms which he had already offered several times before—the cession of most of the kingdom of Jerusalem, the surrender of the cross (captured by Saladin in 1187), and the restoration of all prisoners. King John urged the acceptance of these terms. The legate insisted on a large indemnity in addition: the negotiations failed, and the sultan prepared for war. The crusaders were driven back towards Damietta; and at the end of Aug. 1221 Pelagius had to make a treaty with Malik-al-Kamil, by which he gained a free retreat and the surrender of the Holy Cross at the price of the restoration of Dammietta. The treaty was to last for eight years, and could only be broken on the coming of a king or emperor to the East. In pursuance of its terms the crusaders evacuated Egypt, and the fifth crusade was at an end. It is difficult to decide whether to blame the legate or the emperor more for its failure. If Frederick had only come in person, a single month of his presence might have meant everything: if Pelagius had only listened to King John, the sultan was ready to concede practically everything which was at issue. Unhappily Frederick preferred to put his Sicilian house in order, and the legate preferred to listen to the Italians, who had their own commercial reasons for wishing to establish a strong position in Egypt, and to the Templars and Hospitallers, who did not feel satisfied by the terms offered by the sultan, because he wished to retain in his hands the two fortresses of Krak and Monreal.

[1] A canon of the third Lateran Council (1179) forbade traffic with the Saracens in munitions of war; and this canon had been renewed by Innocent in the beginning of his pontificate.

[1] He had promised the pope, at his coronation in 1220, to begin his crusade in August 1221. But he declared himself exhausted by the expenses of his coronation; and Honorius III. consented to defer his crusade until March 1222. The letter of the pope informing Pelagius of this delay is dated June 20; it would probably reach his hands *after* his departure from Damietta; and thus the cardinal gave the signal for the march, when, as he thought, the emperor's coming was imminent.

THE SIXTH CRUSADE (1228–1229)

The sixth crusade succeeded as signally as the fifth had failed; but the circumstances under which it took place and the means by which it was conducted made its success still more disastrous than the failure of 1221. The last crusade had, after all, been under papal control: if Richard I. directed the third crusade, and the policy of the Hohenstaufen and the Venetians directed the fourth, it was a papal legate who steered the fifth to its fate. The crusade of Frederick II. in 1228–29 finds its analogy in the projected crusade of Henry VI.; it is essentially lay. It is unique in the annals of the crusades. Alone of all crusades (though the fourth crusade offers some analogy) it was not blessed but cursed by the papacy: alone of all the crusades it was conducted without a single act of hostility against the Mohammedan. St. Louis, the true type of the religious crusader, once said that a layman ought only to argue with a blasphemer against Christian law by running his sword into the bowels of the blasphemer as far as it would go: Frederick II. talked amicably with all unbelievers, if one may trust Arabic accounts, and he achieved by mere negotiation the recovery of Jerusalem, for which men had vainly striven with the sword for the 40 years since 1187. It was in 1215 that the leader of this strange crusade had first taken the vow; it was 12 years afterwards when he finally attempted to carry the vow into effective execution. Again and again he had excused himself to the pope, and been excused by the pope, because the exigencies of his policy in Germany or Sicily tied his hands. After the failure of the fifth crusade—for which these delays were in part responsible—Honorius III. had attempted to bind him more intimately to the Holy Land by arranging a marriage with Isabella, the daughter of John of Brienne, and the heiress of the kingdom of Jerusalem. In 1225 Frederick married Isabella, and immediately after the marriage he assumed the title of king in right of his wife, and exacted homage from the vassals of the kingdom[1]. It was thus as king of Jerusalem that Frederick began his crusade in the autumn of 1227. Scarcely, however, had he sailed from Brindisi when he fell sick of a fever which had been raging for some time among the ranks of his army, while they waited for the crossing. He sailed back to Otranto in order to recover his health, but the new pope, Gregory IX., launched in hot anger the bolt of excommunication, in the belief that Frederick was malingering once more. None the less the emperor sailed on his crusade in the summer of 1228, affording to astonished Europe the spectacle of an excommunicated crusader, and leaving his territories to be invaded by papal soldiers, whom Gregory IX. professed to regard as crusaders against a non-Christian king, and for whom he accordingly levied a tithe from the churches of Europe. The paradox of Frederick's crusade is indeed astonishing. Here was a crusader against whom a crusade was proclaimed in his own territories; and when he arrived in the Holy Land he found little obedience and many insults from all but his own immediate followers. Yet by adroit use of his powers of diplomacy and by playing upon the dissensions which raged between the descendants of Saladin's brother (Malik-al-Adil), he was able, without striking a blow, to conclude a treaty with the sultan of Egypt which gave him all that Richard I. had vainly attempted to secure by arduous fighting and patient negotiations. By the treaty of Feb. 18, 1229, which was to last for ten years, the sultan conceded to Frederick, in addition to the coast towns already in the possession of the Christians, Nazareth, Bethlehem and Jerusalem, with a strip of territory connecting Jerusalem with the port of Acre. As king of Jerusalem Frederick was now able to enter his capital: as one under excommunication, he had to see an interdict immediately fall on the city, and it was with his own hands—for no churchman could perform the office—that he had to take his crown from the altar of the church of the Sepulchre, and crown himself king of his new kingdom. He stayed in the Holy Land little more than a month after his coronation; and leaving in May he soon overcame the papal armies in Italy, and secured absolution from Gregory IX. (Aug. 1229). By his treaty with the sultan he had secured for Christianity the last 15 years of its possession of Jerusalem (1229–44): no man after Frederick II., until our own day, ever recovered the holy places for the religion which holds them most holy. Yet the Church might ask, with some justice, whether the means he had used were excused by the end which he had attained. After all, there was nothing of the holy war about the sixth crusade: there was simply huckstering, as in an Eastern bazaar, between a free-thinking, semi-oriental king of Sicily and an Egyptian sultan. It was indeed in the spirit of a king of Sicily, and not in the spirit—though it was in the rôle—of a king of Jerusalem, that Frederick had acted. It was from his Sicilian predecessors, who had made trade treaties with Egypt, that he had learned to make even the crusade a matter of treaty. The Norman line of Sicilian kings might be extinct; their policy lived after them in their Hohenstaufen successors, and that policy, as it had helped to divert the fourth crusade to the old Norman objective of Constantinople, helped still more to give the sixth crusade its secular, diplomatic, non-religious aspect.

[1]John of Brienne had only ruled in right of his wife, Mary. On her death (1212) John might be regarded as only ruling "by the courtesy of the kingdom" until her daughter, Isabella, was married, when the husband would succeed. That, at any rate, was the view Frederick II. took.

Forty years of struggle terminated in the possession of Jerusalem for 15 years. During those 15 years the kingdom of Jerusalem was agitated by a struggle between the native barons, championing the principle that sovereignty resided in the collective baronage, and taking their stand on the assizes, and Frederick II., claiming sovereignty for himself, and opposing to the assizes the feudal law of Sicily. It is a struggle between the king and the *haute cour:* it is a struggle between the aristocratic feudalism of the Franks and the monarchical feudalism of the Normans. Already in Cyprus, in the summer of 1228, Frederick II. had insisted on the right of wardship which he enjoyed as overlord of the island[1], and he had appointed a commission of five barons to exercise his rights. In 1229 this commission was overthrown by John of Ibelin, lord of Beirut, against whom it had taken proceedings. John of Beirut, like many of the Cypriot barons, was also a baron of the kingdom of Jerusalem; and resistance in the one kingdom could only produce difficulties in the other. Difficulties quickly arose when Frederick, in 1231, sent Marshal Richard to Syria as his legate. This in itself was a serious matter; according to the assizes, the barons maintained, the king must either personally reside in the kingdom, or, in the event of his absence, be represented by a regency. The position became more difficult, when the legate took steps against John of Beirut without any authorization from the high court. A gild was formed at Acre—the gild of St. Adrian—which, if nominally religious in its origin, soon came to represent the political opposition to Frederick, as was significantly proved by its reception of the rebellious John of Beirut as a member (1232). The opposition was successful: by 1233 Frederick had lost all hold on Cyprus, and only retained Tyre in his own kingdom of Jerusalem. In 1236 he had to promise to recognize fully the laws of the kingdom: and when, in 1239, he was again excommunicated by Gregory IX., and a new quarrel of papacy and empire began, he soon lost the last vestiges of his power. Till 1243 the party of Frederick had been successful in retaining Tyre, and the baronial demand for a regency had remained without effect; but in that year the opposition, headed by the great family of Ibelin, succeeded, under cover of asserting the rights of Alice of Cyprus to the regency, in securing possession of Tyre, and the kingdom of Jerusalem thus fell back into the power of the baronage. The very next year (1244) Jerusalem was finally lost. Its loss was the natural corollary of these dissensions. The treaty of Frederick with Malik-al-Kamil (d. 1238) had now expired, and new succours and new measures had become necessary for the Holy Land. Theobald of Champagne had taken the cross as early as 1230, and in 1239 he sailed to Acre in spite of the express prohibition of the pope, who, having quarrelled with Frederick II., was eager to divert any succour from Jerusalem itself, so long as Jerusalem belonged to his enemy. Theobald was followed (1240–41) by Richard of Cornwall, the brother of Henry III., who, like his predecessor, had to sail in

[1]Amalric I. of Cyprus had done homage to Henry VI. from whom he had received the title of king (1195).

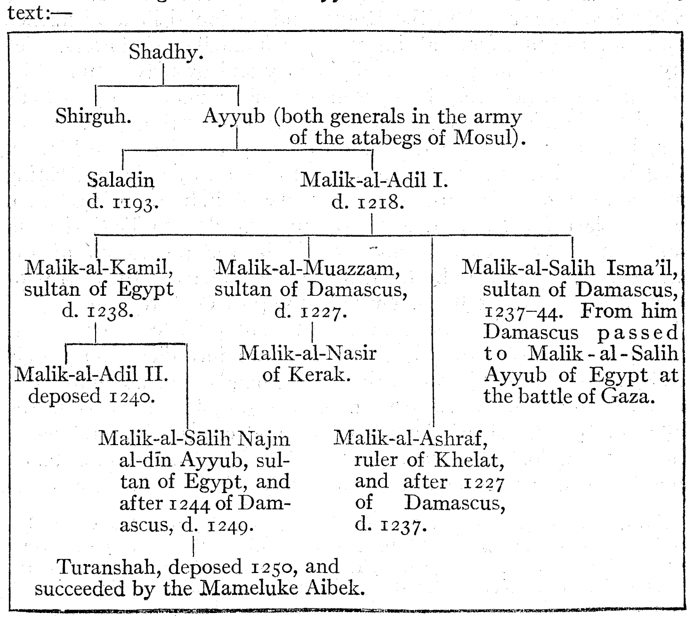
the teeth of papal prohibitions; but neither of the two achieved any permanent result, except the fortification of Ascalon. It was, however, by their own folly that the Franks lost Jerusalem in 1244. They consented to ally themselves with the ruler of Damascus against the sultan of Egypt; but in the battle of Gaza they were deserted by their allies and heavily defeated by Bibars, the Egyptian general and future Mameluke sultan of Egypt. Jerusalem, which had already been plundered and destroyed earlier in the year by Chorasmians (Khwarizmians), was the prize of victory, and Ascalon also fell in 1247.

THE CRUSADES OF ST. LOUIS

The Seventh Crusade.—As the loss of Jerusalem in 1187 produced the third crusade, so its loss in 1244 produced the seventh: as the preaching of the fifth crusade had taken place in the Lateran council of 1215, so that of the seventh crusade began in the Council of Lyons of 1245. But the preaching of the crusade by Innocent IV. at Lyons was a curious thing. On the one hand he repeated the provisions of the Fourth Lateran Council on behalf of the crusade to the Holy Land; on the other hand he preached a crusade against Frederick II., and promised to all who would join the full benefits of absolution and remission of sins. While the papacy thus bent its energies to the destruction of the crusades in their genuine sense, and preferred to use for its own political objects what was meant for Jerusalem, a layman took up the derelict cause with all the religious zeal which any pope had ever displayed. Paradoxically enough, it was now the turn for the papacy to exploit the name of crusade for political ends, as the laity had done before; and it was left to the laity to champion the spiritual meaning of the crusade even against the papacy. It was at the end of the year in which Jerusalem had fallen that St. Louis had taken the cross, and by all the means in his power he attempted to ensure the success of his projected crusade. He sought to mediate, though with no success, between the pope and the emperor; he descended to a whimsical piety, and took his courtiers by guile in distributing to them, at Christmas, clothing on which a cross had been secretly stitched. He started in 1248 with a gallant company, which contained his three brothers and the sieur de Joinville, his biographer; and after wintering in Cyprus he directed his army in the spring of 1249 against Egypt. The objective was unexpected: it may have been chosen by St. Louis, because he knew how seriously the power of the sultan was undermined by the Mamelukes, who were in the very next year to depose the Ayyubite dynasty, which had reigned since 1171, and to substitute one of their number as sultan. Damietta was taken without a blow, and the march for Cairo was begun, as it had been begun by the legate Pelagius in 1221. Again the invading army halted before Mansura (Dec. 1249); again it had to retreat. The retreat became a rout. St. Louis was captured, and a treaty was made by which he had to consent to evacuate Damietta and pay a ransom of 800,000 pieces of gold. Eventually he was released on surrendering Damietta and paying one-half of his ransom, and by the middle of May 1250 he reached Acre, having abandoned the Egyptian expedition. For the next four years he stayed in the Holy Land, seeking to do what he could for the establishing of the kingdom of Jerusalem. He was able to do but little. The struggle of papacy and empire paralysed Europe, and even in France itself there were few ready to answer the calls for help which St. Louis sent home from Acre. The one answer was the Shepherds' crusade, or crusade of the Pastoureaux—"a religious Jacquerie," as it has been called by Dean Milman. It had some of the features of the Children's crusade of 1212. That, too, had begun with a shepherd boy: the leader of the Pastoureaux, like the leader of the children, promised to lead his followers dry-shod through the seas; and tradition even said that this leader, "the master of Hungary," as he was called, was the Stephen of the Children's crusade. But the anti-clerical feeling and action of the Shepherds was new and ominous; and moved by its enormities the Government suppressed the new movement ruthlessly. None came to the aid of St. Louis; and in 1254, on the death of his mother, Blanche, the regent, he had to return to France.

The Mamelukes.—The final collapse of the kingdom of Jerusalem had been really determined by the battle of Gaza in 1244, and by the deposition of the Ayyubite dynasty by the Mamelukes. The Ayyubites had always been, on the whole, chivalrous and tolerant: Saladin and his successors, Malik-al-Adil and Malik-al-Kamil, had none of them shown an implacable enmity to the Christians. The Mamelukes, who are analogous to the janissaries of the Ottoman Turks, were made of sterner and more fanatical stuff; and Bibars, the greatest of these Mamelukes, who had commanded at Gaza in 1244, had been one of the leaders against St. Louis in 1250, and became sultan in 1260, was the sternest and most fanatical of them all. The Christians were, however, able to maintain a footing in Syria for 40 years after St. Louis' departure, not by reason of their own strength, but owing to two powers which checked the advance of the Mamelukes. The first of these was Damascus. The kingdom of Jerusalem, as we have seen, had profited by the alliance of Damascus as early as 1130, when the fear of the atabegs of Mosul had first drawn the two together; and when Damascus had been acquired by the ruler of Mosul, the hostility between the house of Nureddin in Damascus and Saladin in Egypt had still for a time preserved the kingdom (from 1171 onwards). Saladin had united Egypt and Damascus; but after his death dissensions broke out among the members of his family[1] which more than once led to wars between Damascus and Cairo. It has already been noticed that such a war between Malik-al-Kamil and his rivals accounts in large measure for the success of the sixth crusade; and it has been seen that the battle of Gaza (1244) was an act in the long drama of strife between Egypt and northern Syria. The revolution in Egypt in 1250 separated Damascus from Cairo more trenchantly than they had ever been separated since 1171: while a Mameluke ruled in Cairo, Malik-al-Nāsir of Aleppo was elected as sultan by the emirs of Damascus. But an entirely new and far more important factor in the affairs of the Levant was the extension of the empire of the Mongols during the 13th century. That empire had been founded by Jenghiz Khan in the first quarter of the century; it stretched from Peking on the east to the Euphrates and the Dnieper on the west. Two things gave the Mongols an influence on the history of the Holy Land and the fate of the crusades. In the first place, the south-western division of the empire, comprising Persia and Armenia, and governed about 1250 by the Khan Hulaku or Hulagu, was inevitably brought into relations, which were naturally hostile, with the Mohammedan Powers of Syria and Egypt. In the second place, the Mongols of the 13th century were not as yet, in any great numbers, Mohammedans; the official religion was "Shamanism," but in the Mongol army there were many Christians, the results of early Nestorian missions to the far East. This

[1] The following table of the Ayyubite rulers serves to illustrate the text:—



last fact in particular caused western Europe to dream of an alliance with the great khan "Prester John," who should aid in the reconquest of Jerusalem and the final conversion to Christianity of the whole continent of Asia. The crusades thus widen out, towards their close, into a general scheme for the Christianization of all the known world[1]. About 1220 James of Vitry was already hoping that 4,000 knights would, with the assistance of the Mongols, recover Jerusalem; but it is in 1245 that the first definite sign of an alliance with the Mongols appears. In that year Innocent IV. sent a Franciscan friar, Joannes de Plano Carpini, to the Mongols of southern Russia, and despatched a Dominican mission to Persia. Nothing came of either of these missions; but through them Europe first began to know the interior of Asia, for Carpini was conducted by the Mongols as far as Karakorum, the capital of the great khan, on the borders of China. Again in 1252 St. Louis (who had already begun to negotiate with the Mongols in the winter of 1248–49) sent the friar William of Rubruquis to the court of the great khan; but again nothing came of the mission save an increase of geographical knowledge. It was in the year 1260 when it first seemed likely that any results definitely affecting the course of the crusades would flow from the action of the Mongols. In that year Hulagu, the khan of Persia, invaded Syria and captured Damascus. His general, a Christian named Kitboga, marched southwards to attack the Mamelukes of Egypt, but he was beaten by Bibars (who in the same year became sultan of Egypt), and Damascus fell into the hands of the Mamelukes. Once more, in spite of Mongol intervention, Damascus and Cairo were united, as they had been united in the hands of Saladin; once more they were united in the hands of a devout Mohammedan, who was resolved to extirpate the Christians from Syria.

While these things were taking place around them, the Christians of the kingdom of Jerusalem only hastened their own fall by internal dissensions which repeated the history of the period preceding 1187. In part the war of Guelph and Ghibelline fought itself out in the East; and while one party demanded a regency, as in 1243, another argued for the recognition of Conrad, the son of Frederick II., as king. In part, again, a commercial war raged between Venice and Genoa, which attracted into its orbit all the various feuds and animosities of the Levant (1257). Beaten in the war, the Genoese avenged themselves for their defeat by an alliance with the Palaeologi, which led to the loss of Constantinople by the Latins (1261), and to the collapse of the Latin empire after 60 years of infirm and precarious existence. On a kingdom thus divided against itself, and deprived of allies, the arm of Bibars soon fell with crushing weight. The sultan, who had risen from a Mongolian slave to become a second Saladin, and who combined the physique and audacity of a Danton with the tenacity and religiosity of a Philip II., dealt blow after blow to the Franks of the East. In 1265 fell Caesarea and Arsuf; in 1268 Antioch was taken, and the principality of Bohemund and Tancred ceased to exist. In the years which followed on the loss of Antioch several attempts were made in the West to meet the progress of the new conqueror. In 1269 James the Conqueror of Aragon, at the bidding of the pope, turned from the long Spanish crusade to a crusade in the East in order to atone for his offences against the law matrimonial. An opportune storm, however, gave the king an excuse for returning home, as Frederick II. had done in 1227; and though his followers reached Acre, they hardly dared venture outside its walls, and returned home promptly in the beginning of 1270. More serious were the plans and the attempts of Charles of Anjou and Louis IX., in which the crusades may be said to have finally ended, save for sundry disjointed epilogues in the 14th and 15th centuries.

The Eighth Crusade.—Charles of Anjou had succeeded, as a result of the long "crusade" waged by the papacy against the Hohenstaufen from the Council of Lyons to the battle of Tagliacozzo (1245–68), in establishing himself in the kingdom of Sicily. With the kingdom of Frederick II. and Henry VI. he also took over their policy—the "forward" policy in the East which had also been followed by the old Norman kings. On the one hand he aimed at the conquest of Constantinople as Henry VI. had done before; and by the Treaty of Viterbo of 1267 he secured from the last Latin emperor of the East, Baldwin II., a right of eventual succession. On the other hand, like Frederick II., he aimed at uniting the kingdom of Jerusalem with that of Sicily; and here, too, he was able to provide himself with a title. On the death of Conradin, Hugh of Cyprus had been recognized in the East as king of Jerusalem (1269); but his pretensions were opposed by Mary of Antioch, a granddaughter of Amalric II., who was prepared to bequeath her claims to Charles of Anjou, and was therefore naturally supported by him. But the policy of Charles, which thus prepared the way for a crusade similar to those of 1197 and 1202, was crossed by that of his brother Louis IX. Already in 1267 St. Louis had taken the cross a second time, moved by the news of Bibars' conquests; and though the French baronage, including even Joinville himself, refused to follow the lead of their king, Prince Edward of England imitated his example. Louis had been led to think that the bey of Tunis might be converted, and in that hope he resolved to begin this eighth and last of the crusades by an expedition to Tunis. Charles, as anxious to attack Constantinople as he was reluctant to attack Tunis, with which Sicily had long had commercial relations, was forced to abandon his own plans and to join in those of his brother. St. Louis had barely landed in Tunis when he sickened and died, murmuring "Jerusalem, Jerusalem" (Aug. 1270); but Charles, who appeared immediately after his brother's death, was able to conduct the crusade to a successful conclusion. Negotiating in the spirit of a Frederick II., and acting not as a crusader but as a king of Sicily, he not only wrested a large indemnity from the bey for himself and the new king of France, but also secured a large annual tribute for his Sicilian exchequer. So ended the eighth crusade—much as the sixth had done—to the profound disgust of many of the crusaders, including Prince Edward of England, who only arrived on the eve of the conclusion of the treaty. Baulked of any opportunity of joining in the main crusade, Edward, after wintering in Sicily, conducted a crusade of his own to Acre in the spring of 1271. For over a year he stayed in the Holy Land, making little sallies from Acre, and negotiating with the Mongols, but achieving no permanent results. He returned home at the end of 1272, the last of the western crusaders; and thus all the attempts of St. Louis and Charles of Anjou, of James of Aragon and Edward of England left Bibars still in possession of all his conquests.

Two projects of crusades were started before the final expulsion of the Latins from Syria. In 1274, at the Council of Lyons, Gregory X., who had been the companion of Edward in the Holy Land, preached the crusade to an assembly which contained envoys from the Mongol khan and Michael Palaeologus as well as from many western princes. All the princes of western Europe took the cross; not only so, but Gregory was successful in uniting the Eastern and Western Churches for the moment, and in securing for the new crusade the aid of the Palaeologi, now thoroughly alarmed by the plans of Charles of Anjou. Thus was a papal crusade begun, backed by an alliance with Constantinople, and thus were the plans of Charles of Anjou temporarily thwarted. But in 1276 Gregory X. died, and all his plans died with him; there was to be no union of the monarchs of the West with the emperor of the East in a common crusade. Charles was able to resume his plans. In 1277 Mary of Antioch ceded to him her claims, and he was able to establish himself in Acre; in 1278 he took possession of the principality of Achaea. With these bases at his disposal he began to prepare a new crusade, to be directed primarily (like that of Henry VI. in 1197, and like his own projected crusade of 1270) against Constantinople. Once more his plans were fatally crossed: the Sicilian Vespers, followed by the coronation of Peter of Aragon as Sicilian king (1282), gave him troubles at home which occupied him for the rest of his days. This was the last serious attempt which was made in the West

[1] Though Europe indulged in dreams of Mongol aid, the eventual results of the extension of the Mongol empire were prejudicial to the Latin East. The sultans of Egypt were stirred to fresh activity by the attacks of the Mongols; and as Syria became the battle-ground of the two, the Latin principalities of Syria were fated to fall as the prize of victory to one or other of the combatants.

at a crusade on behalf of the dying kingdom of Jerusalem; and its collapse was quickly followed by the final extinction of the kingdom. A precarious peace had reigned in the Holy Land since 1272, when Bibars had granted a truce of ten years; but the fall of the great power of Charles of Anjou set free Kalā'ūn, the successor of Bibars' son, to complete the work of the great sultan. In 1289 Kalā'ūn took Tripoli, and the county of Tripoli was extinguished; in 1290 he died while preparing to besiege Acre, which was captured after a brave defence by his son and successor Khālil in 1291. Thus the kingdom of Jerusalem came to an end. The Franks evacuated Syria altogether, leaving behind them only the ruins of their castles to bear witness, to this very day, of the crusades they had waged and the kingdom they had founded and lost.

THE GHOST OF THE CRUSADES

The loss of Acre failed to stimulate the Powers of Europe to any new effort. France, always the natural home of the crusades, was too fully occupied, first by war with England and then by a struggle with the papacy, to turn her energies towards the East. But it is often the case that theory develops as practice fails; and as the theory of the Holy Roman empire was never more vigorous than in the days of its decrepitude, so it was with the crusades. Particularly in the first quarter of the 14th century, writers were busy in explaining the causes of the failures of past crusades, and in laying down the lines along which a new crusade must proceed. Several causes are recognized by these writers as accounting for the failure of the crusades. Some of them lay the blame on the papacy; and it is true that the papacy had contributed towards the decay of the crusades when it had allowed its own particular interests to overbear the general welfare of Christianity, and had dignified with the name and the benefits of a crusade its own political war against the Hohenstaufen. Others, again, find in the princes of Europe the authors of the ruin of the crusades; they, too, had preferred their own national or dynastic interests to the cause of a common Christianity. They had indeed, as has been already noticed, done even more; they had used the name of crusade, from the days of Henry VI. onwards, as a cover and an excuse for secular ambitions of their own; and in this way they had certainly helped, in very large measure, to discourage the old religious zeal for the Holy War. Other writers, again, blame the commercial cupidity of the Italian towns; of what avail, they asked with no little justice, was the crusade, when Venice and Genoa destroyed the naval bases necessary for its success by their internecine quarrels in the Levant (as in 1257), or—still worse—entered into commercial treaties with the common enemy against whom the crusades were directed? On the very eve of the fifth crusade, Venice had concluded a commercial treaty with Malik-al-Kamil of Egypt; just before the fall of Acre, the Genoese, the king of Aragon and the king of Sicily had all concluded advantageous treaties with the sultan Kalā'ūn. A fourth cause, on which many writers dwelt, particularly at the time when the suppression of the Templars was in question, was the dissensions between the two orders of Templars and Hospitallers, and the selfish policy of merely pursuing their own interest which was followed by both in common. But one might enumerate *ad infinitum* the causes of the failure of the crusades. It is simplest, as it is truest, to say that the crusades did not fail—they simply ceased; and they ceased because they were no longer in joint with the times. The moral character of Europe in 1300 was no longer the moral character of Europe in 1100; and the crusades, which had been the active and objective embodiment of the other worldly Europe of 1100, were alien to the secular, legal, scholastic Europe of 1300. While Edward I. was seeking to found a united kingdom in Great Britain; while the Habsburgs were entrenching themselves in Austria; above all, while Philippe le Bel and his legists were consolidating the French monarchy on an absolutist basis, there could be little thought of the Holy War. These were hard-headed men of affairs—men who would not lightly embark on joyous ventures, or seek for an ideal San Grail; nor were the popes, doomed to the Babylonian captivity for 70 long years at Avignon, able to call down the spark from on high which should consume all earthly ambitions in one great act of sacrifice.

But it is long before the death of any institution is recognized; and it was inevitable that men should busy themselves in trying to rekindle the dead embers into new life. Pierre Dubois, in a pamphlet *"De recuperatione Sanctae Terrae,"* addressed to Edward I. in 1307, advocates a general council of Europe to maintain peace and prevent the dissensions which—as, for instance, in 1192—had helped to cause the failure of past crusades. Along with this advocacy of internationalism goes a plea for the disendowment of the Church, in order to provide an adequate financial basis for the future crusade. Other proposals, made by men well acquainted with the East, are more definitely practical and less political in their intention. A blockade of Egypt by an international fleet, an alliance with the Mongols, the union of the two great orders—these are the three staple heads of these proposals. Something, indeed, was attempted, if little was actually done, under each of these three heads. The plan of an international fleet to coerce the Mohammedan is even to this day ineffective; but the Hospitallers, who acquired a new basis by the conquest of Rhodes in 1310, used their fleet to enforce a partial and, on the whole, ineffective blockade of the coast of the Levant. The union of the two orders, already suggested at the Council of Lyons in 1245, was nominally achieved by the Council of Vienne in 1311; but the so-called "union" was in reality the suppression of the Templars, and the confiscation of all their resources by the cupidity of Philippe le Bel. The alliance with the Mongols remained, from the first to the last, something of a chimera; and the last visionary hope vanished when the Mongols finally embraced Mohammedanism, as, by the end of the 14th century, they had almost universally done.

Isolated enterprises somewhat of the character of a crusade but hardly serious enough to be dignified by that name, recur during the 14th century. The French kings are all crusaders—in name—until the beginning of the Hundred Years' War; but the only crusader who ever waged war in Palestine and sought to shake the hold of the Mamelukes on the Holy Land was Peter I., king of Cyprus from 1359 to 1369. Peter founded the order of the Sword for the delivery of Jerusalem; and instigated by his chancellor, de Mézières (one of the last of the theorists who speculated and wrote on the crusades), he attempted to revive the old crusading spirit throughout the west of Europe. The mission which he undertook with his chancellor for this purpose (1362–65) only produced a crop of promises or excuses from sovereigns like Edward III. or the emperor Charles IV.; and Peter was forced to begin the crusade with such volunteers as he could collect for himself. In the autumn of 1365 he sacked Alexandria; in 1367 he ravaged the coast of Syria, and inflicted serious damages on the sultan of Egypt. But in 1369 he was assassinated, and the last romantic figure of the crusades died, leaving only the legacy of his memory to his chancellor de Mézières, who for nearly 40 years longer continued to be the preacher of the crusades to Europe, advocating—what always continued to be the "dream of the old pilgrim"— a new order of knights of the Passion of Christ for the recovery and defence of Jerusalem. De Mézières was the last to advocate seriously, as Peter I. was the last to attempt, a crusade after the old fashion—an offensive war against Egypt for the recovery of the Holy Sepulchre. From 1350 onwards the crusade assumes a new aspect; it becomes defensive, and it is directed against the Ottoman Turks, a tribe of Turcomans who had established themselves in the sultanate of Iconium at the end of the 13th century, during the confusion and displacement of peoples which attended the Mongol invasions. As early as 1308 the Ottoman Turks had begun to settle in Europe; by 1350 they had organized their terrible army of janissaries. They threatened at once the débris of the old Latin empire in Greece and the Archipelago, and the relics of the Byzantine empire round Constantinople; they menaced the Hospitallers in Rhodes and the Lusignans in Cyprus. It was natural that the popes should endeavour to form a coalition between the various Christian Powers which were threatened by the Turks; and Venice, anxious to preserve her possessions in the Aegean, zealously seconded their efforts. In 1344 a crusade, in which Venice, the Cypriots and the Hospitallers all joined, ended in the conquest of Smyrna; in 1345 another crusade, led by Humbert, dauphin of Vienne, ended in failure. The Turks continued their progress; in 1363 they captured Philippopolis, and in 1365 they entered Adrianople; the whole Balkan peninsula was threatened, and even Hungary itself seemed doomed. Already in 1365 Urban VI. sought to unite the king of Hungary and the king of Cyprus in a common crusade against the Turks; but it was not till 1396 that an attempt was at last made to supplement by a land crusade the naval crusades of 1344 and 1345. Master of Serbia and of Bulgaria, as well as of Asia Minor, the sultan Bayezid was now threatening Constantinople itself. To arrest his progress, a crusade, preached by Boniface IX., led by John the Fearless of Burgundy, and joined chiefly by French knights, was directed down the valley of the Danube into the Balkans; but the old faults stigmatized by de Mézières, *divisio* and *propria voluntas,* were the ruin of the crusading army, and at the battle of Nicopolis it was signally defeated. Not the Western crusades but an Eastern rival, Timur (Tamerlane), king of Transoxiana and conqueror of southern Russia and India, was destined to arrest the progress of Bayezid; and from the battle of Angora (1402) till the days of Murad II. (1422) the Ottoman power was paralysed. Under Murad, however, it rose to its old height. To meet the new danger a new union of the Churches of the East and the West was attempted. As in 1074 Gregory VII. had dreamed of such a union, to be followed by a joint attack of East and West on the Seljuks, so in 1439, at the Council of Florence, a new union of the two Churches was again attempted and temporarily secured, in order that a united Christendom might face the new Turkish danger[1]. The logical result of the union was the crusade of 1443. An army of cosmopolitan adventurers, led by the cardinal Caesarini, joined the forces of Wladislaus of Poland and John Hunyadi of Transylvania, and succeeded in forcing on Murad II. a truce of ten years at Szegedin in 1444. But the crusaders broke the truce, to which Caesarini had never consented; and, attempting to better what was already good enough, they were defeated at Varna. Here the last crusade ended; and nine years afterwards, in 1453, Mohammed II., the successor of Murad, captured Constantinople. It was in vain that the popes sought to gather a new crusade for its recovery; Pius II., who had vowed to join the crusade in person, only reached Ancona in 1464 to find the crusaders deserting and to die. Yet the ghost of the crusades still lingered. It became a convention of diplomacy, designed to cover any particularly sharp piece of policy which needed some excuse; and the Treaty of Granada, formed between Louis XII. and Ferdinand of Aragon for the partition of Naples in 1500, was excused as a thing necessary in the interests of the crusades. In a more noble fashion the crusade survived in the minds of the navigators; "Vasco da Gama, Christopher Columbus, Albuquerque, and many others dreamed, and not insincerely, that they were labouring for the deliverance of the Holy Land, and they bore the Cross on their breasts." "Don Henrique's scheme," it has been said, "represents the final effort of the crusading spirit; and the naval campaigns against the Muslim in the Indian seas, in which it culminated 40 years after Don Henrique's death, may be described as the last crusade."

RESULTS OF THE CRUSADES

In one vital respect the result of the crusades may be written down as failure. They ended, not in the occupation of the East by the Christian West, but in the conquest of the West by the Mohammedan East. The crusades began with the Seljuk Turk planted at Nicaea; they ended with the Ottoman Turk entrenched by the Danube. Nothing is more striking in history than the recession of Christianity in the East after the 13th century. In the 13th century the whole of Europe was Christian; part of Asia Minor still belonged to Greek Christianity, and there was a Christian kingdom in Palestine. Nor was this all. A wide missionary activity had begun in the 13th century—an activity which was the product of the crusades and the contact with the Muslim which they brought, but which yet helped to check the crusades, substituting as it did peaceful and spiritual conquests of souls for the violence and materialism of even a Holy War. The Eastern mission had been begun by St. Francis, who had visited and attempted to convert the sultan of Egypt during the fifth crusade (1220); within 100 years the little seed had grown into a great tree. A great field for missionary enterprise opened itself in the Mongol empire, in which, as has already been mentioned, there were many Christians to be found; and by 1350 this field had been so well worked that Christian missions and Christian bishops were established from Persia to Peking, and from the Dnieper to Tibet itself. But a Mohammedan reaction came, thanks in large measure to the zeal of Timur; and central Asia was lost to Christianity. Everywhere in the 15th century, in Europe and in Asia, the crescent was victorious over the cross; and crusade and mission, whether one regards them as complementary or inimical, perished together. But while from this point of view the crusades appear as a failure, it must not be forgotten that elsewhere than in the East crusades did attain some success. A crusade won for Christianity the coast of the eastern Baltic (*see* TEUTONIC ORDER); and the centuries of the Spanish crusade ended in the conquest of the whole of Spain for Christianity.

The history of the crusades must be viewed rather as a chapter in the history of civilization in the West itself, than as an extension of Western dominion or religion to the East. It is a chapter very difficult to write, for while on the one hand an ingenious and speculative historian may refer to the influence of the crusades almost everything which was thought or done between 1100 and 1300, a cautious writer who seeks to find documentary evidence for every assertion may be rather inclined to attribute to that influence little or nothing[1]. The dissolution of feudalism, the development of towns, the growth of scholasticism, all these and much more have been ascribed to the crusades, when in truth they were concomitants rather than results, or at any rate, if in part the results of the crusades, were in far larger part the results of other things. At most, therefore, it may be admitted that the crusades *contributed* to the dissolution of feudalism by putting property on the market and disturbing the validity of titles; that they aided the development of towns by vastly increasing the volume of trade; and that they furthered the growth of scholasticism by bringing the West into contact with the mind of the East. If we seek the peculiar and definite results of the crusades, we must turn to narrower issues. In the first place, the crusades represent the attempt of a feudal system, bound under the law of primogeniture, to dispose of its younger sons. They are attempts at feudal colonization; and as such they resulted in a number of colonies—the kingdom of Jerusalem, the kingdom of Cyprus, the Latin empire of Constantinople. They resulted, too, in a number of "chartered companies"—that is to say, the three military orders, which, beginning as charitable societies, developed into military clubs, and developed again from military clubs into commercial companies, possessed of banks, navies and considerable territories. In the second place, as has already been noticed, the crusades represent the attempt of Western commerce to find new and more easy routes to the wealth of the East; and in this respect they led to various results. On the one hand they led to the establishment of emporia in the East—for instance, Acre, and after the fall of Acre, Famagusta, both in their day great centres of Levantine trade. On the other hand, the commodities which poured into Venice and Genoa from the East had to find a route for their diffusion through Europe. The great route was that which led from Venice over the Brenner and up the Rhine to Bruges; and

[1]The union of 1274, conceded by the Palaeologi at the Council of Lyons in order to defeat the plans of Charles of Anjou, had only been temporary.

[1]Authors like Heeren (*Versuch einer Entwickelung der Folgen der Kreuzzüge*) and Michaud (in the last volume of his *Histoire des croisades*) fall into the error of assigning all things to the crusades. Even Prutz, in his *Kulturgeschichte der Kreuzzüge,* overestimates the influence of the crusades as a chapter in the history of civilization. He depreciates unduly the Western civilization of the early middle ages, and exalts the civilization of the Arabs; and starting from these two premises, he concludes that modern civilization is the offspring of the crusades, which first brought East and West together.

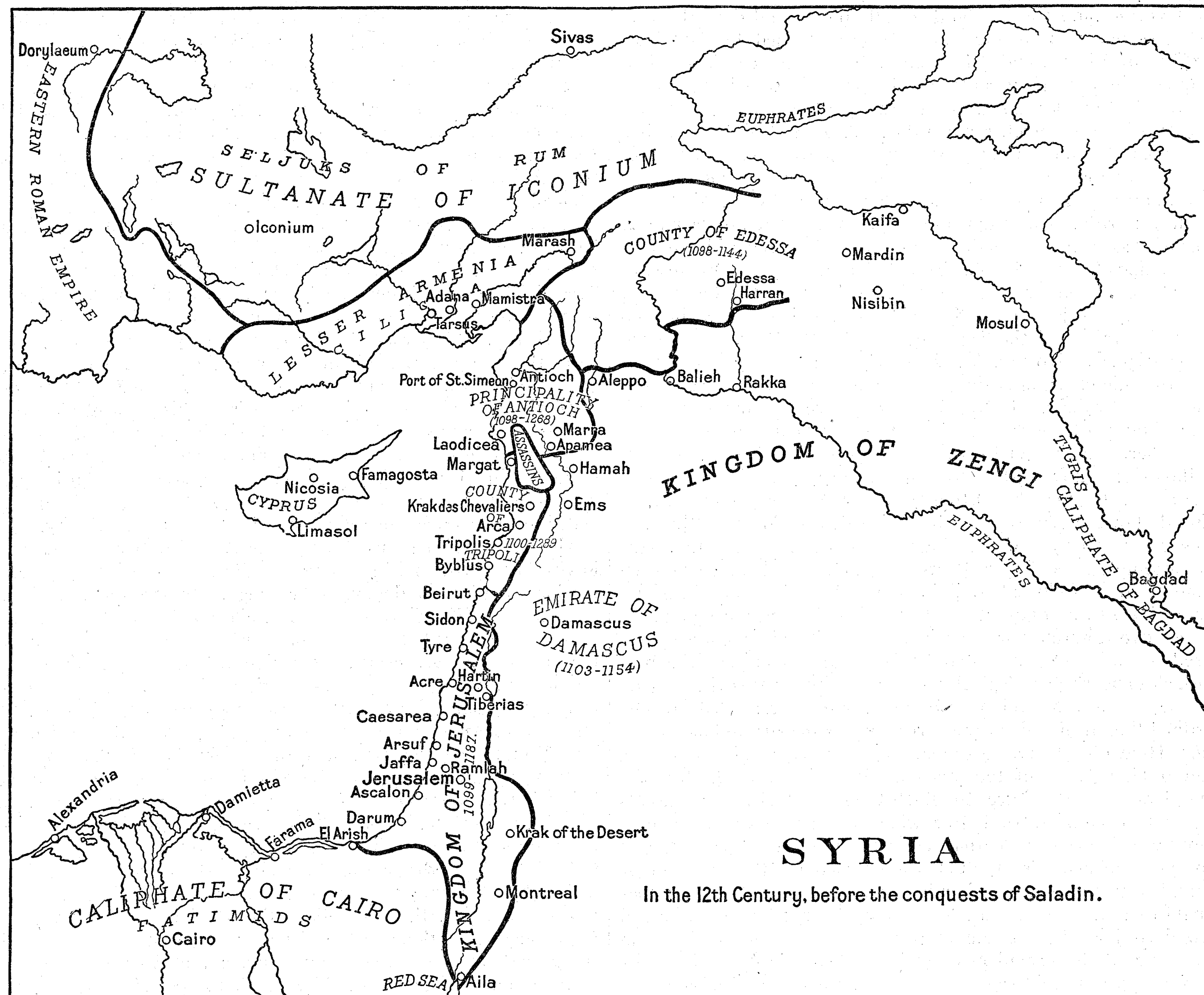


FIG. 5.—THE BATTLEGROUND OF CRUSADERS AND MOHAMMEDANS FOR TWO CENTURIES
There were eight crusades, the first beginning in 1096, the last ending in 1291. During this period Jerusalem was taken, retaken, and ceded, several times. Famous among Crusaders were Godfrey of Bouillon, Conrad II., Louis VII., Richard Coeur-de-Lion, Frederic I., Philip Augustus, St. Louis and Prince Edward of England, while Saladin and Bibars stand out with equal prominence among the Mohammedans

this route became the long red line of municipal development, along which—in Lombardy, Germany and Flanders—the great towns of the middle ages sprang to life. Partly as a result of this trade, ever pushing its way farther east, and partly as a result of the Asiatic missions, which were themselves an accompaniment and effect of the crusades, a third great result of the crusades came to light in the 13th century—the discovery of the interior of Asia, and an immense accession to the sphere of geography. When one remembers that missionaries like Piano Carpini, and traders like the Venetian Polos, either penetrated by land from Acre to Peking, or circumnavigated southern Asia from Basra to Canton, one realizes that there was, about 1300, a discovery of Asia as new and tremendous as the discovery of America by Columbus two centuries later. At the same time the old knowledge of nearer Asia was immensely deepened. It has already been noticed how military reconnaissances of the routes to Egypt came to be made; but more important were the guide-books, of which a great number were written to guide the pilgrims from one sacred spot of Bible history to another. There were mediaeval Baedekers in abundance for the use of the annual flow of tourists, who were carried every Easter by the vessels of the Italian towns or of the Orders to visit the Holy Land and to bathe in Jordan, to gather palms, and to see the miracle of fire at the Sepulchre.

Colonization, trade, geography—these, then, are three things closely connected with the history of the crusades. The development of the art of war, and the growth of a systematic taxation, are two debts which mediaeval Europe also owed to the crusades. Partly by contact with the Byzantines, partly by conflict with the Mohammedans, the Franks learned new methods both of building and of attacking fortifications. The concentric castle, with its rings of walls, began to displace the old keep and bailey with their single wall, as the crusaders brought back news from the East[1]. The art of the sapper and miner, the use of siege instruments like the mangonel, and the employment of various "fires" as missiles, were all known among the Mohammedans; and in all these respects the Franks learned from their enemies. The common use of armorial bearings, and the practice of the tournament, may be oriental in their origin; the latter has its affinities with the equestrian exercises of the Jerid, and the former, though of prehistoric antiquity, may have received a new impulse from contact with the Arabs. The military development which sprang

[1]It is difficult to decide how far Arabic models influenced ecclesiastical architecture in the West as a result of the crusades. Greater freedom of moulding and the use of trefoil and cinquefoil may be, but need not be, explained in this way. The pointed arch owes nothing to the Arabs; it is already used in England in early Norman work. Generally, one may say that Western architecture is independent of the East. It is even possible that the concentric castle was developed originally in the West and only imitated afterwards in Syria.

from the crusades is thus largely a matter of borrowing; the financial development is independent and indigenous in the West. As early as 1147 Louis VII. had imposed a tax in the interests of the crusades; and that tax had been repeated by Louis, imitated by Henry II. in 1166, and still further extended in the Saladin tithe of 1188. The taxation of 1166 is important as the first to fall on "moveables"; the whole scheme of taxation may be regarded as the beginning of a modern system of taxation. But it was not only to the lay power that the crusades gave an excuse for taxation; the papacy also profited. Tithes for the crusades were first imposed on the clergy by Innocent III. at the Lateran Council of 1215; and clerical taxation was thus part of the whole statesmanlike project of the fifth crusade as it was sketched by the great pope. Henceforth tithes for the crusades are regular; under Gregory IX. they become a great part of the papal resources in the crusade against the Hohenstaufen; and in the 16th century they are still a part of the Church government.

In many other ways the Europe over which the crusades had passed was different from the Europe of the 11th century. In the first place, many political changes had been wrought, largely under its influence. Always in large part French, the crusades had on the whole contributed to exalt the prestige of France, until it stood at the end of the 13th century the most considerable Power in Europe. It was France which had colonized the Levant; it was the French tongue which was used in the Levant; and the results of the ancient and continuous connection with the East are still to be traced to-day. Of the other great powers of Europe, England and Germany had been little changed by the crusades, save that Germany had been extended towards the East by the conquests of the Teutonic Order; but the Eastern empire had been profoundly modified, and the papacy had suffered a great change. The Eastern empire had been for a time annihilated by the movement which in 1095 it had helped to evoke; and if it rose from its ashes in 1261 for two centuries of renewed life it was never more than the shadow of its old self, with little hold on Asia Minor and less on Greece and the Archipelago, which the Latins still continued to occupy until they were finally conquered by the Ottoman Turks. The papacy, on the other hand, had grown as a result of the crusades. Popes had preached them; popes had financed them; popes had sent their legates to lead them. Through them the popes had deposed the emperors of the West from their headship of the world, partly because through the crusades the popes were able to direct the common Christianity of Europe in a foreign policy of their own without consultation with the emperor, partly because in the 13th century they were ultimately able to direct the crusade itself against the empire. Yet while they had magnified, the crusades had also corrupted the papacy. They became an instrument in its hands which it used to its own undoing. It cried crusade when there was no crusade; and the long crusade against the Hohenstaufen, if it gave the papacy an apparent victory, only served in the long run to lower its prestige in the eyes of Europe.

When we turn from the sphere of politics to the history of civilization and culture, we find the effects of the crusades as deeply impressed, if not so definitely marked. The crusades had sprung from the policy of a theocratic government counting on the motive of otherworldliness; they had helped in their course to overthrow that motive, and with it the government which it had made possible. In part they had provided a field in which the layman could prove that he, too, was a priest; in part they had brought the West into a living and continuous contact with a new faith and a new civilization. They had torn men loose from the ancestral custom of home to walk in new ways and see new things and hear new thoughts; and some broadening of view, some lessening in the intensity of the old one-sidedness, was the inevitable result. It is not so much that the West came into contact with a particular civilization in the East, or borrowed from that civilization; it is simply that the West came into contact with something unlike itself, yet in many ways as high as, if not higher than, itself. The spirit of *Nathan der Weise* may not have been exactly the spirit engendered by the crusades; and yet it is not without reason that Lessing stages the fable which teaches toleration in the Latin kingdom of Jerusalem. In any case the accusations made against the Templars at the time of their suppression prove that there was, at any rate in the ranks of those who knew the East, too little of absolute orthodoxy. While a new spirit which compares and tolerates thus sprang from the crusades, the large sphere of new knowledge and experience which they gave brought new material at once for scientific thought and poetic imagination. Not only was geography more studied; the crusades gave a great impulse to the writing of history, and produced, besides innumerable other works, the greatest historical work of the middle ages—the *Historia transmarina* of William of Tyre. Mathematics received an impulse, largely, it is true, from the Arabs of Spain, but also from the East; Leonardo Fibonacci, the first Christian algebraist, had travelled in Syria and Egypt. The study of oriental languages began in connection with the Christian missions of the East; Raymundus Lullus, the indefatigable missionary, induced the Council of Vienne to decide on the creation of six schools of oriental languages in Europe (1311). But the new field of poetic literature afforded by the crusades is still more striking than this development of science. New poems in abundance dealt with the history of the crusades, either in a faithful narrative, like that of the *Chanson* of Ambroise, which narrates the third crusade, or in a free and poetical spirit, such as breathes in the *Chanson d'Antioche*. Nor was this all. The crusades afforded new details which might be inserted into old matters, and a new spirit which might be infused into old subjects; and a crusading complexion thus came to be put upon old tales like those of Arthur and Charlemagne. By the side of these greater things it may seem little, and yet, just because it is little, it is all the more significant that the crusades should have familiarized Europe with new plants, new fruits, new manufactures, new colours, and new fashions in dress. Sugar and maize; lemons and melons; cotton, muslin and damask; lilac and purple (azure and gules are words derived from the Arabic); the use of powder and of glass mirrors, and even of the rosary itself—all these things came to mediaeval Europe from the East and as a result of the crusades. To this day there are many Arabic words in the languages of western Europe which are a witness of the crusades—words relating to trade and seafaring, like tariff and corvette, or words for musical instruments, like lute.

When all is said, the crusades remain a wonderful and perpetually astonishing act in the great drama of human life. They touched the summits of daring and devotion, if they also sank into the deep abysms of shame. Motives of self-interest may have lurked in them—otherworldly motives of buying salvation for a little price, or worldly motives of achieving riches and acquiring lands. Yet it would be treason to the majesty of man's incessant struggle towards an ideal good, if one were to deny that in and through the crusades men strove for righteousness' sake to extend the kingdom of God upon earth. Humanity is the richer for the memory of those millions of men, who followed the "way of the Holy Sepulchre" in the sure and certain hope of an eternal reward. The ages were not dark in which Christianity could gather itself together in a common cause, and carry the flag of its faith to the grave of its Redeemer; nor can we but give thanks for their memory, even if for us religion is of the spirit, and Jerusalem in the heart of every man who believes in Christ.

Bibliography.—In dealing with the literature of the crusades, it is perhaps better, though ideally less scientific, to begin with chronicles and narratives rather than with documents. One of the results of the crusades, as has just been suggested above, was a great increase in the writing of history. Crusaders themselves kept diaries or *itineraria;* while home-keeping ecclesiastics in the West—monks like Robert of Reims, abbots like Guibert of Nogent, archbishops like Balderich of Dol—found a fertile subject for their pens in the history of the crusades. The history of a series of actions like the crusades must primarily be based on these accounts, and more particularly on the former: narratives must precede documents where one is dealing, not with the continuous life of an organized kingdom, but with a number of enterprises—especially when those enterprises have been, as in this case, excellently narrated by contemporary writers.

I. Chronicles and Narratives of the Crusades.—(1) Collections. The authorities for the crusades have been collected in Bongars, *Gesta*

GENEALOGY OF THE KINGS OF JERUSALEM

Godfrey, advocatus 1099–1100.

Baldwin I., brother of Godfrey, king 1100–18.

Baldwin II., nephew of Godfrey and Baldwin I., and king 1118–31.

- **Fulk of Anjou,** king 1131–43. = Melisinda
  - **Baldwin III.,** king 1143–62.
  - **Amalric I.,** king 1162–74.
    - **Baldwin IV.,** king 1174–83.
    - Sibylla = (1) William of Montferrat;
      - **Baldwin V.,** king 1183–86.
    - Sibylla = (2) **Guy de Lusignan,** king 1186–92.
    - Isabella = (1) Humfred of Turon.
    - Isabella = (2) **Conrad of Montferrat,** acknowledged king in 1192.
      - Mary, queen under a regency from 1205–10. = **John of Brienne,** king 1210–25.
        - Isabella = **Frederick II.,** emperor of the West and king of Jerusalem 1225–50.
          - **Conrad IV.,** king of Germany and of Jerusalem 1250–55.
            - **Conradin,** king 1255–68.
    - Isabella = (3) **Henry of Champagne,** king 1192–97.
      - Alice = Hugh I. of Cyprus, son of Amalric II. by his first wife.
        - Henry I. of Cyprus = Plaisance of Antioch.
          - Hugh II. of Cyprus.
        - Isabella = John de Lusignan.
          - **Hugh** (III. of Cyprus and) **I. of Jerusalem,** 1269–84.
            - **John I.,** king of Cyprus, 1284–85.
            - **Henry** (III. of Cyprus and) **II. of Jerusalem,** king from 1285 to the fall of the kingdom in 1291.
    - Isabella = (4) **Amalric II.,** brother of Guy de Lusignan, king 1197–1205 (also king of Cyprus).
      - Melisinda = Bohemund IV.
        - Mary of Antioch, who died 1277, leaving her claims to Charles of Anjou (king of Sicily).
- Alice = Bohemund II. of Antioch (*q.v.*).

Dei per Francos (Hanover, 1611) (incomplete); Michaud, *Bibliothèque des croisades* (1829) (containing translations of select passages in the authorities); the *Recueil des historiens des croisades*, published by the Académie des Inscriptions (1841 onwards) (the best general collection, containing many of the Latin, Greek, Arabic and Armenian authorities, and also the text of the assizes; but sometimes poorly edited and still incomplete); and the publications of the Société de l'Orient Latin (founded in 1875), especially the *Archives*, two volumes published in 1881 and 1884, and the volumes of the *Revue*, which contain not only new texts, but articles and reviews of books. (2) Particular authorities. The crusades—a movement which engaged all Europe and brought the East into contact with the West—must necessarily be studied not only in the Latin authorities of Europe and of Palestine, but also in Byzantine, Armenian and Arabic writers. There are thus some four or five different points of view to be considered.

The First Crusade, far more than any other, became the theme of a multitude of writings, whose different degrees of value it is all-important to distinguish. Until about 1840 the authority followed for its history was naturally the great work of William of Tyre. For the first crusade William had followed Albert of Aix; and he had consequently depicted Peter the Hermit as the prime mover in the crusade. But about 1840 Ranke suggested, and von Sybel in his *Geschichte des ersten Kreuzzuges* (1841) proved, that Albert of Aix was *not* a good authority, and that consequently William of Tyre must be set aside for the history of the first crusade, and other and more contemporary authorities used. In writing his account of the first crusade, von Sybel accordingly based himself on the three contemporary Western authorities—the *Gesta Francorum*, Raymund of Agiles, and Fulcher. His view of the value of Albert of Aix, and his account of the first crusade, have been generally followed (Kugler alone having attempted, to some extent, to rehabilitate Albert of Aix); and thus von Sybel's work may be said to mark a revolution in the history of the first crusade, when its legendary features were stripped away, and its real progress was first properly discovered.

Taking the Western authorities for the first crusade separately, one may divide them, in the light of von Sybel's work, into four kinds—the accounts of eye-witnesses; later compilations based on these accounts; semi-legendary and legendary narratives; and lastly, in a class by itself, the "History" of William of Tyre, who is rather a scientific historian than a chronicler.

(*a*) The three chief eye-witnesses are the anonymous author of the *Gesta Francorum*, Raymund of Agiles, and Fulcher. The anonymous author of the *Gesta* (*see* Hagenmeyer's edition, Heidelberg, 1890) was a Norman of south Italy, who followed Bohemund, and accordingly depicts the progress of the first crusade from a Norman point of view. He was a layman, marching and fighting in the ranks; and thus he is additionally valuable as representing the opinion of the ordinary crusader. Finally he was an eye-witness throughout, and absolutely contemporary, in the sense that he wrote his account of each great event practically at the time of the event. He is the primary authority for the first crusade. Raymund of Agiles, a Provençal clerk and a follower of Raymund of Toulouse, writes his *Historia Francorum qui ceperunt Jerusalem* from the Provençal point of view. He gives an ecclesiastic's account of the first crusade, and is specially full on the spiritualistic phenomena which accompanied and followed the finding of the Holy Lance. His book might almost be called the "Visions of Peter Bartholomew and others," and it is written in the plain matter-of-fact manner of Defoe's narratives. He, too, was an eye-witness throughout, and thoroughly honest; and his account ranks second to the *Gesta*. Fulcher of Chartres originally followed Robert of Normandy, but in Oct. 1097 he joined Baldwin of Lorraine in his expedition to Edessa, and afterwards followed his fortunes. His *Historia Hierosolymitana*, which extends to 1127, and embraces not only the history of the first crusade, but also that of the foundation of the kingdom of Jerusalem, is written on the whole from a Lotharingian point of view, and is thus a natural complement to the accounts of the Anonymous and Raymund. His account of the first crusade itself is poor (he was absent at Edessa during its course), but otherwise he is an excellent authority. A kindly old pedant, Fulcher interlards his history with much discourse on geography, zoology and sacred history. Besides these three chief eye-witnesses we may also mention the *Annales Genuenses* by the Genoese consul Caffarus, and the *Annales Pisani* of Bernardus Marago, useful as giving the mercantile and Italian side of the crusade; the *Hierosolymita* of Ekkehard, the German abbot of Aura, who first came to Jerusalem about 1101 (partly based on the *Gesta*, but also of independent value: *see* Hagenmeyer's edition, Tübingen, 1877); and Ralph of Caen's *Gesta Tancredi*, composed on the basis of information supplied by Tancred himself. The last two works, if not actually the works of eye-witnesses, are at any rate first-hand, and belong to the category of primary writers rather than to that of later compilations. Finally, to contemporary writers we may add contemporary letters, especially those written by Stephen of Blois and Anselm of Ribemont, and the three letters sent to the West by the crusading princes during the first crusade (*see* H. Hagenmeyer, *Epistulae et Chartae*, etc., Innsbruck, 1901, and the *Inventaire critique* of the Comte de Riant, Paris, 1880).

(*b*) The later compilations are chiefly based on the *Gesta*, whose uncouth style many writers set themselves to mend. In the first place, there is the *Historia de Hierosolymitano itinere* of Tudebod, which according to Besly, writing in 1641, is the original from which the *Gesta* was a mere plagiarism—an absolute inversion of the truth, as von Sybel first proved two centuries later. Secondly, besides the plagiarist Tudebod, there are the artistic *rédacteurs* of the *Gesta*, who confess their indebtedness, but plead the bad style of their original—Guibert of Nogent, Balderich of Dol, Robert of Reims (all *c.* 1120–30), and Fulco, the author of a Virgilian poem on the crusades, continued by Gilo (*ob. c.* 1142). Of these, the monk Robert was more popular in the middle ages than either the pompous abbot Guibert or the quiet garden-loving archbishop of Dol.

(*c*) The growth of a legend, or perhaps better, a saga of the first crusade began, according to von Sybel, even during the crusade itself. The basis of this growth is partly the story-telling instinct innate in all men, which loves to heighten an effect, sharpen a point or increase a contrast—the instinct which breathes on Icelandic Sagas such as that of *Burnt Njal;* partly the instinct of idolization, if it may be so called, which leads to the perversion into impossible greatness of an approved character, and has created, in this instance, the legendary figures of Peter the Hermit and Godfrey of Bouillon (*qq.v.*); partly the religious impulse, which counted nothing wonderful in a holy war, and imported miraculous elements even into the sober pages of the *Gesta*. These instincts and impulses would be at work already among the soldiers during the crusade, producing a saga all the more readily, as there were poets in the camp; for we know that a certain Richard, who joined the first crusade, sang its exploits in verse, while still more famous is the princely troubadour, William of Aquitaine, who joined the crusade of 1100. If we are to follow von Sybel rather than Kugler, this saga of the first crusade found one of its earliest expressions (*c.* 1120) in the prose work of Albert of Aix (*Historia Hierosolymitana*)—genuine saga in its inconsistencies, its errors of chronology and topography, its poetical colour, and its living descriptions of battles. Kugler, however, regards Albert as a copyist, somewhat in the manner of Tudebod, of an unknown writer of value, who belonged to the Lotharingian ranks during the crusade, and settled in the kingdom of Jerusalem afterwards (*see* B. Kugler, *Albert von Aachen*, Stuttgart, 1885)[1]. In the *Chanson des chétifs* and the *Chanson d'Antioche* the legend of the crusades more certainly finds its expression (*see* Pigonneau, *Le Cycle de la Croisade*, 1877, and J. Bedier, *Les Chansons des Croisades*, 1909). The former, composed at Antioch about 1130, contained an idolization of the Hermit: the latter is a poem written about 1180 by Graindor of Douai, who used as his basis the verses of the crusader Richard (*see* the edition of P. Paris, 1848). It shows the growth of the legend that Graindor regards the vision of the Hermit as responsible for the crusade, and makes the crusade led by him precede, and indeed occasion by its failure, the meeting at Clermont (which is dated in May instead of November). Into the legendary overgrowth of the first crusade we cannot here enter any further; but it is perhaps worth while to mention that the French legend of the third crusade equally perverted the truth, making Richard I. return home in disgrace, while Philip Augustus stays, captures Damascus and mortally wounds Saladin (*cf.* G. Paris, *L'Estoire de la guerre sainte*, 1897; Introduction).

(*d*) William of Tyre is the scientific historian and rationalizer, weaving into a harmonious account, which was followed by historians for centuries, the sober accounts of eye-witnesses and the picturesque details of the saga—with somewhat of a bias towards the latter in regard to the first crusade. He was a native of Palestine, born about 1130, and educated in the West. On his return he was happy in winning the good opinion of Amalric I.; he was made first canon and then archdeacon of Tyre, and tutor of the future Baldwin IV. (1170); while on Baldwin's accession he became chancellor of the kingdom and archbishop of Tyre (1174–75). He was a man often employed on missions and negotiations, and as chancellor he had in his care the archives of the kingdom. His temper was naturally that of a trimmer; and he had thus many qualifications for the writing of well-informed and unbiassed history. He knew Greek and Arabic; and he was well acquainted with the affairs of Constantinople, to which he went at least twice on political business, and with the history of the Mohammedan Powers, on which he had written a work (now lost) at the command of Amalric. It was Amalric also who set him to write the history of the crusades which we still possess (in 22 books, with a fragment of a 23rd)—the *Historia rerum in partibus transmarinis gestarum*. He wrote the book at different times between 1170 and 1183, when it abruptly ends, and its author as abruptly disappears from sight. The book falls into two parts, the first (books i.–xv.) derivative, the second (books xvi.–xxiii.) original. In the second part he had his own knowledge

[1]Von Sybel's view must be modified by that of Kugler, to which a scholar like Hagenmeyer has to some extent given his adhesion (*cf.* his edition of the *Gesta*, pp. 62–68). Hagenmeyer inclines to believe in an original author, distinct from Albert the copyist; and he thinks that this original author (whether or no he was present during the crusade) used the *Gesta* and also Fulcher, though he had probably also *"eigene Notizen und Aufzeichnungen."*

of events and the information of his contemporaries as his source: in the first he used the same authorities which we still possess—the *Gesta,* Fulcher and Albert of Aix—in somewhat of an eclectic spirit, choosing now here, now there, according as he could best weave a pleasant narrative, but not according to any real critical principle. His book thus begins to be a real authority only from the date of the second crusade onwards; but the perfection of his form (for he is one of the greatest stylists of the middle ages) and the prestige of his position conspired to make his book the one authority for the whole history of the first century of the crusades. Nor was he (apart from his reception of legendary elements into his narrative) unworthy of the honour in which he was held; for he is really a great historian, in the form of his matter and in his conception of his subject—diligent, impartial, well-informed and interesting, if somewhat rhetorical in style and vague in chronology.

[During the middle ages his work was current in a French translation, known as the *Chronique d'outremer,* or the *Livre* or *Roman d'Éracles* (so called from the reference at the beginning to the emperor Heraclius). This translation also contained a continuation by various hands down to 1277; while besides the continuation embedded in the *Livre d'Éracles,* there are separate continuations, of the nature of independent works, by Ernoul and Bernard the Treasurer. These latter cover the period from 1183 to 1228; and of the two Ernoul's account seems primary, while that of Bernard is in large part a mere copy of Ernoul. But the whole subject of the continuators of William of Tyre is dubious.]

To the Western authorities for the first crusade must be added the Eastern—Byzantine, Arabic and Armenian. Of these the Byzantine authority, the *Alexiad* of Anna Comnena, is most important, partly from the position of the authoress, partly from the many points of contact between the Byzantine empire and the crusaders. Anna's narrative both furnishes a useful corrective of the prejudiced Western accounts of Alexius, and serves to bring Bohemund forward into his proper prominence. The Armenian view of the first crusade and of Baldwin's principality of Edessa is presented in the *Armenian Chronicle* of Matthew of Edessa. There is little in Arabic bearing on the first crusade: the Arabic authorities only begin to be of value with the rise of the atabegs of Mosul (*c.* 1127). But Kemal-ud-din's *History of Aleppo* (composed in the 13th century) contains some details on the history of the first crusade; and the *Vie d'Ousāma* (the autobiography of a sheik at Caesarea in northern Syria, edited and paraphrased by Derenbourg in the *Publications de l'École des langues orientales vivantes*) presents the point of view of an Arab whose life covered the first century of the crusades (1095–1188).

For the Second Crusade *see* B. Kugler, *Studien zur Geschichte des zweiten Kreuzzuges* (1866). The primary authority in the West is the work of Odo de Deuil, *De profectione Ludovici VII. regis Francorum in Orientem.* Odo was a monk attached by Suger to Louis VII. during the second crusade; and he wrote home to Suger during the crusade seven short letters, afterwards pieced together in a single work. The *Gesta Friderici Primi* of Otto of Freising (who joined in the second crusade) gives some details from the German point of view (i. c. 44 *seq.*). The former is supplemented by the letters of Louis VII. to Suger; the latter by the letters of Conrad III. to Wibald, abbot of Stablo and Corvey. The Byzantine point of view is presented in the Ἐπιτομή of Cinnamus, the private secretary of Manuel, who continued the *Alexiad* of Anna Comnena in a work describing the reigns of John and Manuel. It is from the second crusade that William of Tyre, representing the attitude of the Franks of Jerusalem, begins to be a primary authority; while on the Mohammedan side a considerable authority emerges in Ibn Athīr. His history of the atabegs was written about 1200, and it presents in a light favourable to Zengi and Nureddin, but unfavourable to Saladin (who thrust Nureddin's descendants aside), the history of the great Mohammedan Power which finally crushed the kingdom of Jerusalem.

Side by side with Beha-ud-din's life of Saladin, Ibn Athīr's work is the most considerable historical record written by the Arabs. Generally speaking the Arabic writings are late in point of date, and cold and jejune in style; while it must also be remembered that they are set religious works written to defend Islam. On the other hand they are generally written by men of affairs—governors, secretaries or ambassadors; and a fatalistic temper leads their authors to a certain impartial recording of everything, good or evil, which seems of moment.

The Third Crusade was narrated in the West from very different points of view by Anglo-Norman, French and German authorities. The primary Anglo-Norman authority is the *Carmen Ambrosii,* or, as it is called by M. Gaston Paris, *L'Estoire de la guerre sainte.* This is an octosyllabic poem in French verse, written by Ambroise, a Norman *trouvère* who followed Richard I. to the Holy Land. The poem first came to be known by scholars about 1873, and has been edited by M. Gaston Paris (1897). The *Itinerarium Peregrinorum,* a work in ornate Latin prose, is (except for the first book) a translation of the *Carmen* masquerading under the guise of an independent work. There seems no doubt that it is a piece of plagiary, and that its writer, Richard, "canon of the Holy Trinity" in London, stands to the *Carmen* as Tudebod to the *Gesta,* or Albert of Aix to his supposed original. The third crusade is also described from the English point of view by all contemporary writers of history in England, *e.g.,* Ralph of Coggeshall, who used information gained from crusaders, and William of Newburgh, who had access to a work by Richard I.'s chaplain, Anselm, which is now lost. The French side is presented in Rigord's *Gesta Philippi Augusti* and in the *Gesta* (an abridgement and continuation of Rigord) and the *Philippeis* of William the Breton. The two French writers represent Richard as a faithless vassal: in the German writers—Tagino, dean of Passau, who wrote a *Descriptio* of Barbarossa's crusade (1189–90); and Ansbert, an Austrian clerk, who wrote *De expeditione Friderici Imperatoris* (1187–96)—Richard appears rather as a monster of pride and arrogance. From the Arabic point of view the life of Richard's rival, Saladin, is described by Beha-ud-dīn, a high official under Saladin, who writes a panegyric on his master, somewhat confused in chronology and partial in its sympathies, but nevertheless of great value. The various continuations of William of Tyre above mentioned represent the opinion of the native Franks (which is hostile to Richard I.); while in Nicetas, who wrote a history of the Eastern empire from 1118 to 1206, we have a Byzantine authority who, as Prof. Bury remarks, "differs from Anna and Cinnamus in his tone towards the crusaders, to whom he is surprisingly fair."

For the Fourth Crusade the primary authority is Villehardouin's *La Conquête de Constantinople,* an official apology for the diversion of the crusade written by one of its leaders, and concealing the *arcana* under an appearance of frank naïveté. His work is usefully supplemented by the narrative (*La Prise de Constantinople*) of Robert de Clary, a knight from Picardy, who presents the non-official view of the crusade, as it appeared to an ordinary soldier. The *Χρονικὸν τῶν ἐν ῾ρωμανία* (composed in Greek verse some time after 1300, apparently by an author of mixed Frankish and Greek parentage, and translated into French at an early date under the title "The Book of the Conquest of Constantinople and the Empire of Rumania") narrates in a prologue the events of the fourth (as indeed also of the first) crusade. The *Chronicle of the Morea* (as this work is generally called) is written from the Frankish point of view, in spite of its Greek verse; and the Byzantine point of view must be sought in Nicetas. On the bibliography of the fourth crusade *see* Klimke, *Die Quellen zur Geschichte des vierten Kreuzzuges* (Breslau, 1875).

The history of the Later Crusades, from the fifth to the eighth, enters into the continuations of William of Tyre above mentioned; while the *Historia orientalis* of Jacques de Vitry, who had taken part in the fifth crusade, and died in 1240, embraces the history of events till 1218 (the third book being a later addition). The *Secreta fidelium Crucis* of Marino Sanudo, a history of the crusades written by a Venetian noble between 1306 and 1321, is also of value, particularly for the crusade of Frederick II. The minor authorities for the fifth crusade have been collected by Röhricht, in the publications of the Société de l'Orient Latin for 1879 and 1882; the ten valuable letters of Oliver, bishop of Paderborn, and the *Historia Damiettina,* based on these letters, have also been edited by Röhricht in the *Westdeutsche Zeitschrift für Geschichte und Kunst* (1891). The sixth crusade, that of Frederick II., is described in the chronicle of Richard of San Germano, a notary of the emperor, and in other Western authorities, *e.g.,* Roger of Wendover. For the crusades of St. Louis the chief authorities are Joinville's life of his master (whom he accompanied to Egypt on the seventh crusade), and de Nangis' *Gesta Ludovici regis.* Several works were written on the capture of Acre in 1291, especially the *Excidium urbis Acconensis,* a treatise which emerges to throw light, after many years of darkness, on the last hours of the kingdom. The oriental point of view for the 13th century appears in Jelaleddin's history of the Ayyubite sultans of Egypt, written towards the end of the 13th century; in Maqrizi's history of Egypt, written in the middle of the 15th century; and in the compendium of the history of the human race by Abulfeda (d. 1332); while the omniscient Abulfaragius (whom Rey calls the Eastern St. Thomas) wrote, in the latter half of the 13th century, a chronicle of universal history in Syriac, which he also issued, in an Arabic recension, as a *Compendious History of the Dynasties.*

II. The Documents bearing on the history of the crusades and the Latin kingdom of Jerusalem are various. Under the head of charters come the *Regesta regni Hierosolymitani,* published by Röhricht, Innsbruck, 1893 (with an *Additamentum* in 1904); the *Cartulaire générale des Hospitaliers,* by Delaville Leroulx (1894 *seq.*); and the *Cartulaire de l'église du St. Sépulcre,* by de Rozière (1849).

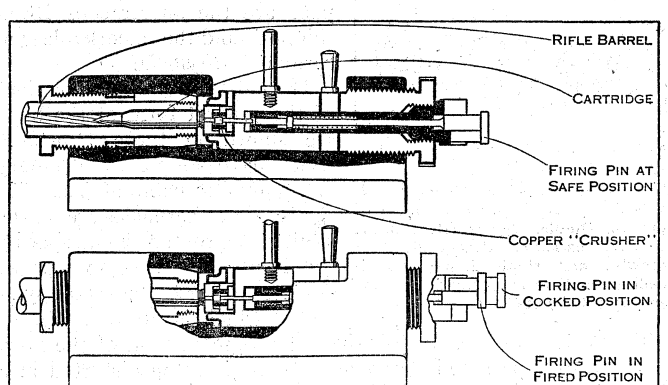
Under the head of laws come the assizes of the Kingdom, edited by Beugnot in the *Recueil des historiens des croisades;* and the assizes of Antioch, printed at Venice in 1876. G. Schlumberger has written on the coins and seals of the Latin East in various publications (and has also published *Prise de St. Jean d'Acre en l'an 1291 par l'armée du Soudan d'Egypte,* 1914, and *Récits de Byzance et des croisades,* 1916). E. G. Rey has written an *Étude sur les monuments de l'architecture militaire* (1871). The genealogy of the Levant is given in *Le Livre des lignages d'outre-mer* (published along with the assizes).

III. Modern Bibliographies.—The best account of original authorities for the crusades is that of A. Molinier, *Les Sources de l'histoire de France* (1901–06), vols. ii. and iii. W. Wattenbach, *Deutschlands Geschichtsquellen,* gives an account of Albert of Aix (vol. ii., ed., 1894, pp. 170–180) and of Ekkehard of Aura (*ibid.* pp. 189–198). Von Sybel's *Geschichte des ersten Kreuzzuges* contains a full study of the authorities for the first crusade; while the prefaces to Hagenmeyer's editions of the *Gesta* and of Ekkehard are also valuable. Gaston Dodu, in the work mentioned below, begins by a brief account of the original authorities, which is chiefly of value so far as it deals with William of Tyre and the history of the assizes; and H. G. Prutz has also a short account of some of the historians of the crusades (*Kulturgeschichte,* pp. 453–469). Finally, reference may be made to the works of Kugler and Klimke mentioned above, and to J. F. Michaud, *Bibliographie des croisades* (1822).

Modern Writers.—The various works of R. Röhricht present the soundest, if not the brightest, account of the crusades. There is a *Geschichte des ersten Kreuzzugs* (Innsbruck, 1901), a *Geschichte des Königreichs Jerusalem* (*ibid.,* 1898) and a *Geschichte der Kreuzzüge in Umriss* (*ibid.,* 1898). For the first crusade von Sybel's work and F. Chalandon's *Alexis Ier Comnène* (1900) may also be mentioned; for the fourth, A. Luchaire's *Innocent III.: La Question d'Orient* (1907); while for the whole of the crusades W. Norden's *Papsttum und Byzanz* (1903) is of value. B. Kugler's *Geschichte der Kreuzzüge* (1880) still remains a suggestive and valuable work; and L. Bréhier's *L'Église et l'orient au moyen âge* (1907) contains not only an up-to-date account of the crusades, but also a full and useful bibliography, which should be consulted for fuller information. The most recent work is that of A. Ruville, *Die Kreuzzüge* (Bonn, 1920). On points of chronology, and on the relations between the crusaders and their Mohammedan neighbours, W. B. Stevenson's *The Crusaders in the East* (1907) is very valuable. A large and important work of reference is G. Golubovich's *Biblioteca bibliografica della Terra Santa e dell' Oriente francescana* (1907, 1915, 1919). On the constitutional and social history of the Latin kingdom of Jerusalem, G. Dodu *Histoire des institutions dans le royaume latin de Jérusalem* (1894), is very useful; E. G. Rey, *Les Colonies franques de Syrie* (1883), gives many interesting details; and H. G. Prutz, *Kulturgeschichte der Kreuzzüge* (1883), gives an estimate of the effects of the crusades on the progress of civilization. The works of Gmelin and J. Delaville-Leroulx on the Templars and Hospitallers respectively are worth consulting; while for Eastern affairs the English reader may be referred to G. Le Strange, *Palestine under the Moslem* (1890), and to S. Lane-Pool, *Mahommedan Dynasties* (1894), a valuable work of reference. For a brief popular account, *see* Konrad Bercovici, *The Crusades* (1929). (E. B.)

CRUSENSTOLPE, MAGNUS JAKOB (1795–1865), Swedish historian, was born at Jönköping on March 11, 1795. His first important work was a *History of the Early Years of the Life of King Gustavus IV. Adolphus* (1837) which was followed by a series of monographs and by some politico-historical novels, of which *The House of Holstein-Gottorp in Sweden* is considered the best. In 1838 he was sentenced to three years' imprisonment for his bitter attacks on the Government. Few Swedish writers have wielded so pure and so incisive a style as Crusenstolpe, but his historical work is vitiated by political and personal bias. He died at Stockholm on Jan. 18, 1865.

CRUSHER-GAUGE, an instrument for the indirect measurement of the pressure in a gun when fired. Lead is the registering agent for shot-guns, but copper is used in other instances. The original type was screwed into the wall of a gun, and the explosion drove a knife-edged piston into a copper disk, the power required to penetrate to various depths being read off from a table. The modern form of gauge is a copper cylinder, compressed between two flat surfaces. Tables are prepared, for various crushers of standard length and diameter, from which the force in tons per square inch can be ascertained easily. Several crushers are tried in turn to give an average. The copper is first given an initial compression in manufacture, a record of the results being made. The simpler method of placing is in the chamber at the back of the charge. A rifle gauge is illustrated in the drawing, before and after firing. It consists of a massive steel block into which a rifle-barrel is locked by means of a screwed gland-fitting. The cartridge base rests on a piston through which the firing pin (striker pin) passes. As the piston is driven back by the explosion it compresses the copper crusher lying behind the piston.



CRUSHER GAUGE, USED FOR MEASURING INDIRECTLY THE PRESSURE IN A RIFLE WHEN FIRED. UPPER FIGURE SHOWS THE INSTRUMENT BEFORE, THE LOWER AFTER, FIRING

CRUSHER: *see* DISINTEGRATOR.

CRUSIUS, CHRISTIAN AUGUST (1715–1775), German philosopher and theologian, was born on Jan. 10, 1715, at Leuna, near Merseburg, in Saxony. He was educated at Leipzig, and became professor of theology there in 1750, and principal of the university in 1773. He died on Oct. 18, 1775. Crusius opposed the philosophy of Wolff from the standpoint of religious orthodoxy. He attacked it mainly on the score of the moral evils that must flow from any system of determinism. The most important works of this period of his life are *Entwurf der nothwendigen Vernunftwahrheiten* (1745), and *Weg zur Gewissheit und Zuverlässigkeit der menschlichen Erkenntniss* (1747). Though diffusely written, and neither brilliant nor profound, Crusius' philosophical books had a great but short-lived popularity.

There is a full notice of Crusius in Ersch and Gruber's *Allgemeine Encyclopädie.* Consult also A. Marquardt, *Kant und Crusius;* and art. in Herzog-Hauck, *Realencyklopädie.*

CRUSTACEA, a very large division of the animal kingdom comprising the crabs, lobsters, crayfish, prawns, shrimps, sand-hoppers, woodlice, barnacles, water-fleas and a vast multitude of less familiar forms that are not distinguished by any popular names. In systematic zoology they are ranked as one of the classes forming the phylum (or sub-phylum) arthropoda, (*q.v.*) and are distinguished from the members of the other classes by being generally of aquatic habits, breathing by gills or by the general surface of the body, having two pairs of antenna-like appendages in front of the mouth and at least three pairs of post-oral limbs acting as jaws. There is so much diversity, both of structure and of habits, within the class, that it is all but impossible to give a brief definition which shall apply to all its members, and all the characters mentioned are subject to modification in parasites and other highly specialised forms.

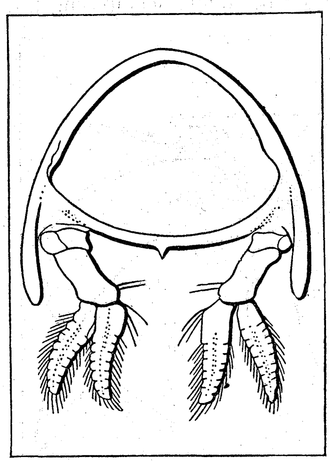


FIG. 1.—SEGMENT OF ABDOMEN OF LOBSTER, VIEWED FROM THE FRONT
Below are the pair of appendages, swimmerets, each with two branches, endopodite and exopodite, which are separated

It would not be altogether misleading to describe the Crustacea as the "insects of the sea." In the great oceans and in the narrow seas their teeming multitudes, the "things creeping innumerable" of the Psalmist, play a part not unlike that taken by the true insects in the life of the land. In fresh waters, where they have to meet with the competition of insects, they are hardly less abundant and there is scarcely a ditch or pond that does not harbour at least some of the more minute forms. On land they are less common, but the woodlice of our gardens and the land-crabs of tropical regions have solved the problem of adaptation to a sub-aerial life.

The most familiar Crustacea are the larger crabs and lobsters which are used as food by man, but the part which these play in the economy of nature is small compared with that of the amphipods and isopods which swarm in the shallower waters of the sea and serve as scavengers, feeding on all kinds of animal and vegetable refuse and forming, in their turn, the food of many of the larger marine animals such as fishes. Vastly more important than any of these, however, are the minute pelagic copepods, of which the shoals may discolour the surface waters of the ocean for many miles and serve to guide the fisherman and the whaler to the most profitable fishing grounds. They form an important constituent of plankton (*q.v.*), the assemblage of minute floating animal and vegetable life in the surface waters of the ocean. It is on the plankton that a great part of the higher animal life of the sea ultimately depends for food. The copepods live upon the diatoms and other microscopic plant life of the plankton and themselves form the food of many fishes such as the herring and the mackerel and even of the gigantic whales.

MORPHOLOGY

External Structure: Body.—As in all arthropods the firm outer covering or exoskeleton of the body consists of a series of segments or somites which may be jointed together or more or less coalesced. The typical form of a somite is seen, for instance, in the segments which make up the abdomen or "tail" of a lobster or crayfish. Each consists of a shelly ring separated from the rings in front and behind by areas of softer integument forming movable joints. The arched plate which forms the dorsal part of the segment is distinguished as the tergum and the narrower ventral bar as the sternum. The tergum is produced on either side as a free plate, the pleuron, and each segment has a pair of limbs articulated to the sternum. The posterior terminal segment of the body, on which the opening of the anus is situated, never bears typical limbs and is known as the telson. Its morphological nature is shown by its development. In the larvae of the more primitive Crustacea, the number of somites, at first small, increases by the successive appearance of new somites between the last-formed somite and the terminal region which bears the anus. The "growing-point" of the body is, in fact, situated in front of this region, and, when the full number of somites has been reached, the unsegmented part remaining forms the telson of the adult. In no crustacean, however, are all the somites of the body distinct and separate from each other. The fore part of the body of the lobster, for instance, has an undivided shelly covering, the "barrel" or carapace, and the number of somites composing this region is only to be inferred from the appendages attached to it. In all Crustacea an anterior region is marked off by having the somites obscured in this way. Apart from the possible existence of an ocular somite corresponding to the eyes (the morphological nature of which is discussed below) the smallest number of somites so united in any adult crustacean is five. Even where a larger number of somites are fused there is generally a marked change in the character of the appendages after the fifth pair, and, since the integumental fold which forms the carapace seems to originate from this point, it is usual to regard these five somites as constituting the head or cephalon. It is quite possible, however, that in the primitive ancestors of existing Crustacea a still smaller number of somites were united in the head. The first three pairs of appendages are alone present in the "nauplius" larva, and they show certain peculiarities of structure and development that seem to place them in a different category from the other limbs. There is therefore some ground for regarding the three corresponding somites as forming a "primary cephalon."

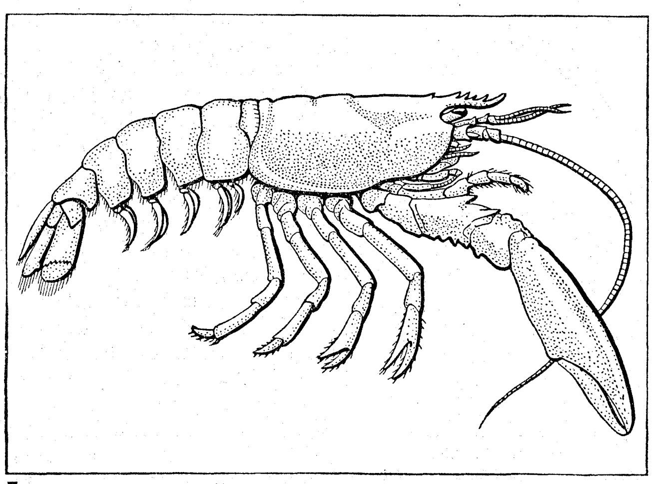


FIG. 2.—COMMON LOBSTER, FEMALE (HOMARUS GAMMARUS) SEEN FROM THE SIDE, THE APPENDAGES OF ONE SIDE ONLY BEING REPRESENTED

In the sub-class Malacostraca, which includes all the larger and better-known Crustacea, the body proper is divided into two regions sharply distinguished by the character of the appendages. These are the "thorax" of eight somites and the abdomen. In the other sub-classes, although the terms thorax and abdomen are often used as descriptive terms, the regions so named are not homologous with those of the Malacostraca. In many of the latter, as, for example, in the lobster, the head and thorax form a single undivided region which is known as the "cephalo-thorax." The shell or carapace covering this region is not simply formed by the coalesced terga of the somites. In some of the lower Malacostraca, such as the Mysidacea, the carapace is a fold of the integument, enveloping, but remaining free from, the thoracic somites. In the lobster and other Decapoda, the carapace has coalesced with the thoracic terga in the middle of the back but remains free at the sides, enclosing a pair of chambers within which lie the gills.

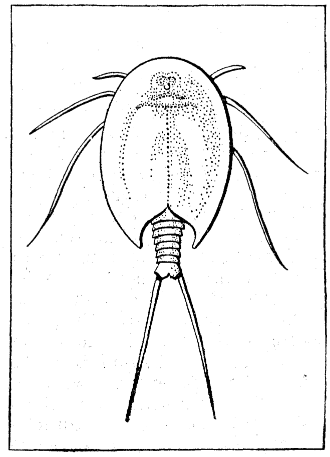


FIG. 3.—APUS CANCRIFORMIS, ONE OF THE BRANCHIOPODA, SHOWING THE BROAD SHIELD-SHAPED CARAPACE COVERING THE GREATER PART OF THE BODY

The possession of this carapace, arising as a dorsal fold from the posterior margin of the head-region, is a character which recurs in the most diverse groups of the Crustacea and is probably to be regarded as a primitive attribute of the class. The carapace may have the form of a bivalve shell, entirely enclosing the body and limbs, as in many Branchiopoda and in the Ostracoda. In the Cirripedia it forms a fleshy mantle strengthened by shelly plates which may have a very complex structure. In the Isopoda and Amphipoda, where, as a rule, all the thoracic somites except the first are distinct, there seems at first to be no carapace-fold. A comparison with the related Tanaidacea and Cumacea, however, suggests that the coalescence of the first thoracic somite with the head really involves a vestigial shell-fold and this is possibly the case also in the Copepoda. The only Crustacea in which there appears to be no trace of a carapace are the anostracous Branchiopoda and the remarkable syncaridan *Bathynella.*

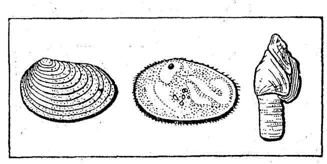


FIG. 4.—THREE TYPES OF CARAPACE

Left, *Estheria* (Branchiopoda), bivalved carapace showing lines of growth. Middle, *Cypris* (Ostracoda), bivalved carapace without lines of growth, and right, *Lepas* (Cirripedia), multivalved carapace at the end of a fleshy stalk

The most extreme modifications of the general form of the body are shown in those Crustacea which have adopted a sedentary or a parasitic habit of life. The Cirripedia or barnacles are, in the adult state, rooted to one spot by the head, and tend, in varying degrees, towards the radial symmetry which is often associated with a sedentary life. In parasites, the segmentation of the body tends to disappear and the general shape is often distorted in a fantastic manner. In the Rhizocephala, and other parasitic cirripedes, the adults have lost nearly every trace, not only of crustacean but even of arthropodous structure.

General Structure of Limbs.—Amid the great variety of forms assumed by the appendages of Crustacea, it is possible to trace, more or less plainly, the modifications of a fundamental type consisting of a peduncle, the protopodite (or sympodite), bearing two branches, the endopodite and exopodite. This simple biramous form is shown in the swimming feet of Copepoda, the "cirri" of Cirripedia and the abdominal limbs of Malacostraca, and it is also found in the earliest and most primitive type of larva known as the "nauplius." The protopodite may have, on its inner and outer margins, additional lobes or processes, known as endites and exites respectively. Some of the exites often function as gills, and the endites of appendages near the mouth frequently form jaw-processes, assisting in mastication and known as gnathobases. In the flattened leaf-like limbs characteristic of the Branchiopoda the endites and exites are so developed that the biramous form of the limb is obscured. It has been supposed that this form of limb, the "phyllopodium," represents the primitive type from which the biramous type has been derived. The recurrence of the biramous type, however, in the most diverse forms of Crustacea and in the simplest larvae, and the evidence of the remarkable fossil branchiopod *Lepidocaris,* all go to show that it represents the fundamental plan of the crustacean limb.

In many Crustacea the paired eyes are borne on stalks which are movably articulated with the head and may be divided into two or three segments. The view has been held that these eye-stalks are really limbs, homologous with the other appendages. The evidence of embryology, however, is decidedly against this view. The stalks appear late in the course of development, after many of the trunk-limbs are fully formed, and the eyes, at their first appearance, are sessile on the sides of the head and only later become pedunculated. The most important evidence in favour of the appendicular nature of the eye-stalks is found in the fact that when the eye-stalk is removed from a living lobster or prawn, a many-jointed appendage like the flagellum of an antenna may grow in its place. It is open to question, however, how far the evidence from such "heteromorphic regeneration" (*see* HETEROMORPHOSIS; REGENERATION IN ANIMALS) can be regarded as conclusive on points of homology.

Special Morphology of Limbs.—The antennules (or first antennae) are generally regarded as true appendages, although they differ from all the other appendages in the facts that they are always innervated from the "brain" (or preoral ganglia) and that they are uniramous in the earliest larvae and in the adults of all sub-classes except the Malacostraca, where they are biramous or sometimes triramous. It is unlikely that the two branches of the biramous type (seen, for instance, in the antennules of the

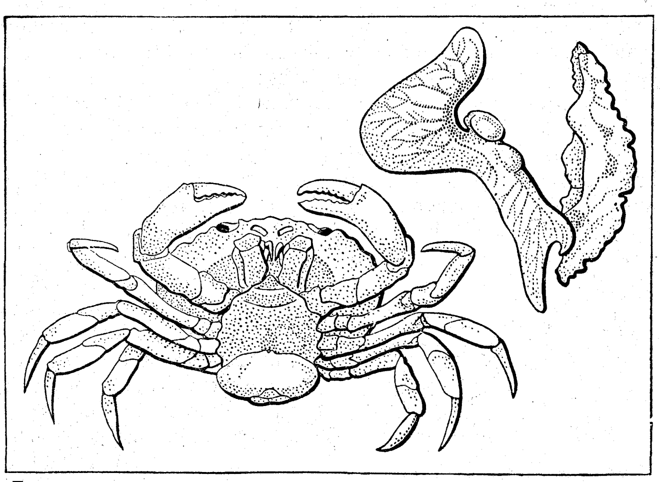


FIG. 5.—EXTREME MODIFICATIONS OF GENERAL FORM IN CRUSTACEA
Left: *Sacculina carcini* (Rhizocephala), attached to the under side of the Shore Crab (*Carcinides maenas*). Right: *Portunion maenadis* (Isopoda), an internal parasite of the same species of crab

lobster) correspond to the endopodite and exopodite of the other limbs.

The antennae (or second antennae) are of special interest on account of the clear evidence that, although preoral in position in all adult Crustacea, they were originally postoral appendages. In the "nauplius" larva they lie at the sides of the mouth and their basal portion carries a hook-like process which assists the similar processes of the mandibles in pushing food into the mouth.

In most Crustacea the antennules are purely sensory in function and carry numerous "olfactory" hairs. They are used as swimming organs in many larvae and some adults, and sometimes, in the male sex, they form clasping organs for holding the female. In the Cirripedia the antennules of the larvae carry the openings of the cement glands and become, in the adult, involved in the attachment of the animal to its support.

The antennae are frequently swimming organs, but may assume other functions as organs of attachment in parasites, as creeping

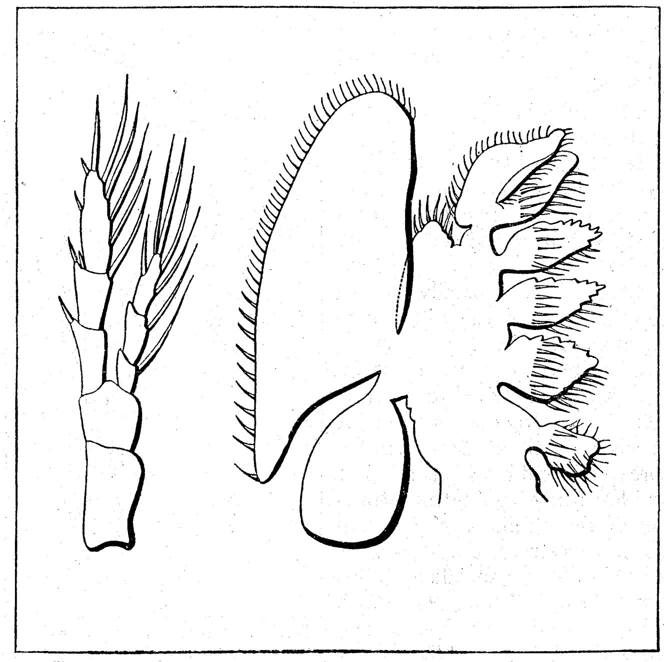


FIG. 6.—SWIMMING FOOT OF A COPEPOD AND A BRANCHIOPOD
Left: one of the swimming-feet of a Copepod (*Calanus*), showing the simple two-branched type of Crustacean appendage. Right: one of the trunk-like limbs of a Branchiopod (*Apus*), showing the flattened leaf-like type, phyllopodium

legs, or as male claspers. In the Malacostraca they are chiefly sensory, the endopodite forming a long many-jointed lash (flagellum) while the exopodite is often a flattened plate, probably used as a balancer in swimming.

The mandibles, like the antennae, have, in the nauplius, the form of biramous swimming limbs, with a jaw-lobe on the protopodite. This form is retained in some adult Copepoda and Ostracoda. In most cases, however, the palp loses its exopodite and it often disappears altogether, and the basal lobe becomes a powerful jaw with the edge variously armed with teeth and spines. In blood-sucking parasites the mandibles are often piercing stylets enclosed in a tubular proboscis formed by the upper and lower lips.

The maxillulae and maxillae, or, as they are often called, first and second maxillae, are nearly always flattened leaf-like appendages with gnathobasic lobes or endites borne by the protopodite. The endopodite, when present, forms a palp of one or a few segments, and exites may also be present.

The limbs behind the head-region show little differentiation among themselves in the Branchiopoda, Cirripedia and many Copepoda. It is characteristic of the Malacostraca that the trunk-limbs are divided into two sharply-defined series or "tagmata," eight corresponding to the thoracic and six to the abdominal region. The thoracic series have the endopodites converted, for the most part, into more or less efficient walking-legs, while the exopodites are swimming organs or disappear. It is usual for one or more of the anterior pairs to be modified as "foot-jaws" or maxillipeds. The abdominal limbs are usually biramous and natatory, the last pair being large and flattened and forming with the telson a lamellar "tail-fan."

Gills.—In many of the smaller Crustacea no special gills are present and respiration is carried on by the general surface of the body and limbs. When gills are present they are generally formed by some of the exites near the base of the limb, which are flattened, thin-walled, and permeated by a network of blood-channels.

In the Decapoda the gills are inserted, in three series, at or near the bases of the thoracic limbs, and lie within a pair of branchial chambers covered by the carapace.

Adaptations for aerial respiration are found in those Crustacea that have taken to terrestrial life. In the land-crabs (of several different families) the branchial chambers are enlarged and serve as lungs, the lining membrane being richly supplied with blood-vessels. In some of the terrestrial Isopoda or woodlice the abdominal appendages contain tufts of branching tubules filled with air, like the tracheae of insects and other terrestrial Arthropoda.

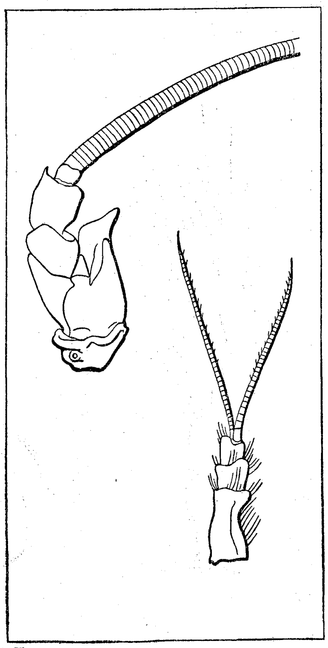


FIG. 7.—LEFT: ANTENNA OF LOBSTER, SHOWING BASAL PORTION ONLY, OF THE FLAGELLUM; RIGHT: ANTENNULE

Internal Structure: Alimentary System.—In almost all Crustaceae the food-canal runs straight through the body, except in front where it curves downwards to the ventrally placed mouth. In a few cases its course is sinuous or twisted and in one or two instances (Cladocera, Cumacea) it is actually coiled upon itself. As in other arthropoda, it consists of three divisions, the fore-, mid- and hind-gut, the first and last being lined by an inturning of the chitinous cuticle. In the Malacostraca, the fore-gut is dilated to form a so-called "stomach," furnished internally with ridges armed with spines and hairs forming a straining apparatus. In the Decapoda this apparatus reaches its greatest complexity, forming a "gastric mill" in which three teeth connected with a system of articulated ossicles are moved by special muscles so as to triturate the food which is passed into the stomach.

The mid-gut is essentially the digestive and absorptive region of the alimentary canal and its surface is, in nearly all Crustacea, increased by pouch-like or tubular outgrowths which not only serve as glands for secretion of the digestive juices, but aid in the absorption of the digested food. In the Decapoda these outgrowths form a massive digestive gland or "liver." In some decapods, as the crayfish, the mid-gut is very short, nearly the whole length of the food-canal being formed by the fore and hind guts. In a few highly modified parasites the alimentary canal is vestigial or absent throughout life as in the Rhizocephala (Cirripedia, *q.v.*).

Circulatory System.—As in the other Arthropoda, the circulatory system in Crustacea is largely lacunar, the blood flowing in spaces or channels without definite walls. The heart is of the usual arthropodous type, lying in a pericardial blood-sinus with which it communicates by valvular openings or ostia. In most Branchiopoda and in some Malacostraca the heart retains more or less completely the primitive form of a long tube, extending throughout the greater part of the length of the body and having a pair of ostia in each somite. In most Crustacea however, it is shortened and gives off one or more main arteries which carry the blood for some distance to pour into the blood-spaces of the body. In many of the smaller Crustacea there is no heart, and it is impossible to speak of a circulation in the proper sense of the word, the blood being merely driven hither and thither by the movements of the body and limbs and of the alimentary canal.

Excretory System.—The most important excretory or renal organs of the Crustacea are two pairs of glands lying at the base of the antennae and of the maxillae respectively. The two are rarely functional together, although one may replace the other in the course of development. In the adult it is sometimes the antennal, sometimes the maxillary gland which persists. The structure of both glands is essentially the same and they are to be regarded as the survivors of a primitive series of segmentally arranged nephridia. Each consists of a thin-walled "end-sac," which development shows to be a vestigial portion of the coelom, communicating with the exterior by a convoluted duct, part of which has glandular walls. Probably in most cases the greater part of this duct arises from mesoblast and only a short terminal part from epiblast, but it is stated that in some cases the whole duct is epiblastic. In the Decapoda the antennal gland is largely developed and is known as the "green gland." The external part of the duct is often dilated into a bladder, and may sometimes send out diverticula forming a system of sinuses ramifying through the body.

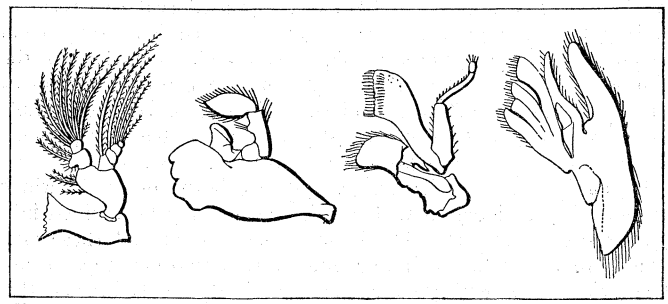


FIG. 8.—MOUTH PARTS OF CRUSTACEA, SHOWING FROM LEFT TO RIGHT: Mandible of *Calanus* (Copepoda) with biramous palp; Mandible of Lobster, with palp reduced and unbranched; Maxillula of Lobster; Maxilla of Lobster

Other excretory organs have been described in certain Crustacea, consisting of groups of mesodermal cells in various parts of the body within which the excretory products are stored up instead of being expelled. Possibly some of these are vestiges of segmentally arranged Nephridia.

Nervous System.—The central nervous system is constructed on the same general plan as in other Arthropoda, consisting of a supraoesophageal ganglionic mass or "brain," united by circumoesophageal connectives with a double ventral chain of segmentally arranged ganglia. In the primitive Branchiopoda the ventral chain retains the ladder-like arrangement found in some annelids, the two halves being widely separated and the pairs of ganglia connected together across the middle line by double transverse commissures. In the other groups the two halves of the chain are more or less coalesced, and, in addition, the ganglia tend to draw together in a longitudinal direction and to fuse, ultimately, into a single mass representing the whole of the ventral chain. This is seen, for example, in the true crabs (Brachyura) among the Decapoda. The brain, or supraoesophageal ganglion, shows various degrees of complexity. In the Branchiopoda it contains two pairs of ganglionic centres giving origin, respectively, to the optic and the antennular nerves. The centres for the antennal nerves form ganglionic swellings on the oesophageal connectives. In the higher forms these centres have moved forwards to become incorporated in the brain, but the fibres which unite them still run backwards to form a transverse commissure behind the oesophagus. This is of importance as showing that the antennae were originally postoral limbs. In the higher Decapoda, additional centres are developed in the brain and its structure becomes very complex. A system of visceral nerves and ganglia associated with the alimentary canal and the heart is well developed in the Decapoda.

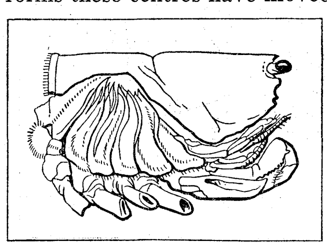


FIG. 9.—GILLS OF LOBSTER, EXPOSED BY CUTTING AWAY THE SIDE OF THE CARAPACE

Eyes.—The eyes of Crustacea are of two kinds, the unpaired, median or "nauplius" eye, and the paired compound eyes. The median eye is generally present in the earliest larval stages (nauplius) and in some instances, as in the Copepoda, it forms the sole organ of vision. It may persist along with the paired eyes, as in the Branchiopoda, or it may become vestigial or disappear in the adult, as in most Malacostraca. It consists typically of three cup-shaped masses of pigment, the cavity of each cup being filled with columnar retinal cells connected at their outer ends with nerve

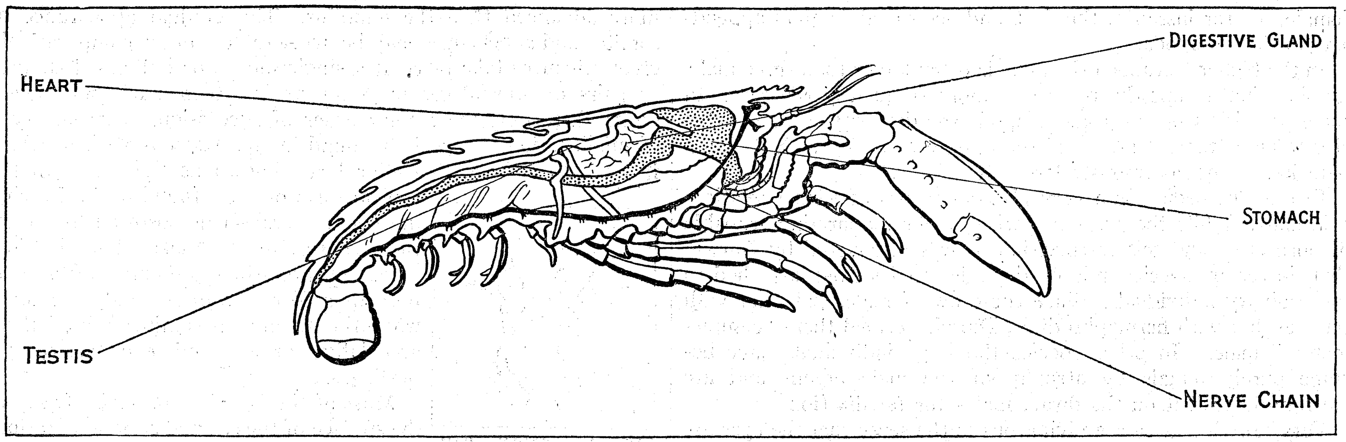
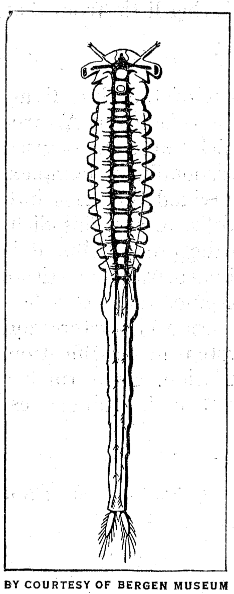


FIG. 10.—DISSECTION OF MALE LOBSTER, FROM THE SIDE
The nervous system is shown in black, the food-canal is stippled. Running downward from the long tubular testis to the base of the last walking-leg is the male genital duct. The heart, lying under the carapace, is continued backward by a large blood vessel, the posterior aorta, and sends downward another large vessel, which is seen in front of the genital duct. The digestive gland or "liver" is a large mass occupying most of the space in the carapace on each side of the stomach

fibres from the brain.

The compound eyes are very similar in the details of their structure to those of insects, consisting of a varying number of visual elements or "ommatidia" separated by pigment sheaths and each terminating in a "crystalline body" covered by the transparent external cuticle which forms the cornea. In most cases the cornea is divided into lens-like facets corresponding to the underlying ommatidia.



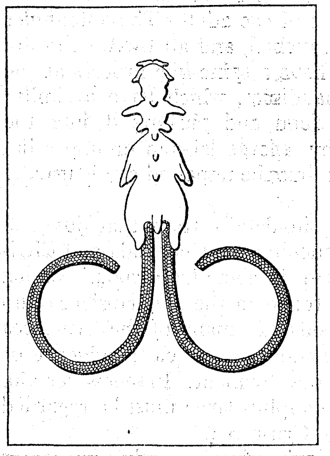
BY COURTESY OF BERGEN MUSEUM FROM SARS "FAUNA NORVEGIAE"
FIG. 11.—NERVOUS SYSTEM OF BRANCHINECTA SHOWING THE "LADDER-LIKE" VENTRAL CHAIN

Other Sense-organs.—As in other Arthropoda, the hairs or setae on the surface of the body are important organs of sense and are variously modified for special functions. Many, perhaps all, of them are organs of the sense of touch. When feathered or provided with secondary barbs the setae will respond to movements or vibrations in the surrounding water and some of this sort have been supposed to have an auditory function. Organs formerly regarded as auditory, but now known to be connected with the maintenance of equilibrium of the body, are the "statocysts" found in various positions in different Crustacea, notably at the base of the antennules in most Decapods. These are open or closed vesicles having sensory hairs on their inner surface and containing one or more "statoliths" which may be grains of sand introduced from the exterior.

Another type of sensory setae is associated with the sense of smell, or rather, perhaps, the "chemical sense." These are bluntly pointed filaments in which the cuticle is extremely delicate. They are found chiefly on the antennules, and are often especially developed in the males, which they are supposed to guide in their pursuit of the females.

Glands.—The most important glandular structures in Crustacea (in addition to the digestive and excretory glands already mentioned) are various types of dermal glands which occur on the surface of the body and limbs. Some of these in the neighbourhood of the mouth or on the walls of the oesophagus have been regarded as salivary, but in some cases are now known to produce a mucous secretion which serves to entangle minute food-particles and is swallowed along with them. In some Amphipoda the secretion of glands on the surface of the body and limbs is used in the construction of protective cases in which the animals live. In some freshwater Copepoda the dermal glands secrete a gelatinous envelope enabling the animals to resist desiccation. The greatly-developed cement glands of the Cirripedia which serve to attach the animals to their support probably also belong to the category of dermal glands.

Phosphorescent Organs.—Like many other marine animals certain Crustacea belonging to very diverse groups (Ostracoda, Copepoda, Mysidacea, Euphausiacea, Decapoda) possess the power of emitting light. All of them are inhabitants of the deep sea or of the surface waters of the ocean. No freshwater Crustacea are phosphorescent. The organs concerned in light-production are curiously varied. In the Ostracoda and Copepoda certain dermal glands produce a luminous secretion. In some Mysidacea and Decapoda the secretion of the excretory organs (maxillary or antennal glands) is luminous. In the Euphausiacea and certain Decapoda the light-producing organs found on the body and limbs are complex structures provided with a reflector and a condensing lens and movable by special muscles so as to vary the direction of the emitted beam. The part which phosphorescence plays in the life of the animals can only be conjectured. In some instances it may serve to attract prey; in others it may help individuals of the same species to keep together in a shoal or to find their mates. The clouds of luminous secretion thrown out by some species may serve to baffle pursuers like the cloud of ink thrown out by a cuttlefish. The elaborate "search-lights" may illuminate objects within the range of vision. But even conjecture seems at a loss when we find that certain deep-sea prawns have complex light-organs placed so as to illuminate the interior of the gill-chambers.



FROM SCOTT, "BRITISH PARASITIC COPEPODA" (RAY SOCIETY)
FIG. 12.—CHONDRACANTHUS (COPEPODA), A FISH PARASITE
Showing the female carrying a pair of long sausage-shaped egg masses. At the base of the right hand egg mass is a small oval body, the dwarfed male

Reproductive System.—In the great majority of Crustacea the sexes are separate, but in the Cirripedia and in some parasitic Isopoda hermaphroditism is the rule, and isolated instances occur in other groups, especially among Decapoda. Parthenogenesis is common in Branchiopoda and Ostracoda and occurs in at least one genus of terrestrial Isopoda. Where the sexes are separate, sexual dimorphism is often striking. The males are often provided with clasping organs for holding the female, and these may be formed by modification of almost any of the appendages, antennules, antennae, thoracic limbs, or even some of the mouth-parts. Some of the appendages in the neighbourhood of the genital openings may be modified for the purpose of transferring the sperm to the female, as, for instance, the first and second abdominal appendages in the Decapoda.

In the higher Decapoda the male is often larger than the female, but in other groups the reverse is more frequently the case. In some parasitic Copepoda and Isopoda the disparity in size is carried to an extreme degree, and the minute male is attached, like a parasite, to the enormously larger female.

In the Cirripedia some very aberrant types of sexual relationship exist. While the great majority are hermaphrodites capable of both cross and self fertilization, it was discovered by Darwin that, in certain species, minute degraded males exist, attached to the ordinary individuals. Since these dwarf males pair, not with females, but with hermaphrodites, Darwin termed them "complemental" males. In other species the large individuals have become purely female by atrophy of the male organs and are entirely dependent on the dwarf males for fertilization.

Very few Crustacea are viviparous in the sense that the eggs are retained within the body until hatching takes place, but, on the other hand, nearly all carry the eggs in some way or other after extrusion. They are retained between the valves of the carapace in some Branchiopoda and Ostracoda or within the mantle-cavity in Cirripedia. Among the Malacostraca the Peracarida have a brood-pouch formed by overlapping plates attached to the bases of some of the thoracic legs. In most Decapoda the eggs are carried by the female attached to the abdominal appendages. In a few cases the developing embryos are nourished by a special secretion while in the brood-chamber (Cladocera, terrestrial Isopoda).

EMBRYOLOGY

The majority of Crustacea are hatched from the egg in a form differing more or less from that of the adult, and pass through a series of free-swimming larval stages. There are many instances, however, in which the metamorphosis is suppressed, and the newly-hatched young resemble th parent in general structure.

In those Crustacea in which the series of larval stages is most complete the starting-point is the form already mentioned under the name of nauplius. In the typical form, this has an oval unsegmented body and three pairs of limbs corresponding to the antennules, antennae and mandibles of the adult. The antennules are simple, the others each two-branched, and all three pairs are used in swimming. The antennae have a spine-like process at the base, and they share with the mandibles, which have a similar process, the function of seizing food and pushing it into the mouth. The mouth is overhung by a large labrum or upper lip. The paired eyes are as yet wanting, but the unpaired eye is usually conspicuous.

A nauplius larva differing only in details from that just described is found in most of the Branchiopoda, Copepoda and Cirripedia, and in a more modified form, in some Ostracoda. Among the Malacostraca, the nauplius is found in the Euphausiacea and some of the most primitive Decapoda. In many of the Crustacea that hatch at a later stage there is more or less clear evidence of a nauplius stage in the embryonic development. It seems certain, therefore, that the possession of a nauplius larva must be regarded as a very primitive character of the Crustacea.

As development proceeds, the body of the nauplius elongates and its posterior part becomes segmented, new somites being added at successive moults from a formative zone in front of the telsonic region. The appendages appear as buds on the ventral surface of the somites, and become differentiated, like the somites that bear them, in regular order from before backwards. With the elongation of the body, its dorsal covering begins to project behind as a shell-fold, the beginning of the carapace. The paired eyes appear under the cuticle at the sides of the head, but only become pedunculated at a comparatively late stage.

The course of development here outlined, in which the somites and appendages appear in regular order, agrees so well with that observed in the typical Annelida that it must be regarded as the most primitive. It is most closely followed in some Branchiopoda and Copepoda. In most Crustacea, however, this primitive scheme is more or less modified. The earlier stages may be passed through within the egg, so that the larva, on hatching, has reached a stage more advanced than the nauplius. The gradual appearance of somites and appendages may be accelerated so that comparatively great advances take place at a single moult, or individual somites or pairs of appendages may appear in advance of their neighbours, disturbing the regular order of succession. This last type of modification is especially found in the Malacostraca, in which it leads to the very peculiar larva known as the zoëa. In the typical form of zoea, found in the Brachyura (or true crabs) the posterior five or six thoracic somites are delayed in development and are still represented by a short unsegmented region of the body at a stage when the abdominal somites behind them are fully formed and even carry appendages.

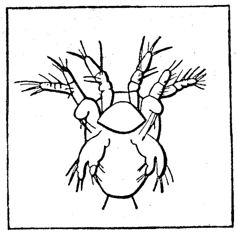


FIG. 13.—EARLY NAUPLIUS LARVA OF A COPEPOD (CYCLOPS)

Most of the larval forms swim freely at the surface of the sea and show adaptations to this "pelagic" habit of life. Various spines and processes from the surface of the body are often developed and are probably less important as defensive organs than as aids to flotation, and the same purpose may be served by the greatly developed carapace of stomatopod larvae and the extreme flattening of the body in the membranous *phyllosoma* larvae of the spiny lobsters and their allies.

Complete suppression of metamorphosis is found in the fresh-water crayfish and the river-crabs, but is by no means universal among freshwater Crustacea. On the other hand, a few marine crabs are known to be hatched in a form differing little from that of the adult.

CLASSIFICATION

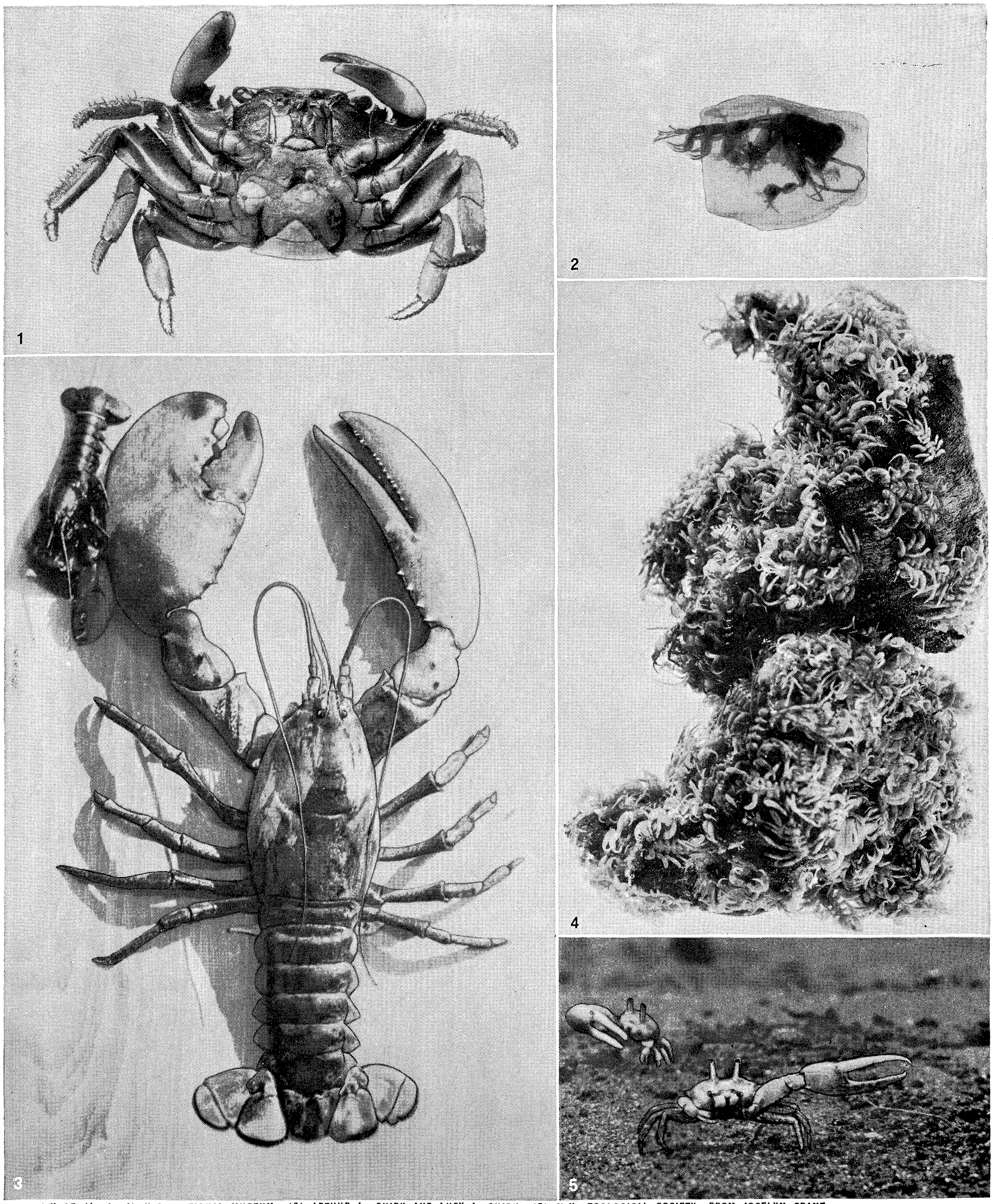
The diversity of structure in the members of the class Crustacea is much greater than in any of the other classes of Arthropoda, and the scheme of classification which must be devised in order to express their affinities is correspondingly complex. Early in the 19th century P. A. Latreille divided the class into two main groups, Malacostraca and Entomostraca, and this dichotomy has persisted in text-books down to the present, but it is now generally recognized that while the Malacostraca constitute a natural and sharply-defined group, the Entomostraca are a heterogeneous assemblage, defined only by negative characters and having no claim to retention in a natural system of classification.

The following is a synopsis of the classification. Some further details will be found in the articles dealing with the sub-classes.

Class CRUSTACEA
- Sub-class *Branchiopoda*
  - Orders *Anostraca, Lipostraca, Notostraca, Conchostraca, Cladocera.*
- Sub-class *Ostracoda.*
  - Orders *Myodocopa, Podocopa.*
- Sub-class *Copepoda.*
  - Orders *Calanoida, Harpacticoida, Cyclopoida, Notodelphyoida, Monstrilloida, Caligoida, Lernaepodoida, Arguloida.*
- Sub-class *Cirripedia.*
  - Orders *Thoracica, Acrothoracica, Ascothoracica, Apoda, Rhizocephala.*
- Sub-class *Malacostraca.*
  - Division *Phyllocarida.* Order *Nebaliacea.*
  - Division *Syncarida.* Order *Anaspidacea.*
  - Division *Peracarida.* Orders.—*Mysidacea, Thermosbaenacea, Cumacea, Tanaidacea, Isopoda, Amphipoda.*
  - Division *Eucarida.* Orders.—*Euphausiacea, Decapoda.*
  - Division *Hoplocarida.* Order *Stomatopoda.*

PAST HISTORY

Fossil remains of Crustacea are abundant in strata belonging to all the main divisions of the geological time-scale from the most ancient up to the most recent, but they teach us disappoint-



COURTESY OF (1, 2, 4) U.S. NATIONAL MUSEUM, (3) ARTHUR L. QUIRK AND LUCY I. QUIRK, (5) N.Y. ZOOLOGICAL SOCIETY, FROM JOCELYN CRANE

VARIOUS CRUSTACEA

1. Crab, *Pachygrapsus marmoratus* (Eucarida, Order Decapoda, Reptantia, Section Brachyura), a common Atlantic and Mediterranean species ranging from the Canaries and Azores to the Black sea; from the underside, with the large tumour-like *Sacculina carcini* (Cirripedia, Order Rhizocephala) attached to sternum and partly shielded by the crab's abdomen; on the sternum adjacent to the *Sacculina* are two small barnacles or acorn shells, *Balanus* species (Cirripedia, Order Thoracica). Natural size
2. *Phronima*, one of the pelagic amphipods (Peracarida, Order Amphipoda, Suborder Hyperiidea) in its floating house, the test of a pelagic tunicate made use of by the amphipod after eating its original owner. Seen by transmitted light, compare with Plate I, fig. 7 Malacostraca. Natural size
3. Lobster, *Homarus americanus* (Eucarida, Order Decapoda, Reptantia, Section Astacura) from Rhode Island. The larger specimen, 24 in. in length of body, is an example of the size to which a lobster may grow if left unmolested; weight 28 lb.
4. Parasitic amphipods, *Cyamus* (Peracarida, Order Amphipoda, Suborder Caprellidea) on portions of skin of infested whale, taken in Shark bay, West Australia, natural size, many adult and younger specimens
5. Fiddler crabs, *Uca stenodactyla* (Eucarida, Order Decapoda, Section Brachyura), a species occurring on the west coast of America from El Salvador to Valparaiso, Chile. About two-thirds natural size

ingly little regarding the phylogeny of the class. This is partly due to the fact that many important forms must have escaped fossilization altogether owing to their small size and delicate structure, while very many of those actually preserved are known only from the carapace or shell, the limbs being absent or represented only by indecipherable fragments. The fortunate accident which has preserved with marvellous completeness the minute branchiopod *Lepidocaris* in the rhynie chert (old red sandstone) is not likely to have been often repeated. But *Lepidocaris* is of recent date as compared with the varied fauna of Crustacea discovered by Walcott in the Middle Cambrian of the Canadian Rockies and there is reason to believe that many of the chief groups were already differentiated before the beginning of the geological record as we now know it. Shrimp-like forms that can be definitely referred to the Malacostraca begin to appear in the Upper Devonian and Mysidacea and Syncarida can be recognized in the Carboniferous, but it is not until true decapods appear in the Trias that anything like a connected story can be made out.

In the dearth of trustworthy evidence from palaeontology we are compelled to rely on the data afforded by comparative anatomy and embryology in attempting to reconstruct the course of evolution within the class. It is perhaps unnecessary to insist that conclusions reached in this way must remain more or less speculative so long as they cannot be checked by the results of palaeontology.

The earlier attempts to reconstruct the genealogical history of the Crustacea started from the assumption that the successive stages of the larval history, especially the nauplius and zoea, reproduced the actual structure of ancestral types. It is now generally agreed that this "theory of recapitulation" cannot be applied to the zoea, the characters of which must be due to secondary modification. As regards the nauplius, however, the constancy of its general structure in the most diverse groups of Crustacea strongly suggests that it is a very ancient type, and

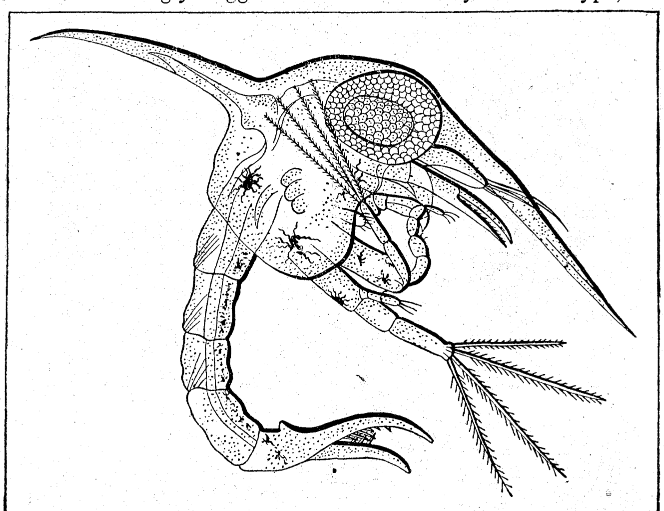


FIG. 14.—ZOEA LARVA OF THE SHORE CRAB (CARCINIDES MAENAS)
In this stage the telson is furcate and the following appendages developed: Antennule, antenna, maxillula, maxilla, mandible, first and second maxillipeds (the first folded up against carapace, second extended). The three little "buds" (showing through the side of the carapace) are the rudimentary third to fifth thoracic appendages.

the view has been strongly advocated that the Crustacea must have arisen from an unsegmented nauplius-like ancestor.

The objections to this view, however, are considerable. The resemblances between the more primitive Crustacea and the annelid worms, in such characters as the structure of the nervous system and the mode of growth of the somites, can hardly be ignored, and it is reasonable to suppose that the Crustacea originated from some stock which already possessed these characters.

If we are to attempt to reconstruct a hypothetical ancestral crustacean, we must suppose it to have approximated, in general form, to some such branchiopod as *Apus,* with an elongated body composed of numerous similar somites and ending in a caudal fork, with a carapace originating as a shell-fold from the maxillary somite, with the eyes, probably, stalked, and the antennae and mandibles both biramous and armed with masticatory processes, and with the trunk-limbs all similar, biramous, with additional endites and exites, and probably all bearing gnathobases. It is to be noted that, except for the absence of a carapace-fold and of eye-stalks, the trilobites are not very far removed from the primitive crustacean here sketched.

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(W. T. C.; W. L. St.)

CRUSTUMERIUM, an ancient town of Latium, on the edge of the Sabine territory, near the headwaters of the Allia, not far from the Tiber. Rome conquered it in 500 B.C. according to Livy, the *tribus Crustumina* (or *Clustumina*) being formed in 471 B.C. Pliny mentions it among the lost cities, but the name clung to the fertile district around it. The site is unknown.

CRUVEILHIER, JEAN (1791–1874), French anatomist, born at Limoges on Feb. 9, 1791, was professor of anatomy in Paris. He gave the first description of disseminated sclerosis, and left an early account of progressive muscular atrophy, but he erroneously supposed that pyemia was always the result of phlebitis which he referred to as an original coagulation of the blood. He even went to the extreme of asserting that phlebitis dominates all pathology. Cruveilhier died at Jussac on March 6, 1874. His chief works are *Anatomie descriptive* (1834–36); *Anatomie pathologique du corps humain* (1829–42), with many coloured plates; *Traité d'anatomie pathologique générale* (1849–64); *Anatomie du système nerveux de l'homme* (1845); *Traité d'anatomie descriptive* (1851).

CRUZ, RAMÓN DE LA (1731–1794), Spanish dramatist. His *sainetes* or farcical sketches of Madrid life, such as *Las Tertulias de Madrid* and *El Prado por la noche,* are delightful specimens of satiric observation.

See E. Cotarelo y Mori, *Don Ramón de la Cruz y sus obras* (1899).

CRUZ E SILVA, ANTONIO DINIZ DA (1731–1799), Portuguese heroic-comic poet, son of a carpenter, was born at Lisbon and educated at the University of Coimbra, where he took his degree in law in 1753. He then settled in Lisbon and began to write. He founded the literary society known as the Arcadia Lusitana, which aimed at resuscitating national poetry. From 1764 to 1774 Diniz held the appointment of auditor to a regiment stationed at Elvas. There he had the opportunity of observing the many intrigues of a cathedral and garrison town. The result was the witty satire in eight cantos of blank verse, *Hyssope* (1772), describing a quarrel between the bishop and the dean. It is much more amusing than Boileau's *Lutrin,* if not so finished a production. Diniz was sent in an official capacity to Brazil, and remained there, as chancellor of the Relação in Rio and then as councillor of the *Conselho ultramarino,* until his death.

BIBLIOGRAPHY.—Diniz's poems were published in 6 vols. (1807–1817). The best edition of *Hyssope,* to which he owes his lasting fame, is that of J. R. Coelho (1879), with an exhaustive introductory study on his life and writings. A French prose version of the poem by Boissonade has gone through two editions (1828 and 1867), and English translations of selections have been printed in the *Foreign Quarterly Review,* and in the *Manchester Quarterly* (April 1896). *See* also Theophilo Braga, *A Arcadia Lusitana* (Oporto, 1899).

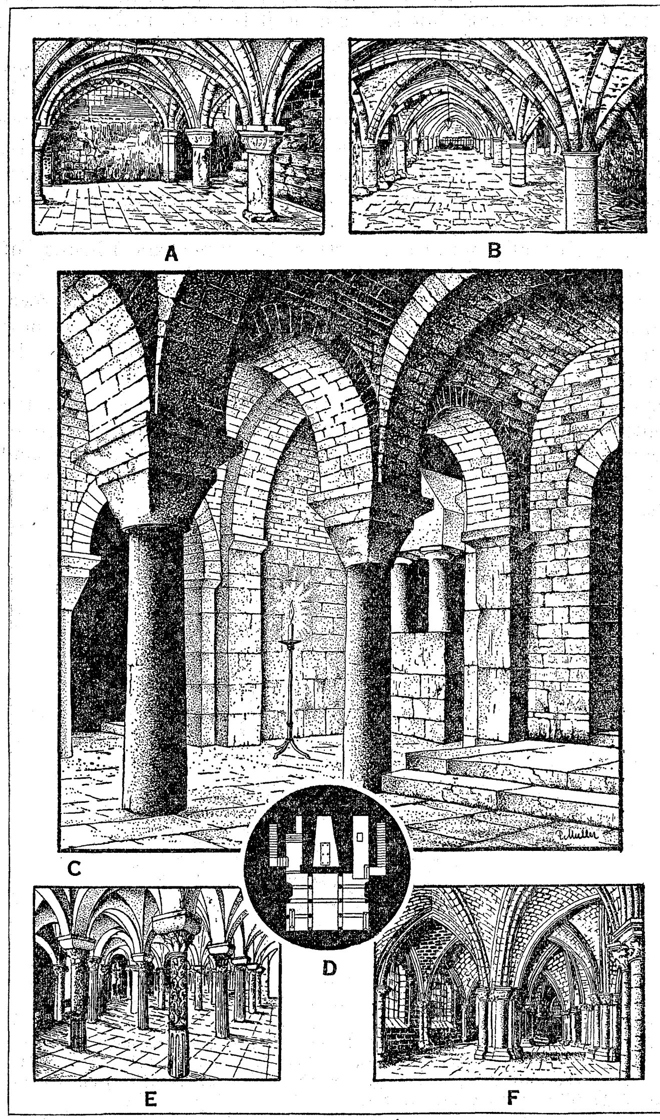
CRYOLITE, a mineral discovered in Greenland by the Danes in 1794, and found to be a compound of fluorine, sodium and aluminium. From its general appearance, and from the fact that it melts readily, even in a candle flame, it was regarded by the Eskimos as a peculiar kind of ice, hence it acquired the name of cryolite (from Gr. *κρύος,* frost and λίθος, stone). Cryolite occurs in colourless or snow-white, cleavable masses, often tinted brown or red with iron oxide, and occasionally passing into a black variety. It is usually translucent, becoming nearly transparent on immersion in water. It cleaves in three nearly rectangular directions, and the crystals occasionally found in the crevices have a cubic habit, but they belong to the monoclinic system. The hardness is 2·5 and the specific gravity 3.

Cryolite occurs almost exclusively at Ivigtut (sometimes written Evigtok), on the Arksut Fjord in south-west Greenland. It has been extensively used as a source of metallic aluminium, and as a flux in smelting the metal. It is largely employed in the manufacture of certain sodium salts, as suggested by Julius Thomsen of Copenhagen, in 1849; and it has been used for the production of certain kinds of porcelain and glass, remarkable for their toughness, and for enamelled ware.

CRYPT, a vault or subterranean chamber, especially under a church floor. In Latin, *crypta* designated any vaulted building partially or entirely below the ground level, such as a sewer (*crypta Suburae,* Juvenal, *Sat.* v., 106); the vaulted stalls for horses and chariots in a circus; farm storage cellars (Vitruvius vi., 8); and a long, vaulted gallery known as *crypto porticus,* like that on the Palatine hill. Seneca (*Epist.* 57) calls the tunnel now known as the Grotto of Posilipo, through which the road passes to Puteoli, *crypta Neapolitana.* It was natural, therefore, for the early Christians to call their catacombs crypts, and when churches came to be built over the tombs of saints and martyrs, subterranean chapels, known as *confessiones,* around the actual tomb, were included. These also were called crypts. The most famous of these was St. Peter's, built on the site of St. Peter's martyrdom, over the circus of Nero (fourth century). Other notable Roman examples are those of S. Prisca, S. Prassede and S. Lorenzo fuori le Mura. In the basilica of S. Maria Maggiore a crypt was furnished, although there was no tomb or martyrdom site to commemorate; it is interesting that as early as this Constantinian church, the crypt was considered a normal part of the church building.

Further incentive to the building of crypts was given by the growing practice of burials within the church walls. This was a much debated usage, and the Council of Braga (563) gave permission for burials only within the churchyard, but not within the church itself. The Council of Mainz (813), however, stated that no one should be buried in a church except bishops, abbots, worthy priests or loyal laymen, and from that time burials within the church multiplied. These were usually in the crypt. An early example of such a burial crypt exists in the church of S. Apollinare in Classe, Ravenna (sixth century), where it takes the form of a small, underground passage around the altar and just within the apse walls (*see* Apse). Later the size of the crypt was increased to include the entire space under the floor of the church choir (*q.v.*), as in the tenth century crypt of S. Ambrogio at Milan. With the increased desire for richness in all parts of the church and increased technical skill, a further step was taken by raising the choir floor boldly and opening the front of the crypt to the nave (*q.v.*), which was on an intermediate level between the crypt and the choir, with monumental flights of steps leading down to the crypt in the centre and up to the choir on either side. The arcaded fronts of these crypts form an effective decoration for the church, as in the 12th century church of S. Zeno in Verona, and that of S. Miniato at Florence (1013). The latter is particularly rich with inlaid polychrome marbles. These crypts within were usually apsidal and the ranges of columns whose vaults supported the floor above gave interesting perspective effects. Where Byzantine influence was strong, crypts are less common, and when found, are of a totally different type, frequently existing as cellars under the entire church area, as in Trani cathedral in southern Italy (12th century), apparently designed by an architect named Nicolaus Sacerdos. St. Mark's at Venice has a remarkable crypt of Greek cross plan, with many short and stumpy columns. This crypt is, in fact, a secondary church; its choir screen is still extant.

Outside Italy there is great variation both in frequency and size of crypts. Lombard influence in Germany is shown by the number of Rhenish churches that follow the Italian precedent of an appreciably raised choir with an important crypt beneath it. The end beneath the nave is usually closed, however. Elsewhere in western Europe the choir level is much less raised and the crypt, where present, tends more and more to become a lower church with a plan largely reproducing that of the church above. The cathedral of S. Bénigne at Dijon possesses the strange crypt of a curious round chapel which seems to date back to the sixth century. It was built over the tomb of the patron saint and is peculiar in the fact that the central circular area, surrounded by a double aisle, ran up through the upper portion of the building and was open to the sky. There is also a remarkable crypt in the cathedral of Auxerre believed to date from 1085, and several examples in Normandy, notably that of Bayeux and the Abbaye aux



FROM (C, D) VIOLLET-LE-DUC, "DICTIONNAIRE RAISONNÉ DE L'ARCHITECTURE FRANCAISE"
A, York Minster; B, Durham Cathedral; C, D, St. Lerin; E, Cathedral of Otranto; F, Bourges Cathedral

Dames at Caen, both of the late 11th century. These are in a crude Norman style with many similarities to contemporary crypts in England. The crypts of Chartres and Bourges cathedrals deserve notice as instances of the more developed type of early Gothic of the late 12th and early 13th centuries.

Crypts were highly developed in English work throughout the Romanesque and Gothic periods (*see* Byzantine and Romanesque Architecture; Gothic Architecture). The one at Canterbury, the western half of which is attributed to Ernulf (*c.* 1100), and the eastern half to William the Englishman, 75 years later, forms a large and complex church, with apse and chapels. The extreme east end, under Trinity chapel, is famous as the original burial-place of Thomas à Becket. Slightly earlier (late 11th century), the crypts of Winchester, Worcester and Gloucester are similarly apsidal, but simpler in plan. Of these Worcester (1084), is the most decorative. Parts of the crypt at Rochester, that at Hereford and the crypt, no longer existing, of old St. Paul's in London, were of rich Gothic type, the last so large that it served as the parish church of St. Faith. Other notable examples in Great Britain are the exquisite crypt of St. Stephen's chapel at Westminster, now incorporated within the Houses of Parliament, and the richly carved 13th century crypt of the cathedral at Glasgow. Small crypts under parish churches are common in England, as at Lastingham in Yorkshire (probably 1080), notable for its size and the crude pseudo-classic character of its ornament; and at Repton in Derbyshire; another very fine Norman example is the crypt of St. Peter's-in-the-East at Oxford.

Technically, as many mediaeval houses were built over vaulted substructures, they may be said to have had crypts, and remains of such non-ecclesiastical crypts occur widely throughout Europe. The German *Rathaüser* have many fine and richly decorated crypts, such as the famous cellar of the Bremen town-hall; a notable monastic cellar still exists in Mainz, and the cellars of the residential buildings at Mont St. Michel in France furnish numerous examples of great size and magnificence, in almost all the mediaeval styles dating from the 11th to the 15th century. Oxford, Rochester and Bristol, in England, contain many remains of vaulted mediaeval cellars, and the city of Chester is built, in great areas, over ranges of such vaults. Notable examples in London are those of Gerard's Hall, now destroyed (reign of Edward I.), and that of the Guildhall, which dates from 1411, and is notable for its rich and intricate ribbed vault, in the design of which the subsidiary ribs, called liernes, play an important part.

Many great modern cathedrals contain crypts. Notable examples exist at Washington, D.C. and St. John the Divine, New York, which contains an elaborate mosaic altar and reredos.

(T. F. H.)

CRYPTEIA, secret police in ancient Sparta (Gr. κρύπτειν hide) founded, according to Aristotle, by Lycurgus. The institution was under the supervision of the ephors (*q.v.*), who, on entering office, annually proclaimed war against the helots (*see* HELOTS), and thus absolved from the guilt of murder any Spartan who should slay a helot. It was instituted as a precaution against the ever-present danger of a helot revolt, and young Spartans were sent out by the ephors to keep watch on the helots and assassinate any who might appear dangerous.

After the revolt of 464 B.C. (*see* CIMON), there was a secret massacre of 2,000 helots who, on the invitation of the ephors, claimed to have rendered distinguished service (Thuc. iv. 80).

See A. H. J. Greenidge, *Handbook of Gk. Const. Hist.* (1896); G. Gilbert, *Gk. Const. Antiq.* (Eng. trans., 1895); L. Whibley, *Companion to Greek Studies* (1923).

CRYPTOBRANCHUS, a genus of aquatic, but lung-breathing, tailed Amphibia of the family Cryptobranchidae, characterized by a heavy, flattened build, a porous tuberculated skin, with a frilled fold along each side, short stout limbs with four fingers and five toes, and minute eyes without lids. Three forms of the family are known. One is a European Tertiary fossil, *Andrias* (first described as that of a man), nearly related to the second type, the giant salamanders of Japan and China of the genus *Megalobatrachus;* the third is *Cryptobranchus,* the hell-bender of North America. The giant Japanese form grows to a length of over 5 ft. and is the largest salamander known. The eastern hell-bender of the United States, *C. alleganiensis,* reaches 27 in.

The eggs of both the giant salamander and the hell-benders are laid in strings. Those of the Japanese salamander are deposited in deep holes in the water, where they form large clumps (70 to 80 eggs) round which the female coils herself. The giant salamander has bred in the Amsterdam zoological gardens. The larva on leaving the egg is about an inch long, provided with three branched external gills on each side, and mere rudiments of the limbs. The tail is used in swimming.

(K. P. S.)

CRYPTOGRAPHY, or writing in cipher (from Gr. κρυπτός hidden, and γράφειν, to write), called also steganography (from Gr. στεγάνη, a covering), the art of writing in such a way as to be incomprehensible except to those who possess the key to the system employed. The unravelling of the writing is called deciphering. Secret modes of communication have been in use from the earliest times. The Lacedemonians had a method called the *scytale,* from the staff (σκυτάλη) employed in constructing and deciphering the message. Polybius has enumerated other methods of cryptography. The art was in use also amongst the Romans.

John Trithemius (d. 1516), the abbot of Spanheim, was the first important writer on cryptography. His *Polygraphia,* published in 1518, has supplied the basis upon which subsequent writers have worked. A *Steganographia* published at Lyons (?1551) and later at Frankfort (1606) is also attributed to him. The next treatises of importance were those of Giovanni Battista della Porta, the Neapolitan mathematician, who wrote *De furtivis litterarum notis,* 1563; and of Blaise de Vigenère, whose *Traité des chiffres* appeared in Paris, 1586. Cryptography having become a distinct art, Bacon classed it (under the name *ciphers*) as a part of grammar. He proposed an ingenious system on the plan of what is called the double cipher. John Wilkins, subsequently bishop of Chester, published in 1641 an anonymous treatise entitled *Mercury, or The Secret and Swift Messenger.* The deciphering of many of the royalist papers of that period has by Henry Stubbe been charged to the celebrated mathematician, Dr. John Wallis (*Athen. Oxon.* iii. 1,072), whose connection with the subject of cipher-writing is referred to by himself in the Oxford edition of his mathematical works, 1689, p. 659. Subsequent writers on the subject are John Falconer (*Cryptomenysis patefacta*), 1685; John Davys (*An Essay on the Art of Decyphering: in which is inserted a Discourse of Dr. Wallis*), 1737; Philip Thicknesse (*A Treatise on the Art of Decyphering and of Writing in Cypher*), 1772; William Blair (the writer of the comprehensive article "Cipher" in Rees's *Cyclopaedia*), 1819; and G. von Marten (*Cours diplomatique*), 1801 (a fourth edition of which appeared in 1851). Perhaps the best modern work on this subject is the *Kryptographik* of J. L. Klüber (Tübingen, 1809), in which the different methods of cryptography are classified. Amongst others of lesser merit who have treated of this art may be named Gustavus Selenus (*i.e.,* Augustus, duke of Brunswick), 1624; Cospi, translated by Niceron in 1641; the marquess of Worcester, 1659; Kircher, 1663; Schott, 1665; Ludwig Heinrich Hiller, 1682; Comiers, 1690; Baring, 1737; Conrad, 1739, etc. *See* also a paper on Elizabethan Cipher-books by A. J. Butler in the Bibliographical Society's *Transactions,* London, 1901.

The simplest and commonest of all the ciphers is that used by Julius Caesar, in which the writer selects in place of the proper letters certain other letters in regular advance. Caesar wrote *d* for *a, e* for *b,* and so on. There are instances of this arrangement in the Jewish rabbis, and even in the sacred writers. An illustration of it occurs in Jeremiah (xxv. 26), where the prophet writes *Sheshak* instead of Babel (Babylon), *i.e.,* in place of using the second and twelfth letters of the Hebrew alphabet (*b, b, l*) from the beginning he wrote the second and twelfth (*sh, sh, k*) from the end. Another Jewish cabalism of like nature was called Albam; of which an example is in Isaiah vii. 6, where Tabeal is written for Remaliah. A rough key to this method of transposition, in its adaptation to English, may be derived from an examination of the respective quantities of letters in a typefounder's bill, or a printer's "case." The decipherer's first business is to classify the letters of the secret message in the order of their frequency. The letter that occurs oftenest is *e*; and the next in order of frequency is *t.* Similarly the commonest words of two, three and four, etc., letters can be ascertained. The decipherer may obtain other hints from Poe's tale called *The Gold Bug.* Rules for deciphering messages in the Continental languages constructed upon this system may be derived from Breithaupt's *Ars decifratoria* (1737).

Bacon remarks that though ciphers were commonly in letters and alphabets yet they might be in words. Upon this basis codes have been constructed, classified words taken from dictionaries being made to represent complete ideas. Figures and other characters have been also used as letters; and with them ranges of numerals have been combined as the representatives of syllables, parts of words, words themselves, and complete phrases. Under this head must be placed the despatches of Giovanni Michael, the Venetian ambassador to England in the reign of Queen Mary, documents which have only of late years been deciphered. Many of the private letters and papers from the pen of Charles I. and his queen are of the same description. One of that monarch's letters, consisting entirely of numerals purposely complicated, was in 1858 deciphered by Professor Wheatstone, the inventor of the ingenious crypto-machine, and printed by the Philobiblon Society. Other letters of the like character have been published in the *First Report of the Royal Commission on Historical Manuscripts* (1870). In the second and subsequent reports of the same commission several keys to ciphers have been catalogued. In this connection also should be mentioned the "characters," which the diarist Pepys drew up and which are frequently mentioned in his journal.

The plan of importing shorthand marks and other arbitrary characters into cryptographic systems to represent both letters and words is said to have been first put into use by the old Roman poet Ennius. A large quantity of these characters has been engraved in Gruter's *Inscriptiones*. The correspondence of Charlemagne was in part made up of marks of this nature. In Rees's *Cyclopaedia* specimens were engraved of the cipher used by Cardinal Wolsey at the court of Vienna in 1524, of that used by Sir Thomas Smith at Paris in 1563, and of that of Sir Edward Stafford in 1586; in all of which arbitrary marks are introduced. The first English system of shorthand—Bright's *Characterie,* 1588—almost belongs to the same category of ciphers. A favourite system of Charles I., made up of an alphabet of twenty-four letters, represented by four simple strokes varied in length, slope and position, is engraved in Clive's *Linear System of Shorthand* (1830).

Complications have been introduced into ciphers by the employment of "dummy" letters, by spelling words backwards, making false divisions between words, and especially by the use of elaborate tables of letters, arranged in the form of the multiplication table, the message being constructed by the aid of preconcerted key-words. A method of this kind is explained in the Latin and English lives of Dr. John Barwick.

An excellent modification of the key-word principle was constructed by Admiral Sir Francis Beaufort. Ciphers have been constructed on the principle of altering the places of the letters without changing their powers. In the celebrated cipher used by the earl of Argyll when plotting against James II., sentences of an indifferent nature were constructed, but the real meaning of the message was to be gathered from words placed at certain intervals. This method, which is connected with the name of Cardan, is sometimes called the trellis or card-board cipher.

The wheel-cipher, which is an Italian invention, the string-cipher, the circle-cipher and many others are fully explained, with the necessary diagrams, in the authorities named above—more particularly by Klüber in his *Kryptographik.*

For modern developments *see* CODES and CIPHERS.

See H. G. Fiske, *Studies in the Biliteral Cipher of Francis Bacon* (1913); A. Langie, *Cryptography* (1922); A. Figl, *Système des Chiffrierens* (1926).

CRYPTOMERIA or **JAPANESE CEDAR,** a genus of conifers, containing a single species, *C. japonica,* a native of Japan. It is one of the finest of Japanese trees, reaching a height of 100 or more feet, usually divested of branches along the lower part of the trunk and crowned with a conical head. The narrow, pointed leaves are spirally arranged and persist for four or five years; the cones are small, globose and borne at the ends of the branchlets, the scales are thickened at the extremity and divided into sharply pointed lobes, three to five seeds are borne on each scale. *Cryptomeria* is extensively used in Japan for reafforesting denuded lands, as it is a valuable timber tree; it is also planted to form avenues along the public roads. Many curious varieties have been obtained by Japanese horticulturists, including dwarf forms a few feet in height. When grown in Great Britain or the northern United States, *Cryptomeria* requires a deep, well-drained soil with plenty of moisture, and protection from cold winds.

CRYPTO-PORTICUS, an architectural term for a concealed or covered passage, generally underground, though lighted and ventilated from the open air. Such passages were much used by the Romans to furnish private communication between various buildings of a group, as in the Palace of the Caesars in Rome, and the Villa of Hadrian in Tivoli.

CRYSTAL-GAZING or **SCRYING,** the term commonly applied to the induction of visual hallucinations by concentrating the gaze on any clear deep, such as a crystal or a ball of polished rock crystal. Some persons do not even find a clear deep necessary, and are content to gaze at the palm of the hand, for example, when hallucinatory pictures, as they declare, emerge. Among objects used are a pool of ink in the hand (Egypt), the liver of an animal (tribes of the North-West Indian frontier), a hole filled with water (Polynesia), quartz crystals (the Apaches and the Euahlayi tribe of New South Wales), a smooth slab of polished black stone (the Huille-che of South America), water in a vessel (Zulus and Siberians), a crystal (the Incas), a mirror (classical Greece and the middle ages), the finger-nail, a sword-blade, a ring-stone, a glass of sherry, in fact almost anything. For a discussion of the problems raised by crystal gazing and similar practices, *see* DIVINATION; PSYCHICAL RESEARCH; SPIRITUALISM and allied articles.

CRYSTALLITE, a name given by Vogelsang to the microscopic bodies occurring in many glassy igneous rocks, such as obsidian, pitchstone and tachylyte. Though possessing no distinct reaction on polarized light and often no recognizable crystallographic form, they are to be regarded as incipient crystals. The larger bodies, often with good crystal form and evident double refraction, are termed microlites. According to their shape and structural arrangement crystallites are subdivided into globulites (small globules), margarites (coalescing globules arranged in rows), cumulites (cloudy aggregate of globules), and globospherites (groups of globulites with a radiate arrangement). Other crystallites assume thread-like forms (trichites) or appear as elongated cylinders or rods (longulites, belonites, baculites). When sufficiently large to be recognizable as mineral species (microlites) they can usually be referred to felspar, pyroxene, amphibole or iron oxides. Acicular microlites bearing divergent arborescent branches are termed scopulites. The pitchstones of Arran are well known for the variety and beauty of their crystallite and microlite constituents (amphibole). In the basaltic glasses of Hawaii similar growths are formed of pyroxene.

CRYSTALLIZATION, the art of obtaining a substance in the form of crystals. It is an important process in chemistry, since it permits the purification of a substance or the separation of the constituents of a mixture. Generally a substance is more soluble in a solvent at a high temperature than at a low, and consequently, if a boiling strong solution be allowed to cool, the substance will separate in virtue of the diminished solubility. The slower the cooling the larger and more perfect will be the crystals formed. If, as sometimes occurs, such a solution refuses to crystallize, the expedient of "inoculating" the solution with a minute crystal of the same substance, or with a similar substance, may be adopted; shaking the solution, or the addition of a drop of another solvent, may also occasion the desired result. "Fractional crystallization" consists in repeatedly partially crystallizing the salt content of a solution so as to separate the substances of different solubilities. Examples are especially presented in the study of the rare-earths. Other conditions under which crystals are formed are given in the article CRYSTALLOGRAPHY.

CRYSTALLOGRAPHY, the science of the forms, properties and structure of crystals. Homogeneous solid matter, the physical and chemical properties of which are the same about every point, may be either amorphous or crystalline. In amorphous matter all the properties are the same in every direction in the mass; but in crystalline matter certain of the physical properties vary with the direction. The essential properties of crystalline matter are of two kinds, viz., the general properties, such as density, specific heat, melting-point and chemical composition, which do not vary with the direction; and the directional properties, such as cohesion and elasticity, various optical, thermal and electrical properties, as well as external form. By reason of the homogeneity of crystalline matter the directional properties are the same in all parallel directions in the mass, and there may be a certain symmetrical repetition of the directions along which the properties are the same.

When the crystallization of matter takes place under conditions free from outside influences the peculiarities of internal structure are expressed in the external form of the mass, and there results a solid body bounded by plane surfaces intersecting in straight edges, the directions of which bear an intimate relation to the internal structure. Such a polyhedron (πολύς, many, ἕδρα, base or face) is known as a crystal. An example of this is sugar-candy, of which a single isolated crystal may have grown freely in a solution of sugar. Matter presenting well-defined and regular crystal forms, either as a single crystal or as a group of individual crystals, is said to be crystallized. If, on the other hand, crystallization has taken place about several centres in a confined space, the development of plane surfaces may be prevented, and a crystalline aggregate of differently orientated crystal-individuals results. Examples of this are afforded by loaf sugar and statuary marble.

After a brief historical sketch, the more salient principles of the subject will be discussed under the following sections:—

I. Crystalline Form.
- (*a*) Symmetry of Crystals.
- (*b*) Simple Forms and Combinations of Forms.
- (*c*) Law of Rational Indices.
- (*d*) Zones.
- (*e*) Projection and Drawing of Crystals.
- (*f*) Crystal Systems and Classes.
  1. Cubic System.
  2. Tetragonal System.
  3. Orthorhombic System.
  4. Monoclinic System.
  5. Anorthic System.
  6. Hexagonal System.
- (*g*) Regular Grouping of Crystals (Twinning, etc.).
- (*h*) Irregularities of Growth of Crystals: Characters of Faces.

II. Physical Properties of Crystals.
- (*a*) Elasticity and Cohesion (Cleavage, Etching, etc.).
- (*b*) Optical Properties (Interference Figures, Pleochroism, etc.).
- (*c*) Thermal Properties.
- (*d*) Magnetic and Electrical Properties.

III. Relations Between Crystalline Form and Chemical Composition.

Most chemical elements and compounds are capable of assuming the crystalline condition. Crystallization may take place when solid matter separates from solution (*e.g.*, sugar, salt, alum), from a fused mass (*e.g.*, sulphur, bismuth, felspar), or from a vapour (*e.g.*, iodine, camphor, haematite; in the last case by the interaction of ferric chloride and steam). Crystalline growth may also take place in solid amorphous matter, for example, in the devitrification of glass, and the slow change in metals when subjected to alternating stresses. Beautiful crystals of many substances may be obtained in the laboratory by one or other of these methods, but the most perfectly developed and largest crystals are those of mineral substances found in nature, where crystallization has continued during long periods of time. For this reason the physical science of crystallography has developed side by side with that of mineralogy. Really, however, there is just the same connection between crystallography and chemistry as between crystallography and mineralogy, but only in recent years has the importance of determining the crystallographic properties of artificially prepared compounds been recognized.

History.—The word "crystal" is from the Gr. κρύσταλλος, meaning clear ice (Lat. *crystallum*), a name which was also applied to the clear transparent quartz ("rock-crystal") from the Alps, under the belief that it had been formed from water by intense cold. It was not until about the 17th century that the word was extended to other bodies, either those found in nature or obtained by the evaporation of a saline solution, which resembled rock-crystal in being bounded by plane surfaces, and often also in their clearness and transparency.

The first important step in the study of crystals was made by Nicolaus Steno, the famous Danish physician, afterwards bishop of Titiopolis, who in his treatise *De solido intra solidum naturaliter contento* (Florence, 1669; English translation, 1671) gave the results of his observations on crystals of quartz. He found that although the faces of different crystals vary considerably in shape and relative size, yet the angles between similar pairs of faces are always the same. He further pointed out that the crystals must have grown in a liquid by the addition of layers of material upon the faces of a nucleus, this nucleus having the form of a regular six-sided prism terminated at each end by a six-sided pyramid. The thickness of the layers, though the same over each face, was not necessarily the same on different faces, but depended on the position of the faces with respect to the surrounding liquid; hence the faces of the crystal, though variable in shape and size, remained parallel to those of the nucleus, and the angles between them constant. Robert Hooke in his *Micrographia* (London, 1665) had previously noticed the regularity of the minute quartz crystals found lining the cavities of flints, and had suggested that they were built up of spheroids. About the same time the double refraction and perfect rhomboidal cleavage of crystals of calcite or Iceland-spar were studied by Erasmus Bartholinus (*Experimenta crystalli Islandici disdiaclastici,* Copenhagen, 1669) and Christiaan Huygens (*Traité de la lumière,* Leyden, 1690); the latter supposed, as did Hooke, that the crystals were built up of spheroids. In 1695 Anton van Leeuwenhoek observed under the microscope that different forms of crystals grow from the solutions of different salts. Andreas Libavius had indeed much earlier, in 1597, pointed out that the salts present in mineral waters could be ascertained by an examination of the shapes of the crystals left on evaporation of the water; and Domenico Guglielmini (*Riflessioni filosofiche dedotte dalle figure de dei sali,* Padova, 1706) asserted that the crystals of each salt had a shape of their own with the plane angles of the faces always the same.

The earliest treatise on crystallography is the *Prodromus Crystallographiae* of M. A. Cappeller, published at Lucerne in 1723. Crystals were mentioned in works on mineralogy and chemistry; for instance, C. Linnaeus in his *Systema Naturae* (1735) described some forty common forms of crystals amongst minerals. It was not, however, until the end of the 18th century that any real advances were made, and the French crystallographers Romé de Lisle and the abbé Haüy are rightly considered as the founders of the science. J. B. L. Romé de Lisle (*Essai de cristallographie,* Paris, 1772; *Cristallographie, ou description des formes propres à tous les corps du règne minéral,* Paris, 1783) made the important discovery that the various shapes of crystals of the same natural or artificial substance are all intimately related to each other; and further, by measuring the angles between the faces of crystals with the goniometer (*q.v.*), he established the fundamental principle that these angles are always the same for the same kind of substance and are characteristic of it. Replacing by single planes or groups of planes all the similar edges or solid angles of a figure called the "primitive form" he derived other related forms. Six kinds of primitive forms were distinguished, namely, the cube, the regular octahedron, the regular tetrahedron, a rhombohedron, an octahedron with a rhombic base, and a double six-sided pyramid. Only in the last three can there be any variation in the angles: for example, the primitive octahedron of alum, nitre and sugar were determined by Romé de Lisle to have angles of 110°, 120° and 100° respectively. René Just Haüy in his *Essai d'une théorie sur la structure des crystaux* (Paris, 1784; *see* also his Treatises on Mineralogy and Crystallography, 1801, 1822) supported and extended these views, but took for his primitive forms the figures obtained by splitting crystals in their directions of easy fracture of "cleavage," which are always the same in the same kind of substance. Thus he found that all crystals of calcite, whatever their external form (*see*, for example, figs. 1–6 in the article CALCITE), could be reduced by cleavage to a rhombohedron with interfacial angles of 75°. Further, by stacking together a number of small rhombohedra of uniform size he was able, as had been previously done by J. G. Gahn in 1773, to reconstruct the various forms of calcite crystals. Fig. 1 shows a scalenohedron built up in this manner of rhombohedra; and fig. 2 a regular octahedron built up of cubic elements, such as are given by the cleavage of galena and rock-salt.

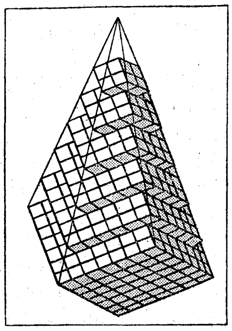


FIG. 1.—SCALENOHEDRON BUILT UP OF RHOMBOHEDRA

The external surfaces of such a structure, with their step-like arrangement, correspond to the plane faces of the crystal, and the bricks may be considered so small as not to be separately visible. By making the steps one, two or three bricks in width and one, two or three bricks in height, the various secondary faces on the crystal are related to the primitive form or "cleavage nucleus" by a law of whole numbers, and the angles between them can be arrived at by mathematical calculation. By measuring with the goniometer the inclinations of the secondary faces to those of the primitive form Haüy found that the secondary forms are always related to the primitive form on crystals of numerous substances in the manner indicated, and that the width and the height of a step are always in a simple ratio, rarely exceeding that of 1:6. This laid the foundation of the important "law of rational indices" of the faces of crystals.

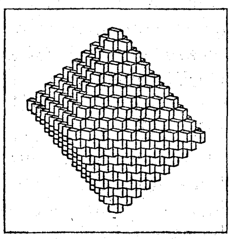
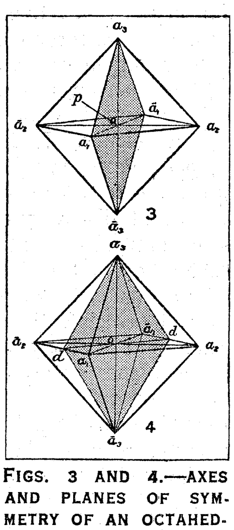


FIG 2.—OCTAHEDRON BUILT UP OF CUBES

The German crystallographer C. S. Weiss (*De indagando formarum, crystallinarum charactere geometrico principali dissertatio*, Leipzig, 1809; *Übersichtliche Darstellung der verschiedenen natürlichen Abtheilungen der Krystallisations-Systeme*, Denkschrift der Berliner Akad. der Wissensch., 1814–1815) attacked the problem of crystalline form from a purely geometrical point of view, without reference to primitive forms or any theory of structure. The faces of crystals were considered by their intercepts on co-ordinate axes, which were drawn joining the opposite corners of certain forms; and in this way the various primitive forms of Haüy were grouped into four classes, corresponding to the four systems described below under the names cubic, tetragonal, hexagonal and orthorhombic. The same result was arrived at independently by F. Mohs, who further, in 1822, asserted the existence of two additional systems with oblique axes. These two systems (the monoclinic and anorthic) were, however, considered by Weiss to be only hemihedral or tetartohedral modifications of the orthorhombic system, and they were not definitely established until 1835, when the optical characters of the crystals were found to be distinct. A system of notation to express the relation of each face of a crystal to the co-ordinate axes of reference was devised by Weiss, and other notations were proposed by F. Mohs, A. Lévy (1825), C. F. Naumann (1826), and W. H. Miller (*Treatise on Crystallography*, Cambridge, 1839). For simplicity and utility in calculation the Millerian notation, which was first suggested by W. Whewell in 1825, surpasses all others and is now generally adopted, though those of Lévy and Naumann are still in use.



FIGS. 3 AND 4.—AXES AND PLANES OF SYMMETRY OF AN OCTAHEDRON

Although the peculiar optical properties of Iceland-spar had been much studied ever since 1669, it was not until much later that any connection was traced between the optical characters of crystals and their external form. In 1818 Sir David Brewster found that crystals could be divided optically into three classes, viz., isotropic, uniaxial and biaxial, and that these classes corresponded with Weiss's four systems (crystals belonging to the cubic system being isotropic, those of the tetragonal and hexagonal being uniaxial, and the orthorhombic being biaxial). Optically biaxial crystals were afterwards shown by J. F. W. Herschel and F. E. Neumann in 1822 and 1835 to be of three kinds, corresponding with the orthorhombic, monoclinic and anorthic systems. It was, however, noticed by Brewster himself that there are many apparent exceptions, and the "optical anomalies" of crystals have been the subject of much study. The intimate relations existing between various other physical properties of crystals and their external form have subsequently been gradually traced.

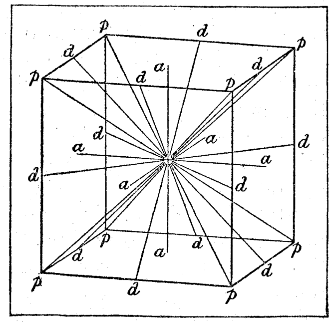


FIG. 5.—AXES OF SYMMETRY OF A CUBE

The symmetry of crystals, though recognized by Romé de l'Isle and Haüy, in that they replaced all similar edges and corners of their primitive forms by similar secondary planes, was not made use of in defining the six systems of crystallization, which depended solely on the lengths and inclinations of the axes of reference. It was, however, necessary to recognize that in each system there are certain forms which are only partially symmetrical, and these were described as hemihedral and tetartohedral forms (*i.e.*, half-faced and quarter-faced forms).

As a consequence of Haüy's law of rational intercepts, or, as it is more often called, the law of rational indices, it was proved by J. F. C. Hessel in 1830 that thirty-two types of symmetry are possible in crystals. Hessel's work remained overlooked for sixty years, but the same important result was independently arrived at by the same method by A. Gadolin in 1867. At the present day, crystals are considered as belonging to one or other of thirty-two classes, corresponding with these thirty-two types of symmetry, and are grouped in six systems. More recently, theories of crystal structure have attracted attention, and have been studied as purely geometrical problems of the homogeneous partitioning of space.

The historical development of the subject is treated in greater detail by the following: C. M. Marx, *Geschichte der Crystallkunde* (Karlsruhe and Baden, 1825); W. Whewell, *History of the Inductive Sciences*, vol. iii. (3rd ed., London, 1857); F. von Kobell, *Geschichte der Mineralogie von 1650–1860* (München, 1864); P. Groth, *Entwicklungsgeschichte der mineralogischen Wissenschaften* (Berlin, 1926).

I. CRYSTALLINE FORM

The fundamental laws governing the form of crystals are:—

1. Law of the Constancy of Angle.
2. Law of Symmetry.
3. Law of Rational Intercepts or Indices.

According to the first law, the angles between corresponding faces of all crystals of the same chemical substance are always the same and are characteristic of the substance.

(*a*) *Symmetry of Crystals*

Crystals may, or may not, be symmetrical with respect to a point, a line or axis, and a plane; these "elements of symmetry" are spoken of as a centre of symmetry, an axis of symmetry, and a plane of symmetry respectively.

Centre of Symmetry.—Crystals which are centro-symmetrical have their faces arranged in parallel pairs; and the two parallel faces, situated on opposite sides of the centre (*O* in fig. 3) are alike in surface characters, such as lustre, striations and figures of corrosion. An octahedron (fig. 3) is bounded by four pairs of parallel faces. Crystals belonging to many of the hemihedral and tetartohedral classes of the six systems of crystallization are devoid of a centre of symmetry.

Axes of Symmetry.—Consider the vertical axis joining the opposite corners a_3 and $\bar{a}_3$ of an octahedron (fig. 3) and passing through its centre O: by rotating the crystal about this axis through a right angle (90°) it reaches a position such that the orientation of its faces is the same as before the rotation; the face $a_1a_2a_3$, for example, coming into the position of $a_1\bar{a}_2a_3$. During a complete rotation of 360° (=90°×4), the crystal occupies four such interchangeable positions. Such an axis of symmetry is known as a tetrad axis of symmetry. Other tetrad axes of the octahedron are $a_2\bar{a}_2$ and $a_1\bar{a}_1$.

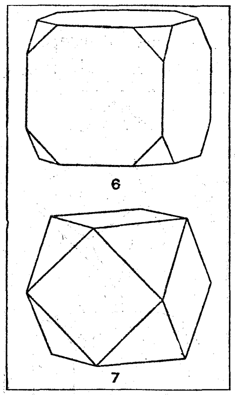


FIG. 6.—CUBE IN COMBINATION WITH OCTAHEDRON. FIG. 7.—CUBO-OCTAHEDRON

An axis of symmetry of another kind is that which passing through the centre O is normal to a face of the octahedron. By rotating the crystal about such an axis Op (fig. 3) through an angle of 120° those faces which are not perpendicular to the axis occupy interchangeable positions; for example, the face $a_1a_3a_2$ comes into the position of $\bar{a}_2a_1\bar{a}_3$, and $\bar{a}_2a_1\bar{a}_3$ to $a_3\bar{a}_2\bar{a}_1$. During a complete rotation of 360° (=120°×3) the crystal occupies similar positions three times. This is a triad axis of symmetry; and there being four pairs of parallel faces on an octahedron, there are four triad axes (only one of which is drawn in the figure).

An axis passing through the centre O and the middle points d of two opposite edges of the octahedron (fig. 4), *i.e.*, parallel to the edges of the octahedron, is a dyad axis of symmetry. About this axis there may be rotation of 180°, and only twice in a complete revolution of 360° (=180°×2) is the crystal brought into interchangeable positions. There being six pairs of parallel edges on an octahedron, there are consequently six dyad axes of symmetry.

A regular octahedron thus possesses thirteen axes of symmetry (of three kinds), and there are the same number in the cube. Fig. 5 shows the three tetrad (or tetragonal) axes (aa), four triad (or trigonal) axes (pp), and six dyad (diad or diagonal) axes (dd).

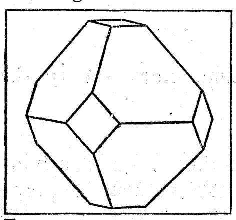


FIG. 8.—OCTAHEDRON IN COMBINATION WITH CUBE

Although not represented in the cubic system, there is still another kind of axis of symmetry possible in crystals. This is the hexad axis or hexagonal axis, for which the angle of rotation is 60°, or one-sixth of 360°. There can be only one hexad axis of symmetry in any crystal. (*See* figs. 77–80.)

Planes of Symmetry.—A regular octahedron can be divided into two equal and similar halves by a plane passing through the corners $a_1a_3\bar{a}_1\bar{a}_3$ and the centre O (fig. 3). One-half is the mirror reflection of the other in this plane, which is called a plane of symmetry. Corresponding planes on either side of a plane of symmetry are inclined to it at equal angles. The octahedron can also be divided by similar planes of symmetry passing through the corners $a_1a_2\bar{a}_1\bar{a}_2$ and $a_2a_3\bar{a}_2\bar{a}_3$. These three similar planes of symmetry are called the cubic planes of symmetry, since they are parallel to the faces of the cube. (Compare figs. 6–8, showing combinations of the octahedron and the cube.)

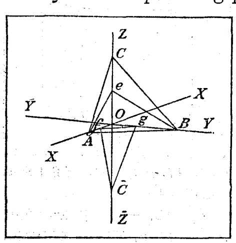


FIG. 9.—CRYSTALLOGRAPHIC AXES OF REFERENCE

A regular octahedron can also be divided symmetrically into two equal and similar portions by a plane passing through the corners a_3 and $\bar{a}_3$, the middle points d of the edges $a_1\bar{a}_2$ and $\bar{a}_1a_2$, and the centre O (fig. 4). This is called a dodecahedral plane of symmetry, being parallel to the face of the rhombic dodecahedron which truncates the edge a_1a_2. (Compare fig. 14, showing a combination of the octahedron and rhombic dodecahedron.) Another similar plane of symmetry is that passing through the corners $a_3\bar{a}_3$ and the middle points of the edges a_1a_2 and $\bar{a}_1\bar{a}_2$, and altogether there are six dodecahedral planes of symmetry, two through each of the corners a_1, a_2, a_3 of the octahedron.

A regular octahedron and a cube are thus each symmetrical with respect to the following elements of symmetry: a centre of symmetry, thirteen axes of symmetry (of three kinds), and nine planes of symmetry (of two kinds). This degree of symmetry, which is the type corresponding to one of the classes of the cubic system, is the highest possible in crystals. As will be pointed out below, it is possible, however, for both the octahedron and the cube to be associated with fewer elements of symmetry than those just enumerated.

(*b*) *Simple Forms and Combinations of Forms*

A single face $a_1a_2a_3$ (figs. 3 and 4) may be repeated by certain of the elements of symmetry to give the whole eight faces of the octahedron. Thus, by rotation about the vertical tetrad axis $a_3\bar{a}_3$ the four upper faces are obtained; and by rotation of these about one or other of the horizontal tetrad axes the eight faces are derived. Or again, the same repetition of the faces may be arrived at by reflection across the three cubic planes of symmetry. (By reflection across the six dodecahedral planes of symmetry a tetrahedron only would result, but if this is associated with a centre of symmetry we obtain the octahedron.) Such a set of similar faces, obtained by symmetrical repetition, constitutes a "simple form." An octahedron thus consists of eight similar faces, and a cube is bounded by six faces all of which have the same surface characters and parallel to each of which all the properties of the crystal are identical.

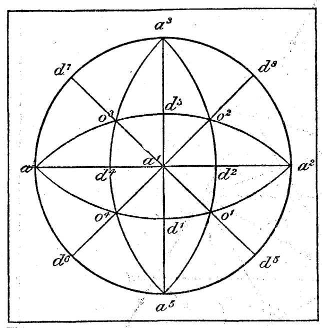


FIG. 10.—STEREOGRAPHIC PROJECTION OF A CUBIC CRYSTAL

Examples of simple forms amongst crystallized substances are octahedra of alum and spinel and cubes of salt and fluorspar. More usually, however, two or more forms are present on a crystal, and we then have a combination of forms, or simply a "combination." Figs. 6, 7 and 8 represent combinations of the octahedron and the cube; in the first the faces of the cube predominate, and in the third those of the octahedron; fig. 7 with the two forms equally developed is called a cubo-octahedron. Each of these combined forms has all the elements of symmetry proper to the simple forms.

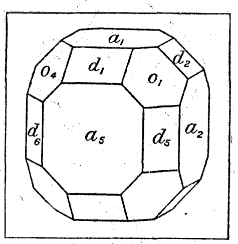


FIG. 11.—CLINOGRAPHIC DRAWING OF A CUBIC CRYSTAL

The simple forms, though referable to the same type of symmetry and axes of reference, are quite independent, and cannot be derived one from the other by symmetrical repetition, but, after the manner of Romé de l'Isle, they may be derived by replacing edges or corners by a face equally inclined to the faces forming the edges or corners; this is known as "truncation." Thus in fig. 6 the corners of the cube are symmetrically replaced or truncated by the faces of the octahedron, and in fig. 8 those of the octahedron are truncated by the cube.

(*c*) *Law of Rational Intercepts*

For axes of reference, OX, OY, OZ (fig. 9), take any three edges formed by the intersection of three faces of a crystal. These axes are called the crystallographic axes, and the planes in which they lie the axial planes. A fourth face on the crystal intersecting these three axes in the points A, B, C is taken as the parametral plane, and the lengths $OA{:}OB{:}OC$ are the parameters of the crystal. Any other face on the crystal may be referred to these axes and parameters by the ratio of the intercepts

$$\frac{OA}{h}:\frac{OB}{k}:\frac{OC}{l}.$$

Thus for a face parallel to the plane ABe the intercepts are in the ratio $OA{:}OB{:}Oe$, or

$$\frac{OA}{1}:\frac{OB}{1}:\frac{OC}{2}$$

and for a plane $fg\bar{C}$ they are $Of:Og:O\bar{C}$ or

$$\frac{OA}{2}:\frac{OB}{3}:\frac{O\bar{C}}{1}.$$

Now the important relation existing between the faces of a crystal is that the denominators h, k and l are always rational

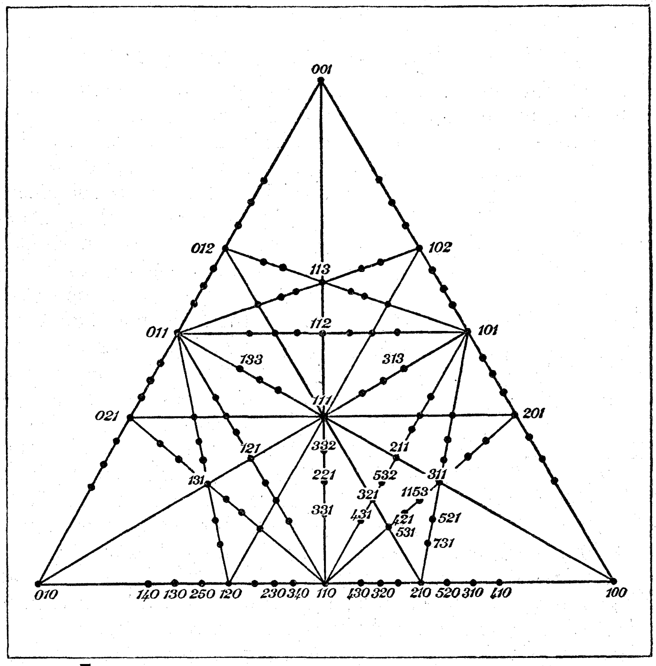
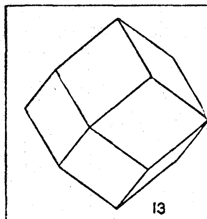


FIG. 12.—GNOMONIC PROJECTION OF A CUBIC CRYSTAL

whole numbers, rarely exceeding 6, and usually 0, 1, 2 or 3. Written in the form $\{hkl\}$, h referring to the axis OX, k to OY, and l to OZ, they are spoken of as the indices (Millerian indices) of the face. Thus of a face parallel to the plane ABC the indices are $\{111\}$, of ABe they are $\{112\}$ and of $fg\bar{C}$ $\{23\bar{1}\}$. The indices are thus inversely proportional to the intercepts, and the law of rational intercepts is often spoken of as the "law of rational indices."

The angular position of a face is thus completely fixed by its indices; and knowing the angles between the axial planes and the parametral plane all the angles of a crystal can be calculated when the indices of the faces are known.



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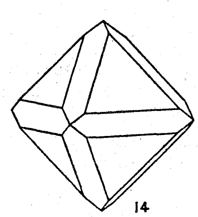

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FIG. 13.—RHOMBIC DODECAHEDRON

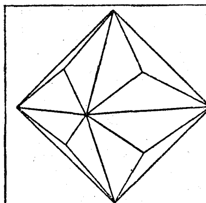
FIG. 14.—COMBINATION OF RHOMBIC DODECAHEDRON AND OCTAHEDRON

Although any set of edges formed by the intersection of three planes may be chosen for the crystallographic axes, it is in practice usual to select certain edges related to the symmetry of the crystal, and usually coincident with axes of symmetry; for then the indices will be simpler and all faces of the same simple form will have a similar set of indices. The angles between the axes and the ratio of the lengths of the parameters $OA:OB:OC$ (usually given as $a:b:c$) are spoken of as the "elements" of a crystal, and are constant for and characteristic of all crystals of the same substance.

The six systems of crystal forms, to be enumerated below, are defined by the relative inclinations of the crystallographic axes and the lengths of the parameters. In the cubic system, for example, the three crystallographic axes are taken parallel to the three tetrad axes of symmetry, *i.e.*, parallel to the edges of the cube (fig. 5) or joining the opposite corners of the octahedron (fig. 3), and they are therefore all at right angles; the parametral plane (111) is a face of the octahedron, and the parameters are all of equal length. The indices of the eight faces of the octahedron will then be $\{111\}$, $\{\bar{1}11\}$, $\{1\bar{1}1\}$, $\{\bar{1}\bar{1}1\}$, $\{11\bar{1}\}$, $\{\bar{1}1\bar{1}\}$, $\{\bar{1}\bar{1}\bar{1}\}$, $\{\bar{1}\bar{1}\bar{1}\}$. The symbol $\{111\}$ indicates all the faces belonging to this simple form. The indices of the six faces of the cube are $\{100\}$, $\{010\}$, $\{001\}$, $\{\bar{1}00\}$, $\{0\bar{1}0\}$, $\{00\bar{1}\}$; here each face is parallel to two axes, *i.e.*, intercepts them at infinity, so that the corresponding indices are zero.

(*d*) *Zones*

An important consequence of the law of rational intercepts is the arrangement of the faces of a crystal in zones. All faces, whether they belong to one or more simple forms, which intersect in parallel edges are said to lie in the same zone. A line drawn through the centre O of the crystal parallel to these edges is called a zone-axis, and a plane perpendicular to this axis is called a zone-plane. On a cube, for example, there are three zones each containing four faces, the zone-axes being coincident with the three tetrad axes of symmetry. In the crystal of zircon (fig. 88) the eight prism-faces, a, m, etc., constitute a zone, denoted by $[a, m, a'$, etc.$]$, with the vertical tetrad axis of symmetry as zone-axis. Again the faces $[a, x, p, e', p', x''', a'']$ lie in another zone, as may be seen by the parallel edges of intersection of the faces in figs. 87 and 88; three other similar zones may be traced on the same crystal.



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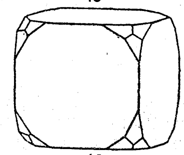

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FIG. 15.—TRIAKIS-OCTAHEDRON

FIG. 16.—COMBINATION OF TRIAKIS-OCTAHEDRON AND CUBE

The direction of the line of intersection (*i.e.*, zone-axis) of any two planes $\{hkl\}$ and $\{h_1k_1l_1\}$ is given by the zone-indices [uvw], where $u=kl_1-lk_1$, $v=lh_1-hl_1$, and $w=hk_1-kh_1$, these being obtained from the face-indices by cross multiplication as follows:

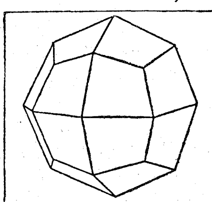
$$\begin{array}{cccccc} h & k & l & h & k & l \\ & \times & \times & \times & & \\ h_1 & k_1 & l_1 & h_1 & k_1 & l_1. \end{array}$$

Any other face $(h_2k_2l_2)$ lying in this zone must satisfy the equation

$$h_2u+k_2v+l_2w=0.$$

This important relation connecting the indices of a face lying in a zone with the zone-indices is known as Weiss's zone-law, having been first enunciated by C. S. Weiss. It may be pointed out that the indices of a face may be arrived at by adding together the indices of faces on either side of it and in the same zone; thus $\{311\}$ in fig. 12 lies at the intersections of the three zones $\{210, 101\}$, $\{201, 110\}$ and $\{211, 100\}$ and is obtained by adding together each set of indices.

(*e*) *Projection and Drawing of Crystals*



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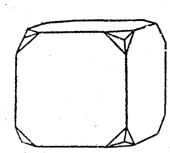

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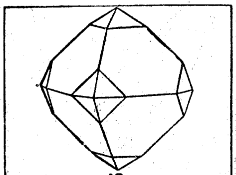
FIG. 17.—ICOSITETRAHEDRON

FIG. 18.—COMBINATION OF ICOSITETRAHEDRON AND CUBE

The shapes and relative sizes of the faces of a crystal being as a rule accidental, depending only on the distance of the faces from the centre of the crystal and not on their angular relations, it is often more convenient to consider only the directions of the normals to the faces. For this purpose projections are drawn, with the aid of which the zonal relations of a crystal are more readily studied and calculations are simplified.

The kind of projection most extensively used is the "stereographic projection." The crystal is considered to be placed inside a sphere from the centre of which normals are drawn to all the faces of the crystal. The points at which these normals intersect the surface of the sphere are called the poles of the faces, and by these poles the positions of the faces are fixed. The poles of all faces in the same zone on the crystal will lie on a great circle of the sphere, which are therefore called zone-circles. The calculation of the angles between the normals of faces and between zone-circles is then performed by the ordinary methods of spherical trigonometry. The stereographic projection, however, represents the poles and zone-circles on a plane surface and not on a spherical surface. This is achieved by drawing lines joining all the poles of the faces with the north or south pole of the sphere and finding their points of intersection with the plane of the equatorial great circle, or primitive circle, of the sphere, the projection being represented on this plane. In fig. 10 is shown the stereographic projection, or stereogram, of a cubic crystal; a^1, a^2, etc., are the poles of the faces of the cube, o^1, o^2, etc., those of the octahedron, and d^1, d^2, etc., those of the rhombic dodecahedron. The straight lines and circular arcs are the projections on the equatorial plane of the great circles in which the nine planes of symmetry intersect the sphere. A drawing of a crystal showing a combination of the cube, octahedron and rhombic dodecahedron is shown in fig. 11, in which the faces are lettered the same as the corresponding poles in the projection. From the zone-circles in the projection and the parallel edges in the drawing the zonal relations of the faces are readily seen: thus $[a^1o^1d^5]$, $[a^1d^1a^5]$, $[a^5o^1d^2]$, etc., are zones. A stereographic projection of a rhombohedral crystal is given in fig. 72.



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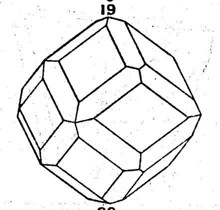

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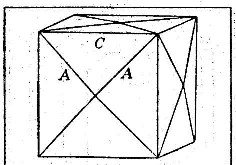
FIG. 19.—COMBINATION OF ICOSITETRAHEDRON AND OCTAHEDRON
FIG. 20.—COMBINATION OF ICOSITETRAHEDRON (211) AND RHOMBIC DODECAHEDRON

Another kind of projection in common use is the "gnomonic projection" (fig. 12). Here the plane of projection is tangent to the sphere, and normals to all the faces are drawn from the centre of the sphere to intersect the plane of projection. In this case all zones are represented by straight lines. Fig. 12 is the gnomonic projection of a cubic crystal, the plane of projection being tangent to the sphere at the pole of an octahedral face {111}, which is therefore in the centre of the projection. The indices of the several poles are given in the figure.

In drawing crystals the simple plans and elevations of descriptive geometry (*e.g.*, the plans in the lower part of figs. 87 and 88) have sometimes the advantage of showing the symmetry of a crystal, but they give no idea of solidity. For instance, a cube would be represented merely by a square, and an octahedron by a square with lines joining the opposite corners. True perspective drawings are never used in the representation of crystals, since for showing the zonal relations it is important to preserve the parallelism of the edges. If, however, the eye, or point of vision, is regarded as being at an infinite distance from the object all the rays will be parallel, and edges which are parallel on the crystal will be represented by parallel lines in the drawing. The plane of the drawing, in which the parallel rays joining the corners of the crystals and the eye intersect, may be either perpendicular or oblique to the rays; in the former case we have an orthographic drawing, and in the latter a clinographic drawing. Clinographic drawings are most frequently used for representing crystals. In representing, for example, a cubic crystal (fig. 11) a cube face a^3 is first placed parallel to the plane on which the crystal is to be projected and with one set of edges vertical; the crystal is then turned through a small angle about a vertical axis until a second cube face a^2 comes into view, and the eye is then raised so that a third cube face a^1 may be seen.



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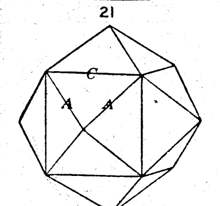

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FIG. 21.—FLAT TETRAKIS-HEXAHEDRON, APPROACHING THE CUBE IN FORM
FIG. 22.—STEEP TETRAKIS-HEXAHEDRON, APPROACHING THE RHOMBIC DODECAHEDRON IN FORM

(*f*) *Crystal Systems and Classes*

According to the mutual inclinations of the crystallographic axes of reference and the lengths intercepted on them by the parametral plane, all crystals fall into one or other of six groups or systems, in each of which there are several classes depending on the degree of symmetry. In the brief description which follows of these six systems and thirty-two classes of crystals we shall proceed from those in which the symmetry is most complex to those in which it is simplest.

1. CUBIC SYSTEM

(Isometric; Regular; Octahedral; Tesseral.)

In this system the three crystallographic axes of reference are all at right angles to each other and are equal in length. They are parallel to the edges of the cube, and in the different classes coincide either with tetrad or dyad axes of symmetry. Five classes are included in this system, in all of which there are, besides other elements of symmetry, four triad axes.

In crystals of this system the angle between any two faces P and Q with the indices $\{hkl\}$ and $\{pqr\}$ is given by the equation

$$\cos PQ = \frac{hp+kq+lr}{\sqrt{(h^2+k^2+l^2)\,(p^2+q^2+r^2)}}.$$

The angles between faces with the same indices are thus the same in all substances which crystallize in the cubic system: in other systems the angles vary with the substance and are characteristic of it.

Holosymmetric Class

(Holohedral; Hexakis-octahedral.)

Crystals of this class possess the full number of elements of symmetry already mentioned above for the octahedron and the cube, viz., three cubic planes of symmetry, six dodecahedral planes, three tetrad axes of symmetry, four triad axes, six dyad axes and a centre of symmetry.

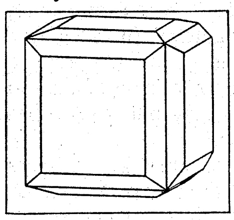
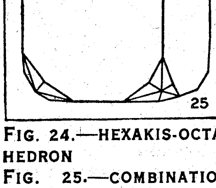


FIG. 23.—COMBINATION OF TETRAKIS-HEXAHEDRON AND CUBE

There are seven kinds of simple forms, viz.:—

Cube (fig. 5).—This is bounded by six square faces parallel to the cubic planes of symmetry; is known also as the hexahedron. The angles between the faces are 90°, and the indices of the form are {100}. Salt, fluorspar and galena crystallize in simple cubes.

Octahedron (fig. 3).—Bounded by eight equilateral triangular faces perpendicular to the triad axes of symmetry. The angles between the faces are 70° 32′ and 109° 28′, and the indices are {111}. Spinel, magnetite and gold crystallize in simple octahedra. Combinations of the cube and octahedron are shown in figs. 6–8.



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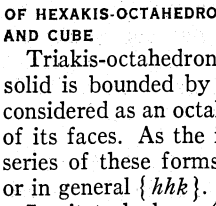

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FIG. 24.—HEXAKIS-OCTAHEDRON
FIG. 25.—COMBINATION OF HEXAKIS-OCTAHEDRON AND CUBE

Rhombic dodecahedron (fig. 13).—Bounded by twelve rhomb-shaped faces parallel to the six dodecahedral planes of symmetry. The angles between the normals to adjacent faces are 60°, and between other pairs of faces 90°; the indices are {110}. Garnet frequently crystallizes in this form. Fig. 14 shows the rhombic dodecahedron in combination with the octahedron.

In these three simple forms of the cubic system (which are shown in combination in fig. 11) the angles between the faces and the indices are fixed and are the same in all crystals; in the four remaining simple forms they are variable.

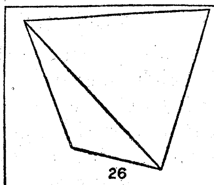
Triakis-octahedron (three-faced octahedron) (fig. 15).—This solid is bounded by twenty-four isosceles triangles, and may be considered as an octahedron with a low triangular pyramid on each of its faces. As the inclinations of the faces may vary there is a series of these forms with the indices {221}, {331}, {332}, etc., or in general $\{hhk\}$.

Icositetrahedron (fig. 17).—Bounded by twenty-four trapezoidal faces, and hence sometimes called a "trapezohedron." The indices are {211}, {311}, {322}, etc., or in general $\{hkk\}$. Analcime, leucite and garnet often crystallize in the simple form {211}. Combinations are shown in figs. 18–20. The plane ABe in fig. 9

is one face $\{112\}$ of an icositetrahedron; the indices of the remaining faces in this octant being $\{211\}$ and $\{121\}$.

Tetrakis-hexahedron (four-faced cube) (figs. 21 and 22).—Like the triakis-octahedron this solid is also bounded by twenty-four isosceles triangles, but here grouped in fours over the cubic faces. The two figures show how, with different inclinations of the faces, the form may vary, approximating in fig. 21 to the cube and in fig. 22 to the rhombic dodecahedron. The angles over the edges lettered *A* are different from the angles over the edges lettered *C*. Each face is parallel to one of the crystallographic axes and intercepts the two others in different lengths; the indices are therefore $\{210\}$,$\{310\}$,$\{320\}$, etc., in general $\{hk0\}$. Fluorspar sometimes crystallizes in the simple form $\{310\}$; more usually, however, in combination with the cube (fig. 23).

Hexakis-octahedron (fig. 24).—Here each face of the octahedron is replaced by six scalene triangles, so that altogether there are forty-eight faces. This is the greatest number of faces possible for any simple form in crystals. The faces are all oblique to the planes and axes of symmetry, and they intercept the three crystallographic axes in different lengths, hence the indices are all unequal, being in general $\{hkl\}$, or in particular cases $\{321\}$, $\{421\}$, $\{432\}$, etc. Such a form is known as the "general form" of the class. The interfacial angles over the three edges of each triangle are all different. These forms usually exist only in combination with other cubic forms (for example, fig. 25), but $\{421\}$ has been observed as a simple form on fluorspar.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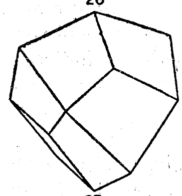
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FIG. 26.—TETRAHEDRON
FIG. 27.—DELTOID DODECAHEDRON

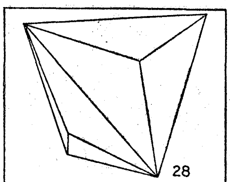
Several examples of substances which crystallize in this class have been mentioned above under the different forms; many others might be cited—for instance, the metals iron, copper, silver, gold, platinum, lead, mercury and the non-metallic elements silicon and phosphorus.

Tetrahedral Class

(Tetrahedral-hemihedral; Hexakis-tetrahedral.)

In this class there is no centre of symmetry nor cubic planes of symmetry; the three tetrad axes become dyad axes of symmetry, and the four triad axes are polar, *i.e.*, they are associated with different faces at their two ends. The six dodecahedral planes are the same as in the last class.

Of the seven simple forms, the cube, rhombic dodecahedron and tetrakis-hexahedron are geometrically the same as before, though on actual crystals the faces will have different surface characters. For instance, the cube faces will be striated parallel to only one of the diagonal (fig. 90), and etched figures on this face will be symmetrical with respect to two lines, instead of four as in the last class. The remaining simple forms have, however, only half the number of faces as the corresponding form in the last class, and are spoken of as "hemihedral with inclined faces."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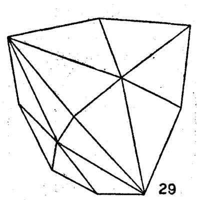
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FIG. 28.—TRIAKIS-TETRAHEDRON
FIG. 29.—HEXAKIS-TETRAHEDRON

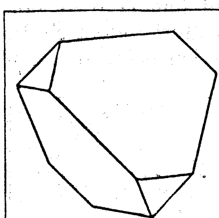
Tetrahedron (fig. 26).—This is bounded by four equilateral triangles and is identical with the regular tetrahedron of geometry. The angles between the normals to the faces are 109° 28′. It may be derived from the octahedron by suppressing the alternate faces.

Deltoid dodecahedron (fig. 27).—This is the hemihedral form of the triakis-octahedron; it has the indices $\{hhk\}$ and is bounded by twelve trapezoidal faces.

Triakis-tetrahedron (fig. 28).—The hemihedral form $\{hkk\}$ of the icositetrahedron; it is bounded by twelve isosceles triangles arranged in threes over the tetrahedron faces.

Hexakis-tetrahedron (fig. 29).—The hemihedral form $\{hkl\}$ of the hexakis-octahedron; it is bounded by twenty-four scalene triangles and is the general form of the class.

Corresponding to each of these hemihedral forms there is another geometrically similar form, differing, however, not only in orientation, but also in actual crystals in the characters of the faces. Thus from the octahedron there may be derived two tetrahedra with the indices $\{111\}$ and $\{\bar{1}11\}$, which may be distinguished as positive and negative respectively. Fig. 30 shows a combination of these two tetrahedra, and represents a crystal of blende, in which the four larger faces are dull and striated, whilst the four smaller are bright and smooth. Figs. 31–33 illustrate other tetrahedral combinations.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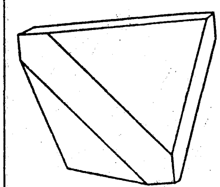
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FIG. 30.—COMBINATION OF TWO TETRAHEDRA
FIG. 31.—COMBINATION OF TETRAHEDRON AND CUBE

Tetrahedrite, blende, diamond, boracite and pharmacosiderite are substances which crystallize in this class.

Pyritohedral Class

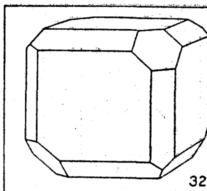
(Parallel-faced hemihedral; Dyakis-dodecahedral.)

Crystals of this class possess three cubic planes of symmetry but no dodecahedral planes. There are only three dyad axes of symmetry, which coincide with the crystallographic axes; in addition there are three triad axes and a centre of symmetry.

Here the cube, octahedron, rhombic dodecahedron, triakis-octahedron and icositetrahedron are geometrically the same as in the first class. The characters of the faces will, however, be different; thus the cube faces will be striated parallel to one edge only (fig. 89), and triangular markings on the octahedron faces will be placed obliquely to the edges. The remaining simple forms are "hemihedral with parallel faces," and from the corresponding holohedral forms two hemihedral forms, a positive and a negative, may be derived.

Pentagonal dodecahedron (fig. 34).—This is bounded by twelve pentagonal faces, but these are not regular pentagons, and the angles over the three sets of different edges are different. The regular dodecahedron of geometry, contained by twelve regular pentagons, is not a possible form in crystals. The indices are $\{hk0\}$: as a simple form $\{210\}$ is of very common occurrence in pyrites, and it is known as the "pyritohedron."

Dyakis-dodecahedron (fig. 35).—This is the hemihedral form of the hexakis-octahedron and has the indices $\{hkl\}$; it is bounded by twenty-four faces. As a simple form $\{321\}$ is met with in pyrites.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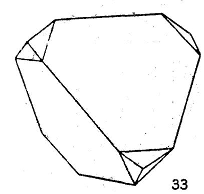
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FIG. 32.—COMBINATION OF TETRAHEDRON, CUBE AND RHOMBIC DODECAHEDRON
FIG. 33.—COMBINATION OF TETRAHEDRON AND RHOMBIC DODECAHEDRON

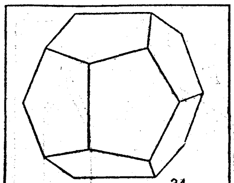
Combinations (figs. 36–39) of these forms with the cube and the octahedron are common in pyrites. Fig. 37 resembles in general appearance the regular icosahedron of geometry, but only eight of the faces are equilateral triangles. Cobaltite, smaltite and other sulphides and sulpharsenides of the pyrites group of minerals crystallize in these forms. The alums also belong to this class; from an aqueous solution they crystallize as simple octahedra, sometimes with subordinate faces of the cube and rhombic dodecahedron, but from an acid solution as octahedra combined with the pentagonal dodecahedron $\{210\}$.

Plagihedral Class

(Plagihedral-hemihedral; Pentagonal-icositetrahedral; Gyroidal.)

In this class there are the full number of axes of symmetry (three tetrad, four triad and six dyad), but no planes of symmetry and no centre of symmetry.

Pentagonal icositetrahedron (fig. 40).—This is the only simple form in this class which differs geometrically from those of the holosymmetric class. By suppressing either one or other set of alternate faces of the hexakis-octahedron two pentagonal icositetrahedra {*hkl*} and {*khl*} are derived. These are each bounded by twenty-four irregular pentagons, and although similar to each other they are respectively right- and left-handed, one being the mirror image of the other; such similar but nonsuperposable forms are said to be enantiomorphous (ἐναντίος, opposite, and μορφή, form), and crystals showing such forms sometimes rotate the plane of polarization of plane-polarized light. Faces of a pentagonal icositetrahedron with high indices have been very rarely observed on crystals of cuprite, potassium chloride and ammonium chloride, but none of these are circular polarizing; nor is the internal structure, as determined by means of X-rays, in agreement with this external development of the faces.



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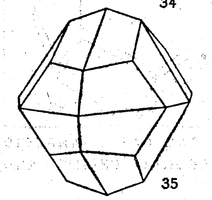

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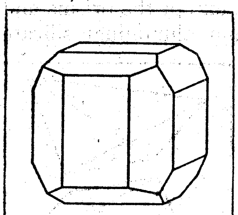
FIG. 34.—PENTAGONAL DODECAHEDRON
FIG 35.—DYAKIS-DODECAHEDRON

Tetartohedral Class

(Tetrahedral-pentagonal-dodecahedral.)

Here, in addition to four polar triad axes, the only other elements of symmetry are three dyad axes, which coincide with the crystallographic axes. Six of the simple forms, the cube, tetrahedron, rhombic dodecahedron, deltoid dodecahedron, triakis-tetrahedron and pentagonal dodecahedron, are geometrically the same in this class as in either the tetrahedral or pyritohedral classes. The general form is the

Tetrahedral pentagonal dodecahedron (fig. 41).—This is bounded by twelve irregular pentagons, and is a tetartohedral or quarter-faced form of the hexakis-octahedron. Four such forms may be derived, the indices of which are {*hkl*}, {*khl*}, $\{\bar{h}kl\}$ and $\{\bar{k}hl\}$; the first pair are enantiomorphous with respect to one another, and so are the last pair. Barium nitrate, lead nitrate, sodium chlorate and sodium bromate crystallize in this class, as also do the minerals ullmannite ($NiSbS$) and langbeinite ($K_2Mg_2(SO_4)_3$).



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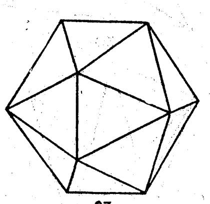

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FIG. 36.—COMBINATION OF PENTAGONAL DODECAHEDRON AND CUBE
FIG. 37.—COMBINATION OF PENTAGONAL DODECAHEDRON AND OCTAHEDRON

2. TETRAGONAL SYSTEM

(Pyramidal; Quadratic; Dimetric.)

In this system the three crystallographic axes are all at right angles, but while two are equal in length and interchangeable the third is of a different length. The unequal axis is spoken of as the principal axis or morphological axis of the crystal, and it is always placed in a vertical position; in five of the seven classes of this system it coincides with the single tetrad axis of symmetry.

The parameters are $a:a:c$, where a refers to the two equal horizontal axes, and c to the vertical axis; c may be either shorter (as in fig. 42) or longer (fig. 43) than a. The ratio $a:c$ is spoken of as the axial ratio of a crystal, and it is dependent on the angles between the faces. In all crystals of the same substance this ratio is constant, and is characteristic of the substance; for other substances crystallizing in the tetragonal system it will be different. For example, in cassiterite it is given as $a:c=1:0{\cdot}67232$ or simply as $c=0{\cdot}6723$, a being unity; and in anatase as $c=1{\cdot}7771$.

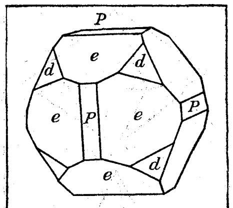
Holosymmetric Class

(Holohedral; Ditetragonal-bipyramidal.)

Crystals of this class are symmetrical with respect to five planes, which are of three kinds; one is perpendicular to the principal axis, and the other four intersect in it; of the latter, two are perpendicular to the equal crystallographic axes, while the two others bisect the angles between them. There are five axes of symmetry, one tetrad and two pairs of dyad, each perpendicular to a plane of symmetry. Finally, there is a centre of symmetry.

There are seven kinds of simple forms, viz.:—

Tetragonal bipyramid of the first order (figs. 42 and 43).—This is bounded by eight equal isosceles triangles. Equal lengths are intercepted on the two horizontal axes, and the indices are {111}, {221}, {112}, etc., or in general {*hhl*}. The parametral plane with the intercepts $a:a:c$ is a face of the bipyramid {111}.



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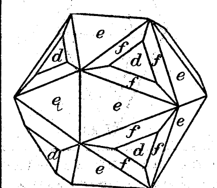

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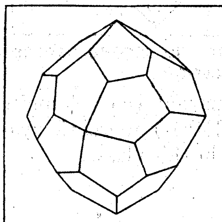
FIG. 38.—COMBINATION OF PENTAGONAL DODECAHEDRON e, CUBE P AND OCTAHEDRON d
FIG. 39.—COMBINATION OF PENTAGONAL DODECAHEDRON e (210), DYAKIS-DODECAHEDRON f (321) AND OCTAHEDRON d (111)

Tetragonal bipyramid of the second order.—This is also bounded by eight equal isosceles triangles, but differs from the last form in its position, four of the faces being parallel to each of the horizontal axes; the indices are therefore {101}, {201}, {102}, etc., or {*h*0*l*}.

Fig. 44 shows the relation between the tetragonal bipyramids of the first and second orders when the indices are {111} and {101} respectively: *ABB* is the face (111), and *ACC* is {101}. A combination of these two forms is shown in fig. 45.

Ditetragonal bipyramid (fig. 46).—This is the general form; it is bounded by sixteen scalene triangles, and all the indices are unequal, being {321}, etc., or {*hkl*}.

Tetragonal prism of the first order.—The four faces intersect the horizontal axes in equal lengths and are parallel to the principal axis; the indices are therefore {110}. This form does not enclose space, and is therefore called an "open form" to distinguish it from a "closed form" like the tetragonal bipyramids and all the forms of the cubic system. An open form can exist only in combination with other forms; thus fig. 47 is a combination of the tetragonal prism {110} with the basal pinacoid {001}. If the faces {110} and {001} are of equal size such a figure will be geometrically a cube, since all the angles are right angles; the variety of apophyllite known as tesselite crystallizes in this form.



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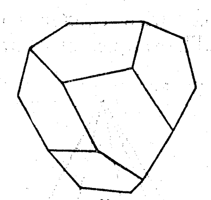

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FIG. 40.—PENTAGONAL ICOSITETRAHEDRON
FIG. 41.—TETRAHEDRAL PENTAGONAL DODECAHEDRON

Tetragonal prism of the second order.—This has the same number of faces as the last prism, but differs in position; each face being parallel to the vertical axis and one of the horizontal axes; the indices are {100}.

Ditetragonal prism.—This consists of eight faces all parallel to the principal axis and intercepting the horizontal axes in different lengths; the indices are {210}, {320}, etc., or {*hk*0}.

Basal pinacoid (from πίναξ, a tablet).—This consists of a single pair of parallel faces perpendicular to the principal axis. It is therefore an open form and can exist only in combination (fig. 47).

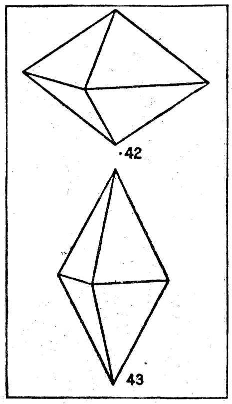
Combinations of holohedral tetragonal forms are shown in figs. 47–49; fig. 48 is a combination of a bipyramid of the first order with one of the second order and the prism of the first order; fig. 49 a combination of a bipyramid of the first order with a ditetragonal bipyramid and the prism of the second order. Compare also figs. 87 and 88.

Examples of substances which crystallize in this class are cassiterite, rutile, anatase, zircon, thorite, idocrase, apophyllite, phosgenite, also boron, tin, mercuric iodide.

Scalenohedral Class

(Bisphenoidal-hemihedral.)

Here there are only three dyad axes and two planes of symmetry, the former coinciding with the crystallographic axes and the latter bisecting the angles between the horizontal pair. The dyad axis of symmetry, which in this class coincides with the principal axis of the crystal, has certain of the characters of a tetrad axis, and is sometimes called a tetrad axis of "alternating symmetry"; a face on the upper half of the crystal if rotated through 90° about this axis and reflected across the equatorial plane falls into the position of a face on the lower half of the crystal. This kind of symmetry, with simultaneous rotation about an axis and reflection across a plane, is also called "composite symmetry."



FIGS. 42 AND 43.—TETRAGONAL BIPYRAMIDS, OBTUSE AND ACUTE

In this class all except two of the simple forms are geometrically the same as in the holosymmetric class.

Bisphenoid (σφήν, a wedge) (fig. 50).—This is a double wedge-shaped solid bounded by four equal isosceles triangles; it has the indices {111}, {211}, {112}, etc., or in general {*hhl*}. By suppressing either one or other set of alternate faces of the tetragonal bipyramid of the first order (fig. 42) two bisphenoids are derived in the same way that two tetrahedra are derived from the regular octahedron.

Tetragonal scalenohedron or ditetragonal bisphenoid (fig. 51).—This is bounded by eight scalene triangles and has the indices {*hkl*}. It may be considered as the hemihedral form of the ditetragonal bipyramid.

The crystal of chalcopyrite ($CuFeS_2$) represented in fig. 52 is a combination of two bisphenoids (*P* and *P′*), two bipyramids of the

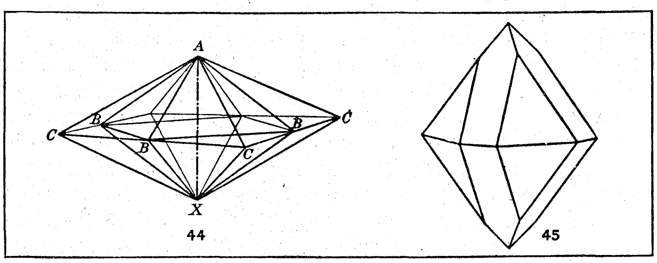


FIG. 44.—TETRAGONAL BIPYRAMIDS OF THE FIRST AND SECOND ORDERS
FIG. 45.—THE SAME IN COMBINATION

second order (*b* and *c*), and the basal pinacoid (*a*). Stannite (Cu_2FeSnS_4), acid potassium phosphate (H_2KPO_4), mercuric cyanide, and urea ($CO(NH_2)_2$) also crystallize in this class.

BIPYRAMIDAL CLASS
(Parallel-faced hemihedral.)

The elements of symmetry are a tetrad axis with a plane perpendicular to it, and a centre of symmetry. The simple forms are the same here as in the holosymmetric class, except the prism {*hk*0}, which has only four faces, and the bipyramid {*hkl*} which has eight faces and is distinguished as a "tetragonal pyramid of the third order."

Fig. 53 shows a combination of a tetragonal prism of the first order with a tetragonal bipyramid of the third order and the basal pinacoid, and represents a crystal of fergusonite. Scheelite (*q.v.*), scapolite (*q.v.*), and erythrite ($C_4H_{10}O_4$) also crystallize in this class.

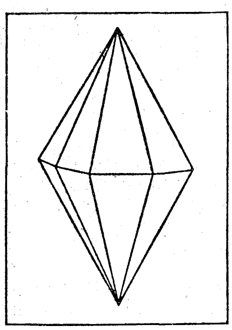


FIG. 46.—DITETRAGONAL BIPYRAMID

PYRAMIDAL CLASS
(Hemimorphic-tetartohedral.)

Here the only element of symmetry is the tetrad axis. The pyramids of the first {*hhl*}, second {*h*0*l*}, and third {*hkl*}, orders have each only four faces at one or other end of the crystal and are hemimorphic. All the simple forms are thus open forms.

Examples: wulfenite ($PbMoO_4$) barium antimonyl dextro-tartrate ($Ba(SbO)_2(C_4H_4O_6)\cdot H_2O$), and iodosuccimide ($C_4H_4O_2NI$).

DITETRAGONAL PYRAMIDAL CLASS
(Hemimorphic-hemihedral.)

Here there are two pairs of vertical planes of symmetry intersecting in the tetrad axis. The pyramids {*hhl*} and {*h*0*l*} and the bipyramid {*hkl*} are all hemimorphic.

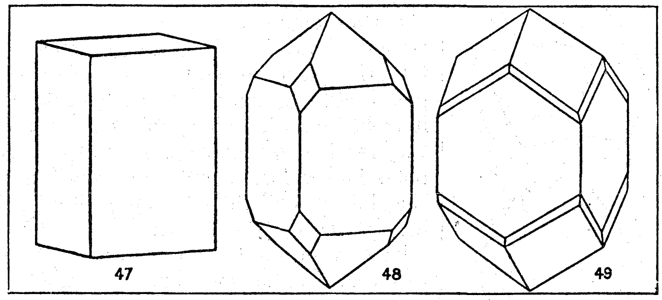


FIG. 47.—COMBINATION OF TETRAGONAL PRISM AND BASAL PINACOID
FIGS. 48 AND 49.—COMBINATIONS OF TETRAGONAL PRISMS AND PYRAMIDS

Examples are silver fluoride ($AgF\cdot H_2O$) and penta-erythrite ($C_5H_{12}O_4$). No examples are known amongst minerals.

TRAPEZOHEDRAL CLASS
(Trapezohedral-hemihedral.)

Here there are the full number of axes of symmetry, but no planes or centre of symmetry. The general form {*hkl*} is bounded by eight trapezoidal faces and is the tetragonal trapezohedron.

Examples are nickel sulphate ($NiSO_4\cdot 6H_2O$) guanidine carbonate ($(CH_5N_3)_2H_2CO_3$), strychnine sulphate
($(C_{21}H_{22}N_2O_2)_2\cdot H_2SO_4\cdot 6H_2O$).

BISPHENOIDAL CLASS
(Bisphenoidal-tetartohedral.)

Here there is only a single dyad axis of symmetry, which coincides with the principal axis. All the forms, except the prisms and basal pinacoid, are sphenoids. The calcium aluminium silicate $2CaO\cdot Al_2O_3\cdot SiO_2$ and meliphane are perhaps representatives of this class.

3. ORTHORHOMBIC SYSTEM

(Rhombic; Prismatic; Trimetric.)

In this system the three crystallographic axes are all at right angles, but they are of different lengths and not interchangeable. The parameters, or axial ratios are $a:b:c$, these referring to the axes OX, OY and OZ respectively. The choice of a vertical axis, $OZ=c$, is arbitrary, and it is customary to place the longer of the two horizontal axes from left to right ($OY=b$) and take it as unity: this is called the "macro-axis" or "macro-diagonal" (from μακρός, long), whilst the shorter horizontal axis ($OX=a$) is called the "brachy-axis" or "brachy-diagonal" (from βραχύς, short). The axial ratios are constant for crystals of any one substance and are characteristic of it; for example, in barytes ($BaSO_4$), $a:b:c=0{\cdot}8152:1:1{\cdot}3136$; in anglesite ($PbSO_4$), $a:b:c=0{\cdot}7852:1:1{\cdot}2894$; in cerussite ($PbCO_3$), $a:b:c=0{\cdot}6100:1:0{\cdot}7230$.

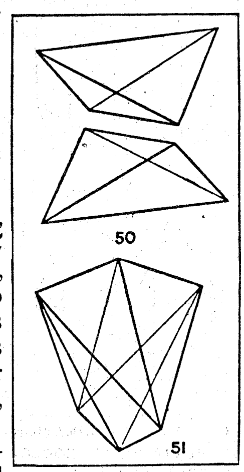


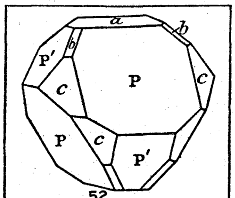
FIG. 50.—TETRAGONAL BISPHENOIDS
FIG. 51.—TETRAGONAL SCALENOHEDRON

There are three symmetry-classes in this system:—

HOLOSYMMETRIC CLASS
(Holohedral; Bipyramidal.)

Here there are three dissimilar dyad axes of symmetry, each coinciding with a crystallographic axis; perpendicular to them are three dissimilar planes of symmetry; there is also a centre of symmetry. There are seven kinds of simple forms:—

Bipyramid (figs. 54 and 55).—This is the general form and is bounded by eight scalene triangles; the indices are {111}, {211}, {221}, {112}, {321}, {213}, {123}, etc., or in general {*hkl*}, The crystallographic axes join opposite corners of these pyramids and in the fundamental bipyramid {111} the parametral plane has the intercepts $a:b:c$. This is the only closed form in this class; the others are open forms and can exist only in combination. Sulphur often crystallizes in simple bipyramids.



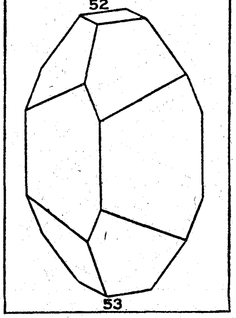


FIG. 52.—CRYSTAL OF CHALCOPYRITE
FIG. 53.—CRYSTAL OF FERGUSONITE

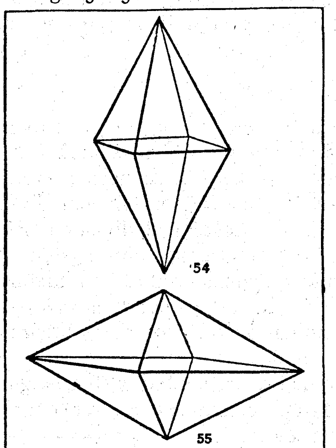
Prism.—This consists of four faces parallel to the vertical axis and intercepting the horizontal axes in the lengths *a* and *b* or in any multiples or sub-multiples of these; the indices are therefore {110}, {210}, {120} or {*hk*0}.

Macro-prism.—This consists of four faces parallel to the macro-axis, and has the indices {101}, {201} . . . or {*h*0*l*}.

Brachy-prism.—This consists of four faces parallel to the brachy-axis, and has the indices {011}, {021} . . . {0*kl*}. The macro- and brachy-prisms are often called "domes."

Pinacoids.—The basal pinacoid consists of a pair of parallel faces perpendicular to the vertical axis; the indices are {001}. The macro-pinacoid {100} and the brachy-pinacoid {010} each consist of a pair of parallel faces respectively parallel to the macro- and the brachy-axis.

Figs. 56–58 show combinations of these six open forms, and fig. 59 a combination of the macro-pinacoid (*a*), brachy-pinacoid (*b*), a prism (*m*), a macro-prism (*d*), a brachy-prism (*k*), and a bipyramid (*u*).



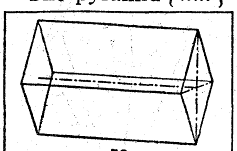
FIGS. 54 AND 55.—ORTHORHOMBIC BIPYRAMIDS

Examples of substances crystallizing in this class are extremely numerous; amongst naturally occurring minerals are sulphur, stibnite, cerussite, chrysoberyl, topaz, olivine, nitre, barytes, columbite and many others; and amongst artificial products iodine, potassium permanganate, potassium sulphate, benzene, barium formate, etc.

PYRAMIDAL CLASS
(Hemimorphic.)

Here there is only one dyad axis in which two planes of symmetry intersect. The crystals are usually so placed that the dyad axis coincides with the vertical crystallographic axis, and the planes of symmetry are also vertical.

The pyramid {*hkl*} has only four faces at one end or other of the crystal. The macro-prism and the brachy-prism of the last class are here represented by the macro-dome and brachy-dome respectively, so called because of the resemblance of the pair of equally sloped faces to the roof of a house. The form {001} is a single plane at the top of the crystal, and is called a "pedion"; the parallel pedion $\{00\bar{1}\}$, if present at the lower end of the crystal, constitutes a different form. The prisms {*hk*0} and the macro- and brachy-pinacoids are geometrically the same in this class as in the last. Crystals of this class are therefore differently developed at the two ends and are said to be "hemimorphic."



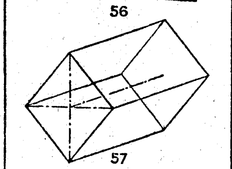
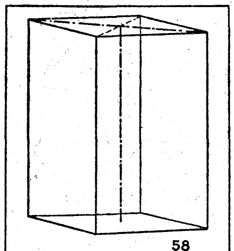


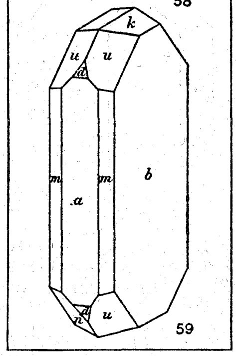
FIG. 56.—MACRO-PRISM AND BRACHY-PINACOID
FIG. 57.—BRACHY-PRISM AND MACRO-PINACOID

Fig. 60 shows a crystal of the mineral hemimorphite ($H_2Zn_2SiO_5$) which is a combination of the brachy-pinacoid {010} and a prism, with the pedion {001}, two brachy-domes and two macro-domes at the upper end, and a pyramid at the lower end. Examples of other substances belonging to this class are struvite ($NH_4MgPO_4{\cdot}6H_2O$), bertrandite ($H_2Be_4Si_2O_9$), resorcin, and picric acid.

BISPHENOIDAL CLASS
(Hemihedral.)

Here there are three dyad axes, but no planes of symmetry and no centre of symmetry. The general form {*hkl*} is a bisphenoid (fig. 61) bounded by four scalene triangles. The other simple forms are geometrically the same as in the holosymmetric class.





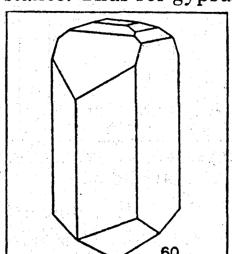
HOLOHEDRAL ORTHORHOMBIC COMBINATIONS
Fig. 58.—Prism and Basal Pinacoid
Fig. 59.—Crystal of Hypersthene

Examples: epsomite (Epsom salts, $MgSO_4{\cdot}7H_2O$), goslarite ($ZnSO_4{\cdot}7H_2O$), silver nitrate, sodium potassium dextro-tartrate (seignette salt, $NaKC_4H_4O_6{\cdot}4H_2O$), potassium antimonyl dextrotartrate (tartar-emetic, $K(SbO)C_4H_4O_6$), and asparagine ($C_4H_8N_2O_3{\cdot}H_2O$).

4. MONOCLINIC SYSTEM

(Oblique; Monosymmetric.)

In this system two of the angles between the crystallographic axes are right angles, but the third angle is oblique, and the axes are of unequal lengths. The axis which is perpendicular to the other two is taken as $OY=b$ (fig. 62) and is called the ortho-axis or orthodiagonal. The choice of the other two axes is arbitrary; the vertical axis ($OZ=c$) is usually taken parallel to the edges of a prominently developed prismatic zone, and the clino-axis or clino-diagonal ($OX=a$) parallel to the zone-axis of some other prominent zone on the crystal. The acute angle between the axes OX and OZ is usually denoted as β, and it is necessary to know its magnitude, in addition to the axial ratios $a:b:c$, before the crystal is completely determined. As in other systems, except the cubic, these elements, $a:b:c$ and β, are characteristic of the substance. Thus for gypsum $a:b:c=0{\cdot}6899:1:0{\cdot}4124$; $\beta=80°\ 42'$; for orthoclase $a:b:c=0{\cdot}6585:1:0{\cdot}5554$; $\beta=63°\ 57'$; and for cane-sugar $a:b:c=1{\cdot}2595:1:0{\cdot}8782$; $\beta=76°\ 30'$.



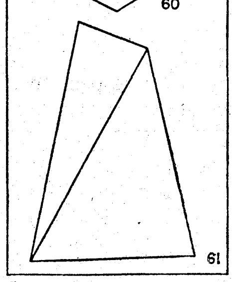


FIG. 60.—CRYSTAL OF HEMIMORPHITE
FIG. 61.—ORTHORHOMBIC BISPHENOID

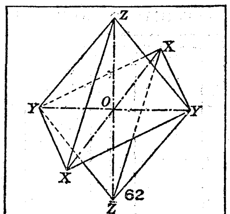
HOLOSYMMETRIC CLASS
(Holohedral; Prismatic.)

Here there is a single plane of symmetry perpendicular to which is a dyad axis; there is also a centre of symmetry. The dyad axis coincides with the ortho-axis OY, and the vertical axis OZ and the clino-axis OX lie in the plane of symmetry.

All the forms are open, being either pinacoids or prisms; the former consisting of a pair of parallel faces, and the latter of four faces intersecting in parallel edges and with a rhombic cross-section. The pair of faces parallel to the plane of symmetry is distinguished as the "clino-pinacoid" and has the indices {010}. The other pinacoids are all perpendicular to the plane of symmetry (and parallel to the ortho-axis); the one parallel to the vertical axis is called the "ortho-pinacoid" {100} whilst that parallel to the clino-axis is the "basal pinacoid" {001}; pinacoids not parallel to the arbitrarily chosen clino- and vertical axes may have the indices {101}, {201}, {102} . . . {*h*0*l*}, or $\{\bar{1}01\}$, $\{\bar{2}01\}$, $\{\bar{1}02\}$ . . . $\{\bar{h}0l\}$, according to whether they lie in the obtuse or the acute axial angle. Of the prisms, those with edges (zone-axis) parallel to the clino-axis, and having indices {011}, {021} $\{0\bar{1}2\}$ . . . {0*kl*}, are called "clino-prisms"; those with edges parallel to the vertical axis, and with the indices {110}, {210},

$\{120\}$ . . . $\{hk0\}$, are called simply "prisms." Prisms with edges parallel to neither of the axes OX and OY have the indices $\{111\}$, $\{221\}$, $\{211\}$, $\{321\}$ . . . $\{hkl\}$ or $\{\bar{1}11\}$ . . . $\{\bar{h}kl\}$, and are usually called "hemi-pyramids" (fig. 62); they are distinguished as negative or positive according to whether they lie in the obtuse or the acute axial angle β.

Fig. 63 represents a crystal of augite bounded by the clino-pinacoid (l), the ortho-pinacoid (r), a prism (M), and a hemi-pyramid (s).



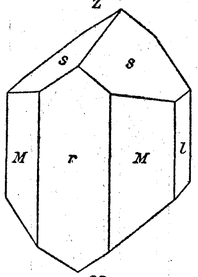


FIG. 62.—MONOCLINIC AXES AND HEMI-PYRAMID FIG. 63.—CRYSTAL OF AUGITE

The substances which crystallize in this class are extremely numerous: amongst minerals are gypsum, orthoclase, the amphiboles, pyroxenes and micas, epidote, monazite, realgar, borax, mirabilite ($Na_2SO_4 \cdot 10H_2O$), melanterite ($FeSO_4 \cdot 7H_2O$) and many others; amongst artificial products are monoclinic sulphur, barium chloride ($BaCl_2 \cdot 2H_2O$), potassium chlorate, potassium ferrocyanide ($K_4Fe(CN)_6 \cdot 3H_2O$)), oxalic acid ($C_2O_4H_2 \cdot 2H_2O$), sodium acetate ($NaC_2H_3O_2 \cdot 3H_2O$) and naphthalene.

Hemimorphic Class

(Sphenoidal.)

In this class the only element of symmetry is a single dyad axis, which is polar in character, being dissimilar at the two ends.

The form $\{010\}$ perpendicular to the axis of symmetry consists of a single plane or pedion; the parallel face is dissimilar in character and belongs to the pedion $\{0\bar{1}0\}$. The pinacoids $\{100\}$, $\{001\}$, $\{h0l\}$ and $\{\bar{h}0l\}$ parallel to the axis of symmetry are geometrically the same in this class as in the holosymmetric class. The remaining forms consist each of only two planes on the same side of the axial plane XOZ and equally inclined to the dyad axis (*e.g.*, in fig. 62 the two planes XYZ and $\bar{X}Y\bar{Z}$); such a wedge-shaped form is sometimes called a sphenoid.

Fig. 64 shows two crystals of tartaric acid, a a right-handed crystal of dextro-tartaric acid, and b a left-handed crystal of laevo-tartaric acid. The two crystals are enantiomorphous, *i.e.*, although they have the same interfacial angles they are not superposable, one being the mirror image of the other. Other examples are potassium dextro-tartrate, cane-sugar, milk-sugar, quercite, lithium sulphate ($Li_2SO_4 \cdot H_2O$); amongst minerals the only example is the hydrocarbon fichtelite ($C_{18}H_{32}$).

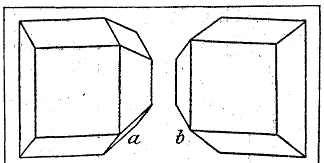


FIG. 64.—ENANTIOMORPHOUS CRYSTALS OF TARTARIC ACID

Clinohedral Class

(Hemihedral; Domatic.)

Crystals of this class are symmetrical only with respect to a single plane. The only form which is here geometrically the same as in the holosymmetric class is the clino-pinacoid $\{010\}$. The forms perpendicular to the plane of symmetry are all pedions, consisting of single planes with the indices $\{100\}$, $\{\bar{1}00\}$, $\{001\}$, $\{00\bar{1}\}$, $\{h0l\}$, etc. The remaining forms, $\{hk0\}$, $\{0kl\}$ and $\{hkl\}$, are domes or "gonioids" (γωνία, an angle and εἶδος, form), consisting of two planes equally inclined to the plane of symmetry.

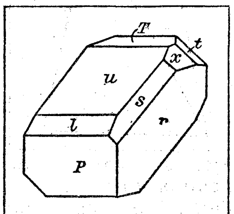


FIG. 65.—CRYSTAL OF AXINITE

Examples are potassium tetrathionate ($K_2S_4O_6$), hydrogen tri-sodium hypophosphate ($HNa_3P_2O_6 \cdot 9H_2O$); and amongst minerals, clinohedrite ($H_2ZnCaSiO_4$) and scolectite.

5. ANORTHIC SYSTEM

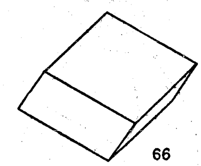
(Triclinic.)

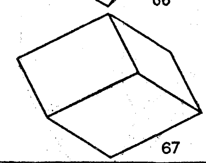
In the anorthic (from ἀν, privative, and ὀρθός, right) or triclinic system none of the three crystallographic axes are at right angles, and they are all of unequal lengths. In addition to the parameters $a:b:c$, it is necessary to know the angles, α, β, and γ, between the axes. In anorthite, for example, these elements are $a:b:c = 0{\cdot}6347:1:0{\cdot}5501$; $\alpha = 93° \ 13'$, $\beta = 115° \ 55'$, $\gamma = 91° \ 12'$.

Holosymmetric Class

(Holohedral; Pinacoidal.)

Here there is only a centre of symmetry. All the forms are pinacoids, each consisting of only two parallel faces. The indices of the three pinacoids parallel to the axial planes are $\{100\}$, $\{010\}$ and $\{001\}$; those of pinacoids parallel to only one axis are $\{hk0\}$, $\{h0l\}$ and $\{0kl\}$; and the general form is $\{hkl\}$.





FIGS. 66 AND 67.—DIRECT AND INVERSE RHOMBOHEDRA

Several minerals crystallize in this class; for example, the plagioclastic felspars, microcline, axinite (fig. 65), kyanite, amblygonite, chalcanthite ($CuSO_4 \cdot 5H_2O$), sassolite (H_3BO_3); among artificial substances are potassium dichromate, racemic acid ($C_4H_6O_6 \cdot 2H_2O$), dibrom-para-nitrophenol, etc.

Asymmetric Class

(Hemihedral, Pediad.)

Crystals of this class are devoid of any elements of symmetry. All the forms are pedions, each consisting of a single plane; they are thus hemihedral with respect to crystals of the last class. Although there is a total absence of symmetry, yet the faces are arranged in zones on the crystals.

Examples are calcium thiosulphate ($CaS_2O_3 \cdot 6H_2O$) and hydrogen strontium dextro-tartrate ($(C_4H_4O_6H)_2Sr \cdot 5H_2O$); there is no example known amongst minerals.

6. HEXAGONAL SYSTEM

Crystals of this system are characterized by the presence of a single axis of either triad or hexad symmetry, which is spoken of as the "principal" or "morphological" axis. Those with a triad axis are grouped together in the rhombohedral or trigonal division, and those with a hexad axis in the hexagonal division. By some authors these two divisions are treated as separate systems; or again the rhombohedral forms may be considered as hemihedral developments of the hexagonal. On the other hand, hexagonal forms may be considered as a combination of two rhombohedral forms.

Owing to the peculiarities of symmetry associated with a single triad or hexad axis, the crystallographic axes of reference are different in this system from those used in the five other systems of crystals. Two methods of axial representation are in common use; rhombohedral axes being usually used for crystals of the rhombohedral division, and hexagonal axes for those of the hexagonal division; though sometimes either one or the other set is employed in both divisions.

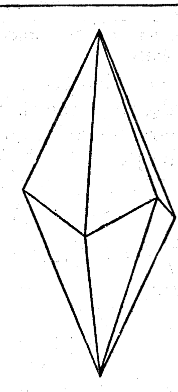


FIG. 68.—SCALENOHEDRON

Rhombohedral axes are taken parallel to the three sets of edges of a rhombohedron (fig. 66). They are inclined to one another at equal oblique angles, and they are all equally inclined to the principal axis; further, they are all of equal length and are interchangeable. With such a set of axes there can be no statement of an axial ratio, but the angle α between the axes (or some other angle which may be calculated from this) may be given as a constant of the substance. Thus in calcite the rhombohedral angle (the angle between two faces of the fundamental rhombohedron) is $74° \ 55'$ or the angle between the normal to a face of this rhombohedron and the principal axis is $44° \ 36\frac{1}{2}'$; whilst the angle α between the axes is $101° \ 55'$, this being the plane angle of the rhomb-shaped faces.

Hexagonal axes are four in number, viz., a vertical axis coinciding with the principal axis of the crystal, and three horizontal axes inclined to one another at 60° in a plane perpendicular to the principal axis. The three horizontal axes, which are taken either parallel or perpendicular to the faces of a hexagonal prism (fig. 71) or the edge of a hexagonal bipyramid (fig. 70), are equal in length (a) but the vertical axis is of a different length (c). The indices of planes referred to such a set of axes are four in number; they are written as $\{hikl\}$, the first three ($h+i+k=0$) referring to the horizontal axes and the last to the vertical axis. The ratio $a:c$ of the parameters, or the axial ratio, is characteristic of all the crystals of the same substance. Thus for beryl (including emerald) $a:c=1:0{\cdot}4989$ (often written $c=0{\cdot}4989$); for zinc $c=1{\cdot}3564$.

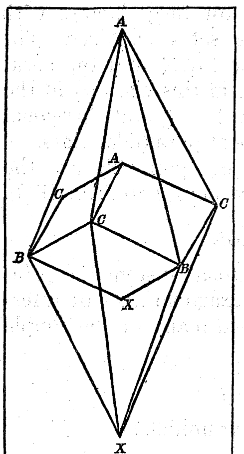


FIG. 69.—SCALENOHEDRON WITH INSCRIBED RHOMBOHEDRON

RHOMBOHEDRAL DIVISION

In the rhombohedral or trigonal division of the hexagonal system there are seven symmetry-classes, all of which possess a single triad axis of symmetry.

HOLOSYMMETRIC CLASS

(Holohedral; Ditrigonal-scalenohedral.)

In this class, which presents the commonents type of symmetry of the hexagonal system, the triad axis is associated with three similar planes of symmetry inclined to one another at 60° and intersecting in the triad axis; there are also three similar dyad axes, each perpendicular to a plane of symmetry, and a centre of symmetry. The seven simple forms are:—

Rhombohedron (figs. 66 and 67), consisting of six rhomb-shaped faces with the edges all of equal lengths: the faces are perpendicular to the planes of symmetry. There are two sets of rhombohedra, distinguished respectively as direct and inverse; those of one set (fig. 66) are brought into the orientation of the other set (fig. 67) by a rotation of 60° or 180° about the principal axis. For the fundamental rhombohedron, parallel to the edges of which are the crystallographic axes of reference, the indices are $\{100\}$. Other rhombohedra may have the indices $\{211\}$, $\{4\bar{1}\bar{1}\}$, $\{110\}$, $\{22\bar{1}\}$, $\{11\bar{1}\}$, etc., or in general $\{hkk\}$. (Compare fig. 72; for figures of other rhombohedra *see* CALCITE.)

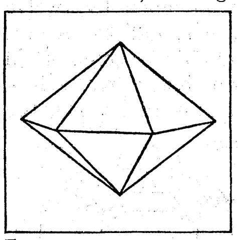


FIG 70.—HEXAGONAL BIPYRAMID

Scalenohedron (fig. 68), bounded by twelve scalene triangles, and with the general indices $\{hkl\}$. The zigzag lateral edges coincide with the similar edges of a rhombohedron, as shown in fig. 69; if the indices of the inscribed rhombohedron be $\{100\}$, the indices of the scalenohedron represented in the figure are $\{20\bar{1}\}$. The scalenohedron $\{20\bar{1}\}$ is a characteristic form of calcite, which for this reason is sometimes called "dog-tooth-spar." The angles over the three edges of a face of a scalenohedron are all different; the angles over three alternate polar edges are more obtuse than over the other three polar edges. Like the two sets of rhombohedra, there are also direct and inverse scalenohedra, which may be similar in form and angles, but different in orientation and indices.

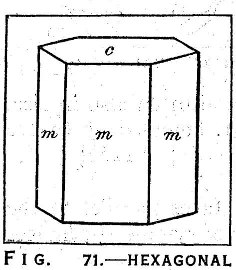


FIG. 71.—HEXAGONAL PRISM AND BASAL PINACOID

Hexagonal bipyramid (fig. 70), bounded by twelve isosceles triangles each of which are equally inclined to two planes of symmetry. The indices are $\{210\}$, $\{41\bar{2}\}$, etc., or in general $\{hkl\}$ where $h-2k+l=0$.

Hexagonal prism of the first order $\{2\bar{1}\bar{1}\}$, consisting of six faces parallel to the principal axis and perpendicular to the planes of symmetry; the angles between (the normals to) the faces are 60°.

Hexagonal prism of the second order $\{10\bar{1}\}$, consisting of six faces parallel to the principal axis and parallel to the planes of symmetry. The faces of this prism are inclined to 30° to those of the last prism.

Dihexagonal prism, consisting of twelve faces parallel to the principal axis and inclined to the planes of symmetry. There are two sets of angles between the faces. The indices are $\{3\bar{2}\bar{1}\}$, $\{5\bar{3}\bar{2}\}$ . . . $\{h\bar{k}\bar{l}\}$, where $h+k+l=0$.

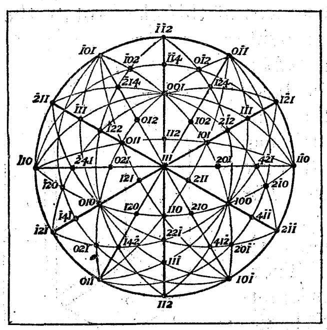


FIG. 72.—STEREOGRAPHIC PROJECTION OF A HOLOSYMMETRIC RHOMBOHEDRAL CRYSTAL

Basal pinacoid $\{111\}$ consisting of a pair of parallel faces perpendicular to the principal axis.

Fig. 71 shows a combination of a hexagonal prism (m) with the basal pinacoid (c). For figures of other combinations *see* CALCITE and CORUNDUM. The relation between rhombohedral forms and their indices are best studied with the aid of a stereographic projection (fig. 72); in this figure the thicker lines are the projections of the three planes of symmetry, and on these lie the poles of the rhombohedra (six of which are indicated).

Numerous substances, both natural and artificial, crystallize in this class; for example, calcite, chalybite, smithsonite, corundum (ruby and sapphire), haematite, chabazite; the elements arsenic, antimony, bismuth, selenium, tellurium and perhaps graphite; also ice, sodium nitrate, thymol, etc.

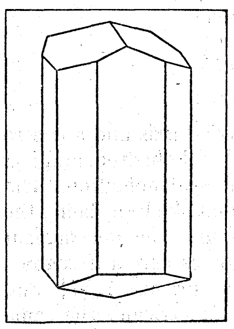


FIG. 73.—CRYSTAL OF TOURMALINE

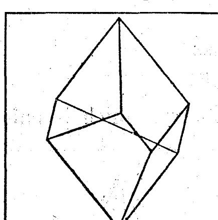
DITRIGONAL PYRAMIDAL CLASS

(Hemimorphic-hemihedral.)

Here there are three similar planes of symmetry intersecting in the triad axis; there are no dyad axes and no centre of symmetry. The triad axis is uniterminal and polar, and the crystals are differently developed at the two ends; crystals of this class are therefore pyro-electric. The forms are all open forms:—

Trigonal pyramid $\{hkk\}$, consisting of three faces which correspond to the three upper or the three lower faces of a rhombohedron of the holosymmetric class.

Ditrigonal pyramid $\{hkl\}$, of six faces, corresponding to the six upper or lower faces of the scalenohedron.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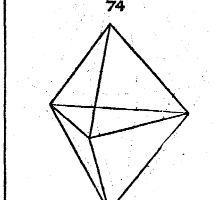
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FIG. 74.—TRIGONAL TRAPEZOHEDRON
FIG. 75.—TRIGONAL BIPYRAMID

Hexagonal pyramid $\{hkl\}$ (where $h-2k+l=0$), of six faces, corresponding to the six upper or lower faces of the hexagonal bipyramid.

Trigonal prism $\{2\bar{1}\bar{1}\}$ or $\{\bar{2}11\}$, two forms each consisting of three faces parallel to the principal axis and perpendicular to the planes of symmetry.

Hexagonal prism $\{10\bar{1}\}$ which is geometrically the same as in the last class.

Ditrigonal prism $\{h\bar{k}\bar{l}\}$, (where $h+k+l=0$), of six faces parallel to the principal axis, and with two sets of angles between them.

Basal pedion $\{111\}$ or $\{\bar{1}\bar{1}\bar{1}\}$, each consisting of a single plane perpendicular to the principal axis.

Fig. 73 represents a crystal of tourmaline with the trigonal prism $\{2\bar{1}\bar{1}\}$ hexagonal prism $\{10\bar{1}\}$ and a trigonal pyramid at each end. Other substances crystallizing in this class are pyrargyrite, proustite, iodyrite (AgI), greenockite, zincite, spangolite, sodium lithium sulphate, tolylphenylketone.

Trapezohedral Class

(Trapezohedral-hemihedral.)

Here there are three similar dyad axes inclined to one another at 60° and perpendicular to the triad axis. There are no planes or centre of symmetry. The dyad axes are uniterminal, and are pyroelectric axes. Crystals of most substances of this class rotate the plane of polarization of a beam of light.

In this class the rhombohedra $\{hkk\}$, the hexagonal prism $\{2\bar{1}\bar{1}\}$ and the basal pinacoid $\{111\}$ are geometrically the same as in the holosymmetric class; the trigonal prism $\{10\bar{1}\}$ and the ditrigonal prisms are as in the ditrigonal pyramidal class. The remaining simple forms are:—

Trigonal trapezohedron (fig. 74), bounded by six trapezoidal faces. There are two complementary and enantiomorphous trapezohedra, $\{hkl\}$ and $\{hlk\}$, derivable from the scalenohedron.

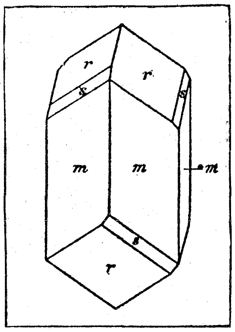


FIG. 76.—CRYSTAL OF DIOPTASE

Trigonal bipyramid (fig. 75), bounded by six isosceles triangles; the indices are $\{hkl\}$, where $h-2k+l=0$, as in the hexagonal bipyramid.

The only minerals crystallizing in this class are quartz (*q.v.*) and cinnabar, both of which rotate the plane of a beam of polarized light transmitted along the triad axis. Other examples are dithionates of lead ($PbS_2O_6{\cdot}4H_2O$), calcium and strontium, and of potassium ($K_2S_2O_6$), benzil, matico-stearoptene.

Rhombohedral Class

(Parallel-faced hemihedral.)

The only elements of symmetry are the triad axis and a centre of symmetry. The general form $\{hkl\}$ is a rhombohedron, and is a hemihedral form, with parallel faces, of the scalenohedron. The form $\{hkl\}$, where $h-2k+l=0$, is also a rhombohedron, being the hemihedral form of the hexagonal bipyramid. The dihexagonal prism $\{\bar{h}\bar{k}\bar{l}\}$ of the holosymmetric class becomes here a hexagonal prism. The rhombohedra $\{hkk\}$, hexagonal prisms $\{2\bar{1}\bar{1}\}$ and $\{101\}$, and the basal pinacoid $\{111\}$ are geometrically the same in this class as in the holosymmetric class.

Fig. 76 represents a crystal of dioptase with the fundamental rhombohedron r $\{100\}$ and the hexagonal prism of the second order m $\{10\bar{1}\}$ combined with the rhombohedron s $\{03\bar{1}\}$.

Examples of minerals which crystallize in this class are phenakite, dioptase, willemite, dolomite, ilmenite and pyrophanite: amongst artificial substances is ammonium diperiodate

$$((NH_4)_4I_2O_9{\cdot}3H_2O).$$

Trigonal Pyramidal Class

(Hemimorphic-tetartohedral.)

Here there is only the triad axis of symmetry, which is uniterminal. The general form $\{hkl\}$ is a trigonal pyramid consisting of three faces at one end of the crystal. All other forms, in which the faces are neither parallel nor perpendicular to the triad axis, are trigonal pyramids. All the prisms are trigonal prisms; and perpendicular to these are two pedions.

The only substance known to crystallize in this class is sodium periodate ($NaIO_4{\cdot}3H_2O$), the crystals of which are circularly polarizing.

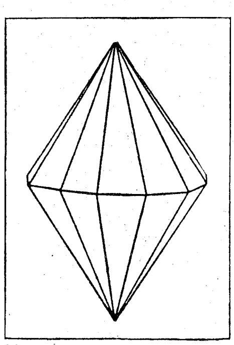


FIG. 77.—DIHEXAGONAL BIPYRAMID

Trigonal Bipyramidal Class

Here there is a plane of symmetry perpendicular to the triad axis. The trigonal pyramids of the last class are here trigonal bipyramids (fig. 75); the prisms are all trigonal prisms, and parallel to the plane of symmetry is the basal pinacoid. No example is known for this class.

Ditrigonal Bipyramidal Class

Here there are three similar planes of symmetry intersecting in the triad axis, and perpendicular to them is a fourth plane of symmetry; at the intersection of the three vertical planes with the horizontal plane are three similar dyad axes; there is no centre of symmetry.

The general form is bounded by twelve scalene triangles and is a ditrigonal bipyramid. Like the general form of the last class, this has two sets of indices $\{hkl, \bar{p}\bar{q}\bar{r}\}$, $\{hkl\}$ for faces above the equatorial plane of symmetry and $\{\bar{p}\bar{q}\bar{r}\}$ for faces below: with hexagonal axes there would be only one set of indices. The hexagonal bipyramids, the hexagonal prism $\{10\bar{1}\}$ and the basal pinacoid $\{111\}$ are geometrically the same in this class as in the holosymmetric class. The trigonal prism $\{2\bar{1}\bar{1}\}$ and ditrigonal prisms $\{\bar{h}\bar{k}\bar{l}\}$ are the same as in the ditrigonal pyramidal class.

The only representatives of this type of symmetry are the mineral benitoite (*q.v.*) and silver hydrogen phosphate, Ag_2HPO_4.

HEXAGONAL DIVISION

In crystals of this division of the hexagonal system the principal axis is a hexad axis of symmetry. Hexagonal axes of reference are used: if rhombohedral axes be used many of the simple forms will have two sets of indices.

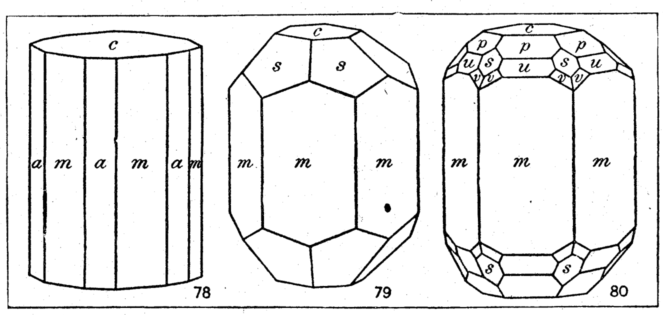
Holosymmetric Class

(Holohedral; Dihexagonal-bipyramidal.)

Intersecting in the hexad axis are six planes of symmetry of two kinds, and perpendicular to them is an equatorial plane of symmetry. Perpendicular to the hexad axis are six dyad axes of two kinds and each perpendicular to a vertical plane of symmetry. The seven simple forms are:—

Dihexagonal bipyramid, bounded by twenty-four scalene triangles (fig. 77; v in fig. 80). The indices are $\{21\bar{3}1\}$, etc., or in general $\{hikl\}$. This form may be considered as a combination of two scalenohedra, a direct and an inverse.

Hexagonal bipyramid of the first order, bounded by twelve isosceles triangles (fig. 70; p and u in fig. 80); indices $\{10\bar{1}1\}$, $\{20\bar{2}1\}$ . . . $\{h0\bar{h}l\}$. The hexagonal bipyramid so common in quartz is geometrically similar to this form, but it really is a combination of two rhombohedra, a direct and an inverse, the faces of which differ in surface characters and often also in size.



FIGS. 78, 79 AND 80.—COMBINATIONS OF HEXAGONAL FORMS

Hexagonal bipyramid of the second order, bounded by twelve faces (s in figs. 79 and 80); indices $\{11\bar{2}1\}$, $\{11\bar{2}2\}$ . . . $\{h.h.\bar{2h}.l\}$.

Dihexagonal prism, consisting of twelve faces parallel to the hexad axis and inclined to the vertical planes of symmetry; indices $\{hik0\}$.

Hexagonal prism of the first order $\{10\bar{1}0\}$, consisting of six faces parallel to the hexad axis and perpendicular to one set of three vertical planes of symmetry (m in figs. 71, 78–80).

Hexagonal prism of the second order $\{11\bar{2}0\}$, consisting of six faces also parallel to the hexad axis, but perpendicular to the other set of three vertical planes of symmetry (a in fig. 78).

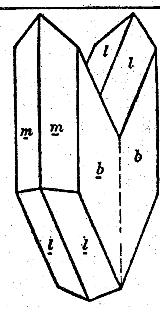
Basal pinacoid $\{0001\}$, consisting of a pair of parallel planes perpendicular to the hexad axis (c in figs. 71, 78–80).

Beryl (emerald), connellite, zinc, magnesium and beryllium crystallize in this class.

Bipyramidal Class
(Parallel-faced hemihedral.)

Here there is a plane of symmetry perpendicular to the hexad axis; there is also a centre of symmetry. All the closed forms are hexagonal bipyramids; the open forms are hexagonal prisms or the basal pinacoid. The general form $\{hikl\}$ is hemihedral with parallel faces with respect to the general form of the holosymmetric class.

Apatite (*q.v.*), pyromorphite, mimetite and vanadinite possess this degree of symmetry.



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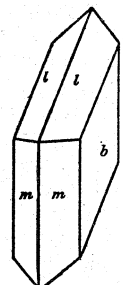

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FIG. 81.—TWINNED CRYSTAL OF GYPSUM
FIG. 82.—SIMPLE CRYSTAL OF GYPSUM

Dihexagonal Pyramidal Class
(Hemimorphic-hemihedral.)

Six planes of symmetry of two kinds intersect in the hexad axis. The hexad axis is uniterminal and all the forms are open forms. The general form $\{hikl\}$ consists of twelve faces at one end of the crystal, and is a dihexagonal pyramid. The hexagonal pyramids $\{h0\bar{h}l\}$ and $\{h.h.\overline{2h}.l\}$ each consist of six faces at one end of the crystal. The prisms are geometrically the same as in the holo-symmetric class. Perpendicular to the hexad axis are the pedions $\{0001\}$ and $\{000\bar{1}\}$.

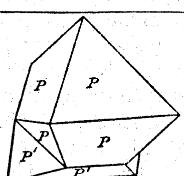
Iodyrite (AgI), greenockite (CdS), wurtzite (Zns) and zincite (ZnO) are often placed in this class, but they more probably belong to the hemimorphic-hemihedral class of the rhombohedral division of this system.

Trapezohedral Class
(Trapezohedral-hemihedral.)

Six dyad axes of two kinds are perpendicular to the hexad axis. The general form $\{hikl\}$ is the hexagonal trapezohedron bounded by twelve trapezoidal faces. The other simple forms are geometrically the same as in the holosymmetric class. Quartz at temperatures above 575° C (and below 870° C)—β-quartz, barium-antimonyl dextro-tartrate+potassium nitrate $(Ba(SbO)_2\text{-}(C_4H_4O_6)_2\cdot KNO_3)$ and the corresponding lead salt crystallize in this class.

Hexagonal Pyramidal Class
(Hemimorphic-tetartohedral.)

No other element is here associated with the hexad axis, which is uniterminal. The pyramids all consist of six faces at one end of the crystal, and prisms are all hexagonal prisms; perpendicular to the hexad axis are the pedions.



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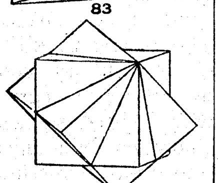
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FIG. 83.—SPINEL-TWIN
FIG. 84.—INTERPENETRATING TWINNED CUBES

Lithium potassium sulphate, strontium-antimonyl dextro-tartrate, and lead-antimonyl dextro-tartrate are examples of this type of symmetry. The mineral nepheline is placed in this class because of the absence of symmetry in the etched figures on the prism faces (fig. 92).

(*g*) *Regular Grouping of Crystals*

Crystals of the same kind when occurring together may sometimes be grouped in parallel position and so give rise to special structures, of which the dendritic (from δένδρον, a tree) or branch-like aggregations of native copper or of magnetite and the fibrous structures of many minerals furnish examples. Sometimes, owing to changes in the surrounding conditions, the crystal may continue its growth with a different external form or colour, *e.g.*, sceptre-quartz.

Regular intergrowths of crystals of totally different substances such as staurolite with kyanite, rutile with haematite, blende with chalcopyrite, calcite with sodium nitrate, are not uncommon. In these cases certain planes and edges of the two crystals are parallel. (*See* O. Mügge, "Die regelmässigen Verwachsungen von Mineralien verschiedener Art," *Neues Jahrbuch für Mineralogie*, 1903, vol. xvi. pp., 335–475.)

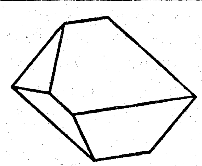
But by far the most important kind of regular conjunction of crystals is that known as "twinning." Here two crystals or individuals of the same kind have grown together in a certain symmetrical manner, such that one portion of the twin may be brought into the position of the other by reflection across a plane or by rotation about an axis. The plane of reflection is called the twin-plane, and is parallel to one of the faces, or to a possible face, of the crystal: the axis of rotation, called the twin-axis, is parallel to one of the edges or perpendicular to a face of the crystal.

In the twinned crystal of gypsum represented in fig. 81 the two portions are symmetrical with respect to a plane parallel to the ortho-pinacoid $\{100\}$, *i.e.*, a vertical plane perpendicular to the face *b*. Or we may consider the simple crystal (fig. 82) to be cut in half by this plane and one portion to be rotated through 180° about the normal to the same plane. Such a crystal (fig. 81) is therefore described as being twinned on the plane $\{100\}$.

An octahedron (fig. 83) twinned on an octahedral face $\{111\}$ has the two portions symmetrical with respect to a plane parallel to this face (the large triangular face in the figure); and either portion may be brought into the position of the other by a rotation through 180° about the triad axis of symmetry which is perpendicular to this face. This kind of twinning is especially frequent in crystals of spinel, and is consequently often referred to as the "spinel twin-law."

In these two examples the surface of the union, or composition-plane, of the two portions is a regular surface coinciding with the twin-plane; such twins are called "juxtaposition-twins." In other juxtaposed twins the plane of composition is, however, not necessarily the twin-plane. Another type of twin is the "interpenetration twin," an example of which is shown in fig. 84. Here one cube may be brought into the position of the other by a rotation of 180° about a triad axis, or by reflection across the octahedral plane which is perpendicular to this axis; the twin-plane is therefore $\{111\}$.

Since in many cases twinned crystals may be explained by the rotation of one portion through two right angles, R. J. Haüy introduced the term "hemitrope" (half turn); the word "macle" had been earlier used by Romé d'Isle. There are, however, some rare types of twins which cannot be explained by rotation about an axis, but only by reflection across a plane; these are known as "symmetric twins," a good example of which is furnished by one of the twin-laws of chalcopyrite.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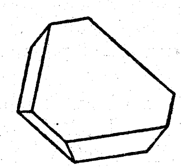
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FIGS. 85 AND 86.—MISSHAPEN OCTAHEDRA

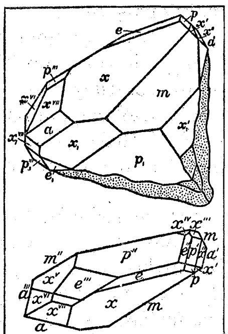
Twinned crystals may often be recognized by the presence of re-entrant angles between the faces of the two portions, as may be seen from the above figures. In some twinned crystals (*e.g.*, quartz) there are, however, no re-entrant angles. On the other hand, two crystals accidentally grown together without any symmetrical relation between them will usually show some re-entrant angles, but this must not be taken to indicate the presence of twinning.

Twinning may be several times repeated on the same plane or on other similar planes of the crystal, giving rise to triplets, quartets and other complex groupings. When often repeated on the same plane, the twinning is said to be "polysynthetic," and gives rise to a laminated structure in the crystal. Sometimes such a crystal (*e.g.*, of corundum or pyroxene) may be readily broken in this direction, which is thus a "plane of parting," often closely resembling a true cleavage in character. In calcite and some other substances this lamellar twinning may be produced artificially by pressure. (*See* below, Sec. II. [*a*], *Glide-plane.*)

Another curious result of twinning is the production of forms which apparently display a higher degree of symmetry than that actually possessed by the substance. Twins of this kind are known as "mimetic twins" or "pseudo-symmetric twins." Two hemihedral or hemimorphic crystals (*e.g.*, of diamond or of hemimorphite) are often united in twinned position to produce a group with apparently the same degree of symmetry as the holosymmetric class of the same system. Or again, a substance crystallizing in, say, the orthorhombic system (*e.g.*, aragonite) may, by twinning, give rise to pseudo-hexagonal fórms: and pseudo-cubic forms often result by the complex twinning of crystals (*e.g.*, stannite, phillipsite, etc.) belonging to other systems. Many of the so-called "optical anomalies" of crystals may be explained by this pseudo-symmetric twinning.

(*h*) *Irregularities of Growth of Crystals; Character of Faces*

Only rarely do actual crystals present the symmetrical appearance shown in the figures given above, in which similar faces are all represented as of equal size. It frequently happens that the crystal is so placed with respect to the liquid in which it grows that there will be a more rapid deposition of material on one part than on another; for instance, if the crystal be attached to some other solid it cannot grow in that direction. Only when a crystal is freely suspended in the mother-liquid and material for growth is supplied at the same rate on all sides does an equably developed form result.



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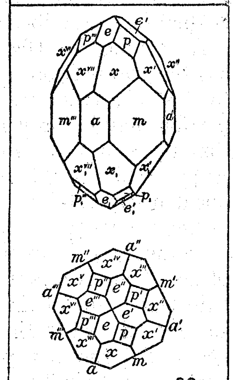

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CRYSTAL OF ZIRCON (CLINOGRAPHIC DRAWINGS AND PLANS)
Fig. 87.—Actual crystal
Fig. 88.—Ideal development

Two misshapen or distorted octahedra are represented in figs. 85 and 86; the former is elongated in the direction of one of the edges of the octahedron, and the latter is flattened parallel to one pair of faces. It will be noticed in these figures that the edges in which the faces intersect have the same directions as before, though here there are additional edges not present in fig. 3. The angles (70° 32′ or 109° 28′) between the faces also remain the same; and the faces have the same inclinations to the axes and planes of symmetry as in the equably developed form. Although from a geometrical point of view these figures are no longer symmetrical with respect to the axes and planes of symmetry, yet crystallographically they are just as symmetrical as the ideally developed form, and, however much their irregularity of development, they still are regular (cubic) octahedra of crystallography. A remarkable case of irregular development is presented by the mineral cuprite, which is often found as well-developed cubes; but in the variety known as chalcotrichite it occurs as a matted aggregate of delicate hairs, each of which is an individual crystal enormously elongated in the direction of an edge of the cube.

The symmetry of actual crystals is sometimes so obscured by irregularities of growth that it can only be determined by measurement of the angles. An extreme case, where several of the planes have not been developed at all, is illustrated in fig. 87, which shows the actual shape of a crystal of zircon from Ceylon; the ideally developed form (fig. 88) is placed at the side for comparison, and the parallelism of the edges between corresponding faces will be noticed. This crystal is a combination of five simple forms, viz., two tetragonal prisms (*a* and *m*), two tetragonal bipyramids (*e* and *p*), and one ditetragonal bipyramid (*x*, with 16 faces).

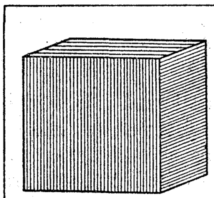
The actual form, or "habit," of crystals may vary widely in different crystals of the same substance, these differences depending largely on the conditions under which the growth has taken place. The material may have crystallized from a fused mass or from a solution; and in the latter case the solvent may be of different kinds and contain other substances in solution, or the temperature may vary. Calcite (*q.v.*) affords a good example of a substance crystallizing in widely different habits, but all crystals are referable to the same type of symmetry and may be reduced to the same fundamental form.

When crystals are aggregated together, and so interfere with each other's growth, special structures and external shapes often result, which are sometimes characteristic of certain substances, especially amongst minerals.

Incipient crystals, the development of which has been arrested owing to unfavourable conditions of growth, are known as crystallites (*q.v.*). They are met with in imperfectly crystallized substances and in glassy rocks (obsidian and pitchstone), or may be obtained artificially from a solution of sulphur in carbon disulphide rendered viscous by the addition of Canada-balsam. To the various forms H. Vogelsang gave, in 1875, the names "globulites," "margarites," "longulites," etc. At a more advanced stage of growth these bodies react on polarized light, thus possessing the internal structure of true crystals; they are then called "microlites." These have the form of minute rods, needles or hairs, and are aggregated into feathery and spherulitic forms or skeletal crystals. They are common constituents of microcrystalline igneous rocks, and often occur as inclusions in larger crystals of other substances.

Inclusions of foreign matter, accidentally caught up during growth, are frequently present in crystals. Inclusions of other minerals are specially frequent and conspicuous in crystals of quartz, and crystals of calcite may contain as much as 60% of included sand. Cavities, either with rounded boundaries or with the same shape ("negative crystals") as the surrounding crystal, are often to be seen; they may be empty or enclose a liquid with a movable bubble of gas.

The faces of crystals are rarely perfectly plane and smooth, but are usually striated, studded with small angular elevations, pitted or cavernous, and sometimes curved or twisted. These irregularities, however, conform with the symmetry of the crystal, and much may be learnt by their study. The parallel grooves or furrows, called "striae," are the result of oscillatory combination between adjacent faces, narrow strips of first one face and then another being alternately developed. Sometimes the striae on crystal-faces are due to repeated lamellar twinning, as in the plagioclase felspars. The directions of the striations are very characteristic features of many crystals: *e.g.*, the faces of the hexagonal prism of quartz are always striated horizontally, whilst in beryl they are striated vertically. Cubes of pyrites (fig. 89) are striated parallel to one edge, the striae on adjacent faces being at right angles, and due to oscillatory combination of the cube and the pentagonal dodecahedron (compare fig. 36); whilst cubes of blende (fig. 90) are striated parallel to one diagonal of each face, *i.e.*, parallel to the tetrahedron faces. (Compare fig. 31.) These striated cubes thus possess different degrees of symmetry and belong to different symmetry-classes. Oscillatory combination of faces gives rise also to curved surfaces. Crystals with twisted surfaces (*see* DOLOMITE) are, however, built up of smaller crystals arranged in nearly parallel position. Sometimes a face is entirely replaced by small faces of other forms, giving rise to a drusy surface; an example of this is shown by some octahedral crystals of fluorspar (fig. 2) which are built up of minute cubes.



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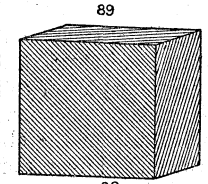

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FIG. 89.—STRIATED CUBE OF PYRITES
FIG. 90.—STRIATED CUBE OF BLENDE

The faces of crystals are sometimes partly or completely replaced by smooth bright surfaces inclined at only a few minutes of arc from the true position of the face; such surfaces are called "vicinal faces," and their indices can be expressed only by very high numbers. In apparently perfectly developed crystals of alum the octahedral face, with the simple indices {111} is usually replaced by faces of very low triakis-octahedra, with indices such as $\{251 \cdot 251 \cdot 250\}$; the angles measured on such crystals will therefore deviate slightly from the true octahedral angle. Vicinal faces of this character are formed during the growth of crystals, and have been studied by H. A. Miers (*Phil. Trans.*, 1903, Ser. A. vol. 202). Other faces with high indices, viz., "prerosion faces" and the minute faces forming the sides of etched figures (*see* below), as well as rounded edges and other surface irregularities, may, however, result from the corrosion of a crystal subsequent to its growth. The pitted and cavernous faces of artificially grown crystals of sodium chloride and of bismuth are, on the other hand, a result of rapid growth, more material being supplied at the edges and corners of the crystal than at the centres of the faces.

The internal structure of crystals has, since 1912, been worked out by the application of X-rays, and is now such an extensive and specialized subject that a separate article is devoted to it. (*See* X-RAYS AND CRYSTAL STRUCTURE.)

II. PHYSICAL PROPERTIES OF CRYSTALS

Many of the physical properties of crystals vary with the direction in the material, but are the same in certain directions; these directions obeying the same laws of symmetry as do the faces on the exterior of the crystal. The symmetry of the internal structure of crystals is thus the same as the symmetry of their external form.

(*a*) *Elasticity and Cohesion*

The elastic constants of crystals are determined by similar methods to those employed with amorphous substances, only the bars and plates experimented upon must be cut from the crystal with known orientations. The "elasticity surface" expressing the coefficients in various directions within the crystal has a configuration symmetrical with respect to the same planes and axes of symmetry as the crystal itself. In calcite, for instance, the figure has roughly the shape of a rounded rhombohedron with depressed faces and is symmetrical about three vertical planes. In the case of homogeneous elastic deformation, produced by pressure on all sides, the effect on the crystal is the same as that due to changes of temperature; and the surfaces expressing the compression coefficients in different directions have the same higher degree of symmetry, being either a sphere, spheroid or ellipsoid. When strained beyond the limits of elasticity, crystalline matter may suffer permanent deformation in one or other of two ways, or may be broken along cleavage surfaces or with an irregular fracture. In the case of plastic deformation, *e.g.*, in a crystal of ice, the crystalline particles are displaced but without any change in their orientation. Crystals of some substances (*e.g.*, para-azoxyanisol) have such a high degree of plasticity that they are deformed even by their surface tension, and the crystals take the form of drops of doubly refracting liquid which are known as "liquid crystals." (*See* O. Lehmann, *Flüssige Kristalle*, Leipzig, 1921.)

In the second, and more usual kind of permanent deformation without fracture, the particles glide along certain planes into a new (twinned) position of equilibrium. If a knife-blade be pressed into the edge of a cleavage rhombohedron of calcite (at *b*, fig. 91) the portion *abcde* of the crystal will take up the position *a′b′cde*. The obtuse solid angle at *a* becomes acute (*a′*), whilst the acute angle at *b* becomes obtuse (*b′*); and the new surface *a′ce* is as bright and smooth as before.

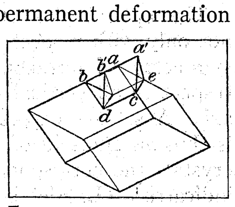


FIG. 91.—GLIDE-PLANE OF CALCITE

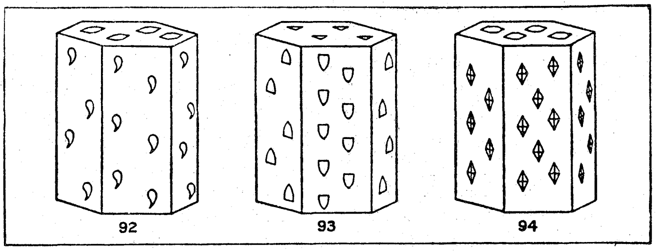
This result has been effected by the particles in successive layers gliding or rotating over each other, without separation, along planes parallel to *cde*. This plane, which truncates the edge of the rhombohedron and has the indices $\{1\bar{1}0\}$ is called a "glide-plane." The new portion is in twinned position with respect to the rest of the crystal, being a reflection of it across the plane *cde*, which is therefore a plane of twinning. This secondary twinning is often to be observed as a repeated lamination in the grains of calcite composing a crystalline limestone, or marble, which has been subjected to earth movements. Planes of gliding have been observed in many minerals (pyroxene, corundum, etc.) and their crystals may often be readily broken along these directions, which are thus "planes of parting" or "pseudo-cleavage." The characteristic transverse striae, invariably present on the cleavage surfaces of stibnite and kyanite are due to secondary twinning along glide-planes, and have resulted from the bending of the crystals.

One of the most important characters of crystals is that of "cleavage"; there being certain plane directions across which the cohesion is a minimum, and along which the crystal may be readily split or cleaved. These directions are always parallel to a possible face on the crystal and usually one prominently developed and with simple indices, it being a face in which the crystal molecules are most closely packed. The directions of cleavage are symmetrically repeated according to the degree of symmetry possessed by the crystal. Thus in the cubic system, crystals of salt and galena cleave in three directions parallel to the faces of the cube $\{100\}$, diamond and fluorspar cleave in four directions parallel to the octahedral faces $\{111\}$, and blende in six directions parallel to the faces of the rhombic dodecahedron $\{110\}$. In crystals of other systems there will be only a single direction of cleavage if this is parallel to the faces of a pinacoid; *e.g.*, the basal pinacoid in tetragonal (as in apophyllite) and hexagonal crystals; or parallel (as in gypsum) or perpendicular (as in mica and cane-sugar) to the plane of symmetry in monoclinic crystals. Calcite cleaves in three directions parallel to the faces of the primitive rhombohedron. Barytes, which crystallizes in the orthorhombic system, has two sets of cleavages, viz., a single cleavage parallel to the basal pinacoid $\{001\}$ and also two directions parallel to the faces of the prism $\{110\}$. In all of the examples just quoted the cleavage is described as perfect, since cleavage flakes with very smooth and bright surfaces may be readily detached from the crystals. Different substances, however, vary widely in their character of cleavage; in some it can only be described as good or distinct, whilst in others, *e.g.*, quartz and alum, there is little or no tendency to split along certain directions and the surfaces of fracture are very uneven. Cleavage is therefore a character of considerable determinative value, especially for the purpose of distinguishing different minerals.

Another result of the presence in crystals of directions of minimum cohesion are the "percussion figures," which are produced on a crystal-face when this is struck with a sharp point. A percussion figure consists of linear cracks radiating from the point of impact, which in their number and orientation agree with the symmetry of the face. Thus on a cube face of a crystal of salt the rays of the percussion figure are parallel to the diagonals of the face, whilst on an octahedral face a three-rayed star is developed. By pressing a blunt point into a crystal face a somewhat similar figure, known as a "pressure figure," is produced. Percussion and pressure figures are readily developed in cleavage sheets of mica (*q.v.*).

Closely allied to cohesion is the character of "hardness," which is often defined, and measured by, the resistance which a crystal face offers to scratching. That hardness is a character depending largely on crystalline structure is well illustrated by the two crystalline modifications of carbon: graphite is one of the softest of minerals, whilst diamond is the hardest of all. The hardness of crystals of different substances thus varies widely, and with minerals it is a character of considerable determinative value; for this purpose a scale of hardness is employed. (*See* MINERALOGY.) Various attempts have been made with the view of obtaining accurate determinations of degrees of hardness, but with varying results; an instrument used for this purpose is called a sclerometer (from σκληρός, hard). It may, however, be readily demonstrated that the degree of hardness on a crystal face varies with the direction, and that a curve expressing these relations possesses the same geometrical symmetry as the face itself. The mineral kyanite is remarkable in having widely different degrees of hardness on different faces of its crystals and in different directions on the same face.

Another result of the differences of cohesion in different directions is that crystals are corroded, or acted upon by chemical solvents, at different rates in different directions. This is strikingly shown when a sphere cut from a crystal, say of calcite or quartz, is immersed in acid; after some time the resulting form is bounded by surfaces approximating to crystal faces, and has the same symmetry as that of the crystal from which the sphere was cut. When a crystal bounded by faces is immersed in a



ETCHED FIGURES ON HEXAGONAL PRISMS. FIG. 92.—NEPHELINE. FIG. 93.—CALCITE. FIG. 94.—BERYL

solvent the edges and corners become rounded and "prerosion faces" developed in their place; the faces become marked all over with minute pits or shallow depressions, and as these are extended by further solution they give place to small elevations on the corroded face. The sides of the pits and elevations are bounded by small faces which have the character of vicinal faces. These markings are known as "etched figures" or "corrosion figures," and they are extremely important aids in determining the symmetry of crystals. Etched figures are sometimes beautifully developed on the faces of natural crystals, *e.g.,* of diamond, and they may be readily produced artificially with suitable solvents.

As an example, the etched figures on the faces of a hexagonal prism and the basal plane are illustrated in figs. 92–94 for three of the several symmetry-classes of the hexagonal system. The classes chosen are those in which nepheline, calcite and beryl (emerald) crystallize, and these minerals often have the simple form of crystal represented in the figures. In nepheline (fig. 92) the only element of symmetry is a hexad axis; the etched figures on the prism are therefore unsymmetrical, though similar on all the faces; the hexagonal markings on the basal plane have none of their edges parallel to the edges of the face; further the crystals being hemimorphic, the etched figures on the basal planes at the two ends will be different in character. The facial development of crystals of nepheline gives no indication of this type of symmetry, and the mineral has been referred to this class solely on the evidence afforded by the etched figures. In calcite there is a triad axis of symmetry parallel to the prism edges, three dyad axes each perpendicular to a pair of prism edges and three planes of symmetry perpendicular to the prism faces; the etched figures shown in fig. 93 will be seen to conform to all these elements of symmetry. There being in calcite also a centre of symmetry, the equilateral triangles on the basal plane at the lower end of the crystal will be the same in form as those at the top, but they will occupy a reversed position. In beryl, which crystallizes in the holosymmetric class of the hexagonal system, the etched figures (fig. 94) display the fullest possible degree of symmetry; those on the prism faces are all similar and are each symmetrical with respect to two lines, and the hexagonal markings on the basal planes at both ends of the crystal are symmetrically placed with respect to six lines. A detailed account of the etched figures of crystals is given by H. Baumhauer, *Die Resultate der Ätzmethode in der krystallographischen Forschung* (Leipzig, 1894).

(*b*) *Optical Properties*

The complex optical characters of crystals are not only of considerable interest theoretically, but are of the greatest practical importance. In the absence of external crystalline form, as with a faceted gem-stone, or with the minerals constituting a rock (thin, transparent sections of which are examined in the polarizing microscope), the mineral species may often be readily identified by the determination of some of the optical characters.

According to their action on transmitted plane-polarized light (*see* LIGHT) all crystals may be referred to one or other of the five groups enumerated below. These groups correspond with the six systems of crystallization (in the second group two systems being included together). The several symmetry-classes of each system are optically the same, except in the rare cases of substances which are circularly polarizing.

(1) Optically isotropic crystals—corresponding with the cubic system.

(2) Optically uniaxial crystals—corresponding with the tetragonal and hexagonal systems.

(3) Optically biaxial crystals in which the three principal optical directions coincide with the three crystallographic axes—corresponding with the orthorhombic system.

(4) Optically biaxial crystals in which only one of the three principal optical directions coincides with a crystallographic axis—corresponding with the monoclinic system.

(5) Optically biaxial crystals in which there is no fixed and definite relation between the optical and crystallographic directions—corresponding with the anorthic system.

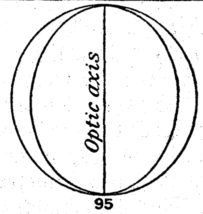
Optically Isotropic Crystals.—These belong to the cubic system, and like all other optically isotropic (from ἴσος, like, and τρόπος, character) bodies have only one index of refraction for light of each colour. They have no action on polarized light (except in crystals which are circularly polarizing); and when examined in the polariscope or polarizing microscope they remain dark between crossed nicols, and cannot therefore be distinguished optically from amorphous substances, such as glass and opal.

Optically Uniaxial Crystals.—These belong to the tetragonal and hexagonal (including rhombohedral) systems, and between crystals of these systems there is no optical distinction. Such crystals are anisotropic or doubly refracting (*see* LIGHT: *Refraction and Double Refraction*); but for light travelling through them in a certain, single direction they are singly refracting. This direction, which is called the optic axis, is the same for light of all colours and at all temperatures; it coincides in direction with the principal crystallographic axis, which in tetragonal crystals is a tetrad (or dyad) axis of symmetry, and in the hexagonal system a triad or hexad axis.

For light of each colour there are two indices of refraction; namely, the ordinary index (ω) corresponding with the ordinary ray, which vibrates perpendicular to the optic axis; and the extraordinary index (ϵ) corresponding with the extraordinary ray, which vibrates parallel to the optic axis. If the ordinary index of refraction be greater than the extraordinary index, the crystal is said to be optically negative, whilst if less the crystal is optically positive. The difference between the two indices is a measure of the strength of the double refraction or birefringence. Thus in calcite, for sodium (D) light, $\omega=1{\cdot}6585$ and $\epsilon=1{\cdot}4863$; hence this substance is optically negative with a relatively high double refraction of $\omega-\epsilon=0{\cdot}1722$. In quartz $\omega=1{\cdot}5442$, $\epsilon=1{\cdot}5533$ and $\epsilon-\omega=0{\cdot}0091$; this mineral is therefore optically positive with low double refraction. The indices of refraction vary, not only for light of different colours, but also slightly with the temperature.

The optical characters of uniaxial crystals are symmetrical not only with respect to the full number of planes and axes of symmetry of tetragonal and hexagonal crystals, but also with respect to all vertical planes, *i.e.,* all planes containing the optic axis. A surface expressing the optical relations of such crystals is thus an ellipsoid of revolution about the optic axis. (In cubic crystals the corresponding surface is a sphere.) In the "optical indicatrix" (L. Fletcher, *The Optical Indicatrix and the Transmission of Light in Crystals,* London, 1892), the length of the principal axis, or axis of rotation, is proportional to the index of refraction (*i.e.,* inversely proportional to the velocity) of the extraordinary rays, which vibrate along this axis and are transmitted in directions perpendicular thereto; the equatorial diameters are proportional to the index of refraction of the ordinary rays, which vibrate perpendicular to the optic axis. For positive uniaxial crystals the indicatrix is thus a prolate spheroid (egg-shaped), and for negative crystals an oblate spheroid (orange-shaped).

In "Fresnel's ellipsoid" the axis of rotation is proportional to the velocity of the extraordinary ray, and the equatorial diameters proportional to the velocity of the ordinary ray; it is therefore an oblate spheroid for positive crystals, and a prolate spheroid for negative crystals. The "ray-surface," or "wave-surface," which represents the distances traversed by the rays during a given interval of time in various directions from a point of origin within the crystal, consists in uniaxial crystals of two sheets; namely, a sphere, corresponding to the ordinary rays, and an ellipsoid of revolution, corresponding to the extraordinary rays. The difference in form of the ray-surface for positive and negative crystals is shown in figs. 95 and 96.



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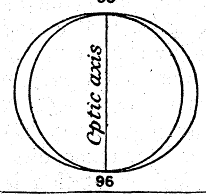

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FIG. 95.—RAY-SURFACE SECTION OF A POSITIVE UNIAXIAL CRYSTAL
FIG. 96.—RAY-SURFACE SECTION OF A NEGATIVE UNIAXIAL CRYSTAL

When a uniaxial crystal is examined in a polariscope or polarizing microscope between crossed nicols (*i.e.*, with the principal planes of the polarizer or analyser at right angles, and so producing a dark field of view) its behaviour differs according to the direction in which the light travels through the crystal, to the position of the crystal with respect to the principal planes of the nicols, and further, whether convergent or parallel polarized light be employed. A tetragonal or hexagonal crystal viewed, in parallel light, through the basal plane, *i.e.*, along the principal axis, will remain dark as it is rotated between crossed nicols, and will thus not differ in its behaviour from a cubic crystal or other isotropic body. If, however, the crystal be viewed in any other direction, for example, through a prism face, it will, except in certain positions, have an action on the polarized light. A plane-polarized ray entering the crystal will be resolved into two polarized rays with the directions of vibration parallel to the vibration-directions in the crystal. These two rays on leaving the crystal will be combined again in the analyser, and a portion of the light transmitted through the instrument; the crystal will then show up brightly against the dark field. Further, owing to interference of these two rays in the analyser, the light will be brilliantly coloured, especially if the crystal be thin, or if a thin section of a crystal be examined. The particular colour seen will depend on the strength of the double refraction, the orientation of the crystal or section, and upon its thickness. If now, the crystal be rotated with the stage of the microscope, the nicols remaining fixed in position, the light transmitted through the instrument will vary in intensity, and in certain positions will be cut out altogether. The latter happens when the vibration-directions of the crystal are parallel to the vibration-directions of the nicols (these being indicated by cross-wires in the microscope). The crystal, now being dark, is said to be in position of extinction; and as it is turned through a complete rotation of 360° it will extinguish four times. If a prism face be viewed through, it will be seen that, when the crystal is in a position of extinction, the cross-wires of the microscope are parallel to the edges of the prism: the crystal is then said to give "straight extinction."

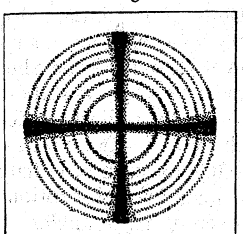


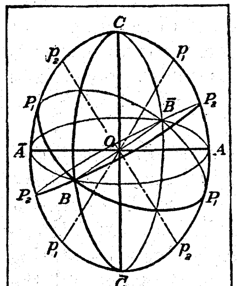
FIG. 97.—INTERFERENCE FIGURE OF A UNIAXIAL CRYSTAL

In convergent light, between crossed nicols, a very different phenomenon is to be observed when a uniaxial crystal, or section of such a crystal, is placed with its optic axis coincident with the axis of the microscope. The rays of light, being convergent, do not travel in the direction of the optic axis and are therefore doubly refracted in the crystal; in the analyser the vibrations will be reduced to the same plane and there will be interference of the two sets of rays. The result is an "interference figure" (fig. 97), which consists of a number of brilliantly coloured concentric rings, each showing the colours of the spectrum of white light; intersecting the rings is a black cross, the arms of which are parallel to the principal planes of the nicols. If monochromatic light be used instead of white light, the rings will be alternately light and dark. The number and distance apart of the rings depend on the strength of the double refraction and on the thickness of the crystal. By observing the effect produced on such a uniaxial interference figure when a "quarter undulation (or wave-length) mica-plate" is superposed on the crystal, it may be at once decided whether the crystal is optically positive or negative. Such a simple test may, for example, be applied for distinguishing certain faceted gem-stones: thus zircon and phenakite are optically positive, whilst corundum (ruby and sapphire) and beryl (emerald) are optically negative.

Optically Biaxial Crystals.—In these crystals there are three principal indices of refraction, denoted by α, β and γ; of these γ is the greatest and α the least ($\gamma>\beta>\alpha$). The three principal vibration-directions, corresponding to these indices, are at right angles to each other, and are the directions of the three rectangular axes of the optical indicatrix. The indicatrix (fig. 98) is an ellipsoid with the lengths of its axes proportional to the refractive indices; $OC=\gamma$, $OB=\beta$, $OA=\alpha$, where $OC>OB>OA$. The figure is symmetrical with respect to the principal planes OAB, OAC, OBC.

In Fresnel's ellipsoid the three rectangular axes are proportional to $1/\alpha$, $1/\beta$, and $1/\gamma$, and are usually denoted by $\mathfrak{a}$, $\mathfrak{b}$ and $\mathfrak{c}$ respectively, where $\mathfrak{a}>\mathfrak{b}>\mathfrak{c}$: these have often been called "axes of optical elasticity," a term now generally discarded.

The ray-surface (represented in fig. 99 by its sections in the three principal planes) is derived from the indicatrix in the following manner. A ray of light entering the crystal and travelling in the direction OA is resolved into polarized rays vibrating parallel to OB and OC, and therefore propagated with the velocities $1/\beta$ and $1/\gamma$ respectively: distances Ob and Oc (fig. 99) proportional to these velocities are marked off in the direction OA. Similarly, rays travelling along OC have the velocities $1/\alpha$ and $1/\beta$, and those along OB the velocities $1/\alpha$ and $1/\gamma$. In the two directions Op_1 and Op_2 (fig. 98), perpendicular to the two circular sections P_1P_1 and P_2P_2 of the indicatrix, the two rays will be transmitted with the same velocity $1/\beta$. These two directions are called the optic axes ("primary optic axis"), though they have not all the properties which are associated with the optic axis of a uniaxial crystal. They have very nearly the same direction as the lines Os_1 and Os_2 in fig. 99, which are distinguished as the "secondary optic axes." In most crystals the primary and secondary optic axes are inclined to each other at not more than a few minutes, so that for practical purposes there is no distinction between them.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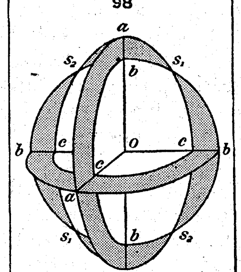
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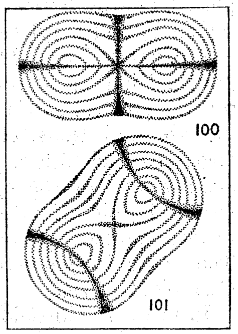
FIG. 98.—OPTICAL INDICATRIX OF A BIAXIAL CRYSTAL
FIG. 99.—RAY-SURFACE OF A BIAXIAL CRYSTAL

The angle between Op_1 and Op_2 is called the "optic axial angle"; and the plane OAC in which they lie is called the "optic axial plane." The angles between the optic axes are bisected by the vibration-directions OA and OC; the one which bisects the acute angle being called the "acute bisectrix" or "first mean line," and the other the "obtuse bisectrix" or "second mean line." When the acute bisectrix coincides with the greatest axis OC of the indicatrix, *i.e.*, the vibration-direction corresponding with the refractive index γ (as in figs. 98 and 99), the crystal is described as being optically positive; and when the acute bisectrix coincides with OA, the vibration-direction for the index α the crystal is negative. The distinction between positive and negative biaxial crystals thus depends on the relative magnitude of the three principal indices of refraction; in positive crystals β is nearer to α than to γ whilst in negative crystals the reverse is the case. Thus in topaz, which is optically positive, the refractive indices for sodium light are $\alpha=1{\cdot}6120$, $\beta=1{\cdot}6150$, $\gamma=1{\cdot}6224$; and for orthoclase which is optically negative, $\alpha=1{\cdot}5190$,

$\beta = 1{\cdot}5237$, $\gamma = 1{\cdot}5260$. The difference $\gamma - \alpha$ represents the strength of the double refraction.

Since the refractive indices vary both with the colour of the light and with the temperature, there will be for each colour and temperature slight differences in the form of both the indicatrix and the ray-surface; consequently there will be variations in the positions of the optic axes and in the size of the optic axial angle. This phenomenon is known as the "dispersion of the optic axes." When the axial angle is greater for red light than for blue the character of the dispersion is expressed by $\rho > v$, and when less by $\rho < v$. In some crystals, *e.g.*, brookite, the optic axes for red light and for blue light may be, at certain temperatures, in planes at right angles.



FIGS. 100 AND 101.—INTERFERENCE FIGURES OF A BIAXIAL CRYSTAL

The type of interference figure exhibited by a biaxial crystal in convergent polarized light between crossed nicols is represented in figs. 100 and 101. The crystal must be viewed along the acute bisectrix, and for this purpose it is often necessary to cut a plate from the crystal perpendicular to this direction: sometimes, however, as in mica and topaz, a cleavage flake will be perpendicular to the acute bisectrix. When seen in white light, there are around each optic axis a series of brilliantly coloured ovals, which at the centre join to form an 8-shaped loop, whilst farther from the centre the curvature of the rings is approximately that of lemniscates. In the position shown in fig. 100 the vibration-directions in the crystal are parallel to those of the nicols, and the figure is intersected by two black bands or "brushes" forming a cross. When, however, the crystal is rotated with the stage of the microscope the cross breaks up into the two branches of a hyperbola, and when the vibration-directions of the crystal are inclined at 45° to those of the nicols the figure is that shown in fig. 101. The points of emergence of the optic axes are at the middle of the hyperbolic brushes when the crystal is in the diagonal position: the size of the optic axial angle can therefore be directly measured with considerable accuracy.

In orthorhombic crystals the three principal vibration-directions coincide with the three crystallographic axes, and have therefore fixed positions in the crystal, which are the same for light of all colours and at all temperatures. The optical orientation of an orthorhombic crystal is completely defined by stating to which crystallographic planes the optic axial plane and the acute bisectrix are respectively parallel and perpendicular. Examined in parallel light between crossed nicols, such a crystal extinguishes parallel to the crystallographic axes, which are often parallel to the edges of a face or section; there is thus usually "straight extinction." The interference figure seen in convergent polarized light is symmetrical about two lines at right angles.

In monoclinic crystals only one vibration-direction has a fixed position within the crystal, being parallel to the ortho-axis (*i.e.*, perpendicular to the plane of symmetry or the plane $\{010\}$). The other two vibration-directions lie in the plane $\{010\}$, but they may vary in position for light of different colours and at different temperatures. In addition to dispersion of the optic axes there may thus, in crystals of this system, be also "dispersion of the bisectrices." The latter may be of one or other of three kinds, according to which of the three vibration-directions coincides with the ortho-axis of the crystal. When the acute bisectrix is fixed in position, the optic axial planes for different colours may be crossed, and the interference figure will then be symmetrical with respect to a point only ("crossed dispersion"). When the obtuse bisectrix is fixed, the axial planes may be inclined to one another, and the interference figure is symmetrical only about a line which is perpendicular to the axial planes ("horizontal dispersion"). Finally, when the vibration-direction corresponding to the refractive index β, or the "third mean line," has a fixed position, the optic axial plane lies in the plane $\{010\}$, but the acute bisectrix may vary in position in this plane; the interference figure will then be symmetrical only about a line joining the optic axes ("inclined dispersion"). Examples of substances exhibiting these three kinds of dispersion are borax, orthoclase and gypsum respectively. In orthoclase and gypsum, however, the optic axial angle gradually diminishes as the crystals are heated, and after passing through a uniaxial position they open out in a plane at right angles to the one they previously occupied; the character of the dispersion thus becomes reversed in the two examples quoted. When examined in parallel light between crossed nicols monoclinic crystals will give straight extinction only in faces and sections which are perpendicular to the plane of symmetry (or the plane $\{010\}$); in all other faces and sections the extinction-directions will be inclined to the edges of the crystal. The angles between these directions and edges are readily measured, and, being dependent on the optical orientation of the crystal, they are often characteristic constants of the substance. (See, *e.g.*, PLAGIOCLASE.)

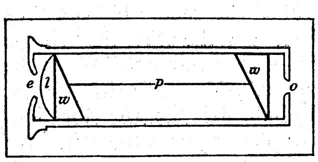


FIG. 102.—DICHROSCOPE

In anorthic crystals there is no relation between the optical and crystallographic directions, and the exact determination of the optical orientation is often a matter of considerable difficulty. The character of the dispersion of the bisectrices and optic axes is still more complex than in monoclinic crystals, and the interference figures are devoid of symmetry.

Absorption of Light in Crystals: Pleochroism.—In crystals other than those of the cubic system, rays of light with different vibration-directions will, as a rule, be differently absorbed; and the polarized rays on emerging from the crystal may be of different intensities and (if the observation be made in white light and the crystal is coloured) differently coloured. Thus, in tourmaline the ordinary ray, which vibrates perpendicular to the principal axis, is almost completely absorbed, whilst the extraordinary ray is allowed to pass through the crystal. A plate of tourmaline cut parallel to the principal axis may therefore be used for producing a beam of polarized light, and two such plates placed in crossed position form the polarizer or analyser of "tourmaline tongs," with the aid of which the interference figures of crystals may be simply shown. Uniaxial (tetragonal and hexagonal) crystals when showing perceptible differences in colour for the ordinary and extraordinary rays are said to be "dichroic." In biaxial (orthorhombic, monoclinic and anorthic) crystals, rays vibrating along each of the three principal vibration-directions may be differently absorbed, and, in coloured crystals, differently coloured; such crystals are therefore said to be "trichroic" or in general "pleochroic" (from πλέων, more, and χρώς, colour). The directions of maximum absorption in biaxial crystals have, however, no necessary relation with the axes of the indicatrix, unless these have fixed crystallographic directions, as in the orthorhombic system and the ortho-axis in the monoclinic. In epidote it has been shown that the two directions of maximum absorption which lie in the plane of symmetry are not even at right angles.

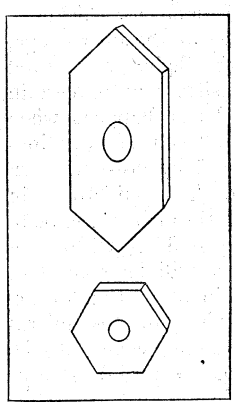


FIG. 103.—CONDUCTIVITY OF HEAT IN QUARTZ

The pleochroism of some crystals is so strong that when they are viewed through in different directions they exhibit marked differences in colour. Thus a crystal of the mineral cordierite (called also dichroite because of its strong pleochroism) will be seen to be dark blue, pale blue or pale yellow according to which of three perpendicular directions it is viewed. The "face colours" seen directly in this way result, however, from the mixture of two "axial colours" belonging to rays vibrating in two directions. In order to see the axial colours separately the crystal must be examined with a dichroscope, or in a polarizing microscope from which the analyser has been removed. The dichroscope, or dichroiscope (fig. 102), consists of a cleavage rhombohedron of calcite (Iceland-spar) p, on the ends of which glass prisms w are cemented: the lens l is focused on a small square aperture o in the tube of the instrument. The eye of the observer placed at e will see two images of the square aperture, and if a pleochroic crystal be placed in front of this aperture the two images will be differently coloured. On rotating this crystal with respect to the instrument the maximum difference in the colours will be obtained when the vibration-directions in the crystal coincide with those in the calcite. Such a simple instrument is especially useful for the examination of faceted gem-stones, even when they are mounted in their settings. A single glance suffices to distinguish between a ruby and a "spinel-ruby," since the former is dichroic and the latter isotropic and therefore not dichroic.

The characteristic absorption bands in the spectrum of white light which has been transmitted through certain crystals, particularly those of salts of the cerium metals, will, of course, be different according to the direction of vibration of the rays.

Circular Polarization in Crystals.—Like the solutions of certain optically active organic substances, such as sugar and tartaric acid, some optically isotropic and uniaxial crystals possess the property of rotating the plane of polarization of a beam of light. This property has also been proved, but much less easily, in certain biaxial crystals. In uniaxial (tetragonal and hexagonal) crystals it is only for light transmitted in the direction of the optic axis that there is rotatory action, but in isotropic (cubic) crystals all directions are the same in this respect. Examples of circularly polarizing cubic crystals are sodium chlorate, sodium bromate, and sodium uranyl acetate; amongst tetragonal crystals are strychnine sulphate and guanidine carbonate; amongst rhombohedral are quartz (*q.v.*) and cinnabar (*q.v.*) (these being the only two mineral substances in which the phenomenon has been observed), dithionates of potassium, lead, calcium and strontium, and sodium periodate; and amongst hexagonal crystals is potassium lithium sulphate. Crystals of all these substances belong to one or other of the several symmetry-classes in which there are neither planes nor centre of symmetry, but only axes of symmetry. They crystallize in two complementary hemihedral forms, which are respectively right-handed and left-handed, *i.e.,* enantiomorphous forms. Some other substances which crystallize in enantiomorphous forms are, however, only "optically active" when in solution (*e.g.,* sugar and tartaric acid); and there are many other substances presenting this peculiarity of crystalline form which are not circularly polarizing either when crystallized or when in solution. Further, in the examples quoted above, the rotatory power is lost when the crystals are dissolved (except in the case of strychnine sulphate, which is only feebly active in solution). The rotatory power is thus due to different causes in the two cases, in the one depending on a spiral arrangement of the crystal particles, and in the other on the structure of the molecules themselves.

The circular polarization of crystals may be imitated by a pile of mica plates, each plate being turned through a small angle on the one below, thus giving a spiral arrangement to the pile.

"Optical Anomalies" of Crystals.—When, in 1818, Sir David Brewster established the important relations existing between the optical properties of crystals and their external form, he at the same time noticed many apparent exceptions. For example, he observed that crystals of leucite and boracite, which are cubic in external form, are always doubly refracting and optically biaxial, but with a complex internal structure; and that cubic crystals of garnet and analcime sometimes exhibit the same phenomena. Also some tetragonal and hexagonal crystals, *e.g.,* apophyllite, idocrase, beryl, etc., which should normally be optically uniaxial, sometimes consist of several biaxial portions arranged in sectors or in a quite irregular manner. Such exceptions to the general rule have given rise to much discussion. They have often been considered to be due to internal strains in the crystals, set up as a result of cooling or by earth pressures, since similar phenomena are observed in chilled and compressed glasses and in dried gelatine. In many cases, however, as shown by E. Mallard, in 1876, the higher degree of symmetry exhibited by the external form of the crystals is the result of mimetic twinning, as in the pseudo-cubic crystals of leucite (*q.v.*) and boracite (*q.v.*). In other instances substances not usually regarded as cubic, *e.g.,* the monoclinic phillipsite (*q.v.*), may by repeated twinning give rise to pseudo-cubic forms. In some cases it is probable that the substance originally crystallized in one modification at a higher temperature, and when the temperature fell it became transformed into a dimorphous modification, though still preserving the external form of the original crystal. (*See* BORACITE.) A summary of the literature is given by R. Brauns, *Die optischen Anomalien der Krystalle* (Leipzig, 1891).

(C) THERMAL PROPERTIES

The thermal properties of crystals present certain points in common with the optical properties. Heat rays are transmitted and doubly refracted like light rays; and surfaces expressing the conductivity and dilatation in different directions possess the same degree of symmetry and are related in the same way to the crystallographic axes as the ellipsoids expressing the optical relations. That crystals conduct heat at different rates in different directions is well illustrated by the following experiment. Two plates (fig. 103) cut from a crystal of quartz, one parallel to the principal axis and the other perpendicular to it, are coated with a thin layer of wax, and a hot wire is applied to a point on the surface. On the transverse section the wax will be melted in a circle, and on the longitudinal section (or on the natural prism faces) in an ellipse. The isothermal surface in a uniaxial crystal is therefore a spheroid; in cubic crystals it is a sphere; and in biaxial crystals an ellipsoid, the three axes of which coincide, in orthorhombic crystals, with the crystallographic axes.

With change of temperature cubic crystals expand equally in all directions, and the angles between the faces are the same at all temperatures. In uniaxial crystals there are two principal coefficients of expansion; the one measured in the direction of the principal axis may be either greater or less than that measured in directions perpendicular to this axis. A sphere cut from a uniaxial crystal at one temperature will be a spheroid at another temperature. In biaxial crystals there are different coefficients of expansion along three rectangular axes, and a sphere at one temperature will be an ellipsoid at another. A result of this is that for all crystals, except those belonging to the cubic system, the angles between the faces will vary, though only slightly, with changes of temperature. E. Mitscherlich found that the rhombohedral angle of calcite decreases 8′ 37″ as the crystal is raised in temperature from 0° to 100° C.

As already mentioned, the optical properties of crystals vary considerably with the temperature. Such characters as specific heat and melting-point do not vary with the direction.

(D) MAGNETIC AND ELECTRICAL PROPERTIES

Crystals, like other bodies, are either paramagnetic or diamagnetic, *i.e.,* they are either attracted or repelled by the pole of a magnet. In crystals other than those belonging to the cubic system, however, the relative strength of the induced magnetization is different in different directions within the mass. A sphere cut from a tetragonal or hexagonal (uniaxial) crystal will if freely suspended in a magnetic field (between the poles of a strong electro-magnet) take up a position such that the principal axis of the crystal is either parallel or perpendicular to the lines of force, or to a line joining the two poles of the magnet. Which of these two directions is taken by the axis depends on whether the crystal is paramagnetic or diamagnetic, and on whether the principal axis is the direction of maximum or minimum magnetization. The surface expressing the magnetic character in different directions is in uniaxial crystals a spheroid; in cubic crystals it is a sphere. In orthorhombic, monoclinic and anorthic crystals there are three principal axes of magnetic induction, and the surface is an ellipsoid, which is related to the symmetry of the crystal in the same way as the ellipsoids expressing the thermal and optical properties.

Similarly, the dielectric constants of a non-conducting crystal may be expressed by a sphere, spheroid or ellipsoid. A sphere cut from a crystal will when suspended in an electro-magnetic field set itself so that the axis of maximum induction is parallel to the lines of force.

The electrical conductivity of crystals also varies with the direction, and bears the same relation to the symmetry as the thermal conductivity. In a rhombohedral crystal of haematite the electrical conductivity along the principal axis is only half as great as in directions perpendicular to this axis; whilst in a crystal of bismuth, which is also rhombohedral, the conductivities along and perpendicular to the axis are as 1·6:1.

Conducting crystals are thermo-electric: when placed against another conducting substance and the contact heated there will be a flow of electricity from one body to the other if the circuit be closed. The thermo-electric force depends not only on the nature of the substance, but also on the direction within the crystal, and may in general be expressed by an ellipsoid. A remarkable case is, however, presented by minerals of the pyrites group: some crystals of pyrites are more strongly thermo-electrically positive than antimony, and others more negative than bismuth, so that the two when placed together give a stronger thermo-electric couple than do antimony and bismuth. In the thermo-electrically positive crystals of pyrites the faces of the pentagonal dodecahedron are striated parallel to the cubic edges, whilst in the rarer negative crystals the faces are striated perpendicular to these edges. Sometimes both sets of striae are present on the same face, and the corresponding areas are then thermo-electrically positive and negative.

The most interesting relation between the symmetry of crystals and their electrical properties is that presented by the pyro-electrical phenomena of certain crystals. This is a phenomenon which may be readily observed, and one which often aids in the determination of the symmetry of crystals. It is exhibited by crystals in which there is no centre of symmetry, and the axes of symmetry are uniterminal or polar in character, being associated with different faces on the crystal at their two ends. When a non-conducting crystal possessing this hemimorphic type of symmetry is subjected to changes of temperature a charge of positive electricity will be developed on the faces in the region of one end of the uniterminal axis, whilst the faces at the opposite end will be negatively charged. With rising temperature the pole which becomes positively charged is called the "analogous pole," and that negatively charged the "antilogous pole": with falling temperature the charges are reversed. The phenomenon was first observed in crystals of tourmaline, the principal axis of which is a uniterminal triad axis of symmetry. In crystals of quartz there are three uniterminal dyad axes of symmetry perpendicular to the principal triad axis (which is here similar at its two ends): the dyad axes emerge at the edges of the hexagonal prism, alternate edges of which become positively and negatively charged on change of temperature. In boracite there are four uniterminal triad axes, and the faces of the two tetrahedra perpendicular to them will bear opposite charges. Other examples of pyro-electric crystals are the orthorhombic mineral hemimorphite (called also, for this reason, "electric calamine") and the monoclinic tartaric acid and cane-sugar, each of which possesses a uniterminal dyad axis of symmetry. In some exceptional cases, *e.g.*, axinite, prehnite, etc., there is no apparent relation between the distribution of the pyro-electric charges and the symmetry of the crystals.

The distribution of the electric charges may be made visible by the following simple method, which may be applied even with minute crystals observed under the microscope. A finely powdered mixture of red-lead and sulphur is dusted through a sieve over the cooling crystal. In passing through the sieve the particles of red-lead and sulphur become electrified by mutual friction, the former positively and the latter negatively. The red-lead is therefore attracted to the negatively charged parts of the crystal and the sulphur to those positively charged, and the distribution of the charges over the whole crystal becomes mapped out in the two colours red and yellow.

Since, when a crystal changes in temperature, it also expands or contracts, a similar distribution of "piezo-electric" (from πιέζειν, to press) charges are developed when a crystal is subjected to changes of pressure in the direction of a uniterminal axis of symmetry. Thus increasing pressure along the principal axis of a tourmaline crystal produces the same electric charges as decreasing temperature.

Crystals of various substances are extensively used as radio-detectors in wireless telephony, but no satisfactory explanation of their action has yet been given. An essential character of crystals is a variation of many of their physical properties with the direction within the crystal—in other words, such properties are vectorial.

III. RELATIONS BETWEEN CRYSTALLINE FORM AND CHEMICAL COMPOSITION

That the general and physical characters of a chemical substance are profoundly modified by crystalline structure is strikingly illustrated by the two crystalline modifications of the element carbon—namely, diamond and graphite. The former crystallizes in the cubic system, possesses four directions of perfect cleavage, is extremely hard and transparent, is a non-conductor of heat and electricity and has a specific gravity of 3·5; whilst graphite crystallizes in the hexagonal system, cleaves in a single direction, is very soft and opaque, is a good conductor of heat and electricity and has a specific gravity of 2·2. Such substances, which are identical in chemical composition, but different in crystalline form and consequently in their physical properties, are said to be "dimorphous." Numerous examples of dimorphous substances are known; for instance, calcium carbonate occurs in nature either as calcite or as aragonite, the former being rhombohedral and the latter orthorhombic; mercuric iodide crystallizes from solution as red tetragonal crystals, and by sublimation as yellow orthorhombic crystals. Some substances crystallize in three different modifications, and these are said to be "trimorphous"; for example, titanium dioxide is met with as the minerals rutile, anatase and brookite (*q.v.*). In general, or in cases where more than three crystalline modifications are known (*e.g.*, in sulphur no less than six have been described), the term "polymorphism" is applied.

On the other hand, substances which are chemically quite distinct may exhibit similarity of crystalline form. For example, the minerals iodyrite (AgI), greenockite (CdS) and zincite (ZnO) are practically identical in crystalline form; calcite ($CaCO_3$) and sodium nitrate ($NaNO_3$); celestine ($SrSO_4$) and marcasite (FeS_2); epidote and azurite; and many others, some of which are no doubt only accidental coincidences. Such substances are said to be "homoeomorphous" (Gr. ὅμοιος, like, and μορφή, form).

Similarity of crystalline form in substances which are chemically related is frequently met with and is a relation of much importance: such substances are described as being "isomorphous." Amongst minerals there are many examples of isomorphous groups, *e.g.*, the rhombohedral carbonates, garnet (*q.v.*), plagioclase (*q.v.*); and amongst crystals of artificially prepared salts isomorphism is equally common, *e.g.*, the sulphates and selenates of potassium, rubidium and caesium. The rhombohedral carbonates have the general formula $R''CO_3$, where R'' represents calcium, magnesium, iron, manganese, zinc, cobalt or lead, and the different minerals (calcite, ankerite, magnesite, chalybite, rhodochrosite and smithsonite [*q.v.*]) of the group are not only similar in crystalline form, cleavage, optical and other characters, but the angles between corresponding faces do not differ by more than 1° or 2°. Further, equivalent amounts of the different chemical elements represented by R'' are mutually replaceable, and two or more of these elements may be present together in the same crystal, which is then spoken of as a "mixed crystal" or isomorphous mixture.

In another isomorphous series of carbonates with the same general formula $R''CO_3$, where R'' represents calcium, strontium, barium, lead or zinc, the crystals are orthorhombic in form, and are thus dimorphous with those of the previous group (*e.g.*, calcite and aragonite, the other members being only represented by isomorphous replacements). Such a relation is known as "isodimorphism." An even better example of this is presented by the arsenic and antimony trioxides, each of which occurs as two distinct minerals:—

As_2O_3, Arsenolite (cubic); Claudetite (monoclinic).
Sb_2O_3, Senarmontite (cubic); Valentinite (orthorhombic).

Claudetite and valentinite though crystallizing in different systems have the same cleavages and very nearly the same angles, and are strictly isomorphous.

Substances which form isodimorphous groups also frequently crystallize as double salts. For instance, amongst the carbonates quoted above are the minerals dolomite ($CaMg(CO_3)_2$) and barytocalcite ($CaBa(CO_3)_2$). Crystals of barytocalcite (*q.v.*) are monoclinic; and those of dolomite (*q.v.*), though closely related to calcite in angles and cleavage, possess a different degree of symmetry, and the specific gravity is not such as would result by a simple isomorphous mixture of the two carbonates. A similar case is presented by artificial crystals of silver nitrate and potassium nitrate. Somewhat analogous to double salts are the molecular compounds formed by the introduction of "water of crystallization," "alcohol of crystallization," etc. Thus sodium sulphate may crystallize alone or with either seven or ten molecules of water, giving rise to three crystallographically distinct substances.

A relation of another kind is the alteration in crystalline form resulting from the replacement in the chemical molecule of one or more atoms by atoms or radicals of a different kind. This is known as a "morphotropic" relation (Gr. μορφή, form, τρόπος, habit). Thus when some of the hydrogen atoms of benzene are replaced by (OH) and (NO_2) groups the orthorhombic system of crystallization remains the same as before, and the crystallographic axis *a* is not much affected, but the axis *c* varies considerably:—

	a : *b* : *c*
Benzene, C_6H_6	0·891 : 1 : 0·799
Resorcin, $C_6H_4(OH)_2$	0·910 : 1 : 0·540
Picric acid, $C_6H_2(OH)(NO_2)_3$	0·937 : 1 : 0·974

A striking example of morphotropy is shown by the humite (*q.v.*) group of minerals: successive additions of the group Mg_2SiO_4 to the molecule produce successive increases in the length of the vertical crystallographic axis.

In some instances the replacement of one atom by another produces little or no influence on the crystalline form; this happens in complex molecules of high molecular weight, the "mass effect" of which has a controlling influence on the isomorphism. An example of this is seen in the replacement of sodium or potassium by lead in the alunite (*q.v.*) group of minerals, or again in such a complex mineral as tourmaline, which, though varying widely in chemical composition, exhibits no variation in crystalline form.

For the purpose of comparing the crystalline forms of isomorphous and morphotropic substances it is usual to quote the angles or the axial ratios of the crystal, as in the table of benzene derivatives quoted above. A more accurate comparison is, however, given by the "topic axes," which are calculated from the axial ratios and the molecular volume; they express the relative distances apart of the crystal molecules in the axial directions.

The two isomerides of substances, such as tartaric acid, which in solution rotate the plane of polarized light either to the right or to the left, crystallize in similar but enantiomorphous forms.

References.—An introduction to crystallography is given in most text-books of mineralogy, *e.g.*, those of H. A. Miers and of E. S. Dana. (*See* Mineralogy.) Standard works treating of the subject generally are A. E. H. Tutton, *Crystallography and practical crystal measurement* (2nd edit., 2 vols., London, 1922); P. Groth, *Physikalische Krystallographie* (4th ed., Leipzig, 1905). A popular book is A. E. H. Tutton, *The Natural History of Crystals* (London, 1924).

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CRYSTALLOID is a substance which dialyses through a parchment membrane. Dialysis is a process for separating colloidal and crystalline substances. If a salt solution be placed in a drum provided with a parchment bottom, termed a "dialyser," and the drum and its contents placed in a larger vessel of water, the salt will pass through the membrane. If the salt solution is replaced by one of glue, it will be found that the membrane is impermeable. The salt solution is termed a "crystalloid" and the glue a "colloid." By adding hydrochloric acid to a container holding a solution of an alkaline silicate, no precipitate will fall, and the solution will contain hydrochloric acid, an alkaline chloride (*e.g.*, salt) and silicic acid. If the solution be transferred to a "dialyser," the hydrochloric acid and the alkaline chloride will pass through the parchment while the silicic acid will be retained.

CRYSTAL PALACE, a well-known English resort in the neighbourhood of Sydenham just outside the southern boundary of the county of London. The building, chiefly of iron and glass, was designed by Sir Joseph Paxton (*q.v.*), and was originally erected in Hyde Park for the 1851 Exhibition. It was enlarged and re-erected on high ground in its new site in 1854 and for a quarter century was very popular as an amusement centre and show place. After that it declined somewhat, but after the World War it was chosen because of its spaciousness to house the Imperial War Museum, which comprises a large collection of war relics, souvenirs, photographs and other records. There are accommodations in the grounds for many sports and games. On Nov. 30, 1936, the building was almost wholly destroyed by fire.

CSAKY, ALBIN, Count (1841–1912), Hungarian statesman, was born on April 18, 1841, at Krompach, in the county of Szepes, and studied law in Kassa (Daschau) and Budapest. In 1888 he was minister of education in the cabinet of Koloman Tisza. Together with Szilagyi, the minister of justice, Csaky was one of the most decided champions of obligatory civil marriage and of the rights of the Jews. He resigned in 1894, and in 1900 was appointed president of the house of Magnates, an office which he resigned on the fall of the Liberal party in 1906. Under the Khuen-Hédervåry Government he became on June 18, 1910, once more president of the house of Magnates. He died at Budapest on Dec. 15, 1912.

CSÁRDÁS or **CZÁRDÁS** (chardash), a national dance of Hungary, distinguished especially by its violent alternations of tempo, so that it is now wild and furious, now slow and restrained.

CSENGERY, ANTON (1822–1880), Hungarian publicist, and a historical writer of great influence on his time, was born at Nagyvárad on the 2nd of June 1822. He took, at an early date, a very active part in the literary and political movements immediately preceding the Hungarian Revolution of 1848. He and Baron Sigismund Kemény may be considered as the two founders of high-class Magyar journalism. After 1867 the greatest of modern Hungarian statesmen, Francis Deák, attached Csengery to his personal service, and many of the momentous state documents inspired or suggested by Deák were drawn up by Csengery. As a historical writer he excelled chiefly in brilliant and thoughtful essays on the leading political personalities of his time, such as Paul Nagy, Bertalan, Szemere and others. He died at Budapest on the 13th of July 1880.

CSIKY, GREGOR (1842–1891), Hungarian dramatist, was born on Dec. 8, 1842, at Pankota, in the county of Arad. He studied Roman Catholic theology at Pest and Vienna, and was professor in the Priest's College at Temesvár from 1870 to 1878. In the latter year, however, he joined the Evangelical Church, and took up literature. Beginning with novels and works on ecclesiastical history, which met with some recognition, he ultimately devoted himself to writing for the stage. Here his success was immediate. His play *Az ellenállhatatlan* ("L'Irrésistible"), which obtained a prize from the Hungarian academy, showed the distinctive features of his talent—directness, freshness, realistic vigour, and highly individual style. In rapid succession he enriched Magyar literature with realistic genre-pictures, such as *A Proletárok* ("Proletariat"), *Buborckok* ("Bubbles"), *Két szerelem* ("Two Loves"), *A szégyenlös* ("The Bashful"), *Athalia*, etc., in all of which he seized on some feature or type of modern life, dramatizing it with unusual intensity, qualified by chaste and well-balanced diction. Of the latter his classical studies may, no doubt, be taken as the inspiration, and his translation of Sophocles and Plantus will long rank with the most successful of Magyar translations of the ancient classics. Among the best known of his novels are *Arnold, Az Atlasz család* ("The Atlas Family"). He died at Budapest on Nov. 19, 1891.

CSOKONAI, MIHALY VITEZ (1773–1805), Hungarian poet, was born at Debrecen on Nov. 17, 1773, and died there on Jan. 28, 1805. Appointed professor of poetry in his native town he lost his position on account of his irregular life, and the rest of his short existence was spent in extreme poverty. He had real genius and some of the lyrical fire of Petöfi. His comedies and farces had some success, but his fame rests on his lyrics, inspired by the rich stores of Hungarian folk-song.

His collected works were edited in 1831 by Máxton; there are other editions, the latest (3 vols.) in 1924.

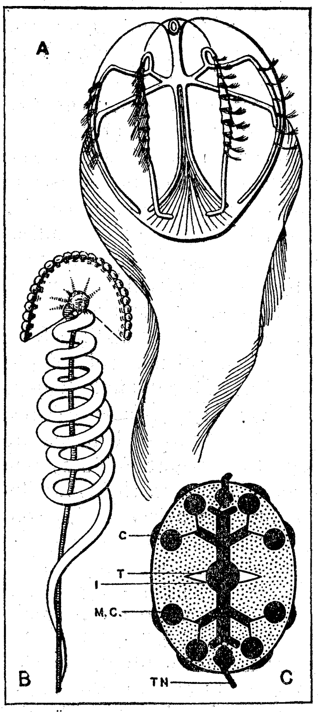
CSOMA DE KÖRÖS, ALEXANDER (1784–1842), or, as the name is written in Hungarian, KÖRÖSI CSOMA SANDOR, Hungarian traveller and philologist, born April 4, 1784, at Körös in Transylvania, belonged to a noble family which had sunk into poverty. He was educated at Nagy-Enyed and at Göttingen. In 1820, having received from a friend the promise of an annuity of 100 florins (about £10) to support him during his travels, he set out for the east to investigate the origin of the Magyars. He visited Egypt and then disguising himself as an Armenian he crossed central Asia to Tibet, where he spent four years in a Buddhist monastery studying the language and the Buddhist literature. To his intense disappointment he soon discovered that he could not thus obtain any assistance in his great object; but, having visited Bengal, his knowledge of Tibetan obtained him employment in the library of the Asiatic society there, which possessed more than 1,000 volumes in that language; and he was afterward supported by the government of Bengal while he published a Tibetan-English dictionary and grammar (both of which appeared at Calcutta in 1834). He also contributed several articles on the Tibetan language and literature to the *Journal of the Asiatic Society of Bengal,* and he published an analysis of the *Kah-Gyur,* the most important of the Buddhist sacred books. Meanwhile his fame had reached his native country and procured for him a pension from the government, which, with characteristic devotion to learning, he devoted to the purchase of books for Indian libraries. He spent some time in Calcutta studying Sanskrit and several other languages; but, early in 1842, he commenced his second attempt to discover the origin of the Magyars. He died at Darjeeling on April 11, 1842. An oration was delivered in his honour before the Hungarian academy by Jozsef Eötvös, the novelist.

See Duka, *Life and Travels of Alexander Csoma* (1886).

CTENOPHORA, a group of extremely curious marine animals, mostly pelagic, that is, frequenting the open sea. Their distribution is world-wide. They are jellyfish in the popular sense, but their structure is quite unlike that of the more familiar jellyfish belonging to the phylum of animals known as the Coelenterata (*q.v.,* and *cf.* HYDROZOA and SCYPHOZOA). The question of the relationship of the Ctenophora to the Coelenterata and other animals is discussed at the end of this article.

The Ctenophora are constructed on the same general plan as the Coelenterata, possessing a single internal cavity only, which opens to the exterior by one main aperture, the mouth. The body is composed of three layers of tissue. The outer layer (*ectoderm*), covering the surface of the body and lining the throat, is cellular in structure. The inner layer (*endoderm*), also cellular, lines the internal cavity and produces the sex cells. Between these layers is a third, the *mesoderm,* which is jellylike and contains cells and muscle fibres.

A common example of a ctenophore is *Pleurobrachia,* a "sea gooseberry" which under favourable conditions may be taken plentifully in a tow net in the English channel. It is an ovoid jellyfish half an inch or more in length, very soft and of glass-like transparency. It possesses two long feathered tentacles, each of which can be withdrawn into a pit in the substance of the body. The animal is an active swimmer, and swims not by repeated contractions of a bell-shaped body as do the coelenterate jellyfish, but by the action of a number of minute comblike plates which are attached to the body in eight vertically arranged series. These rows of combs are visible in the living animal as vertical stripes, in which a rippling movement, caused by the motion of successive combs, can be detected.



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

FIG. 1.—STRUCTURE OF A CTENOPHORE

A. General view, showing the two feathered tentacles; four of the 8 rows of comb plates; sense organ at upper end; and internal canals, visible because the body is transparent. B. An adhesive cell (colloblast). C. Diagram of transverse section: c. comb plate; i. infundibulum; m.c. meridional canal; t. throat; tn. tentacle

The general structure of the animal may be understood by reference to fig. 1. In the middle of the more pointed end of the ovoid body lies the mouth. This leads into a flattened throat extending some distance into the interior and opening in its turn into the central cavity of the animal, the *infundibulum.* This cavity is not large, but from it there radiate a number of canals which run to various parts of the body and mostly end blindly. All the space between the throat, central cavity and canals on the one hand and the skin on the other is filled in by jellylike mesoderm, which is so perfectly transparent that the whole system of internal organs is clearly visible from outside. The various canals are very definitely arranged, the most important being eight *meridional canals* which run longitudinally, one beneath each of the eight rows of combs. Each of these canals possesses, in the endoderm lining its outer wall, two concentrations of sex cells—a strip of egg-forming tissue beside a strip of cells which produce spermatozoa.

The other organs are constructed as follows: each of the tentacles is a long solid filament, bearing short lateral branches and composed of ectoderm covering a solid muscular core. At the base it is thickened and is attached to the wall of a deep pocket, lined by ectoderm, which penetrates the side of the animal. The tentacle bases lie one on each side of the throat in such a way that a line drawn from one to the other would intersect at right angles the longer diameter of the flattened throat. The ectoderm of the tentacles is crowded with cells of a unique description, known as *colloblasts.* Each colloblast (fig. 1) possesses a dome-like portion which is exposed at the surface of the ectoderm and adheres to any prey it touches, and also a spirally coiled contractile fibre descending into the substance of the ectoderm, whose function probably is to resist the strain put on the adhesive dome by the struggles of a prey and so prevent the tearing off of the dome. There is probably also poison connected with the capture of the prey.

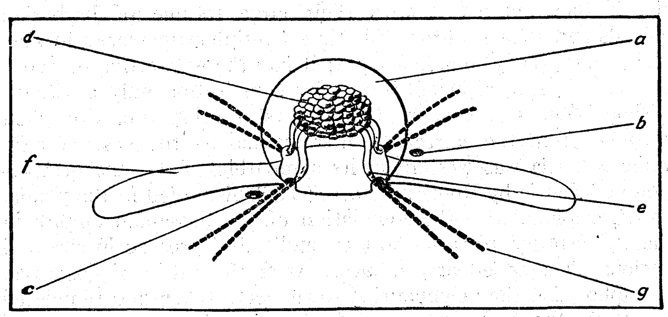
Each of the rows of combs is situated along a meridian of the body and consists of a series of transverse strips of modified ectoderm cells which cross the meridian at right angles. Each strip bears a comblike plate whose teeth are made up of large stiff fused cilia; and the cells of one strip are in direct continuity with those of the next along the meridian. The comb as a whole can beat rapidly and repeatedly upward, and it works in unison with the others in its row.

The animal also possesses a complicated sense organ (fig. 2), situated in the middle of the aboral end of the body and consisting essentially of a small mass of minute calcareous particles (*statoliths*) supported on four legs composed of fused cilia. The whole structure is roofed in and protected by a little glasslike dome, and from the base of each of the four supporting legs there run out two narrow ciliated grooves, one to each row of combs; these grooves are underlain by special strands of the general nerve net.

Finally, the ctenophore possesses a diffuse nervous system like that of a coelenterate, consisting of a subepithelial network of nerve cells and fine fibrils. Its muscular system consists of muscle fibres traversing the mesoderm and concentrated as longitudinal muscle in the axes of the tentacles, and as sheets near the surface of the body and under the epithelium of the canals and throat.

The general functions of the ctenophore resemble those of a coelenterate. Respiration is performed by general surfaces, and whether there are definite excretory organs is as yet uncertain. There are neither blood nor blood vessels, and circulation in the true sense does not exist, the movements of fluid in the internal cavities being due to ciliary action. Food consists of fishes, their eggs and young, other ctenophores, crustacea, medusae and larvae of other animals which are found in the strata of the sea inhabited by the ctenophore. The prey is captured by the tentacles (assisted by their sticky cells) and swallowed by the throat. Digestion is a process involving first the breaking down of the food into particles and secondly the engulfing or ingestion of these particles by individual cells inside which the remaining processes of digestion occur. Both intra- and extra-cellular digestion appear to take place within the throat, which is not the case in the Coelenterata, and intra-cellular digestion also occurs in the endoderm of the canal system, assimilated products being apparently carried away by wandering cells. Indigestible waste is voided mainly through the mouth, partly also through pores lying below the apical sense organ.

The method of swimming in the Ctenophora is most interesting. A ctenophore of ordinary shape usually swims mouth forward and the motion is effected by the rows of combs. Each comb lashes sharply upward (*i.e.*, away from the mouth) and returns more slowly to its previous position; and the wave of motion affecting successive combs, which traverses the whole vertical row, passes from the aboral end downward. The beat of the combs was formerly believed to be controlled from the sense organ by the transmission of impulses along the epithelium of the ciliated grooves. Later it was shown, however, that special nervous tracts underlie the grooves and that the supporting tissues of the combs are richly innervated. The comb beat is under nervous control, and the sense organ is concerned in maintaining the co-ordination between the rows of combs, and with the ability of the animal to maintain its normal resting position.



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

FIG. 2.—THE SENSE ORGAN OF A CTENOPHORE, SHOWING THE MASS OF STATOLITHS WITH ITS SUPPORTS. THE EIGHT CILIATED GROOVES ARE REPRESENTED AS DOTTED LINES. A. BELL; B. & C. EXCRETORY PORES; D. STATOLITHS; E. SPRING; F. POLAR PLATE; G. CILIATED GROOVE

Space forbids the detailed consideration here of the variations of form exhibited by the Ctenophora. Suffice it to say that although there is strong adherence throughout the greater part of the group to the fundamental principles of the type of structure described in *Pleurobrachia,* the general form of the body as a whole undergoes startling modification, the various organs and systems being distorted out of all spatial relationship to that state of affairs. The best example of this is provided by the genus *Cestus* (fig. 3), where the body has become a flattened translucent girdle, sometimes more than a yard in length, but in which nonetheless the fundamental ctenophoran structure is easily recognizable. Mention must also be made of a small series of aberrant but most interesting genera, the *Platyctenea,* in which the structure has become more radically modified. In *Coeloplana* (fig. 4), which will serve as an example, the animal has assumed a flattened, leaflike form, astonishingly similar at first sight to that of one of those flattened worms, the Turbellaria (*q.v.*). *Coeloplana* adheres to or creeps over the surface of alcyonarian colonies, seaweeds, etc., and although the adult form is so unlike a ctenophore, the larva is much like *Pleurobrachia* in structure.

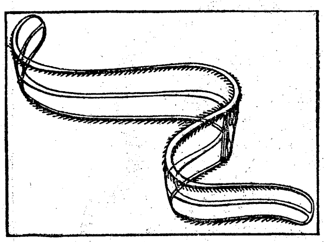
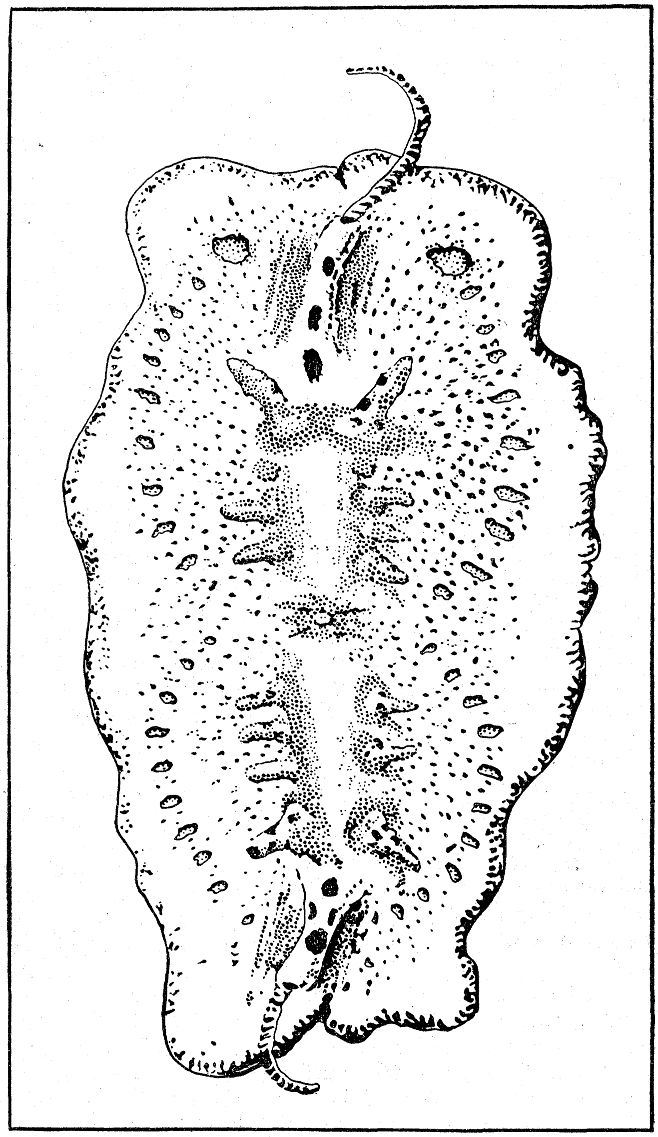

FROM CHUN, "CTENOPHORA" IN "FAUNA UND FLORA DES GOLFES VON NEAPEL"

FIG. 3.—GIRDLE OF VENUS, A TRANSLUCENT BELTLIKE CTENOPHORE

The development of the Ctenophora cannot be described here, but it is important to note that it is a process very different from that of a coelenterate egg. One result of the difference is that, if the two cells which result from the first cleavage be separated from one another, each of these may continue to develop, but it will form half a ctenophore only; on the other hand, cells similarly isolated in at least the simpler coelenterates will grow into perfect adults.

With these facts about the Ctenophora before us, discussion of their relationships becomes possible. First, the respects in which they resemble that group to which they are usually thought to be most closely allied, the Coelenterata, must be considered. The chief resemblance between the two groups lies in the fact that their general anatomical principle is the same; both possess a single internal cavity only, opening to the exterior by the mouth, and not comparable with the food canal of a higher animal (small pores of various kinds which exist in both Coelenterata and Ctenophora are obviously of no importance in this connection). In both the tissues are arranged in three layers, cellular ectoderm and endoderm with a jellylike layer between; in both the sex products originate in ectoderm or endoderm and are not formed by the intermediate layer even should they subsequently become embedded in it; and while neither possess true nerves both develop a subepithelial nerve net. The symmetry of the body is, however, not strictly comparable in the two groups; a typical coelenterate is either radially symmetrical or, if it is an anthozoan, has a bilateral symmetry underlying the radial. It will be seen from the description given above of *Pleurobrachia* (and by reference to fig. 1) that a ctenophore is radially symmetrical only as regards part of its structure, principally the rows of combs and the meridional canals. Regarded as a whole it can be divided into perfectly equivalent portions along two vertical planes only; *i.e.,* a ctenophore is bilaterally symmetrical about two vertical planes. In this it differs from an anthozoan, which is symmetrical about one plane only if its development be taken into account.

In several other respects a ctenophore differs from a coelenterate. First, the egg of a ctenophore, with its cleavage into cells each of which is destined to form only part of an adult, is markedly unlike the coelenterate egg, as has been mentioned. Second, a typical ctenophore swims by means of combs composed of cilia, muscular swimming motions coming into play on a large scale only in special cases; but in coelenterates swimming is essentially muscular save in larvae. Again the aboral end of a ctenophore produces an elaborate sense organ, that of a coelenterate being the least developed end. Furthermore, a coelenterate always possesses those explosive capsules known as *cnidae,*



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

FIG. 4.—COELOPLANA, A CTENOPHORE WHICH HAS BECOME FLATTENED AND LEAFLIKE IN FORM

whereas in the Ctenophora these are replaced by the colloblasts, with which cnidae are not directly comparable. The tentacles of a ctenophore, with their solid muscular axis, are also unlike those of a coelenterate. Capital has been made of the statement that in the development of a ctenophore there is a definite embryonic mesoderm, a set of cells cut off from the endoderm at an early stage and destined to form the axes of the tentacles and to provide most of the cells and muscle fibres of the adult mesoderm; whereas a coelenterate develops no such embryonic layer; these statements are, however, queried by certain authorities and cannot at present be regarded as decisive evidence. Epitheliomuscular cells (*see* COELENTERATA) do not occur among ctenophores.

There is last the question of the relationship of the Ctenophora to those animals which come next above them in the scale. Their nearest allies on the upgrade are generally considered to be some of the Turbellaria (*q.v.*), and much discussion has centred around their possible affinity with these. We know from the existence of *Coeloplana* that an animal in certain respects similar to a flatworm can arise from a ctenophore, and on a number of grounds it is possible reasonably to maintain that the Ctenophora and flatworms are allied, an idea that recent work on the comparative anatomy and development of the two groups has strengthened. This does not mean that *Coeloplana* is intermediate between a ctenophore and a flatworm; and, in fact, it has evolved along lines of its own; but it does mean that there may be ancestral connection between the two groups, though how far back in their evolution we cannot tell. In conclusion, although the Ctenophora resemble both the Coelenterata on the one hand and the Turbellaria on the other, the resemblance is not sufficient to warrant their inclusion in either group.

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CTESIAS, of Cnidus in Caria, Greek physician and historian, flourished in the 5th century B.C. In early life he was physician to Artaxerxes Mnemon, whom he accompanied (401) on his expedition against his brother Cyrus the Younger. Ctesias was the author of treatises on rivers, and on the Persian revenues, of an account of India and of a history of Assyria and Persia in 23 books, called *Persica,* written in opposition to Herodotus in the Ionic dialect, and professedly founded on the Persian royal archives. The first six books treated of the history of Assyria and Babylon to the foundation of the Persian empire; the remaining 17 went down to the year 398. Of the two histories we possess abridgments by Photius, and fragments in Athenaeus, Plutarch, and especially Diodorus Siculus, whose second book is mainly from Ctesias.

As to the worth of the *Persica* there has been much controversy, both in ancient and modern times. Being based upon Persian authorities, it was naturally looked upon with suspicion by the Greeks and censured as untrustworthy.

For an estimate of Ctesias as a historian *see* G. Rawlinson's *Herodotus,* i, 71–74; or R. W. Macan's *Herodotus,* vol. ii. Appendix I §5; also the edition of the fragments of the *Persica* by J. Gilmore (1888, with introduction and notes and list of authorities).

CTESIPHON, an ancient city on the left bank of the Tigris in 33° N. and 45° E., and about 25 miles southeast of Baghdad. The site is famous for the remains of one of the most magnificent buildings in Mesopotamia, a great vaulted hall of the Sassanian period. It is first mentioned in the year 220 B.C. by Polybius v. 45, 4. When the Parthian Arsacids had conquered the land east of the Euphrates in 129 B.C., they established their winter residence in Ctesiphon. They dared not stay in Seleucia, on the opposite bank of the Tigris, as this city, the most populous town of western Asia, always maintained its Greek self-government and a strong feeling of independence, which made it incline to the west whenever a Roman army attacked the Parthians. The Arsacids also were afraid of destroying the wealth and commerce of Seleucia, if they entered it with their large retinue of barbarian officials and soldiers. From this time Ctesiphon increased in size, and many splendid buildings rose; it had the outward appearance of a large town, although it was by constitution only a village. Although for a short period in the 1st century A.D. Ctesiphon revolted from the Parthians, it remained as the eastern city, while Seleucia was western in its sympathies. After the destruction of Seleucia by Rome in A.D. 164 Hellenism died in Babylonia, and Ctesiphon, with the foundation of the Sassanian empire in the 2nd century, became the metropolis. It increased in size and various kings added new suburbs. After the battle of Qadisaya, Ctesiphon and the neighbouring towns were taken and plundered in 637 by the Arabs, who brought home an immense amount of booty.

The removal of the capital to Baghdad marks the definite recognition by the Abbasids of the shifting of the centre of power. From this time Ctesiphon was dead.

Ctesiphon, Battle of, Nov. 21, 1915. This denoted the highwater mark of the first British advance toward Baghdad in World War I. After successive victories, gained by skilful tactics rather than superior force, General Townshend reached Ctesiphon and there attacked the Turkish forces which were concentrating to cover the close approach to Baghdad. Townshend gained an initial advantage, but the arrival of Turkish reinforcements nullified much of his success, and three days later, Townshend was compelled to give the order for retreat, and to extricate his force from their dangerously isolated situation by falling back to Kut-al'-Amara (*q.v.*), where he was shortly besieged. For an account of these operations and the strategy which dictated them, *see* MESOPOTAMIA, OPERATIONS IN.

CUBA (the aboriginal name), a republic and a member of the League of Nations, the largest and most populous of the West Indian islands, included between the meridians of 74° 7′ and 84° 57′ W. long. and (roughly) the parallels of 19° 48′ and 23° 13′ N. lat. It divides the entrance to the Gulf of Mexico into two passages of nearly equal width—the Strait of Florida, about 112 mi. wide between Capes Hicacos in Cuba and Arenas in Florida (Key West being a little over 100 mi. from Havana [Habana]); and the Yucatan channel, about 130 mi. wide between Capes San Antonio and Catoche. On the northeast, east and southeast, narrower channels separate it from the Bahamas, Haiti (48 mi.) and Jamaica (87 mi.).

Physical Features.—The island of Cuba is long and narrow, somewhat in the form of an irregular crescent, convex toward the north. Its length from Cape Maisí to Cape San Antonio along a medial line is about 730 mi.; its breadth, which averages about 50 mi., ranges from a maximum of 160 mi. to a minimum of about 22 mi. The total area is estimated at 44,217 sq.mi. including the Isle of Pines (area about 1,182 sq.mi.). The coast line, including larger bays, but excluding reefs, islets, keys and all minute sinuosities, is about 2,175 mi. in length.

The north littoral, characterized by bluffs, becomes higher and higher toward the east, rising to 600 ft. at Cape Maisí. The bluffs are marked by distinct terraces. The southern coast near Cape Maisí is low and sandy. From Guantánamo to Santiago de Cuba it rises in high escarpments; westward, where the Sierra Maestra runs close to the sea, there is a very high abrupt shore. To the west of Manzanillo it sinks again, and throughout most of the remaining distance to Cape San Antonio is low, with a sandy or marshy littoral; at places sand hills fringe the shore; near Trinidad there are hills of considerable height; and the coast becomes high and rugged west of Point Fisga, in the province of Pinar del Río. On both the north and south sides of the island there are long chains of islets and reefs and coral keys (of which it is estimated there are 1,300), which limit access to probably half of the coast, and on the north, render navigation difficult and dangerous. On the south, they are covered with mangroves. A large part of the southern littoral is subject to overflow, and much more of it is permanently marshy. The Zapata swamp near Cienfuegos is 600 sq.mi. in area; other large swamps are the Majagüillar, east of Cárdenas, and the Ciénaga del Buey south of the Cauto river. A remarkable feature of the Cuban coast is the number of excellent anchorages, roadsteads and harbours. On the north shore, beginning at the west, Bahía Honda, Havana, Matanzas, Cárdenas, Nuevitas and Nipe; and on the south shore running westward Guantánamo, Santiago de Cuba and Cienfuegos are harbours of the first class, several of them among the best of the world. Mariel, Cabañas, Banes, Sagua la Grande and Baracoa on the north, and Manzanillo, Santa Cruz, Batabanó and Trinidad on the south are also excellent ports or anchorages. The peculiar pouch shape of almost all the harbours named (Matanzas being a marked exception) greatly increases their security and defensibility. The number of small bays that can be utilized for coast trade traffic is extraordinary.

In popular language the different portions of the island are distinguished as the Vuelta Abajo ("lower turn"), west of Havana; the Vuelta Arriba ("upper turn"), east of Havana to Cienfuegos—Vuelta Abajo and Vuelta Arriba are also used colloquially at any point in the island to mean "east" and "west"—Las Villas—*i.e.*, Villa Clara, Trinidad, Remedios, Cienfuegos and Sancti Spiritus—between Cienfuegos and Sancti Spiritus; and Tierra Adentro, referring to the region between Cienfuegos and Bayamo. These names are extremely common. The province and city of Puerto Príncipe are officially known as Camagüey, their original Indian name, which has supplanted the Spanish name in local usage.

Five topographic divisions of the island are fairly marked. Oriente province is high and mountainous, Camagüey is characterized by rolling, open plains, slightly broken, especially in the west, by low mountains. The east part of Las Villas (formerly Santa Clara) province is decidedly rough and broken. The west part, with the provinces of Matanzas and La Habana, is flat and rolling, with occasional hills a few hundred feet high. Finally, Pinar del Río is dominated by a prominent mountain range and by outlying piedmont hills and mesas. There are mountains in Cuba from one end of the island to the other, but they are not derived from any central mass and are not continuous. As just indicated there are three distinctively mountainous districts, various minor groups lying outside these. The three main systems are known in Cuba as the occidental, central and oriental. The first, the Organ mountains, in Pinar del Río, rises in a sandy, marshy region near Cape San Antonio. The crest runs near the north shore, leaving various flanking spurs and foothills, and a coastal plain which at its greatest breadth on the south is some 20 mi. wide. The plain on the north is narrower and higher. The southern slope is smooth, and abounds in creeks and rivers. The portion of the southern plain between the bays of Cortés and Majana is the most famous portion of the Vuelta Abajo tobacco region. The mountain range is capriciously broken at points, especially near Bejucal. The highest part is the Pan de Guajaibón, near Bahía Honda, at the west end of the chain; its altitude is 2,494 ft. The central system has two wings, one approaching the north coast, the other covering the island between Sancti Spiritus and Santa Clara. It comprehends a number of independent groups. The highest point, the Pico Potrerillo, is about 3,280 ft. in altitude. The summits are generally well rounded, while the lower slopes are often steep. Frequent broad intervals of low upland or low level plain extend from sea to sea between and around the mountains. Near the coast runs a continuous belt of plantations, while grazing, tobacco and general farm lands cover the lower slopes of the hills, and virgin forests much of the uplands and mountains.

The eastern mountain region includes the province of Oriente and a portion of Camagüey. In extent, in altitude, in mass, in complexity and in geological interest, it is much the most important of the three systems. Almost all the mountains are very bold. There are two main ranges, the Sierra Maestra, and a line of various groups along the north shore. The former runs from Cape Santa Cruz eastward along the coast some 125 mi. to beyond the river Baconao. The Sierra de Cobre, a part of the system in the vicinity of Santiago de Cuba, has a general elevation of about 3,000 ft. Pico Turquino, 6,400 ft. in altitude, is the highest peak of the island. Gran Piedra rises more than 4,900 ft., the Ojo del Toro about 3,300 ft., the Anvil de Baracoa is somewhat lower, and Pan de Matanzas is 1,315 ft. The western portions of the range rise abruptly from the ocean, forming a bold and beautiful coast. A multitude of ravines and gullies, filled with torrential streams or dry, according to the season of the year, and characterized by many beautiful cascades, seam the narrow coastal plain and the flanks of the mountains. The spurs of the central range are a highly intricate complex, covered with dense forests of superb woods. Many points are inaccessible, and the scenery is wild in the extreme. The mountains beyond Guantánamo are known locally by a variety of names, though topographically a continuation of the Sierra Maestra. The same is true of the chains that coalesce with those near Cape Maisí and diverge northwesterly along the north coast of the island. The general character of this northern marginal system is like that of the southern, save that the range is much less continuous. The range near Baracoa is extremely wild and broken. The region between the lines of the two coastal systems is a much dissected plateau, imperfectly explored. The Cauto river, the only one flowing east or west and the largest of Cuba, flows through it westward to the southern coast near Manzanillo. The scenery in the eastern portion of the island is very beautiful, with wild mountains and tropical forests. In the central part there are extensive prairies. In the west there are swelling hills and gentle valleys, with the royal palm the dominating tree.

A very peculiar feature is the abundance of caverns in the limestone beneath the surface. The caves of Cotilla near Havana, of Bellamar near Matanzas, of Monte Libano near Guantánamo, and those of San Juan de los Remedios are the best known. Many streams have part of their course through underground tunnels. Thus the Río San Antonio suddenly disappears near San Antonio de los Baños; the cascades of the Jatibónico del Norte disappear and reappear in a surprising manner; the Moa cascade (near Guantánamo) drops 300 ft. into a cavern and its waters later reissue from the earth; the Jojo river disappears in a great "sink" and later issues with violent current at the edge of the sea. The springs of fresh water that bubble up among the keys of the south coast are also supposedly the outlets of underground streams.

The number of rivers is very great, but almost without exception their courses are normal to the coast, and they are so short as to be of but slight importance. The Cauto river in Oriente province is exceptional; it is more than 155 mi. long, and navigable by small vessels for about 55 mi. Inside the bar at its mouth (formed by a storm in 1616) ships of 200 tons can still ascend to Cauto. In Camagüey province the Jatibónico del Sur; in Oriente the Salado, a branch of the Cauto; in Las Villas the Sagua la Grande (which is navigable for some 20 mi. and has an important traffic), and the Damuji; in Matanzas, the Canimar; and in Pinar del Río the Cuyaguateje are important streams. The water parting in the four central provinces is very indefinite. There are a few river valleys that are noteworthy—those of the Yumurí, the Trinidad and the Güines. At Guantánamo and Trinidad are other valleys, and between Mariel and Havana is the fine valley of Ariguanabo. Of lakes, there are a few on the coast, and a very few in the mountains. The finest is Lake Ariguanabo, near Havana, 6 sq.mi. in area. Of the almost innumerable river cascades, those of the Sierra Maestra mountains, and in particular the Moa cascade, have already been mentioned. The Guamá cascade in Oriente province and the Hanabanilla Fall near Cienfuegos (each more than 300 ft. high), the Rosario Fall in Pinar del Río, and the Almendares cascade near Havana, may also be mentioned.

Geology.—The foundation of the island is formed of metamorphic and igneous rocks, which appear in the Sierra Maestra and are exposed in other parts of the island wherever the comparatively thin covering of later beds has been worn away. A more or less continuous band of serpentine belonging to this series forms the principal watershed, although it nowhere rises to any great height. It is in this band that most of the minerals are found. These ancient rocks have hitherto yielded no fossils and their age is therefore uncertain, but they are probably pre-Cretaceous at least. Fossiliferous Cretaceous limestones containing *Rudistes* have been found, as at Santiago de los Baños, Las Villas province. At the base there is often an arkose, composed largely of fragments of serpentine and granite derived from the ancient floor. In Las Villas province bituminous plant-bearing beds occur beneath the Tertiary limestones, and at Baracoa a Radiolarian earth occupies a similar position. The latter, like the similar deposits in other West Indian islands, is probably of Oligocene age. Tertiary limestones are the predominant feature. Although they do not exceed 1,000 ft. in thickness, they probably at one time covered the whole island except the summits of the Sierra Maestra, where they have been observed, resting upon the older rocks, up to a height of 2,300 feet. They contain corals, but are not coral reefs. The shells which have been found in them indicate that they belong for the most part to the Oligocene period. They are frequently very much disturbed and often strongly folded. Around the coast there is a raised shelf of limestone which was undoubtedly a coral reef. But it is of recent date and does not attain an elevation of more than 40 or 50 feet.

Minerals are fairly abundant in number, but few are present in sufficient quantity to be industrially important. Oriente province is distinctively the mineral province of the island. Large copper deposits of peculiar richness occur in the Sierra de Cobre, and both iron and manganese are abundant. Besides the deposits in Oriente province, iron is known to exist in considerable amount in Camagüey and Las Villas, and copper in Camagüey and Pinar del Río provinces. The copper deposits are mainly in serpentine. Manganese occurs especially along the coast between Santiago de Cuba and Manzanillo. Chromium and other rare minerals exist, but not in commercially available quantities. Bituminous products of every grade, from clear translucent oils to lignite-like substances, occur in all parts of the island. Much of the bituminous deposits is on the dividing line between asphalt and coal. There is but little stone which is hard enough to be good for building material, the greatest part being a soft coralline limestone. There are extensive and valuable deposits of beautiful marbles in the Isle of Pines, and lesser ones near Santiago de Cuba. The Organ mountains contain a hard blue limestone; and sandstones occur on the north coast of Pinar del Río province. Clays of all qualities and colours abound. Mineral waters, though not yet important in trade, are extremely abundant, and a score of places in Cuba and the Isle of Pines are popular health resorts.

The soil of the island is mainly alluvial on the lowlands and disintegrated limestone on the uplands. In the original formation of the island, volcanic disturbances and coral growth played some part. Noteworthy earthquakes are rare. They have been most common in Oriente province. Those of 1776, 1842 and 1852 were particularly destructive, and of earlier ones those of 1551 and 1624 at Bayamo and of 1578 and 1678 at Santiago de Cuba. Every year there are light seismic disturbances, Santiago de Cuba being the point of most frequent visitation.

Flora.—The tropical heat and humidity of Cuba make possible a flora of splendid richness. All the characteristic species of the West Indies, the Central American and Mexican and southern Florida seaboard, and nearly all the large trees of the Mexican tropic belt, are embraced in it. The total number of native flowering species has been estimated at between 5,000 and 6,000. According to the census of 1919 wooded lands comprised 13,600,000 ac., but wasteful clearing after that time has reduced this area to less than 3,500,000 ac. (1940 est.). The woods are so dense over large districts as to be impenetrable, except by cutting a path foot by foot through the close network of vines and undergrowth. The jagüey (*Ficus* sp.), which stifles in its giant coils the greatest trees of the forest, and the copey (*Clusia rosea*) are remarkable parasitic lianas.

Of the palm there are more than 30 species. The royal palm is the most characteristic tree of Cuba. It attains a height of from 50 to 75 ft., and sometimes of more than 100 ft. Alone, or in groups, or in long aisles, towering above the plantations or its fellow trees of the forest, its beautiful crest dominates every landscape. Every portion, from its roots to its leaves, serves some useful purpose. The *corojo* palm (*Acrocomia crispa*) rivals the royal palm in beauty and utility; oil, sugar, drink and wood are derived from it. The *coco* palm (*Cocos nucifera*) is also put to varied uses. The mango is planted with the royal palm along the avenues of the plantations. The beautiful *ceiba* (*Bombax ceiba, Ceiba pentandra*) or silk-cotton tree is the giant of the Cuban forests; it often grows to a height of 100 to 150 ft. with enormous girth. The royal *piñón* (*Erythrina grisebachii*) is remarkable for the magnificent red flowers that cover it. The tamarind and banyan are also noteworthy. Utilitarian trees and plants are legion.

There are at least 40 choice cabinet and building woods. Of these, ebonies, mahogany, *cuyá* (or *cullá, Dipholis* spp.), *cocuyo* (*Bumelia* spp.), *ocuje* (also *ocuje macho, María, palo de María: Calophyllum antillanum*), *jigüe* (*Lysiloma sabicu*), *majagua* (*Hibiscus tiliaceus*), *granadillo* (*Brya ebenus*), and *icaquillo* (or *hicaquillo: Licania* sp.) are perhaps the most beautiful. Other woods, beautiful and precious, include *guayacán* (*Guaiacum sanctum*), *baría* (or *varía: Cordia gerascanthoides*), *quiebrahacha* (*Copaifera hymenaefolia*), which three are of wonderful lasting qualities; the *jiquí* (*Bumelia obovata*), *acana* (*Mimusops jaimiqui, Bassia albescens*), *caguirán* (or *caguairán: Pseudocopaiva hymenaefolia*), and the *dagame* (*Calycophyllum candidissimum*), which four, like the *cuyá*, are all wonderfully resistant to humidity; the *caimitillo* (*Chrysophyllum oliviforme*), the *yaya* (or *yayajabico, yayajabito: Erythalis fructicosa, Oxandra lanceolata, Mouriria acuta, Asimina rhombifolia*), a magnificent construction wood; the *maboa* (*Cameraria latifolia*) and the *jocuma* (jocum:

Sideroxylon mastichodendron, Dipholis salicifolia), all of individual beauties and qualities.

Many species are rich in gums and resins; others are oleaginous; and many are medicinal. There are also various dyewoods; rosewood, logwood (or campeachy wood), indigo, *manajú* (*Rheedia aristata*), brazilwood and saffron. Textile plants are extremely common. The *majagua* tree grows as high as 40 ft.; from its bark is made cordage of the finest quality. Strong, fine, glossy fibres are yielded by the exotic ramie (*Boehmeria nivea*); by the maya or rat pineapple (*Bromelia Pinguin*), and by the *daguilla* (*Lagetta lintearia, L. valenzuelana*), which like the maya yields a brilliant flexible product like silk; stronger cordage by the *corojo* palms, and various *henequén* plants, native and exotic (especially *Agave americana, A. cubensis*); and various plantains, the exotic *Sansevieria guinensis*, okra, jute, *Laportea*, various lianas, and a great variety of reeds, supply varied textile materials. The yuca is a source of starch. For building and miscellaneous purposes, in addition to the rare woods above named, there are cedars (used in great quantities for cigar boxes); the pine, found only in the west, where it gives its name to the Isle of Pines and the province of Pinar del Río; and various palms and oaks. Among economic plants are the coffee, cacao, citron, cinnamon, coconut and rubber tree. Wheat, Indian corn and many vegetables, especially tuberous, are important. Plantain in several varieties is a cheap and healthful substitute for bread, as is also the bitter cassava, after the poison is extracted. The sweet cassava yields tapioca. Bread trees are fairly common. White and sweet potatoes, yams, sweet and bitter yucas, sago and okra are raised.

The pineapple is the fruit most favoured by Cubans. The tamarind is everywhere. Bananas are grown particularly in the region about Nipe, Gibara and Baracoa, whence they are exported in large quantities. Mangoes, though exotic, are extremely common, and in the east grow wild in the forests. Oranges are little cultivated. Lemons yield continuously through the year, but like oranges, not much has yet been done with them commercially. Pomegranates are universally used, but figs and grapes degenerate. The coconut palm is most abundant in the vicinity of Baracoa. Among the common fruits are custard apples (*Anona cherimolia*), sweetsops (*A. squamosa*), soursops (*A. muricata*), mamons (*A. reticulata*), star apples (*Chrysophyllum cainito, C. pomiferum*), rose apples (*Eugenia jambos*), pawpaws, canistes (*Lucuma nervosa*), *jaguas* (*Genipa americana*), avocados (*Persea gratissima*), yellow mammees (*Mammea americana*), "red mammees" (*Achras zapota*) and limes.

Fauna.—The fauna, like the flora, is still imperfectly known. Collectively it shows long isolation from the other Antilles. Only two land mammals are known to be indigenous. One is the *jutía* (agouti) or Cuban rat, of which three species are known (*Capromys prehensiles, C. melanurus* and *C. pilorides*). It lives in the most solitary woods, especially in the eastern hills. The other is a peculiar insectivore (*Solenodon paradoxus*), the only other representatives of whose family are found in Madagascar. Various animals, apparently indigenous, that are described by the early historians of the conquest, have disappeared. An Antillean rabbit is very abundant. Bats in prodigious numbers, and some of them of extraordinary size, inhabit the many caves of the island; more than 20 species are known. Rats and mice, especially the *guayabito* (*Mus musculus*), an extremely destructive rodent, are very abundant. The manatee, or sea cow, frequents the mouths of rivers, the sargasso drifts and the regions of submarine fresh-water springs off the coast. Horses, asses, cows, deer, sheep, goats, swine, cats and dogs were introduced by the early Spaniards. The last three are common in a wild state. Deer are not native, and are very rare; a few live in the swamps.

Birds recorded in Cuba numbered, in 1928, 276 species. Two-thirds of these, including gulls, terns, ducks, waders, flycatchers, orioles, finches and warblers, are also found in the United States. The remaining third includes the Cuban crab hawk, snail kite, quail, rails, crane, blue-headed quail dove, macaw, paroquet, parrot, lizard cuckoo, bare-legged owl, tody, collared and palm swifts, fairy hummingbird, solitaire, cave swallow, blue-headed honey creeper and black finch. The earliest observations of Cuban birds were made by Columbus on his first voyage; the nightingales which charmed him were probably Cuban solitaires. See *The Birds of Cuba*, by Thomas Barbour, 1923.

Reptiles are numerous. Many tortoises are notable. The crocodile and cayman occur in the swampy littoral of the south. Of lizards the *iguana* (*Cyclura ciclura*) is noteworthy. Chameleons are common. Snakes are not numerous, and it is said that none is poisonous or vicious. There is one enormous boa, the *maja* (*Epicrates angulifer*), which feeds on pigs, goats and the like, but does not molest man.

Fishes are present in even greater variety than birds. Felipe Poey, in his *Ictiología Cubana*, listed 782 species of fish and crustaceans, of which 105 were doubtful; but more than one-half of the remainder were first described by Poey. The fish of Cuban waters are remarkable for their metallic colourings. The largest species are found off the northern coast. Food fishes are relatively not abundant, presumably because the deep sea escarpments of the north are unfavourable to their life. Shell fish are unimportant. Two species of blind fish, of extreme scientific interest, are found in the caves of the island. Of the "percoideos" there are many genera. Among the most important are the *robalo* (*Centropomus*), an exquisite food fish, the tunny, eel, Spanish sardine and *manjua*. Of the sharks the genus *Squalus* is represented by individuals that grow to a length of 26 to 30 feet. The hammerhead attains a weight at times of 600 lb. The sawfish is common. Of fresh-water fish the *liza, dogro, guajacón* and *biajaca* (*Parapetoenia tetracamtha*) are possibly the most noteworthy.

Molluscs are extraordinarily numerous; and many, both of water and land, are rarities among their kind for size and richness of colour. Of crustaceans, land crabs are remarkable for size and number. Arachnids are prodigiously numerous. Insect life is abundant and beautiful. The bite of the scorpion and of the numerous spiders produces no serious effects. The *nigua*, the Cuban jigger, is a pest of serious consequence, and the *mal de nigua* (jigger sickness) sometimes causes the death of lower animals and men. Sand flies and biting gnats are lesser nuisances. Lepidoptera are very brilliant in colouring. The *cucujo* or Cuban firefly (*Pyrophorus noctilucus*) gives out so strong a light that a few of them serve effectively as a lantern. The *Stegomyia* mosquito is the agent of yellow fever inoculation. Sponges grow in great variety.

Climate.—The climate of Cuba is typically that of islands in the trade wind belt, and distinctively insular in characteristics of humidity and equability. There are two distinct seasons: a "dry" season from November to April, and a hotter, "wet" season. About two-thirds of the total precipitation falls in the latter. Droughts, extensive in area and in duration, are by no means uncommon. At Havana the mean temperature is about 77° F., with a range between the means of the coldest and warmest months of 10° (71° to 81°), temperatures below 50° or above 90° being rare. The mean rainfall at Havana is about 44.9 in. (sometimes over 80), and the mean absolute humidity of different months ranges from 70% to 80%. These figures represent fairly well the conditions of much of the northern coast. The average rainfall is greatest in the northwestern part of the island. The heat of the day is relieved by the afternoon sea breezes. The trades are steady through the year, and in the dry season the western part enjoys cool "northers." Despite this the interior is somewhat cooler than the coast, and in the uplands frost is not uncommon. The southern littoral is also (except in sheltered points such as Santiago de Cuba, which is one of the hottest cities) somewhat cooler than the northern.

Eight or ten years rarely pass without tornadoes or hurricanes of local severity at least. Notably destructive ones occurred in 1768, 1774, 1842, 1844, 1846, 1865, 1870, 1882, 1888, 1894, 1896, 1906, 1910, 1912, 1915, 1917, 1924, 1926, 1932, 1935 and 1944. Those of 1842 and 1844 caused extreme distress. In 1846, 300 vessels and 2,000 houses were destroyed at Havana; in 1896 the banana groves of the northeast coast were ruined; and in 1926 Havana suffered severe damage. Such storms most frequently occur in September, October and November.

Health.—Convincing evidence is offered by the qualities of the Spanish people in Cuba that white men of temperate lands can be perfectly acclimatized in this tropical island. As for diseases, some common to Cuba and Europe are more frequent or severe in the island, others rarer or milder. There are the usual malarial, bilious and intermittent fevers, and liver, stomach and intestinal complaints prevalent in tropical countries and chiefly due to unhygienic living. Yellow fever (which first appeared in Cuba in 1647) was long the only epidemic disease, Havana being an endemic focus. The danger of an outbreak was never absent, until the work of the U.S. army in 1901–02 conclusively proved that this disease could be eradicated entirely by removing the possibility of inoculation by the *Stegomyia* mosquito. Since then yellow fever has ceased to be a scourge in Cuba. Smallpox was the cause of a greater mortality than yellow fever even before the means of combating the latter had been ascertained. The remarkable sanitary work begun during the American occupation and continued by the republic of Cuba, has shown that the ravages of this and other diseases can be greatly diminished. Leprosy is rather common, but seemingly only slightly contagious. Consumption is very prevalent. Malaria has been greatly reduced by the campaign against the anopheles mosquito, the carrier of the malady.

HISTORY

Cuba was discovered by Christopher Columbus in the course of his first voyage, on Oct. 27, 1492. In 1508 Sebastian de Ocampo circumnavigated it. In 1511 Diego Velázquez began the conquest of the island. Baracoa (the landing point), Bayamo, Santiago de Cuba, Puerto Príncipe, Sancti Spiritus, Trinidad and the original Havana were all founded by 1515. Velázquez's reputation and legends of wealth drew many immigrants to the island. From Cuba went the expeditions that discovered Yucatan (1517), and explored the shores of Mexico, Hernando Cortés's expedition for the invasion of Mexico, and de Soto's for the exploration of Florida. The last two had a pernicious effect on Cuba, draining it of horses, money and of men. At least as early as 1523 the African slave trade was begun. In 1544 the Indians, so far as they had not succumbed to the labour of the mines and fields to which they were put by the Spaniards, were proclaimed emancipated. The administration in the 16th century was loose and violent. The local authorities were divided among themselves by bitter feuds; brigandage, mutinies and internal struggles disturbed the peace. As a result of the transfer of Jamaica to England, the population of Cuba was augmented by Jamaican immigrants to about 30,000 in the middle of the 17th century.

The activity of English and French pirates began in the 16th, and reached its climax in the middle of the 17th century. So early also began dissatisfaction with economic regulations and even grave resistance to their enforcement. Illicit trade with privateers and foreign colonies had begun long before, and in the 17th and 18th centuries was the basis of the island's wealth. In 1762 Havana was captured after a long resistance by a British force under Admiral Sir George Pocock and the earl of Albemarle, with heavy loss to the besiegers. It was returned to Spain the next year in exchange for the Floridas. The British opened the port to commerce and the slave trade and revealed its possibilities. The government of Spain, beginning in 1764, made notable breaches in the old monopolistic system of colonial trade throughout America; and Cuba received special privileges. Spain paid increasing attention to the island, and in harmony with the policy of the Laws of the Indies many decrees intended to stimulate agriculture and commerce were issued by the crown, first in the form of monopolies, then with increased freedom and with bounties. Various colonial products and the slave trade were favoured in this way. After the cession of the Spanish portion of Santo Domingo to France, hundreds of Spanish families emigrated to Cuba, and many thousand more immigrants, mainly French, followed them during the revolution of the blacks. Most of them settled in Oriente province, where their names and blood are still apparent, and with their *cafetales* and sugar plantations converted that region from neglect and poverty to high prosperity.

Under a succession of liberal governors (especially Luis de las Casas, 1790–96, and the marqués de Someruelos, 1799–1813), at the end of the 18th century and the first part of the 19th, when the wars in Europe cut off Spain almost entirely from the colony, Cuba was practically independent. Trade was comparatively free, and worked a revolution in culture and material conditions. Gen. las Casas, in particular, left behind him in Cuba an undying memory of good efforts. Free commerce with foreigners—a fact after 1809—was definitely legalized in 1818 (confirmed in 1824). The state tobacco monopoly was abolished in 1817. The reported populations by the (untrustworthy) censuses of 1774, 1792 and 1817 were 161,670; 273,301 and 553,033. Something of political freedom was enjoyed during the two terms of Spanish constitutional government under the constitution of 1812. The sharp division between creoles and peninsulars (*i.e.*, between those born in Cuba and those born in Spain), the question of annexation to the United States or possibly to some other power, the plotting for independence, all go back to the early years of the century.

Misgovernment.—Partly owing to these political and social divisions, conspiracies being rife during 1820–30, and partly as preparation for the defense against Mexico and Colombia, who throughout these same years were threatening the island with invasion, the captains general, in 1825, received the powers above referred to, which became, as time passed, monstrously in discord with the general tendencies of colonial government and with increasing liberties in Spain, but continued to be the spiritual basis of Spanish rule in the island. Among the governors was Miguel Tacón (1834–39), a forceful and high-handed soldier; he ruled as a tyrant, made many reforms, and left Havana, in particular, full of municipal improvements. The good he did was limited to the spheres of public works and police; in other respects his rule was a pernicious influence for Cuba. Politically it was marked by the proclamation at Santiago in 1836, without his consent, of the Spanish constitution of 1834; he repressed the movement, and in 1837 the deputies of Cuba to the Cortes of Spain (to which they were admitted in the two earlier constitutional periods) were excluded from that body, and it was declared in the national constitution that Cuba (and Puerto Rico) should be governed by "special laws." The inapplicability of many laws passed for the peninsula was indeed notorious; and Cuban opinion had repeatedly, through official bodies, protested against laws thus imposed that worked injustice, and had pleaded for special consideration of colonial conditions. The promise of "special laws" based upon such consideration was therefore not, in itself, unjust, nor unwelcome. But as the colony had no voice in the Cortes, and the "special laws" were never passed, the arbitrary rule of the captains general remained quite supreme. The rule of Leopold O'Donnell was marked in 1844 by a bloody persecution of Negroes for a supposed plot against their masters; O'Donnell's actions being partly due to the inquietude that had prevailed for some years over the supposed machinations of English abolitionists and even of English official residents in the island, and also over the mutual jealousies and supposed annexation ambitions of Great Britain and the United States.

A Cuban international question had arisen before 1820. Spain, the United States, England, France, Colombia and Mexico were all fully involved in it, the first four continually. In the 1850s a strong proslavery interest in the United States advocated the acquisition of the island. One feature of this was the "Ostend Manifesto" (*see* BUCHANAN, JAMES), in which the ministers of the United States at London, Paris and Madrid declared that if Spain refused a money offer for the colony the United States should seize it. Their government gave this document publicity. The Cuban policy of Presidents Pierce and Buchanan (during 1853–61) was vainly directed to acquiring the island. From 1849 to 1851 there were three abortive filibustering expeditions from the United States, two being under a Spanish general, Narciso López (1798–1851). Domestic discontent had become acute by 1850, and from then on to 1868 there was conflict between liberal and reactionary sentiment, centring about the asserted connivance of the captains general in the illegal slave trade (declared illegal by the treaties of 1817 and 1835 between Great Britain and Spain), the notorious immorality and prodigal wastefulness of the government, and the selfish exploitation of the colony by Spaniards and the Spanish government. From early in the 19th century there had always been separatists, reformists and repressionists in the island, but they were individuals rather than groups. The last were peninsulars, the others mainly creoles, and among the wealthy classes of the latter the separatists gradually gained increasing support.

Civil Wars.—An ineffective and corrupt administration, a grave economic condition, new and heavy taxes, military repression, recurring heavy deficits in the budget, adding to a debt (about $150,000,000 in 1868) already very large and burdensome, and the complete fiasco of the *junta* of inquiry of Cuban and Puerto Rican representatives which met in Madrid in 1866–67—all were important influences favouring the outbreak of the Ten Years' War. Among those who waged the war some desired reforms; others annexation to the United States; others, independence. The reformists demanded action against slavery, assimilation of rights between peninsulars and creoles and the practical recognition of equality (*e.g.*, in the matter of officeholding) and guarantees of personal liberties. The separatists, headed by Carlos Manuel de Céspedes (1819–1874), a wealthy planter who proclaimed the revolution at Yara on Oct. 10, 1868, demanded the same reforms, including gradual emancipation of the slaves with indemnity to owners, and the grant of free and universal suffrage. War was confined throughout the ten years almost wholly to the east provinces. The policy of successive captains general was alternately uncompromisingly repressive and conciliatory. The Spanish volunteers committed horrible excesses in Havana and other places; the rebels also burned and killed indiscriminatingly, and the war became increasingly cruel and sanguinary. Intervention by the United States seemed probable, but did not come. Martínez Campos in Jan. 1878 secured the acceptance by the rebels of the convention of Zanjón, which promised amnesty, liberty to rebel slaves, the abolition of slavery, reforms in government and colonial autonomy. A small rising after peace (the "Little War" of 1879–80) was easily repressed. Gradual abolition of slavery was declared by a law of Feb. 13, 1880; definitive abolition in 1886; and in 1893 equal civil status of blacks and whites was proclaimed by Gen. Calleja. Coolie importation from China had been stopped in 1871.

The change from the old regime was only superficial. The Spanish constitution of 1876 was proclaimed in Cuba in 1881. In 1878–95 political parties had a complex development. The Liberals were becoming radical, the Union Constitutionalists, conservative; and after 1893 a Reformist party was launched that drew the compromisers and the waverers. The demands of the Liberals were as in 1868; those for personal and property rights were much more definitely stated, and among explicit reforms demanded were the separation of civil and military power, general recognition of administrative responsibility under a colonial autonomous constitutional regime; customs reforms and reciprocity with the United States were also demanded. As for the representation accorded Cuba in the Spanish Cortes, as a rule about a quarter of its deputies were Cuban-born, and the choice of only a few autonomists was allowed by those who controlled the Cuban elections. A reciprocity arrangement with the United States was in force from 1891 to 1894 and was found to be extremely beneficial to Cuba.

Discontent grew, and another war was prepared for. On Feb. 23, 1895, Gen. Calleja suspended the constitutional guarantees. The leading chiefs of the Ten Years' War took the field again —Máximo Gómez, Antonio Macéo, José Martí, Calixto García and others. This war was carried to the western provinces, and indeed was fiercest there. Among the military means adopted by the Spaniards to isolate their foe were entrenchments, barbwire fences, and lines of block-houses across the narrow parts of the island, and noncombatant detention camps. The latter measure produced extreme suffering and much starvation. In Oct. 1897 the Spanish premier, P. M. Sagasta, announced the policy of autonomy, and the new dispensation was proclaimed in Cuba in December. But again all final authority was reserved to the captain general. The system was never to have a practical trial, although a full government was quickly organized under it. President McKinley, while opposing recognition of the rebels, affirmed the possibility of intervention; Spain resented this attitude; and finally, in Feb. 1898, the United States battleship "Maine" was blown up—by whom will probably never be known—in the harbour of Havana.

American Occupation.—On April 20, the United States demanded the withdrawal of Spanish troops. War followed at once. A fine Spanish squadron seeking to escape from Santiago harbour was utterly destroyed by the American blockading force on July 3; Santiago was invested by land forces, and on July 5, surrendered. Other operations in Cuba were slight. By the treaty of Paris, signed on Dec. 10, Spain "relinquished" the island to the United States in trust for its inhabitants; the temporary character of American occupation being recognized throughout the treaty, in accord with the terms of the American declaration of war, in which the United States disclaimed any intention to control the island except for its pacification, and expressed the determination to leave the island thereupon to the control of its people. Spanish authority ceased on Jan. 1, 1899, and was followed by American "military" rule from Jan. 1, 1899 to May 20, 1902. During these three years the great majority of offices were filled by Cubans. Very much was done for public works, sanitation, the reform of administration, civil service and education. Most notable of all, yellow fever was eradicated where it had been endemic for centuries. A constitutional convention sat at Havana from Nov. 5, 1900 to Feb. 21, 1901. Certain definite conditions known as the Platt amendment were finally imposed by the United States, and accepted by Cuba (on June 12, 1901) as a part of its constitution. By these Cuba was bound not to incur debts its current revenues will not bear; to continue the sanitary administration undertaken by the military government of intervention; to lease naval stations to the United States; and finally, the right of the United States to intervene, if necessary, in the affairs of the island was explicitly affirmed. The status of the Isle of Pines was left an open question by the treaty of Paris, but a decision of the United States supreme court which recognized it as a part of Cuba was finally ratified by the United States senate on March 13, 1925.

The Republic.—The first Cuban congress met on May 5, 1902, and took over the government from the American military authorities on May 20; Tomás Estrada Palma (1835–1908) became the first president of the Republic. Material prosperity from 1902 to 1906 was very great; but various political, social and economic conditions led once more to revolution. Congress neglected to pass certain laws required by the constitution regarding municipal autonomy, independence of the judiciary, and congressional representation of minority parties. The preliminaries of the elections of Dec. 1905 and March 1906 being marked by frauds and injustice, the Liberals deserted the polls at those elections, and instead of appealing to judicial tribunals controlled by the Moderates, issued a manifesto of revolution on July 28, 1906. This insurrection rapidly assumed large proportions. The government was weak and lacked moral support in the whole island. After repeated petitions from President Palma for intervention by the United States, commissioners were sent from Washington to act as mediators.

All possible efforts to secure a compromise that would preserve the republic failed. The president resigned (on Sept. 28), congress dispersed without choosing a successor, and as an alternative to anarchy the United States was compelled to proclaim on Sept. 29, 1906, a provisional government,—to last "long enough to restore order and peace and public confidence," and hold new elections. The insurrectionists promptly disbanded. Government was maintained under the Cuban flag,—the diplomatic and consular relations with even the United States remained outwardly unchanged; and the regular constitutional forms were maintained so far as possible. No use was made of American military force save as a passive background to the government. The first effort was simply to hold the country together, without undertaking much that could divide public opinion; and later to establish a few fundamental laws which, when intervention ceased, should give greater simplicity, strength and stability to a new native government. These laws strictly defined the powers of the president; more clearly separated the executive departments, so as to lessen friction and jealousies; reformed the courts and administrative routine; and increased the strength of the provinces at the expense of the municipalities. On Jan. 28, 1909, the American administration ceased, and the republic was a second time inaugurated, with Gen. José Miguel Gómez (1858–1921) as president and Alfredo Zayas as vice-president. Both were Liberals. The last U.S. troops were withdrawn April 1, 1909.

Gómez remained in office until May 20, 1913. His term was marked by a return to the traditional political evils of the former Spanish colony; but though the government was corrupt the country prospered and public works were developed. Among a number of political disturbances the race war of 1912 was the most serious. This was a Negro uprising in Oriente which, however, was quickly suppressed; a body of U.S. marines was landed for the protection of foreign nationals and their property. Owing to friction within the Liberal party the Conservative candidate, Gen. Mario G. Menocal, was elected in 1912 and took office in 1913.

Charges of maladministration and dictatorial methods were persistently brought against Menocal's government, which was unable, furthermore, to show much in the way of positive achievement. Nevertheless, the first three years of his term were moderately successful. Menocal was again a candidate in 1916, and won the election by the employment of violence and other improper methods. In consequence there was a serious civil war under the leadership of Gómez in Feb. 1917, but Menocal was able to defeat his opponents and entered upon his second term. Meanwhile, Cuba had declared war on Germany on April 7, 1917. Great help was rendered through stimulating the production of sugar for sale to the Allies. In anticipation of the elections of 1920 Gen. Enoch H. Crowder of the U.S. army was invited in 1919 to draw up an election law. This he did, but the law was flagrantly disregarded in the ensuing elections. Alfredo Zayas, who had been the Liberal candidate in 1916, was now backed by Menocal in a Conservative-Popular alliance against Gómez, who was nominated by the Liberals. Zayas was successful but Gómez raised a protest, and new partial elections were called for at the suggestion of Gen. Crowder. Gómez withdrew before they could be completed, asserting that the government methods were unfair, and Zayas had an easy victory.

Meanwhile, Cuba had enjoyed phenomenal prosperity in 1919, but this was followed by a severe financial crisis in the depression of 1920–21. Despite a moratorium many banks and other business concerns became bankrupt. Because of the financial difficulties President Zayas, who went into office on May 20, 1921, was at first amenable to suggestions for reform made by the U.S. government. A loan of $50,000,000 was approved by the United States and floated in Jan. 1923, and finances rapidly improved. The Cuban war loan of $10,000,000 was liquidated and the year 1922–23 closed with a surplus. But with the return of prosperity in 1923 President Zayas broke away from his advisers, and his political improprieties led to the formation of the Veterans' and Patriots' association, whose reform movement was badly mismanaged and failed in the abortive revolution of April–May 1924. Zayas would not indulge in the violence of his predecessor, however, and when he was defeated by Menocal for the Conservative nomination, made a pact with Gen. Gerardo Machado, the Liberal candidate, to assist him against Menocal in the presidential election of 1924. Machado assumed office on May 20, 1925 and was re-elected on Nov. 1, 1928. Amendments voted by congress in June 1927, and approved by a constitutional convention on May 9, 1928, provided that the president's term be increased from four to six years and that he be ineligible for re-election; abolished the office of vice-president; increased the term of senators from six to nine years, and of representatives from two to six years, with national elections to be held every three years. The franchise was extended to all males over 21.

Political opposition, allayed by an adroit distribution of patronage in 1928, revived against President Machado as the economic depression deepened. The Chadbourne agreement of Dec. 1930 failed to stabilize the price of sugar and no substantial relief came from the public works program. Repressive measures, instead of silencing opposition, incited a violent outbreak and ruthless execution without civil trial was resorted to as the army maintained the government. At this point the good offices of the new United States ambassador, Sumner Welles, were accepted, a general amnesty was declared and constitutional and political reforms were undertaken. But the economic crisis would not wait and a general strike in Aug. 1933 forced Machado to flee the country.

A combination of parties named Dr. Carlos Manuel de Céspedes as provisional president and set aside the constitution of 1928. But the rank and file of the army revolted against its officers and joined with a radical group of Havana University students to set up a revolutionary Junta with Dr. Grau San Martín at its head.

After four months of intermittent and bloody strife, during which time the United States refused recognition of any government, Dr. Grau, deserted by some of the students and faced with renewed strikes, retired, and the Junta shortly thereafter, Jan. 17, 1934, surrendered power to Col. Carlos Mendieta, upon whom all parties agreed to confer the presidency. Recognition was promptly granted by the United States and other countries.

Disorder and strikes continued to prevail, but Mendieta and his chief of staff, Fulgencio Batista, asserted their dictatorial authority more frankly and postponed the election until Dec. 1935. As commander in chief of the army, Batista continued to rule Cuba through a succession of presidents (José Barnet, Dec. 1935–May 1936; Miguel Gómez, May 1936–Dec. 1936; Federico Laredo, Dec. 1936–Oct. 1940). In the presidential elections of July 14, 1940, Col. Fulgencio Batista Zaldivar, candidate of a Socialist-Democratic coalition of seven parties, defeated his opponent—ex-president Ramón Grau San Martín. With his inauguration on Oct. 10, 1940, Batista's administration co-operated closely with the U.S. The political scene has been dominated by problems associated with the war. Cuba declared war against Japan on Dec. 9, 1941, and against Germany and Italy on Dec. 11. The Declaration of the United Nations was signed by the Cuban ambassador to the United States on Jan. 1, 1942, and diplomatic relations were established with the soviet union in October of that year. (C. E. Ch.; G. M. McB.; R. W. Rd.)

Agriculture.—Cuba is predominantly an agricultural country: approximately 50% of the gainfully employed population is engaged in agriculture and more than 90% of the total exports are derived directly or indirectly from the soil. It is estimated (1940) that farm lands occupy slightly more than 55% of the total area, the cultivated area being 25% of the farms or 14% of the whole. Although the average size of a farm in 1930 was 188 ac., nearly one-third of the farms were less than one *caballería* ($33\frac{1}{3}$ ac.) and more than 70% were less than three *caballerías*. The greatest number of small farms is in the province of La Habana; the large cattle ranches and sugar centrals are most numerous in the province of Camagüey. It was estimated in 1940 that of the cultivated area 57% was devoted to sugar, 10% to bananas and plantains, more than 7% to corn, nearly 4% to coffee and slightly less than 3% to tobacco. About 14% of the total area of the island was classified as permanent pasture and wasteland. Of the 87,396 farms in Cuba reported in the census of 1930, 32,314 (32% of the cultivated farm acreage) were operated by owners, 44,284 (less than 29% of the cultivated acreage) were rented either on a cash or share basis, and 10,798 (nearly 40% of the cultivated acreage) were operated by administration, *i.e.*, hired managers and labourers.

Sugar has been the dominant crop in Cuba since the end of the 18th century. In addition to occupying more than one-half of the total land under cultivation, sugar and sugar products accounted for 75% of the value of all exports in 1940 and 82% of the export value of all agricultural products, including meat and hides. But dependence on one crop began to cause serious economic difficulties in Cuba as early as 1925, when world production of sugar began to exceed demands. After 1926 "Cuba has experimented with restricted production, delayed production, and market quotas; it has had pools and cartels, single sellers and a near valorization scheme; it has acted unilaterally and has sought international co-operation; and it has experienced spasms of complete laissez-faire." (*See* Foreign Policy Assoc., Commission on Cuban Affairs, *Problems of the New Cuba,* 1935). Under the United States quota system (Jones-Costigan act of 1934, superseded by the Sugar Quota law of 1937) and the adoption of flexible tariff provisions, the Cuban sugar industry, controlled by the Instituto Cubano de Estabilización del Azúcar, has enjoyed substantial benefits. During World War II the industry has been further benefited by increases in quotas and prices and the removal of tariffs. These are temporary measures, however, designed to help Cuba help itself; the success or failure of the United States policy with regard to Cuban sugar rests largely on Cuba's ability to revise and strengthen its economic, political and social structures. During and after the war of 1868–78, many families emigrated and were ruined; the ownership of plantations largely passed from Cubans to Spaniards. About 1885 began an immense development of centralization. Plantations have increased greatly in size (and also diminished in number), and extraction instead of being carried on on all plantations has been (after 1880) concentrated in comparatively few centrals. In 1941 there were 158 active sugar mills (16 inactive ones), 112 of which were in the provinces of Las Villas, Oriente and Camagüey. Of these more than 55% were owned or controlled by United States interests, slightly less than 22% Cuban, nearly 14% Spanish, and less than 5% Canadian. Prior to 1902 the production of sugar exceeded 1,000,000 tons only twice—in 1894 and 1895. Following the resuscitation of the industry after the Spanish-American War, the island's crop rose steadily from one-sixth to a full quarter of the total cane sugar output of the world. Of the total world production of nearly 40,000,000 tons in 1940, Cuba produced more than 3,000,000 tons, about four-fifths of which was exported to the United States. In 1941 Cuba produced (in addition to some 440,000,000 gal. of molasses and invert sirups, 34,600,000 gal. of alcohol and 7,700,000 gal. of cane brandy and rum) 2,695,827 tons of sugar.

Tobacco, the second most important export crop grown in Cuba, is noted throughout the world for its fine quality in the manufacture of cigars. The principal producing regions, identified according to the type of tobacco grown in each region, are Vuelta Abajo, in the province of Pinar del Río; Semi-Vuelta, adjoining the Vuelta Abajo on the east; Partido, mostly in La Habana province; Remedios, largely in Las Villas province but extending eastward into Camagüey province; and Oriente. Measured in terms of the number of farms, acreage, production and quality of the tobacco grown, the most important regions are Vuelta Abajo and Remedios, which together accounted for about 93% of the total tobacco produced in Cuba in 1941. In that year there were 4,435 tobacco farms (5,025 in 1940), ranging in area from 4 to 6 ac. per farm in the Partido region to about 26 ac. in the Remedios region. Practices with respect to the operation of farms vary considerably within and between regions. Farms in the Vuelta Abajo region are operated for the most part by owners, whereas in the Remedios region tenant farming on a share basis is the common practice. Farms are also owned by tobacco manufacturers and are operated by administration. Seedbeds are planted in August and September and transplanting begins toward the end of October. Harvesting, which begins as early as December, is usually completed in February. In order to produce mild tobacco, having a light colour and fine texture, much of the cigar wrapper leaf is grown under cloth. This is particularly true in certain districts in the Vuelta Abajo and throughout most of the Partido region. The use of commercial fertilizers and irrigation is confined to these same regions, and is closely correlated with the areas in which tobacco is grown under shade. Of the 56,219,000 lb. of tobacco produced in Cuba in 1940, 26,359,000 lb. of unmanufactured tobacco were exported, 383,000 lb. were used in the manufacture of cigars for export, and 21,971,000 lb. were reserved for domestic consumption. The total value of tobacco exports in 1940 was more than $12,000,000, or nearly 10% of Cuba's total exports. Approximately one-half the quantity or three-fourths the value of exports of unmanufactured tobacco is normally imported by the United States.

Coffeegrowing first attained prominence with the settlement in eastern Cuba, in the 18th century, of French immigrants from Santo Domingo. Coffee is grown in three widely separated regions in Cuba, but the mountainous districts of eastern and southern Oriente province are still of major importance, accounting for more than 85% of the total production. From 12% to 14% of Cuba's coffee is produced in the mountainous area between Cienfuegos and Trinidad in Las Villas province, and about 1% is grown in Pinar del Río province. Cuba's production of coffee is relatively small (59,256,000 lb. in 1941), but is sufficient to meet domestic needs and permits an average annual export (mostly to the United States) of more than 16,000,000 lb.

The production of fruit for export is Cuba's third largest agricultural industry, although it is small in comparison to that of sugar and tobacco. Among the fruits exported are bananas, pineapples (fresh and canned), grapefruit, avocados, guava products, plantains, papayas and limes. Of these, bananas and pineapples are the most important, together accounting for more than 80% of the value of the total fruit exports in 1940. These and many other tropical fruits, including coconuts, are grown widely for domestic consumption, but fruits grown for export are limited largely to accessible areas having suitable soils. Bananas for export are grown exclusively in two regions in the province of Oriente: the hill country surrounding Baracoa and the Nipe region on the north coast. Both of the fungus diseases (Panama disease and sigatoka) which are prevalent in most of the banana-producing areas in the Caribbean countries are affecting the plantations in Cuba. Although pineapples are grown in all the provinces, Pinar del Río province had, in 1939, nearly 60% of the total acreage and produced more than 55% of the crop. Other important producing regions are in the provinces of La Habana and Camagüey.

In addition to crops produced primarily or exclusively for domestic consumption, such as corn, rice, beans, peas, sweet potatoes, yams, white potatoes, onions, yuca, malanga, plantains and peanuts, Cuba produces appreciable quantities of winter vegetables for export to the United States. Crops normally grown for export include tomatoes, lima beans, eggplant, green peppers, okra and cucumbers. Exports of these and other fresh vegetables averaged $1,341,000 annually in the period 1936–40. Winter vegetables are grown chiefly in the western provinces and in the Isle of Pines.

From the earliest years of Spanish occupation until the Cuban War of Independence (1895) cattle breeding was a thriving industry. During the war the number of cattle was reduced from more than 3,000,000 head to about a quarter that number. Subsequent censuses, however, showed a steady recovery from this situation, there being more than 5,000,000 head of cattle in Cuba in 1940. Cattle are raised throughout the island, but are particularly numerous on the poorer lands in the east-central part. The climate permits pasturing the year round and cattle rarely get any feed other than pasture. Cuba produces sufficient quantities of beef and dairy products for its own needs and even has small surpluses for export. Oxen for draught purposes, horses, mules, and relatively insignificant numbers of hogs, sheep and goats are also raised.

Manufactures.—Only about 20% of all wage earners in Cuba are engaged in manufacturing and the mechanical trades. The leading manufactures are principally connected with the sugar and tobacco industries; nonagricultural industries employed about 32,000 people in 1939 and evaluated production at $64,000,000. The value of forest products (lumber, poles, posts, railroad ties, firewood and charcoal) in 1939 amounted to $4,402,000. Industrial products manufactured chiefly from raw materials produced in Cuba include sugar, molasses, sirups, rum, cane brandy, alcohol, cigars, cigarettes, cigar boxes, sponges, cement, cordage, salt, dressed hides, dairy products and canned goods. Scores of other products, such as paint, soap, shoes, hats, clothing, cotton cloth, burlap and cotton sacks, paper and matches, are made from domestic raw materials and imported raw and processed materials.

Mining.—Mining for precious metals ceased at a very early date, after rich discoveries were made on the continent. The mining of iron, copper, manganese and chromium, however, is of considerable importance, and the estimated reserves of these and other minerals, particularly petroleum, hold great promise for the future. Iron ore is particularly abundant and accessible, and is mined chiefly at Daiquiri (the most famous of Cuba's iron mines), Nipe and other places in Oriente province. Total Cuban reserves are estimated at 3,500,000,000 tons, 90% of which are held in reserve by United States steel interests. The Cobre copper mines near Santiago de Cuba were once the richest in the world, but the Matahambre mine on the north coast in Pinar del Río province has been more productive, producing more than $150,000,000 worth of ore in the period 1913–42. Cuba is the second largest producer of manganese in Latin America; this is mined mainly near La Maya and El Cristo in Oriente province. Following the outbreak of World War II mineral production in and exports of minerals from Cuba were changed somewhat to conform with the needs of the United Nations for strategic minerals. With virtually all exports going to the United States, Cuba exported 31,300 tons of copper, 80,350 tons of iron, 179,800 tons of chromium, 277,026 tons of manganese and more than 2½ tons of tungsten in 1941.

Commerce.—In 1904–08 exports and imports averaged $192,313,000 annually; in 1914–18, $491,744,000; in 1924–28, $589,799,000; in 1934–38, $243,408,000 and in 1941, $345,398,000. Sugar, tobacco and a few other farm products constitute almost all exports; imports are primarily manufactured products, although agricultural commodities constitute about one-fourth the average value of imports. After 1901 the balance of foreign trade has been in Cuba's favour, the value of imports averaging about 70% of the value of exports. Out of $211,507,591 worth of exports from Cuba in 1941, the United States took $181,220,419, while the United Kingdom was in second place with $16,759,757. The same year the United States furnished Cuba with $117,110,950 worth of imports out of a total of $133,890,137, while the United Kingdom was again placed second with $3,416,295. In 1936–40, United States trade with Cuba was greater than with any of the other American republics.

Communications.—No part of the island is far distant from some one of a great number of excellent harbours, the principal ones being Antilla, Banes, Baracoa, Caibarién, Cárdenas, Cienfuegos, General Peraza, Gibara, Guantánamo (location of U.S. naval base), Havana, Júcaro, Manzanillo, Mariel, Matanzas, Nueva Gerona, Nuevitas, Puerto Padre, Santa Cruz del Sur, Santiago de Cuba and Trinidad. All of these are connected with the interior either by railroads or roads, or both. In normal times all are visited regularly by foreign vessels; coastwise trade is carried on between these and a great number of lesser but serviceable harbours. In 1941, 8,158 vessels (30,310,114 gross tons) engaged in foreign trade entered and cleared all ports, while 7,774 vessels (1,967,252 gross tons) carried on coastwise traffic. In 1941 it was estimated that Cuba had more than 3,600 miles of roads, about 1,500 miles of which were only suitable for ox-drawn carts. The most notable road is the central highway (713 miles), extending from Pinar del Río to Santiago de Cuba and built by the government at a cost of $75,000,000. This was opened to traffic in 1931. The Cuban department of public works is planning an extensive road-building program which will provide sorely needed transportation facilities to many of the isolated rural regions.

Cuban railway history dates from 1834, in which year Ferdinand VII of Spain authorized the borrowing of 2,000,000 pesos from England for the purpose of building a railroad from Havana to Güines. The first section of this road (Havana to Bejucal) was opened in Nov. 1837. This was the beginning of what is the largest railroad in Cuba—the United Railways of Havana and Regla Warehouses, Ltd. (British-owned)—operating more than 46% of the common carrier trackage and serving all of the larger ports and cities in the provinces of Pinar del Río, La Habana, Matanzas and the western part of Las Villas. The second major development in rail transportation, designed to develop the eastern provinces, began in 1902 with the completion of a line from Santa Clara to Santiago de Cuba. A vast network of rails, representing about 35% of the common carrier trackage, and operated by the Consolidated Railways of Cuba (mostly owned by United States interests), covers large parts of the provinces of Las Villas, Camagüey and Oriente. At least 16 other common carrier railways, operating a total of about 700 mi. of track, are scattered throughout the six provinces. On June 30, 1940, the total length of common carrier trackage in Cuba was 3,152 mi., in addition to which there were about 700 mi. of yard track and sidings, some 5,000 mi. of private railways (mostly serving the larger sugar estates) and approximately 250 mi. of electric railways. Cuba is served by inter-regional air lines operated by Pan American Airways and Koninklijke Luchtvaart Maatschappij (Dutch); domestic service from Havana to Cienfuegos, Camagüey, Manzanillo, Santiago de Cuba, Guantánamo, Antilla, Preston, Cayo Mambí and Baracoa is maintained by the Compañía Nacional Cubana de Aviación, a subsidiary of Pan American Airways.

The telegraph (374 offices and 3,545 mi. of line in 1941) and telephone systems are owned by the government. Telephone service (59,870 telephones in Dec. 1940) reaches virtually every section of the country, and long-distance connection is possible with the United States and the United Kingdom. Cable service, too, is maintained between Cuba and the above countries. In 1941 there were seven radio-telephone stations operated by the government, in addition to which there were 84 commercial long-wave and 15 short-wave broadcasting stations. It was estimated in 1943 that there were more than 250,000 radio receiving sets in the republic.

Population.—The census of 1887 showed a population of 1,631,687; that of 1899 a population of 1,572,792 (decrease of 3.6% is explained by the intervening war); that of 1907, 2,048,980; that of 1919, 2,889,004; and that of 1931, 3,962,344. According to the general census of 1943, the population was 4,778,583. The average number of inhabitants per square mile in the six provinces is as follows: Camagüey, 47.9; Pinar del Río, 76.5; Oriente, 96.0; Matanzas, 110.8; Las Villas, 113.5; and La Habana (includes the Isle of Pines), 389.4. The average density of population for the entire country is 108.1 persons per square mile. The 1943 census lists 14 cities having a population of more than 25,000—Havana, 659,883; Marianao, 120,163; Santiago de Cuba, 118,266; Camagüey, 80,509; Matanzas, 54,844; Santa Clara, 53,981; Cienfuegos, 52,910; Guantánamo, 42,423; Cardenas, 37,059; Manzanillo, 36,295; Holguín, 35,865; Guanabacoa, 30,287, Sancti Spiritus, 28,262; Pinar del Rio, 26,241.

The aboriginal (Indian) population of Cuba was decimated so rapidly and completely during the first years of Spanish occupancy that a mestizo population never developed on the island. In the place of Indians and mestizos there is a large Negro and mulatto population, descendants for the most part of the hundreds of thousands of Negro slaves which were imported over a period of more than 350 years. Miscegenation of Negroes and whites was extremely common prior to the formal abolition of slavery in 1886. From the standpoint of racial composition and culture Cuba also differs from many of the other Latin American republics in that the number of Spaniards in relation to the total population is very large. The composition of the population, according to the census of 1931, was as follows: Cuban white and mulatto, 2,278,288; Cuban coloured, 925,297; Spaniards, 613,970; Haitians, 79,838; Jamaicans, 40,471; Chinese, 24,480—the latter being largely the descendants of contract labourers brought to Cuba in the early part of the 19th century. It is officially estimated at the present time (1944) that 75% of the population is white (approximately one-third of which is mulatto), 24% coloured, and 1% Mongoloid (mostly Chinese). In Dec. 1941 there were 334,033 unnaturalized foreigners registered in the republic. Of these, 187,183 were Spaniards, 64,988 Haitians, 29,444 Chinese, 27,602 British and 9,607 were citizens of the United States.

Constitution.—The constitution which was framed during United States military occupancy and accepted on June 12, 1901, was replaced by a new constitution on Oct. 10, 1940. Under the new constitution, the president of the republic, who is elected for a period of four years by the direct vote of the people, cannot succeed himself in office, and is ineligible for re-election for a period of eight years. The executive powers of the president are exercised with the assistance of a cabinet (*Consejo de Ministros*).

whose members the president appoints and removes freely, their number (17, including four without portfolio) being determined by law. The president sanctions, promulgates and executes the laws, and supplements them (partly co-ordinately with congress) by administrative regulations; holds veto and pardoning power; controls with the senate political appointments and removals; conducts foreign relations, submitting treaties to the senate for ratification; and is commander in chief of the armed forces of the republic. Congress consists of two houses. The senate contains nine members from each province, elected for four years by direct vote; candidates for the office are ineligible if they have been on active duty in the armed forces within two years of the date of their candidacy. The senate is the court of trial for the president, ministers of the government and provincial governors when accused of political offenses. It also acts jointly with the president in political appointments and treaty making. The house of representatives is composed of one member for every 35,000 inhabitants or fraction thereof in each of the provinces, the number being determined by the latest official national census. Members are elected by direct vote, one-half retiring every two years. The house of representatives has the special power of impeaching the president and ministers of government. Both houses hold regular sessions at the same time, twice a year, the first beginning the third Monday in September and the second commencing the third Monday in March. Each session of congress lasts not less than 60 days. The powers of congress are extensive, including, in addition to ordinary legislative powers, control of financial and foreign affairs and the power to declare war and approve treaties of peace.

The constitution of 1940 provides for a centralized republic of six provinces—Pinar del Río, La Habana, Matanzas, Las Villas, Camagüey and Oriente. Each has a provincial governor and assembly chosen directly by the people, generally charged with independent control of matters affecting the province; but the president may interfere against an abuse of power by either the governor or the assembly. Municipalities are administered by mayors (*alcaldes*) and assemblies elected by the people, and control strictly municipal affairs. The *término municipal* is the chief political and administrative civil division. It is an urban district together with contiguous rural territory. Its divisions are *barrios*. The president may interfere if necessary in the municipality as in the province; and so may the governor of the province. But all interference is subject to review of claims by the courts. Both provinces and municipalities are forbidden by the constitution to contract debts without a coincident provision of permanent revenue for their settlement.

The franchise is granted to all citizens of Cuba over 21 years of age not mentally incapacitated nor convicted of crime nor serving in the armed forces nor on the police force. A foreigner may become a naturalized citizen after five years of continuous residence, or he may gain citizenship in a shorter period of time by marrying a citizen of Cuba. The government may not subsidize any religion. Provisions regarding labour protection and social security are among the most advanced in Latin America.

Primary education is compulsory and supported by the state. All schools supported by the state, province or municipality, except universities and schools offering specialized pre-university studies, are free. Teachers in the primary schools must receive their training in one of the normal schools supported by the state, or from the "schools of pedagogy in the universities." Included in the school system of Cuba are kindergartens, lower primary schools (six years), higher primary schools (three years), secondary schools (four years), normal schools, various types of special rural, vocational and adult training centres, and the University of Havana. Data on enrolments and the number of schools in each category differ as a result of the arbitrary groupings which are frequently made. Ofelia Morales (see *Educational Yearbook of the International Institute of Teachers College*, Columbia University, 1942) cites the following statistics on schools and enrolments for an unspecified but presumably recent year: 565 urban kindergartens attended by about 31,000 children; 4,227 urban and semi-urban lower primary schools with an average attendance of 437,965 pupils; 37 urban higher primary schools with 7,741 pupils; 1,113 civic-rural lower primary schools with 57,050 pupils; 40 rural boarding schools for children (*hogares infantiles campesinos*—a type of higher primary school of prevocational character), each with 100 pupils; 24 secondary schools with 18,664 pupils; two schools for the preparation of kindergarten teachers with an enrolment of 475 students; and six normal schools with an enrolment of 3,087 students. In the field of vocational education there are four schools of arts and trades with 1,600 students; two technical industrial schools (one for boys with 331 students, and one for girls with 122 students); an unspecified number of schools of commerce attended by about 3,000 students; and six provincial schools of agriculture (*granjos agrícolas*). Adult education is given in 144 public night schools, while more than 40,000 adults in rural areas attend evening classes held twice a week in the civic-rural schools. The University of Havana (founded 1728), which enjoyed autonomy from 1937 on, had 13,949 students enrolled in 1941. (R. W. Rd.)

Finance.—In 1891–96 the average annual income was $20,738,930, the annual average expenditure $25,967,139. More than half of the revenue was derived from customs duties. Every Cuban paid about twice as heavy taxes as a Spaniard of the peninsula. Very little was spent on sanitation, roads, other public works and education. Lotteries, which were an important source of revenue under Spain, were abolished under the republic. The debt resting on the colony in 1895 (a large part of it as a result of the war of 1868–78, the entire cost of which was laid upon the island, but a part as the result of Spain's war adventures in Mexico and Santo Domingo, home loans, etc.) was $168,500,000. The attainment of independence freed the island from this debt, and from enormous contemplated additions to cover the expense incurred by Spain during the last insurrection. After that time the public finances have greatly improved, with enlarged income and all foreign expenditures eliminated. The consolidated public debt on June 30, 1942, exclusive of the floating debt, was $120,995,000, itemized as follows: foreign debt, $113,628,000, and domestic debt, $7,367,000. The following table shows the national revenue and expenditure for the years 1938–39 to 1943:—

	Revenue	*Expenditure*
1938–39	$83,250,000	$83,173,788
1940	75,670,000	79,238,000
1941	75,945,000	77,549,000
1942	89,960,000	89,956,000
1943	89,375,000	89,994,080

In 1939 the fiscal year was changed to coincide with the calendar year, but this change was reversed in Nov. 1941, and the fiscal year again runs from July 1 to June 30. United States and British investments, always important in the agriculture and manufactures of the island, greatly increased following 1898, and by 1940 amounted to $559,797,000 for the United States and (1942) £26,970,685 for the British. United States investments were $80,000,000 in 1901. While most of the United States money is in sugar, there are also large sums in tobacco, mining, fruit, railways, streetcar companies, docks, electric light and power companies, telephone companies, banks, hotels, steamship lines and Cuban bonds. Under a law of Nov. 7, 1914, a Cuban coinage system similar to that of the United States was introduced. Par value of the peso is $1 U.S. currency; the average exchange rate was 90 cents in 1940.

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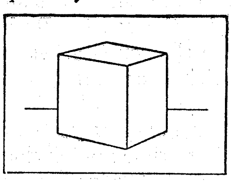
(C. E. CH.; G. M. MCB.; R. W. RD.)

CUBATURE: *see* QUADRATURE.

CUBE, a regular solid with six square faces; that is, a regular hexahedron. Since the volume of a cube is expressed, in terms of an edge, as e^3, in arithmetic and algebra the third power of a quantity is called the cube of that quantity. That is, 3^3, or 27, is the cube of 3; and x^3 is the cube of x.



A number of which a given number is the cube is called the cube root of the latter number; that is, since 27 is the cube of 3, 3 is the cube root of 27—symbolically, $3=\sqrt[3]{27}$. A number that is not a cube is said to have a cube root, the value being expressed approximately; that is, 4 is not a cube, but we speak of the cube root of 4, $\sqrt[3]{4}$, the approximate value being 1.587, because 1.587^3 is approximately 4. In Greek geometry the duplication of the cube was one of the most famous of the unsolved problems. It required the construction of a cube that should have twice the volume of a given cube. This has been proved to be impossible by the aid of the straight edge and compasses alone, but the Greeks were able to effect the construction by the use of higher curves, notably by the cissoid of Diocles (*see* CURVE). Hippocrates (*c.* 430 B.C.) showed that the problem reduced to that of finding two mean proportionals between a line segment and its double; that is algebraically, to that of finding x and y in the proportion $a:x=x:y=y:2a$, from which $x^3=2a^3$, and hence the cube with x as an edge has twice the volume of one with a as an edge.

CUBEBS, the fruit of several species of pepper (*Piper*), family Piperaceae. The cubebs of pharmacy are produced by *Piper Cubeba*, a climbing woody shrub indigenous to south Borneo, Sumatra, Prince of Wales island, and Java. The cubeb is cultivated in Java and Sumatra, the fruits are gathered before they are ripe, and carefully dried. Commercial cubebs consist of the dried berries, usually with their stalks attached; the pericarp is grayish-brown, or blackish and wrinkled; and the seed, when present, is hard, white and oily. The odour of cubebs is agreeable and aromatic; the taste, pungent, acrid, slightly bitter and persistent. About 15% of a volatile oil is obtained by distilling cubebs with water; after rectification with water, or on keeping, this deposits rhombic crystals of camphor of cubebs, $C_{15}H_{26}O$; cubebene, the liquid portion, has the formula $C_{15}H_{24}$. Cubebin, $CH_2[O]_2C_6H_3 \cdot CH : CH \cdot CH_2OH$, is crystalline and may be prepared from cubebene, or from the pulp left after the distillation of the oil. The drug, along with gum, fatty oils, and malates of magnesium and calcium, contains also about 1% of cubebic acid, and about 6% of a resin.

The volatile oil—oleum cubebae—is the form in which this drug is most commonly used, the dose being 5 to 20 minims, which may be suspended in mucilage or given after meals in a cachet. The drug has the typical actions of a volatile oil, but exerts some of them in an exceptional degree. Thus it is liable to cause a cutaneous erythema in the course of its excretion by the skin; it has a marked diuretic action; and is an efficient disinfectant of the urinary passages. Cubeb is often used in the form of cigarettes for asthma, chronic pharyngitis and hay-fever and in lozenges for use in bronchitis. It is also given in gonorrhoea, where its antiseptic action is of much value.

CUBE ROOT: *see* Root.

CUBIC CURVE: *see* Curve.

CUBICLE, a small chamber containing a couch or a bed. The rooms opening into the atrium of a Roman house are known as cubicula. In modern usage, a cubicle is one of the small separate bedrooms or cells into which a dormitory may be divided; or similarly separated space, as in a library, for private study.

CUBITT, THOMAS (1788–1855), English builder, was born at Buxton, near Norwich, on Feb. 25, 1788. He was responsible for many splendid ranges of London houses, such as Tavistock, Gordon, Belgrave and Lowndes squares and the district of South Belgravia, and was one of the originators of Battersea Park, the first of the people's parks. He died at Denbies, near Dorking, on Dec. 20, 1855.

CUBITT, SIR WILLIAM (1785–1861), English engineer, was born in 1785 at Dilham in Norfolk, where his father was a miller. Among his works were a number of canals, including drainage sluices, besides docks and coal drops, and the S.E. railway, of which he was chief engineer. He was consulted by foreign governments and municipalities, and reported on the construction of the Paris and Lyons railway. He was knighted for his services in connection with the buildings erected in Hyde Park for the exhibition of 1851. He died on Oct. 13, 1861.

CÚ CHULAINN, the chief hero of the second of the three cycles of ancient Irish mythology. He is closely associated with the warriors who centre in Conchobar mac Nessa, the Ultonian king; but although he is represented as being a son of Dechtire, the king's sister, he is racially distinct from them, for he is usually represented as short in stature and of dark complexion. According to one story, he was son of Sualtam, a minor warrior of the Conchobar cycle; according to another, he was a son and incarnation of the sun-god Lug. His first name, Setanta, can hardly be dissociated from that of the Setantii, a Brythonic people situated at the mouth of the Mersey. He joined the court of Conchobar at the age of six, and even then distinguished himself in deeds of prowess; he killed the watch-dog of the smith Culann, and acted as guard in its stead; whence his most familiar name, Cú Chulainn, "the Hound of Culann." He studied the art of the warrior with Scáthach, a she-warrior in Alba; married Emer, daughter of Forgall, and settled in Dún Delgan (Dundalk). The earthwork there called "Cú Chulainn's fort" is, however, merely a Norman motte. He was the foremost champion of Ulster in the great raid described in the tale *Táin Bó Cúalnge* ("The Cattle-raid of Cooley"), in which he single-handed held back the advancing hosts of Connacht. He was slain at the age of 27 by Lugaid, son of Cú-Roí mac Daire, warrior of Munster. But whatever may be the historical basis of the legend, practically all the details about Cú Chulainn transmitted to us must be regarded as mythical.

The chief tales about Cú Chulainn which have been preserved have been collected in translations by various hands by E. Hull, *The Cuchullin Saga* (1898). *See* also Windisch's edition (Leipzig, 1905) and Dunne's translation (1914) of *Táin Bó Cúalnge;* as well as the relevant sections of Thurneysen's *Die irische Helden und Königsage* (Halle, 1921). (R. A. S. M.)

CUCKOO, a well-known bird, distributed during the breeding season over most of Europe and Northern Asia; in many languages its name is derived from its frequently repeated call. Its abnormal breeding habits have made it the subject of much controversy among ornithologists. The fact that it was parasitic on other birds in the early stages of its life was known as far back as the time of Aelian, yet it is only within the last 50 years that the details have been gradually worked out and there are still some obscure points.

The common cuckoo, *Cuculus canorus,* Linn., winters in Africa south of the Sahara, India, the Malay Peninsula, south China and New Guinea. On the south coast of England it usually arrives about the second week of April. On the Continent many pass beyond the Arctic circle to the tree limit in north Finland. The bird itself is far oftener heard than seen. Its bluish colour, barred breast and long tail suggest a likeness to the sparrow-hawk (*Accipiter nisus*) and it is no uncommon sight to see it mobbed by small birds in the neighbourhood of a nest.

Breeding Habits.—On reaching its breeding grounds each female cuckoo asserts a claim over a definite territory, which varies in size with pressure from other competitors and the amount of food and fosterers' nests available. If another hen invades her domain, fighting takes place continually till one or the other is driven off. At least early in the season, each hen is usually attended by two or three cock birds. These also seem to return year after year to the same districts.

In the British Isles alone 60 species have been recorded as foster parents of the cuckoo and 120 on the Continent. Out of the dozen regular fosterers in England only about six are really common.

Variation in Eggs.—It is now definitely known that each hen cuckoo lays eggs of the same type throughout her life, but eggs from different individuals show much variation. A series from Europe and Asia not only shows astonishing variability but, as first pointed out by Baldamus (*Naumannia,* 1853), many eggs show a remarkable similarity to those of the fosterers in whose nests they are found. The theory of mimicry was at first hotly disputed by many English naturalists, mainly on the ground that many cuckoos' eggs deposited in the nests of the hedge sparrow (*Prunella modularis*) show no likeness whatever to the vivid blue eggs of the host. With other common English fosterers such as the robin or pied wagtail, often no great similarity is apparent, and the occasional instances of close mimicry might be dismissed as accidental if all the evidence were derived from south England alone.

A more comprehensive view, however, leads to different conclusions. In vast forested areas of north-eastern Europe the cuckoo is mainly parasitic on the redstart (*Phoenicurus phoenicurus*), and occasionally other species, all of which lay blue, or bluish-green eggs. Here practically all cuckoos' eggs are blue. In the great reed-beds round some Hungarian lakes the normal host is the great reed warbler (*Acrocephalus arundinaceus*) and a cuckoo's egg, boldly marked with grey and black, has been evolved which closely matches the host's. Many similar instances could be quoted, but it is evident that mimicry has become general because it is useful in reconciling the fosterer to the presence of the parasite's egg.

Any theory must take into account the fact that in some districts mimicry is only occasional. Statistics derived from series of cuckoos' eggs in museums and private collections are misleading, because nests of some species are much more readily found than others. In English collections cuckoos' eggs from nests of the reed warbler and hedge sparrow are common, while those from meadow pipits' nests are less frequently found. Yet the latter is the most numerous host over the greater part of Britain. From the study of the scanty material available we find that in the meadow pipit-cuckoos mimicry is very close, but in those districts where three or four species are victimized we often meet with a "mixed type" which shares in the characters of the various fosterers, and as regards the hedge sparrow mimicry is almost lacking.

Influence of Selection.—Dismissing this last species for a moment, it appears that the fosterers have allowed only those strains of cuckoo to survive which laid eggs harmonizing more or less closely with their own, by elimination (either through desertion of the nest or ejection of the egg) of all eggs in strong contrast with their own. This process has gone on uninterruptedly where the cuckoo is parasitic on one species only, or on two or three which lay similar eggs; but in districts where two or more fosterers which lay eggs of divergent types are victimized, interbreeding between the strains of cuckoo has produced the "mixed type" which passes muster with either, but avoids close mimicry. In the case of the hedge sparrow, experiment confirms the supposition that while other species resent the intrusion of strongly contrasting eggs, this species accepts them with indifference. The intensive study of the cuckoo by Dr. E. Rey and especially by V. Čapek has shown that where close mimicry has been thus obtained the percentage of rejections by the fosterer falls to 5%, but where the host is more exacting or mimicry is less perfect it may rise to 10, 30 or even 77%. Yet in all these cases the cuckoo has obtained a foothold and some proportion of young are reared annually. There are, however, a few cases in which the cuckoo is apparently struggling with little or no success to impose her eggs on an unwilling host. (Experimental research has been carried on in Germany by Dr. Rensch and in Africa by Swynnerton on these lines.)

Method of Egg Deposition.—The method by which the cuckoo inserts her egg in the fosterer's nest is still the subject of keen controversy. The careful work of E. P. Chance, supported by the evidence of films and photographs, has proved that in the case of ground-building species such as the meadow pipit, the cuckoo takes up her position on some commanding site near a selected nest, some time before laying is due. She glides down to the nest, picks up one of the eggs with her bill, settles on the nest for five or ten seconds, during which period the egg is laid, then backs out of the nest and flies away, taking the host's egg with her and usually devouring it. The same process also takes place in most open nests in trees or bushes. In the case of small birds which make domed nests with circular openings, or breed in holes of trees or rocks, this method seems at first impracticable, though we have good evidence that the cuckoo can squeeze into a very small opening, and domed nests often show traces of damage to their superstructure by the cuckoo when inserting her egg. Levaillant's suggestion that the egg is carried in the mouth and inserted by the bill provides such a simple explanation that it has been perhaps too hastily adopted, but most of the evidence fails to stand the test of close examination, and definite proof of its adoption is still lacking. The alternative suggestion is that the egg is laid direct into the nest hole while the bird is clinging with outspread wings to the side of the nest, and that a certain measure of direction can be imparted to the egg at the moment of laying by the extrusion of the lower walls of the oviduct. Occasional instances in which a cuckoo's egg has been found lying beneath the entrance to a wren's nest are more readily explained thus than if we accept the suggestion of insertion by the bill.

Rey was the first to assume that the eggs of the cuckoo are usually laid at intervals of about 48 hours, and Chance has proved this. By systematically removing the eggs as laid and providing a succession of fosterers' nests at the necessary intervals, Chance has also proved that a single hen may lay up to 25 eggs in a season. This was in 1922, the next highest being 21 from the same bird in 1920. Under natural conditions, nests are not always available and probably the average clutch of the cuckoo consists of five to seven eggs, laid on alternate days, followed by a pause and then by a further clutch of four or five.

Ejection of Foster-brothers.—The cuckoo's egg is relatively small, and the incubation period extends for just over 12 days, so that it is frequently hatched before the foster-brothers. The young bird, blind and naked, with long fore-limbs with which it feels its way, does not rest till it has worked itself underneath its companions one by one, and backing to the edge of the nest, has thrown them out over the rim. Burdet has filmed a case in which the young were thus ejected from under a brooding redstart. No notice is taken by the parents of their dead or dying young: all their efforts are devoted to satisfying the ravenous usurper. The young cuckoo remains in the nest about 20 days, keeping up a continual metallic chirp and opening its wide orange gape frequently. Even after leaving the nest a foster parent will often alight on the back of the young bird in order to deliver food into its gaping maw, and other species have also been known to respond to the stimulus of its food-appeal. The mortality among the young is heavy: out of 34 observed by J. H. Owen, 17 failed to survive. The old birds, whose impending departure is heralded by a change of note, begin to leave England in July, and have all gone by the end of August, but the juveniles may be seen even in September.

Economic Status.—Although Collinge estimates that 83% of the food of the cuckoo consists of injurious insects, especially hairy caterpillars, which are rejected by most birds, and regards it as extremely useful, it must be remembered that every cuckoo is reared at the expense of a brood of young insectivorous birds, and monopolizes the attentions of the old birds for some five weeks in the breeding season. Cuckoos also destroy nests with incubated eggs or young in order to force the parents to lay again.

Great-Spotted Cuckoo.—In another group of cuckoos, which includes the great-spotted (*Clamator glandarius*) and the crested cuckoos (*C. jacobinus*) inhabiting southern Europe, Asia and Africa, a different type of parasitism prevails. The former species is parasitic on magpies, crows or ravens, and its eggs show a striking resemblance to the Corvine type. When hatched the young parasites (sometimes as many as three to five in one nest) do not eject their foster-brothers, and the whole family lives in harmony. It has been pointed out by the writer that striking mimicry exists between the young cuckoos and their companions. This is also the case with the Indian koel (*Eudynanys scolopaceus*) which is parasitic in a similar way on crows. All cuckoos have not adopted the parasitic habit, for the two common species of North America, the black-billed and yellow-billed cuckoos (*Coccyzus erythrophthalmus*) and (*C. americanus*) both rear their own young, as also do the road runners (*Geococcyx*) and in the old world, the coucals. Two groups, however, deserve mention on account of their abnormal habits. The ani (*Crotophaga ani*) nests socially, several females combining to build a large nest, in which they deposit their eggs together and apparently incubate side by side. The Guira cuckoo (*Guira guira*), of Brazil, Paraguay and Argentina, lays extraordinary eggs, blue with a raised network of white chalky matter. The first nest of the season is so flimsy that the eggs fall to the ground and perish, but the second is more substantial.

See E. P. Chance, *The Cuckoo's Secret* (1922); F. B. Kirkman, *British Bird Book* (for less recent work); F. C. R. Jourdain, *Proc. Zool. Soc.* 1925 (Bibl.) (F. C. R. J.)

CUCKOO-PINT, called also lords-and-ladies and wake-robin (*Arum maculatum*), the only plant of the arum family (Araceae) indubitably native to the British Isles. It is common in woods and hedgerows in England, but probably not wild in Scotland. It grows from a whitish root-stock, which sends up in the spring a few long-stalked, arrow-shaped, polished green leaves, often marked with dark blotches. These are followed by the inflorescence, a fleshy spadix bearing in the lower part numerous crowded simple unisexual flowers and continued above into a purplish or yellowish appendage; the spadix is enveloped by a leafy spathe, constricted in the lower part to form a chamber, in which are the flowers. The mouth of this chamber is protected by a ring of hairs pointing downwards, which allow the entrance but prevent the escape of small flies; after fertilization of the pistils the hairs wither. Insects visit the plant, attracted by the foetid smell, and carry the pollen from one spathe to another. As the fruit ripens the spathe withers, and the brilliant red berries are exposed. This interesting aroid occurs in various parts of Europe and also in northern Africa. Its counterpart in eastern North America is the jack-in-the-pulpit. (*See* ARACEAE, ARUM, JACK-IN-THE-PULPIT.)

CUCKOO-SPIT, a frothy secretion found upon various plants and produced by the immature stages of insects known as froghoppers, pertaining to the family Cercopidae of the order Hemiptera. The origin and formation of the froth has been much discussed. It appears that juices of the plant imbibed by the insect, when voided from the alimentary canal, become mixed with the secretion of special abdominal glands, which enables the product to maintain its foamy coherence and hold the air-bubbles which are introduced through a special valve. Cuckoo-spit is believed to protect the insects from the attacks of enemies and also from desiccation. The common cuckoo-spit insect of Europe is *Cercopis spumaria* which also occurs in North America.

More than 2,000 species of this family have been described from various parts of the world. Most of the species are small insects, but in the tropical regions some of the species are medium sized; in Africa certain species occur in enormous numbers and secrete large amounts of honey dew, which drips from the branches like rain. Such trees are called rain trees. One species, the sugar cane froghopper, *Tomaspis saccharina,* is very destructive to sugar cane in Trinidad. Another species, *Aphrophora salicis,* has been imported from Europe to North America and is sometimes a serious pest of basket and ornamental willow. In Africa, India, the East Indian Islands and Australia there is a group of froghoppers which secrete small calcareous tubes of various shapes. The nymphs live inside these tubes in a mass of spittle. The tubes resemble small snail shells and curiously enough were described as species of snails by some of the earlier zoologists. (Z. P. M.)

CUCULIDAE: *see* Cuckoo; Road-runner.

CUCUMBER (*Cucumis sativus*), a creeping plant of the family Cucurbitaceae. It is widely cultivated for its fruit and originated probably in northern India. It is a tender annual with a rough, succulent trailing stem and stalked hairy leaves with three to five pointed lobes; the stem bears branched tendrils by which the plant can be trained to supports. The short-stalked, yellow, bell-shaped flowers are unisexual, but staminate and pistillate are borne on the same plant; the latter are recognized by the swollen warty green ovary below the rest of the flower. Pollination is dependent on an outside agency such as bees. Cucumbers grown in frames or a greenhouse may be pollinated by keeping a hive nearby or inside. In Great Britain and northern Europe the cucumber is extensively grown in frames or on trellises in greenhouses because the climate is so cool that few varieties are productive in out-of-door culture. Its heat requirement is one of the highest among the common vegetables. There are three groups of varieties, based on adaptability and use: (1) very large-fruited, strong-growing varieties adapted only to greenhouse or frame culture. Several English greenhouse varieties will form fruits without pollination and seed formation, and are generally much larger than those popular in the United States; (2) large-fruited varieties grown out-of-doors for slicing or raw salads, and generally having white spines; (3) small-fruited prolific varieties grown out-of-doors principally for making pickles, and having black spines. The food value of the cucumber is low but it is popular for salads and relishes. In the U.S. relatively few cucumbers are grown under glass but they are widely grown in the field. About 4,200,000 bu. were grown annually from 1930 to 1941 for marketing fresh; and about 5,600,000 bu. for preserving in brine for making pickles, together requiring about 128,000 ac. of land. They are extensively grown in home gardens. In the open, cucumbers are planted in "hills" about 5 ft. by 5 ft. apart, with two plants per hill; or with the plants spaced singly about 2 ft. apart in rows 5 ft. apart. An excess of seed, about 2 lb. to 3 lb. per acre, is sown, and the small plants are thinned to the number desired. The Sikkim cucumber, *C. sativus* var. *sikkimensis,* is a large-fruited form, reaching 15 in. long by 6 in. thick, grown in the Himalayas of Sikkim and Nepal. The West India gherkin, *Cucumis Anguria,* has small, slender vines, and abundant small ellipsoid green fruit covered with warts and spines. It is used for pickling. (V. R. B.)

Fig. 1. — BRYONY, A HEDGE-CLIMBER WHICH BEARS SMALL GREENISH FLOWERS AND RED BERRIES
A. Male flowers. B. Female flowers

CUCURBITACEAE, a botanical family of dicotyledons, containing 90 genera and about 750 species, found in the temperate and warmer parts of the earth but especially developed in the tropics. The plants are generally annual herbs, climbing by means of tendrils and having a rapid growth. The long-stalked leaves are arranged alternately, and are generally palmately lobed and veined. The flowers or inflorescences are borne in the leaf-axils, in which a vegetative bud is also found, and at the side of the leaf-stalk is a simple or branched tendril. There has been much difference of opinion as to what member or members the tendril represents; the one which seems most in accordance with facts regards the tendril as a shoot, the lower portion representing the stem, the upper twining portion a leaf. The flowers are unisexual, and markedly epigynous, the perianth and stamens being attached to a bell-shaped prolongation of the receptacle above the ovary. The five narrow pointed sepals are followed by five petals which are generally united to form a more or less bell-shaped corolla. There are five stamens in the male flowers; the anthers open toward the outside, are one-celled, with the pollen-sacs often elaborately twisted and variously united. The carpels, normally three in number, form an ovary with three thick, fleshy, bifid placentas bearing a large number of ovules on each side, and generally filling the interior of the ovary with a juicy mass. The short thick style has generally three branches, each bearing a fleshy, usually forked stigma. The fruit is a fleshy many-seeded berry with a tough rind (*pepo*), and often attains considerable size. The embryo completely fills the seed. The family is represented in Britain by bryony (*Bryonia dioica*), (fig. 1) a hedge-climber, perennial by means of large fleshy tubers which send up each year a number of slender angular stems. The leaves are heart-shaped with wavy margined lobes. The flowers are greenish, $\frac{1}{2}$ to $\frac{3}{4}$ in. in diameter; the fruit, a red several-seeded berry, is about $\frac{1}{4}$ in. in diameter. In North America the family is represented by a few genera comprising about 40 species, which occur chiefly in the southern parts of the United States and Mexico. Among these are the climbing wild cucumber or balsam apple (*Echinocystis lobata*) and the star-cucumber (*Sicyos angulatus*), of the eastern United States and Canada; the calabazilla or mock orange (*Cucurbita foetidissima*), of the southwestern U.S. and Mexico; and the man-root (*Echinocystis fabacea*), of California.

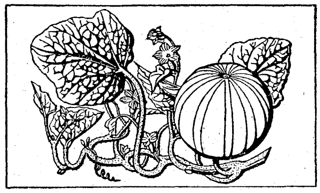


Fig. 2.—MELON, AN EDIBLE MEMBER OF THE GOURD FAMILY, SHOWING FLOWERS AND FRUIT (PEPO) AND GENERAL HABIT OF GROWTH

Many genera are of economic importance; *Cucumis* affords cucumber and muskmelon (*qq.v.*); *Cucurbita,* pumpkin, squash and marrow; *Citrullus vulgaris* is watermelon (*q.v.*), and *C. Colocynthis,* colocynth; *Ecballium Elaterium* (squirting cucumber), ejects its seeds, with a watery fluid, by the contraction of the wall of the fruit; *Sechium edule* (chocho), a tropical American species, is cultivated for its edible fruit; it contains one large seed which germinates *in situ. Lagenaria* is the gourd (*q.v.*). The fruits of *Luffa cylindrica* have closely netted vascular bundles in the pericarp, forming a kind of loose felt which supplies the well-known loofah or bath-sponge; its fruits are edible when not fully mature.

CUDAHY, an industrial city of Milwaukee county (Wis.), U.S.A., on Lake Michigan, 7 mi. S. of Milwaukee. It is served by the Chicago and North Western railway and the Pennsylvania-Central and Northwest air lines. Pop. (1940) 10,561. Its industries include a packing house, tannery and machine shops, and factories making drop forgings, bottling equipment and vinegar. Cudahy was founded in 1892 and incorporated in 1906.

CUDDALORE, a town of British India, the administrative headquarters of the South Arcot district of Madras, on the coast 125 mi. S. of Madras by the South Indian railway. Pop. (1941) 60,632. It lies low, but is regarded as exceptionally healthy. The principal exports are sugar, oilseeds and cake, and cotton goods. Trade is mostly coastal, and steamers lie 1 mi. offshore. The wharves, with a railway siding are on a backwater. Weaving and dyeing are carried on. There is a training school and an American mission. In the neighbourhood are the ruins of Fort St. David situated on the river Gadilam. As a small fort built by a Hindu merchant it fell into the hands of the Mahrattas after the capture of Gingi by Sivaji in 1677. From them it was purchased by the English in 1690, the purchase including not only the fort but the adjacent towns and villages "within ye randome shott of a piece of ordnance," and still spoken of as "cannon ball villages." The fortifications were greatly strengthened and in 1746 Fort St. David became the British headquarters for the south of India, and Dupleix' attack was successfully repulsed. Clive was appointed its governor in 1756. The French took it in 1758, abandoned it two years later, retook it, and withstood a British attack in 1783. In 1785 it finally passed into British possession.

CUDDAPAH, town and district, British India, in the Madras presidency. The town is 6 m. from the right bank of the river Pennar, and 161 m. by rail from Madras. Pop. (1941) 28,246. Once the capital of the Nawabs of Cuddapah, it is now a poor place. Hills rise on three sides, and it has a bad reputation from a health standpoint.

The district of Cuddapah has an area of 5,923 square miles. It is in shape an irregular parallelogram, divided into two nearly equal parts by the range of the Eastern Ghats, which intersects it throughout its entire length. The north, east and south-east is a low-lying plain; the other part, in the south and south-west, forms a high table-land from 1,500 to 2,500 ft. above sea-level. The chief river is the Pennar, which enters the district from Bellary on the west, and flows eastwards into Nellore. In the rains it contains a great volume of water but becomes an inconsiderable stream in the hot weather. The most interesting and ancient fort of Gurramkonda, which is supposed to have been built by the Golconda sultans, stands on a hill 500 ft. high, three sides of which consist of almost perpendicular precipices. The population of the district in 1941 was 1,056,507. The principal crops are millet, rice, other food grains, melons, groundnut and cotton. There are several factories for pressing cotton, and asbestos is worked. The district is served by lines of the Madras and the South Indian railways.

CUDWORTH, RALPH (1617–1688), English philosopher, was born at Aller, Somersetshire, the son of Dr. Ralph Cudworth (d. 1624), rector of Aller, formerly fellow of Emmanuel College, Cambridge. Cudworth was sent to his father's college, and was elected fellow in 1639. In 1642 he published *A Discourse concerning the true Notion of the Lord's Supper,* and a tract entitled *The Union of Christ and the Church.* In 1645 he was appointed master of Clare Hall and the same year was elected Regius professor of Hebrew. He was now recognized as a leader among the remarkable group known as the Cambridge Platonists (*q.v.*). The whole party were more or less in sympathy with the Commonwealth, and Cudworth was consulted by John Thurloe, Cromwell's secretary of state, in regard to university and government appointments. His sermons, such as that preached before the House of Commons on March 31, 1647, advocate principles of religious toleration and charity. In 1654 he was elected master of Christ's college, whereupon he married, and in the year 1662 he was presented to the rectory of Ashwell, Herts. In 1678 he completed and published *The True Intellectual System of the Universe: the first part, wherein all the reason and philosophy of atheism is confuted and its impossibility demonstrated* (imprimatur dated 1671). No more was published, perhaps because of the theological clamour raised against this first part. He died on June 26, 1688, and was buried in the chapel of Christ's. Much of Cudworth's work still remains in manuscript; *A Treatise concerning eternal and immutable Morality* was published in 1731; and *A Treatise of Freewill,* edited by John Allen, in 1838; both are connected with the design of his *magnum opus,* the *Intellectual System.*

The *Intellectual System* arose, so its author tells us, out of a discourse refuting "fatal necessity" or determinism. The immense fragment dealing with atheism is all that was published by its author. Cudworth criticizes two main forms of materialistic atheism, the atomic, adopted by Democritus, Epicurus and Hobbes; and the hylozoic, attributed to Strato, which explains everything by the supposition of an inward self-organizing life in matter. Atomic atheism is by far the more important, if only because Hobbes, the great antagonist whom Cudworth always has in view, is supposed to have held it. Atomism, in its purely physical application, is a theory that he fully accepts; he holds that it was taught by nearly all the ancient philosophers, and was only perverted to atheism by Democritus. It is only in conjunction with corporatism that it gives rise to atheism.

The only interest of the *Intellectual System* now is the light it throws upon the state of religious thought after the Restoration. As Bolingbroke said, Cudworth "read too much to think enough, and admired too much to think freely."

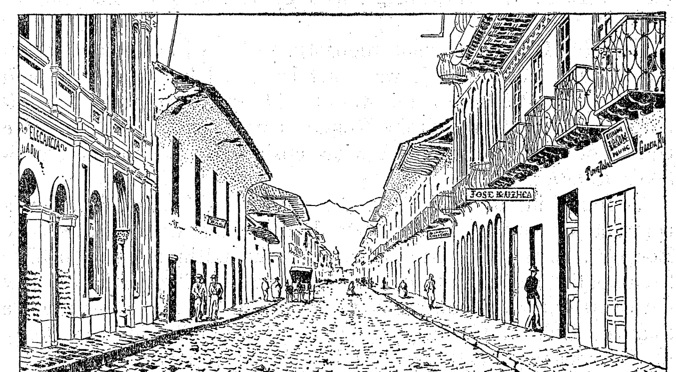
A much more favourable judgment must be given upon the short *Treatise concerning eternal and immutable Morality,* which deserves to be read by those interested in the development of British moral philosophy. It was an answer to Hobbes's famous doctrine that moral distinctions are created by the state, an answer from the standpoint of Platonism. Just as knowledge contains a permanent, intelligible element over and above the flux of sense-impressions, so there exist eternal and immutable ideas of morality. Cudworth's ideas, like Plato's, have "a constant and never-failing entity of their own," such as we see in geometrical figures; but, unlike Plato's, they exist in the mind of God, whence they are communicated to finite understandings. Hence "it is evident that wisdom, knowledge and understanding are eternal and self-subsistent things, superior to matter and all sensible beings, and independent upon them"; and so also are moral good and evil. The cardinal weakness of this form of intuitionism is its inability to give a list of the moral ideas that are self-evident like the axioms of geometry.

The *Intellectual System* was translated into Latin by J. L. Mosheim and furnished with notes and dissertations which were translated into English in J. Harrison's edition (1845). Our chief biographical authority is T. Birch's "Account," which appears in editions of the *Works.* There is a good chapter on Cudworth in J. Tulloch's *Rational Theology,* vol. ii. Consult also P. Janet's *Essai sur le médiateur plastique* (1860), W. R. Scott's *Introduction to Cudworth's "Treatise,"* and J. Martineau's *Types of Ethical Theory,* vol. ii. C. E. Lowrey, *The Philosophy of R. Cudworth* (1884).

CUENCA, a province in central Spain, part of the ancient kingdom of New Castile. It is bounded on the north by Guadalajara, north-east by Teruel, east by Valencia, south by Albacete, south-west by Ciudad Real, west by Toledo and north-west by Madrid. Pop. (1940) 333,335; area 6,588 sq. miles. The north-east districts of Cuenca are occupied by the rugged ridges and high plateaus of the Serranía de Cuenca, rising on the border of the province to the Cerro de san Felipe (5,932 ft.). Westward lie the Sierra de Altomira and broken country, sloping in the south-west to plains which form part of the district known as La Mancha. The province is drained by the upper streams of the Tagus in the north, and the Guadiana in the south-west and by the Júcar and its tributaries in the south-east. The climate is bleak and cold in the mountains and extreme on the plains, where summer heat is excessive. Prolonged droughts are common. The soil is fertile, where well watered, but the people are chiefly occupied in rearing sheep, goats, mules and asses. In the Alcarria region of the north, watered by the Guadiela, and near the rivers in La Mancha, olives, wine, cereals, saffron, wax, honey and silk are produced. The coniferous forests of the Serranía rival those of Soria. Owing to the scarcity of roads and railways the timber is exported almost entirely by river, much being floated down the Tagus to Madrid. Mineral output is confined to a little coal and salt, and the only industries, beyond saw-milling, are the making of rough cloth and pottery. Cuenca, the capital, pop. (1940) 23,038, is the terminus of the one railway line, a branch from Aranjuez which passes through Tarancón (6,673), the only other town with more than 6,000 inhabitants. The population is one of the scantiest and most illiterate in Spain. The province was held by Loyalists until the last stages of the civil war of 1936–39. (*See* also CASTILE.)

CUENCA, capital of Cuenca province, Spain; 125 mi. by rail S.E. of Madrid. Pop. (1940) 23,038 (mun., 24,702). The picturesque old town of Cuenca rises like a pyramid up a rugged height, crowned with a castle, which is separated from the surrounding Serranía de Cuenca by the deep gorges of the Júcar and Huecar rivers which unite at its foot. An iron bridge, built in 1906, replaces a 15th century structure across the Huecar gorge to the convent of San Pablo. The modern well-built quarter, with factories and the terminus of the Aranjuez railway, occupies flatter land below the Huecar. Cuenca, a Moorish fortress, was captured by Alphonso VIII of Castile in 1177. Shortly afterwards created an episcopal see, it became famous for its learning and industries, especially of wool and silver. Many of its convents and churches and the Gothic cathedral, celebrated for its sculpturing and for its beautifully carved 16th century wooden doorway, date from this period of prosperity. It was partially destroyed by Napoleonic troops, and later by Carlist rebels in 1874. Its chief trade is in timber from the pine forests; its industries are furniture, pottery, paper and leather manufacturing. Loyalists held it during the civil war of 1936–39.

CUENCA, a city and the capital of the province of Azuay, Ecuador, about 190 mi. S. of Quito and 70 mi. S.E. of Guayaquil. Pop. (1942 estimate) 49,569 (largely Indians), including the suburb of Ejido. Cuenca stands at the northern end of a broad valley, or basin, of the Andes, lying between the transverse ridges of Azuay and Loja, and is about 8,640 ft. above sea level. Near by is the hill of Tarqui which the French astronomers chose for their meridian in 1742. Communication with the coast is difficult. Cuenca is the third most important city of Ecuador, being the seat of a bishopric, and having a college, a university faculty, a cathedral and several churches, and a considerable industrial and commercial development. It manufactures sugar, woollen goods and pottery, and exports Peruvian bark (cinchona), hats, cereals,



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A STREET IN CUENCA, THE THIRD CITY OF ECUADOR, FOUNDED BY THE SPANIARDS IN 1557

cheese, hides, etc. It was founded in 1557 on the site of a native town called Tumibamba, and was made an episcopal see in 1786.

CUESTA, a name of Spanish origin principally used in New Mexico for low ridges of steep gradient on one side and gentle slope on the other. It has been suggested as a general term for any land form having a steep scarp or "strike" face, and gently inclined "dip" slope.

CUEVA, JUAN DE LA (1550?–1610?), Spanish dramatist and poet, was born at Seville. A precursor of Lope, he draws his inspiration from the national legend, historic tradition, and contemporary life, as in *Los siete Infantes de Lara, El saco de Roma,* and *El Infamador,* an anticipation of Don Juan. As an initiative force, Cueva is a figure of historical importance; his epic poem, *La Conquista de Bética* (1603) shows his weakness as an artist. In his *Ejemplar poético* (1606) he gave expression to his literary theories.

See E. Walberg, "Juan de la Cueva et son Exemplar poético," in *Acta Universitatis Lundensis,* xxxix (1904).

CUEVAS DE VERA, a city of southeast Spain on the right bank of the river Almanzora, in Almería province. Pop. (1940) 2,920 (mun., 9,530). It is isolated by the Sierra de los Filabres from the railway system of Almería. It is, however, the chief market for the cereals, fruit and vegetables, especially tomatoes, produced in the rich agricultural districts towards the south, and for the argentiferous lead and iron from mines in the mountains. In appearance it is modern, with an 18th century church in Doric style, but in reality the town is of considerable antiquity. One of the towers in the Moorish palace is probably of Roman origin. Also called Cuevas de Almanzora.

CUFF, the lower edge of a sleeve turned back to show an ornamental border, or with an addition of lace or trimming; now used chiefly of the stiff bands of linen worn under the coat sleeve either loose or attached to the shirt. "Cuff," meaning a blow with the hand either open or closed, has probably no connection with the above.

CUI, CÉSAR ANTONOVITCH (1835–1918), Russian composer, was born in Vilna on Jan. 18, 1835, the son of a French officer, who had been left behind in the retreat from Moscow in 1812, and was educated at Vilna and at the School of Military Engineering, St. Petersburg (Leningrad). He became a distinguished military engineer, and lectured at the Artillery school and the Staff college. He had little formal training in music, but in 1857 he met Balakirev, who gave him some guidance and criticism on his compositions. In 1858 he married the pianist, Mademoiselle Hamberg and next year produced privately his first operetta. From 1869 onward he produced a number of operatic works, most of them for French texts and all of them in the romantic style. The most important of these are *The Captive in the Caucasus* (1859), the libretto of which is based on Pushkin; *William Ratcliffe* (St. Petersburg, 1861), the libretto of which is drawn from Heine; *Angelo* (St. Petersburg, 1876) with the libretto drawn from Victor Hugo; and *The Captain's Daughter* (St. Petersburg, 1911). In addition Cui wrote a long series of songs, choral and orchestral works, chamber music and pianoforte pieces.

See Comtesse de Mercy-Argenteau, *César Cui* (1888).

CUIABÁ or CUYABÁ, capital of the inland state of Mato Grosso, Brazil, about 972 mi. N.W. of Rio de Janeiro, on the Cuiabá river, the principal Brazilian tributary of the Paraguay. Pop. of the *município* (1940) 54,770. Cuiabá has uninterrupted steamer communication with Montevideo, over 2,000 mi. distant, but has no rail or highway communication with the national capital. The climate is hot and malaria is prevalent. Cuiabá was founded in 1719 by Paulista gold hunters, and its gold washings, now apparently exhausted, yielded rich results in the 18th century. It is the centre of a cattle-raising area and headquarters of an important military district, having an arsenal and military barracks.

CUIRASS (Fr. *cuirasse,* Lat. *coriaceus,* made of leather, from *corium,* the original breastplate being of leather), the plate armour, formed of one or more pieces of metal or other rigid material which covers the front of the wearer's person (*see* ARMS AND ARMOUR). In a suit of armour it was generally worn in connection with a corresponding defense for the back and is understood to imply the complete body armour, described in the middle ages as a "pair of plates." The corselet (Fr. *corselet,* diminutive of the O.Fr. *cors,* body), a comparatively light cuirass, is more strictly a breastplate only. As parts of the military equipment of classic antiquity, cuirasses and corselets of bronze and of other rigid substances were common, but while some special kind of secondary protection for the breast had been worn in earlier times in addition to hauberks and studded "cotes" it was not until the 14th century that a regular body defense of plate was adopted. From that time the cuirass came into general use as well as plate coverings for the limbs, and by the end of the century had superseded the familiar chain mail. In the early 15th century entire plate armour began to be worn without any surcoat, but toward its end the short surcoat or "tabard" came into general use over the armour. At this time small plates of various shapes and sizes (and not always in matching pairs) were attached to the armour in front of the shoulders to defend these vulnerable points. In the middle of the century the breastplate of the cuirass was made in two parts, the lower overlapping the upper and contrived, by means of a strap or sliding rivet, to give flexibility. Later the cuirass was sometimes superseded by the "brigandine jacket," made generally of a rich textile lined throughout with overlapping metal scales riveted on with studs also of metal. In the 16th century the cuirass, with globular breast-plate, was reinforced by strong additional plates attached by rivets or screws. In about 1550 the breast-plate of the cuirass was characterized by a vertical central ridge, called the "tapul," having near its centre a projecting point; this projection, somewhat later, was lowered to the base of the plate and assumed the form which was known as the "peascod cuirass."

Corselets provided with both breast and back pieces were worn by foot-soldiers in the 17th century, while their mounted comrades were equipped with heavier and stronger cuirasses. These defences continued in use after the other pieces of armour had gradually been discarded, and their use has never altogether ceased. In modern armies mounted cuirassiers have in some degree perpetuated the character of the mediaeval body-armour although the steel-jacketed bullet of present-day warfare has demonstrated the futility of light metal-plate armour as a means of body protection.

CUIRASSIERS, a kind of heavy cavalry, originally developed out of the men-at-arms or gendarmerie forming the heavy cavalry of feudal armies. Their special characteristic was the wearing of full armour, which they retained long after other troops had abandoned it. Hence they became distinguished as cuirassiers. The first Austrian corps of *kyrissers* was formed in 1484 by the emperor Maximilian and was 100 strong. In 1705 Austria possessed 20 regiments of cuirassiers. After the war of 1866, however, the existing regiments were converted into dragoons. Russia likewise in modern times abolished all but a few guard regiments of cuirassiers. The Prussian cuirassiers were first so called under Frederick William I., and in the wars of his successor, Frederick the Great, they bore a conspicuous part. After the Seven Years' War they ceased to wear the cuirass on service, but after 1814 these were re-introduced, the spoils taken from the French cuirassiers being used to equip the troops. The cuirass is now worn only on ceremonial parades. In France the cuirassiers date from 1666, when a regiment was formed. During the First Empire many regiments were created, until in 1812 there were 14. The number was reduced after the fall of Napoleon, but was again increased in the period previous to the World War when the French regiments alone in Europe wore the cuirass on all parades and at manoeuvres.

CUISSES, plural of *cuisse,* French, meaning thigh and referring to the mediaeval plate armour worn on the front of the thighs. ("I saw young Harry, . . . with cuisses on his thighs, gallantly armed" Henry IV., pt. I.–iv. 1.)

CUJAS or CUJACIUS, **JACQUES** (or as he called himself, JACQUES DE CUJAS) (1520–1590), French jurisconsult, was born at Toulouse, where his father, whose name was Cujaus, was a fuller. Having taught himself Latin and Greek, he studied law under Arnoul Ferrier, then professor at Toulouse, and rapidly gained a great reputation as a lecturer on Justinian. In 1554 he was appointed professor of law at Cahors, and about a year after L'Hôpital called him to Bourges. Duaren, however, who also held a professorship at Bourges, stirred up the students against the new professor, and such was the disorder produced in consequence that Cujas yielded, and accepted an invitation he had received to the University of Valence. Recalled to Bourges at the death of Duaren in 1559, he remained there till 1567, when he returned to Valence. There he gained a European reputation, and collected students from all parts of the Continent, among whom were Joseph Scaliger and de Thou. In 1573 Charles IX. appointed Cujas counsellor to the *parlement* of Grenoble, and in the following year a pension was bestowed on him by Henry III. Margaret of Savoy induced him to remove to Turin; but after a few months (1575) he once more took his old place at Bourges. But the religious wars drove him thence. He was called by the king to Paris, and permission was granted him by the parlement to lecture on civil law in the university of the capital. A year after, however, he finally took up his residence at Bourges, where he remained till his death.

The life of Cujas was altogether that of a scholar and teacher. In the religious wars which filled all the thoughts of his contemporaries he steadily refused to take any part. *Nihil hoc ad edictum praetoris,* "This has nothing to do with the edict of the praetor," was his usual answer to those who spoke to him on the subject. His surpassing merit as a jurisconsult consisted in the fact that he turned from the ignorant commentators on Roman law to the Roman law itself. He collected more than 500 mss. but his library was broken up after his death and a great part lost. His emendations, of which a large number were published under the title of *Animadversiones et observationes,* were not confined to law books, but extended to many of the Latin and Greek classical authors. In jurisprudence his study was far from being devoted solely to Justinian; he recovered and gave to the world a part of the Theodosian Code, with explanations; and he procured the manuscript of the *Basilica,* a Greek abridgment of Justinian, afterwards published by Fabrot (*see* BASILICA). He also composed a commentary on the *Consuetudines Feudorum,* and on some books of the Decretals. In the *Paratitla,* or summaries which he made of the Digest, and particularly of the Code of Justinian, he condensed into short axioms the elementary principles of law, and gave definitions remarkable for their admirable clearness and precision. The edition of his works (Neville, 1577) is now very scarce. The edition of Colombet (1634) is incomplete. Fabrot, however, collected the whole in the edition which he published at Paris (1658), and which was reprinted at Naples (1722, 1727), and at Naples and Venice (1758), with an index forming an 11th volume.

See Papire Masson *Vie de Cujas* (1590); A. Terrasson *Histoire de la jurisprudence romaine* (1750); and *Mélanges d'histoire, de littérature, et de jurisprudence* (1768); J. E. D. Bernardi *Éloge de Cujas* (Lyons, 1775); G. Hugo *Civilistisches Magazine* (1791, etc.); J. Berriat Saint Prix *Mémoires de Cujas,* appended to his *Histoire du droit romain* (1821); E. P. J. Spangenberg *Jacob Cujas und seine Zeitgenossen* (Leipzig, 1822).

CULDEES, an ancient monastic order with settlements in Ireland and Scotland. It was long imagined by Protestant and especially by Presbyterian writers that they had preserved primitive Christianity free from Roman corruptions in one remote corner of western Europe, a view enshrined in Thomas Campbell's *Reullura.*

As found in the Irish mss. the name is *Céle Dé, i.e.,* God's comrade or sworn ally. It was latinized as *Coli dei,* whence Boece's *culdei.* The term seems, like the Latin *vir dei,* to have been applied generally to monks and hermits. There are very few trustworthy ancient sources of information, but it seems probable that the Rule of Chrodegang (devised originally for the clergy of Chrodegang's cathedral, and largely an adaptation of St. Benedict's rule to secular clergy living in common), archbishop of Metz (d. 766), was brought by Irish monks to their native land from the monasteries of N.E. Gaul, and that Irish anchorites originally unfettered by the rules of the cloister bound themselves by it. In the course of the 9th century we find mention of nine places in Ireland (including Armagh, Clonmacnoise, Clones, Devenish and Sligo) where communities of these Culdees were established as a kind of annexe to the regular monastic institutions. They seem especially to have had the care of the poor and the sick, and were interested in the musical part of worship. Meanwhile in Scotland the Iona monks had been expelled by the Pictish king Nechtan in 717, and the vacancies thus caused were by no means filled by the Roman monks who thronged into the north from Northumbria. Into the gap, towards the end of the 8th century, came the Culdees from Ireland. The features of their life in Scotland, which is the most important epoch in the history of the order, seem to resemble closely those of the secular canons of England and the continent. From the outset they were more or less isolated, and, having no fixed forms or common head, tended to decay. In the 12th century the Celtic Church was completely metamorphosed on the Roman pattern, and in the process the Culdees also lost any distinctiveness they may formerly have had, being brought, like the secular clergy, under canonical rule. The pictures that we have of Culdee life in the 12th century vary considerably. The chief houses in Scotland were at St. Andrews, Dunkeld, Lochleven, Monymusk in Aberdeenshire, Abernethy and Brechin. Each was an independent establishment controlled entirely by its own abbot and apparently divided into two sections, one priestly and the other lay and even married. At St. Andrews about the year 1100 there were thirteen Culdees holding office by hereditary tenure and paying more regard to their own prosperity and aggrandizement than to the services of the church or the needs of the populace. A much-needed measure of reform, inaugurated by Queen Margaret, was carried through by her sons Alexander I and David I. Canons Regular were instituted and some of the Culdees joined the new order. Those who declined were allowed a life-rent of their revenues and lingered on as a separate but ever-dwindling body till the beginning of the 14th century, when they disappeared from history.

The Culdees of Lochleven lived on St. Serf's Inch, which had been given them by a Pictish prince, Brude, about 850. In 1093 they surrendered their island to the bishop of St. Andrews in return for perpetual food and clothing, but Robert, who was bishop in 1144, handed over all their vestments, books and other property, with the island, to the newly founded Canons Regular, in which probably the Culdees were incorporated. There is no trace of such partial independence as was experienced at St. Andrews itself, possibly because the bishop's grant was backed up by a royal charter. In the same fashion the Culdees of Monymusk, originally perhaps a colony from St. Andrews, became Canons Regular of the Augustinian order early in the 13th century, and those of Abernethy in 1273. At Brechin, famous like Abernethy for its round tower, the Culdee prior and his monks helped to form the chapter of the diocese founded by David I in 1145, though the name persisted for a generation or two. Similar absorptions no doubt account for the disappearance of the Culdees of York, a name borne by the canons of St. Peter about 925, and of Snowdon and Bardsey Island in Wales mentioned by Giraldus Cambrensis (*c.* 1190) in his *Speculum Ecclesiae* and *Itinerarium* respectively. The former community was, he says, sorely oppressed by the covetous Cistercians. These seem to be the only cases where the Culdees are found in England and Wales. In Ireland the Culdees of Armagh endured until the dissolution in 1541, and enjoyed a fleeting resurrection in 1627, soon after which their ancient property passed to the vicars choral of the cathedral.

See W. Reeves, *The Culdees of the British Islands* (Dublin, 1864), and in *Trans. Roy. Irish Acad.* vol. xxiv (1873); F. W. Skene, *Celtic Scotland* (1876–1880), especially vol. ii; Helen Zimmern, *Celtic Church* (1902); W. Beveridge, *Makers of the Scottish Church* (1908), and reff. given by T. J. Parry, art. "Culdees," Hastings' *Encyclopaedia of Religion and Ethics.*

CULEBRA, the smaller of two islands lying in the Virgin Passage immediately east of Puerto Rico and known as the *Islas de Passaje.* It is about 18 mi. distant from Cape San Juan and rises from the same submerged plateau with the larger islands of the Antilles. Its extreme dimensions are 3 by 6 mi., and its surface is low and comparatively uniform, which gives the prevailing winds an unbroken sweep across it. For this reason the rainfall is limited to a short season, and the population is compelled to store rainwater in cisterns for drinking purposes. Its soil is fertile, and cattle, poultry, vegetables and bananas are produced. The island has been a dependency of Puerto Rico since 1879, when its colonization was formally undertaken, and it is now in the municipality of Culebra. In 1902 the American naval authorities selected the Playa Sardinas harbour on the south side of Culebra as a rendezvous of the fleet and marine encampments were set up on shore. The strategic position of the island as a naval station has given it considerable importance. Pop. (1910) 1,315; (1920) 839; (1930) 847; (1940) 860.

CULIACÁN, or **CULIACÁN ROSALES,** capital of the state of Sinaloa on the west coast of Mexico. On the left bank of the Culiacán river and at the foot of the lofty Sierra Madre Occidental, this city of 22,025 population (1940) lies at an elevation of 175 ft. on a small coastal plain. The centre of the city is the *Plaza de la Constitución,* around which are grouped various municipal buildings and the cathedral. Along the river bank is the *Jardín Rosales* with many cultivated plants and a great variety of bird life. The climate is hot and semiarid. The average January temperature is 67° F., that of July, 84° F. The lowest temperature ever recorded is 38° F., the highest, 105° F. Summer is the rainy season, total precipitation, 24 in.; winter and spring are almost rainless. An elaborate system has been installed in the valley of the Culiacán river, making it possible to irrigate more than 100,000 ac. Only about 30,000 ac. are under cultivation, however. Great varieties of crops are grown for local subsistence and export, including maize, sugar cane, chick peas, beans, chile peppers, melons, potatoes, groundnuts and tobacco. Oranges, limes, bananas and grapes are the chief fruits. Swine, burros, horses, mules, sheep and goats make up the livestock. Mining is important in the hinterland. Although connected with the small port of Altata on the Pacific ocean by a branch railway 37 mi. long, Culiacán exports its surplus of tomatoes, beans, maize and cattle mostly via the Southern Pacific railway.

(S. N. D.)

CULIN, ROBERT STEWART (1858–1929), U.S. anthropologist, was born on July 13, 1858, in Philadelphia, Pa., and was educated at Nazareth hall, Pa. He studied archaeology until 1890, during which time he was also engaged in commercial enterprise, and two years later became director of the University of Pennsylvania Archaeological museum. In 1899 he left the university museum to become curator of American archaeology and general ethnology at the Free Museum of Science and Art and at the same time lectured in both subjects at the University of Pennsylvania. He went to New York in 1903, where he had been appointed curator in ethnology at the Museum of the Brooklyn Institute of Arts and Sciences, retaining that position for the remainder of his life. Culin founded the Oriental club in Philadelphia and was its secretary for 14 years. He was also one of the founders of the American Anthropological society and was a member of many scientific societies in the U.S., Spain, Sweden, Italy and Mexico. He held royal orders in Spain and Czechoslovakia.

During 1892–93 he was in Madrid as secretary to the U.S. commission sent to the Historical American exposition in that city. The following year, he was an assistant in the anthropological department at the Columbian exposition in Chicago. Culin travelled frequently, making studies of primitive games in Japan, Chosen, China and India, as well as among American Indians. His books include *Korean Games* (1896); *Chess and Playing Cards* (1896); and *American Indian Games* (1905). He died on April 8, 1929.

CULION RESERVATION is a municipality, not divided into barrios, on the island of Culion in the province of Palawan, Philippine Islands. Population (1939) 7,328, of whom 4,748 were males; only 11 of the total were whites. It is the leper colony (founded 1906) and its inhabitants are gathered from all parts of the archipelago and are kept at government expense. Excellent medical and hospital service are furnished free of charge, and many cures have been made. The local government is administered by the lepers themselves, who, so far as possible, live a normal village life.

CULLEN, PAUL (1803–1878), Irish cardinal and archbishop of Dublin, was born near Ballytore, Co. Kildare, and educated first at the Quaker school at Carlow and afterward at Rome, where he joined the Urban College of the Propaganda and, after passing a brilliant course, was ordained in 1829. He then became vice-rector, and afterward rector, of the Irish National college in Rome; and during the Mazzini revolution of 1848 he was rector of the Urban college, saving the property under the protection of the American flag. In 1849, on the strong recommendation of Archbishop John MacHale of Tuam, Cullen was nominated as successor to the primatial see of Armagh; and, on his return to Ireland, presided as papal delegate at the national council of Thurles in Aug. 1850. Taking a strong line on the educational question which was then agitating Ireland, he took a leading part in the National movement of 1850–52, and at first supported the Tenant Rights league. In May 1852 he was translated to Dublin, and soon a divergence of opinion broke out between him and the more ardent Nationalists under Archbishop MacHale. When the Irish university was started, with Cardinal

Newman, appointed by Cullen, at its head, the scheme was wrecked by the personal opposition to the archbishop of Dublin. As time went on, his distrust of the National movement grew deeper; and in 1853 he sternly forbade his clergy to take part publicly in politics, and for this he was denounced by the *Tablet* newspaper. His own political opinion had best be told in his own words. "For thirty years I have studied the revolution on the continent, and for nearly thirty years I have watched the Nationalist movement in Ireland. It is tainted at its sources with the revolutionary spirit. If any attempt is made to abridge the rights and liberties of the Catholic Church in Ireland, it will not be by the English government nor by a 'No Popery' cry in England, but by the revolutionary and irreligious Nationalists of Ireland" (Edward Purcell's *Life of Manning,* ii, 610). Cullen, therefore, while an ardent patriot, was consistently an opponent of Fenianism. He was made cardinal in 1866, being the first Irish cardinal. Energetic as an administrator, churches and schools rose throughout his diocese; the excellent Mater Misericordiae hospital and the Catholic University of Ireland are lasting memorials of his zeal. He took part in the Vatican council as an ardent infallibilist. In 1873 he was defendant in a libel action brought against him by the Rev. R. O'Keefe, parish priest of Callan, on account of two sentences of ecclesiastical censure pronounced by the cardinal as papal delegate. The damages were laid at £10,000. Three of the four judges allowed the defense of the cardinal to be valid; but it was held that the papal rescript upon which he relied for his extraordinary powers as delegate was illegal under statute; and the lord chief justice decided that the plaintiff could not renounce his natural and civil liberty. After several days' trial, during which Cullen was submitted to a very close examination the verdict was given for the plaintiff with $\frac{1}{4}d.$ damages. The cardinal died in Dublin on Oct. 24, 1878. (E. TA.)

CULLEN, WILLIAM (1710–1790), Scottish physician and medical teacher, was born at Hamilton, Lanarkshire, on April 15, 1710. He received his early education at the grammar school of Hamilton, and subsequently attended some classes at the University of Glasgow. He began his medical career as apprentice to John Paisley, a Glasgow surgeon, and after completing his apprenticeship he became surgeon to a merchant vessel trading between London and the West Indies. On his return to Scotland in 1732 he settled as a practitioner in the parish of Shotts, Lanarkshire, and in 1734–36 studied medicine at Edinburgh, where he was one of the founders of the Royal Medical society. In 1736 he began to practice in Hamilton, where he rapidly acquired a high reputation. From 1737–40 William Hunter was his resident pupil and at one time they proposed to enter into partnership. In 1740 Cullen took the degree of M.D. at Glasgow, where he removed in 1744. During his residence at Hamilton, besides the arduous duties of medical practice, he found time to devote to the study of the natural sciences, especially chemistry. On coming to Glasgow, he began to lecture in connection with the university, the medical school of which was as yet imperfectly organized. Besides the subjects of theory and practice of medicine, he lectured systematically on botany, materia medica and chemistry. His great abilities, enthusiasm and power of conveying instruction made him a successful and highly popular teacher, and his classes increased largely in numbers. At the same time he diligently pursued the practice of his profession. Chemistry was the subject which at this time seemed to have engaged the greatest share of his attention. He was himself a diligent investigator and experimenter, and he did much to encourage original research among his pupils, one of whom was Dr. Joseph Black. In 1751 he was appointed professor of medicine, but continued to lecture on chemistry; in 1756 he was elected joint professor of chemistry at Edinburgh along with Andrew Plummer, on whose death in the following year the sole appointment was conferred on Cullen. This chair he held for ten years—his classes always increasing in numbers. He also practised his profession as a physician with eminent success. From 1757 he delivered lectures on clinical medicine in the Royal Infirmary. This was a work for which his experience, habits of observation and scientific training peculiarly fitted him, and in which his popularity as a teacher, no less than his power as a practical physician, became more than ever conspicuous. On the death of Charles Alston in 1760, Cullen, at the request of the students, undertook to finish his course of lectures on materia medica; he delivered an entirely new course, which was published in an unauthorized edition in 1771, but which he rewrote and issued as *A Treatise on Materia Medica* in 1789.

On the death of Robert Whytt (1714–1766), the professor of the institutes of medicine, Cullen accepted the chair, at the same time resigning that of chemistry. In the same year, he had been an unsuccessful candidate for the professorship of the practice of physic, but subsequently an arrangement was made between him and John Gregory, who had gained the appointment, by which they agreed to deliver alternate courses on the theory and practice of physic. This arrangement proved eminently satisfactory, but it was brought to a close by the sudden death of Gregory in 1773. Cullen was then appointed sole professor of the practice of physic, and he continued in this office till a few months before his death, on Feb. 5, 1790.

As a lecturer Cullen stood unrivalled in his day. His clearness of statement and power of imparting interest to the most abstruse topics were the conspicuous features of his teaching, and in his various capacities as a scientific lecturer, a physiologist and a practical physician, he was ever surrounded with large and increasing classes of intelligent pupils, to whom his eminently suggestive mode of instruction was especially attractive. Living at the time he did, when the doctrines of the humoral pathologists were carried to an extreme, and witnessing the ravages which disease made on the solid structures of the body, it was not surprising that he should oppose a doctrine which appeared to him to lead to a false practice and to fatal results, and adopt one which attributed more to the agency of the solids and very little to that of the fluids of the body. His chief works were *First Lines of the Practice of Physic* (1774); *Institutions of Medicine* (1770); and *Synopsis Nosologicae Medicae* (1785), which contained his classification of diseases into (1) pyrexiae, or febrile diseases, as typhus fever; (2) neuroses, or nervous diseases, as epilepsy; (3) cachexiae, or diseases resulting from bad habit of body, as scurvy; and (4) locales, or local diseases, as cancer.

Cullen's eldest son Robert became a Scottish judge in 1796 under the title of Lord Cullen, and was known for his powers of mimicry.

See Dr. John Thomson, *Cullen's Life, Lectures and Writings* (1832), re-issued with the second volume by Dr. W. Thomson and Dr. D. Craigie in 1859; *Jour. of Psychological Medicine,* vol. xiii, p. 82 (1860).

CULLEN, royal and small burgh, Banffshire, Scotland. Pop. (est. 1938) 1,738. It is situated on Cullen bay, $11\frac{1}{2}$ mi. W. by N. of Banff and $66\frac{1}{2}$ mi. N.W. of Aberdeen by the L.N.E.R. Deskford Burn, after a course of $7\frac{1}{2}$ mi. enters the sea at Cullen, which it divides into two parts, Seatown, the older, and Newtown, dating only from 1822, the old town having been pulled down to extend the grounds of Cullen house. St. Mary's, the parish church, a cruciform structure, was founded by Robert Bruce, whose second wife died at Cullen. The harbour, constructed 1817–34, though artificial, is one of the best on this coast. Fish is exported. About 1 mi. to the S. is Cullen house, a seat of the earl of Seafield, which contains some fine works of art. To the west $1\frac{1}{2}$ mi. is the fishing village of Portknockie (pop. 1,657), a small burgh dating from 1912, with a deep-sea harbour built in 1891. On the cliffs, 2 mi. E., stands the ruins of Findlater castle, fortified in 1455.

CULLERA, a port of east Spain, in the province of Valencia, on the Mediterranean sea, at the mouth of the river Júcar, and the terminus of the Valencia-Silla-Cullera railway. Pop. (1940) 13,943 (mun., 15,005).

Cullera, at the foot of the Monte de las Zorras, which terminate eastward in Cape Cullera, and dominated by a ruined Moorish citadel, overlooks to the south a rich, irrigated plain producing cereals and fruit. The harbour consists of a roadstead from the mouth of the Júcar to Cape Cullera, where ships anchor and discharge into lighters, which alone can ascend the shallow river to the port.

Cullera is a fishing port but is chiefly engaged in exporting oranges, tomatoes and rice (ordinarily to Great Britain), and in importing artificial fertilizers, flour and timber.

CULLINAN, a town in the Transvaal, Union of South Africa, 25° 43′ S., 28° 34′ E., which grew up round the Premier diamond mine, and dates from 1903. It is connected by a branch railway (6 mi.) with Rayton, on the Pretoria-Delagoa bay line, and 24 mi. E. of Pretoria. Pop. (1936) 589; of which 395 were whites. There was discovered, in 1905, the Cullinan diamond, $3,024\frac{3}{4}$ carats, which was presented by the Transvaal government to King Edward VII, two stones cut from it being used for the British sceptre and crown. (*See* DIAMOND.)

CULLIS, CHARLES (1833–1892), U.S. physician, was born in Boston, Mass., on March 7, 1833. Between the ages of 16 and 19 he clerked in a mercantile establishment in Boston until serious ill-health forced him to leave. At about this time he was persuaded to study medicine, which he began on his recovery. It was through his medical work that the concept of a "consumptive's home" was born in him, out of which grew his life's work. His attention was drawn to the German orphanage founded by Herman Francke, and he read George Müller's *Life of Trust,* then newly published. They provided him with a working plan through which to consolidate his profound belief in the power of faith, and his compassion for incurables to whom the shelter of public hospitals was not open. His aim was to provide a home for such unfortunates which would be made possible through faith and prayer alone. His ideas were spread at first among friends, and later through meetings and published reports.

About 1865, with unsolicited public contributions ranging from pennies to hundreds of dollars, Cullis made his first purchase, for $4,000, of a house on Beacon Hill which became the Consumptives' Home. With later additions, including a church, this became the centre of the Faith-Cure movement. The home for consumptives was later moved to the place near Boston known as Oak Grove. There, on the 11 acres purchased, were constructed separate chapels for inmates and the public, 2 orphan homes, a spinal home, the Faith-Cure house and a deaconess' house which was a home for women workers. Churches and missions were established in Boston, and the movement spread to other states and abroad. Missions arose in Virginia, California, West Virginia, North Carolina and India, and there were tract repositories in New York, Boston and Philadelphia. Cullis died on June 18, 1892, and shortly afterward, for lack of funds and leadership, the movement for the most part died.

CULLMAN, a town in north central Alabama, U.S.A., the county seat of Cullman county. It is 34 mi. south of Decatur and about 5 mi. from the summit of Sand mountain. It is on U.S. highway 31, and is served by the Louisville and Nashville railroad. The land area is $2\frac{1}{2}$ sq.mi.; the altitude 802 ft. The population was 1,255 in 1900; 2,786 in 1930; and 5,074 by the census of 1940, of whom 4,966 were native white and 39 Negro.

The town owns and operates its own water works, electric generation and distribution system and sewage treatment plant. It is an industrial and agricultural centre, producing lumber, cotton, oil products, fertilizer and staves. It is in a rich strawberry growing region, and during the harvest season almost all farm labour is marshalled for picking. Cotton is also grown, and the town is an important shipping centre for the Sand mountain area. Cullman is administered by a mayor-council government elected by direct nonpartisan ballot, for four-year terms. Its assessed property value (1943) was $788,375 and its bonded debt (Sept. 30, 1943) $335,000. It publishes three weekly newspapers, each with a circulation of more than 2,000. A general hospital was established in 1939 and is under joint city-county management.

Cullman was founded by John G. Cullman, an immigrant from Bavaria, Germany. He purchased 349,000 acres of railroad-owned property in 1872, and planned the foundation of a German colony in the south. This was difficult at first, for the general line of migration was east to west, and not south. But by 1873, the first five families arrived from Cincinnati, Ohio, others following from Indiana and Illinois, and by 1876 a contemporary newspaper estimated a population of 800. Cullman was incorporated as a town in 1874.

CULLODEN, a tract of moorland in Inverness-shire, Scotland. It forms part of the northeast of Drummossie Muir, and is situated about 6 mi. by road east of Inverness, and $\frac{1}{2}$ mi. from Culloden Moor station on the L.M.S.R. from Aviemore to Inverness via Daviot. It is celebrated as the scene of the battle of April 16, 1746 (*see* below; also CUMBERLAND, WILLIAM AUGUSTUS, DUKE OF, and MURRAY, LORD GEORGE), by which the fate of the house of Stuart was decided. By Highlanders the battle is more generally described as the battle of Drummossie. Several memorials have been erected.

The *Culloden Papers,* a number of historical documents ranging from 1625 to 1748, were discovered in Culloden House in 1812 and published in 1815 by Duncan George Forbes. About 1 mi. to the south of the field, on the right bank of the Nairn, is the plain of Clava, containing several stone circles, monoliths, cairns and other prehistoric remains. The circles, some apparently never completed, vary in circumference from 12 yards to 140 yards.

Battle of Culloden.—For the course of the 1745 rebellion which was crushed at the battle of Culloden, *see* SCOTLAND. After a week's retreat, Charles Edward awaited the British on Drummossie Moor. Hearing, however, that Cumberland had halted at Nairn, eight miles away, to celebrate his 25th birthday, Charles decided to surprise his camp. The long night march over the moors, however, was too much for the tired and starving Highlanders and they returned to their old position, more exhausted and depressed than ever. Early on April 16, 1746, Cumberland obtained contact with the pretender's army. The Highlanders, about 7,000 strong, were drawn up in two widely separated lines, with a small reserve of horse, one flank resting on the park walls of Culloden House. The British, 9,000 strong, were also in two lines, at a distance of 50 paces, with cavalry on each flank and a reserve of Highland irregulars. The battle began with a duel between the nine Scottish and ten British guns; the latter, far better served, caused great distress to the Highlanders, who sought to escape their fire by attack. The British infantry awaited them in three ranks, the first kneeling, the second stooping, the third standing. Cumberland had trained each soldier to engage the man to his right front, so evading the Highlander's target and thrusting under his raised sword arm. On the British right the Highlanders only made feint attacks, trying to draw fire while still out of range; on the left they broke through at one point, but were taken in flank by supports from the second line, and thrown back in great confusion. Seeing this, the Scottish centre and left lost heart and retreated, the British following up and causing heavy losses with their musketry fire. At the same time the dragoons broke through the walls protecting the Scottish flanks and attacked the second line in rear. The Highlanders finding themselves surrounded, broke and fled, leaving 1,000 dead and many wounded and prisoners upon the field of battle, while 1,000 more fell in the subsequent pursuit. The British lost only 50 killed and 200 wounded.

CULLUM, GEORGE WASHINGTON (1809–1892), U.S. soldier and author, was born in New York city on Feb. 25, 1809. He entered the U.S. military academy at West Point in 1829 and after graduation in 1833 received a commission in the corps of engineers. He was promoted to captain in 1838, and during the Mexican War he superintended the engineering of sapper, miner, and pontoon trains for the use of the army in Mexico. From 1848 to 1855, he taught practical military engineering at West Point. In the years remaining before the outbreak of the Civil War, with the exception of two years spent abroad while on sick-leave, he was active in the supervision of fortifications and other public works, and served on several important boards and commissions. He was ordered to Washington in 1861 and in April became aide-de-camp to Gen. Winfield Scott, then commander in chief of the U.S. army. He was promoted to major of engineers in August, and on Nov. 19, 1861, became chief of staff and chief engineer to Gen. H. W. Halleck commanding the department of Missouri. Here he rendered invaluable service in supervising construction engineering on the western rivers, in preparation for the Union plan of separating the armies of the Confederacy. He also directed the engineering operations at the siege of Corinth, and elsewhere. Returning to Washington in 1862 with Gen. Halleck, now general in chief of the army, he served on the general's staff until Sept. 5, 1864, after which he became superintendent of the U.S. military academy. On March 13, 1865, he was brevetted colonel, brigadier general and major general in the regular army for meritorious service during the Civil War, and mustered out of the volunteer service the following year. For the next eight years, he served as military engineer in the vicinity of New York city and retired from active service in 1874. He spent the rest of his life in New York where he devoted himself to literary, scientific and military studies. He had already published (1863) his translation of Duparq's *Elements of Military Art and History,* and his own book *Systems of Military Bridges.* He also wrote *Campaigns of the War of 1812–15 against Great Britain sketched and criticized; with brief biographies of the American engineers* (1879) and numerous other military works, biographies, reviews and reports. But his most valuable literary achievement was the *Biographical Register of the Officers and Graduates of the U.S. Military Academy from 1802 to 1850.* A second edition was extended to cover 1867, and a third, in three volumes, 1890. This tremendous work included the military activities of all graduates of West Point from its foundation in 1802, as well as biographical sketches of many of its alumni, and a historical account of the academy itself. By the terms of Cullum's will, provisions were made for the continuance of the *Biographical Register,* and supplements were published in 1900, 1910 and 1920. Cullum also bequeathed to West Point more than $250,000 for the erection of a memorial hall. He died in New York city on Feb. 29, 1892.

CULMANN, KARL (1821–1881), German engineer, was born in Bergzabern, Germany on July 10, 1821, the son of a Bavarian clergyman. At 17 he matriculated in the engineering school of the Polytechnical institute in Karlsruhe. At the close of his studies, he entered the Bavarian civil service as an apprentice on the Hof railway section, where he remained until 1847. For the next three years he travelled in England, Ireland and North America, re-entering the civil service on his return. With an appointment to the faculty of the Polytechnical institute in Zurich, Switzerland (1855), he began a career of teaching and research. In 1864 he made a valuable report following his investigation of the wild mountain streams of Switzerland, the control of which was a seasonal problem. His most important work, however, was concerned with the problem of determining the distribution of stresses in structures. With the publication of *Die Graphische Statik* (1865, Zurich, vol. 1, no more published; 2nd ed. 1875), he presented a survey of all that had been done up to that point toward the solution of static problems by the graphic method, at the same time laying a foundation for its use as an exact science. The Culmann method of graphostatics has been used extensively in many problems of engineering and mechanics. In connection with this problem, he proved an interesting analogy with the mechanics of the human body. He demonstrated that the curves apparent in the thighbone, when the calcium phosphate has been dissolved, coincide with the ideal lines of main stress for minimum material, as determined by graphostatics. In 1880, Culmann was made honorary doctor of the faculty of philosophy at the University of Zurich. He died at Reisbach near Zurich on Dec. 9, 1881.

See Conrad Matschoss, *Männer der Technik* (Berlin, 1925); Wilhelm Ritter, *Anwendungen der graphischen statik, Nach Professor Dr. C. Culmann,* (Zurich, 1888–1906), 4 vols. in 2; Moritz Rühlmann, *Vorträge über die geschichte der technischen mechanik und theoretischen maschinenlehre* (Leipzig, 1885).

CULMINATION, the attainment of the highest point (from Lat. *culmen,* summit). In astronomy the term is given to the passage of a heavenly body over the meridian of a place. Two culminations take place in the course of the day, one above and the other below the pole. The first is called the upper, the second the lower. Either or both may occur below the horizon and therefore be invisible.

CULP, JULIA (1881–), Dutch mezzo-soprano, was born in Groningen, Holland on Oct. 1, 1881. Her musical training began with the violin and then turned to voice. At 15 she gave recitals at Groningen and at Amsterdam, but in 1897 she settled down to two years of study with Cornelia van Zanten at the Amsterdam conservatory. At 19, she went to Berlin, Germany, and although her concerts were successful, she gave them up to continue her studies with Etelka Gerster from whom, she wrote afterward, she learned all that she knew. Her formal debut was in 1901 in a joint recital with Ferruccio Busoni at Magdeburg, Germany. Success came early in her career, and not long after her debut there were invitations to almost every important European capital. In the years that followed she performed with Edvard Grieg, Charles Saint-Saëns, and Richard Strauss and sang with the principal European orchestras in Germany, Austria, the Netherlands, France, Spain and Russia. Her repertoire included the traditional Schubert, Schumann and Brahms. She also became impressed with the charm and intensity of Hugo Wolf's music and was among the first to bring his songs before the public. Wolf's close friend, Dr. Heinrich Potpeschnigg, was for some time her accompanist. *My Favorite Songs,* which she published in Boston, Mass., in 1916 also listed the music of Richard Strauss, C. A. P. Cornelius and Johann Karl Loewe (*qq.v.*) who wrote the ballad of the *Erlkönig.* With her reputation as an outstanding *lieder* singer established, Mme. Culp made her U.S. debut in New York on Jan. 10, 1913, winning immediate success and engagements for the remainder of the season with the major symphony orchestras throughout the country. She continued to visit the U.S. annually for many years. Reviews of her first New York concerts remarked on the happy blending in her voice of both the soprano and alto qualities, and of the sensitivity and understanding which she brought to her art. During World War I, she was occupied almost exclusively with hospital work among Allied sick and wounded. In 1937 she taught at the Vienna Music academy. Following the German invasion of the Sudetenland where she was living in 1938, she returned to her native land.

CULPEPER, a town in northern Virginia, U.S.A., and the county seat of Culpeper county. It is about 35 mi. northwest of Fredericksburg on U.S. highways 15 and 29 and state highway 3; and is served by the Chesapeake & Ohio and Southern railroads. The population was 1,819 in 1920; 2,379 in 1930; and 2,316 by the census of 1940, of whom 1,729 were native white and 538 Negro.

The town of Fairfax, as Culpeper was originally named, was laid out in 1759 on the property of Robert Coleman. During the American Revolution, the Culpeper minute men answered John Hancock's call to arms in 1775, bearing the flag whose legends read, "Don't Tread on Me" and "Liberty or Death." The minute men retained their identity as an organization, although they merged with regular regiments in the Civil and Spanish-American Wars. Located in the most contested area of the Civil War, it was occupied in the summer of 1862 by Union troops under Gen. John Pope. The Virginia hotel, where officers were billeted, was also the headquarters of General U. S. Grant during April 1864.

Culpeper is a trading centre for the surrounding agricultural area, and itself produces dairy products, livestock and apples. Manufactures include chairs and textiles; there are also silk, flour and lumber mills and a bottling works. It was incorporated Jan. 11, 1898, and a new charter was granted by act of legislature in 1936 with amendments in 1940. The town is administered by a mayor and council.

CULPEPER'S REBELLION (1677–79), one of the first popular uprisings in the American colonies against British authority. The northern, or Albemarle colony in Carolina consisted at that time of not more than 4,000 persons. They were engaged, mainly, in the raising of tobacco, which they traded for necessities with New England merchants. But enforcement of the navigation laws denied them a free market outside of England, and heavy duties placed on every pound of tobacco sold was directed at keeping the northern merchants from their harbour. Resentment was fostered by refugees from Virginia, where Nathaniel Bacon's rebellion had been put down with repressive measures, and by the New England men who were anxious to resume a profitable trade. All feelings of repression found an object in Gov. Miller, who in the absence of Governor Eastchurch was at once the governor, secretary and collector. The insurrection came to a head in 1677 with John Culpeper as its leader. Culpeper had emigrated to the southern or Clarendon colony at about 1670, where he was commissioned surveyor-general, and was active in political life. At the time of the insurrection, he was said to have been a refugee from Clarendon where he was wanted for inciting poor planters to riot. Under his leadership, the first act of the insurgent settlers was to imprison Gov. Miller and seven proprietary deputies, that is, the entire council except the president whose sympathies they had won. They also appropriated some £3,000 and all public records, established courts of justice, appointed judges and convoked a legislative assembly. On Dec. 3, 1677, they issued the first American manifesto entitled "Remonstrance of the inhabitants of Pasquetanke to all the rest of the county of Albemarle" and signed by 34 persons. In an outline of the grievances justifying their rebellion, they protested against excessive taxation, the denial of a freely elected assembly and interference with the regular channels of commerce. Miller had no military forces at his disposal and the settlers were virtually unopposed. For two years, with Culpeper as governor, they exercised all the powers and duties of government and functioned as an independent commonwealth. When Eastchurch arrived from England the following year, he was not accorded recognition, but before he could enlist military assistance from the governor of Virginia, he died of a fever. The settlers, hopeful of a just settlement, sent Culpeper and his assistant Holden to England, promising submission to proper authority. But Gov. Miller had in the meantime managed his escape and was in England to greet Culpeper with charges of treason and embezzlement. Culpeper submitted to trial, but requested that, if pardon was denied, he be allowed trial in Carolina, where the events charged had taken place. This was not necessary for he found support in the influential earl of Shaftesbury, himself a proprietor, who defended him claiming that no regular government existed in Albemarle and that Culpeper's actions were not treasonable. Culpeper returned to South Carolina in 1680 where he surveyed and laid out Charles Town (now Charleston).

CULPRIT, properly the prisoner at the bar; so one guilty of an offense. In origin the word is a combination of two Anglo-French legal words, *culpable,* guilty, and *prit* or *prist,* i.e., *prest,* O.Fr. for *prêt,* ready. On the prisoner at the bar pleading "not guilty," the clerk of the crown answered "culpable," and stated that he was ready (*prest*) to join issue. The words *cul. prist* (or *prit*) were then entered on the roll. When French law terms were discontinued the words were taken as forming one word addressed to the prisoner.

CULROSS (locally pronounced *Coo-rus*), a royal and small burgh, Fifeshire, Scotland, 6½ mi. southwest of Dunfermline. There is a station on the L.N.E.R. from Dunfermline to Kincardine, and another 2½ mi. away on the line from Dunfermline to Stirling. Pop. (est. 1938) 537. It is attractively situated on a hillside sloping gently to the Forth. There St. Serf founded a church and cemetery, and there he died and was buried. For centuries the townsfolk used to celebrate his day (July 1) by walking in procession bearing green boughs. Kentigern, the apostle to Cumbria and first bishop of Glasgow is said to have been born at Culross and to have been adopted by St. Serf as his son. These religious associations, coupled with the fertility of the soil, led to the founding of a Cistercian abbey in 1217. Of this structure the only remains are the western tower and the choir, which forms the parish church. It is supposed that a chapel of which some traces exist in the east end of the town was dedicated to Kentigern. James VI made Culross a royal burgh in 1588. In 1808 there was discovered in the abbey church, embalmed in a silver casket, still preserved there, bearing his name and arms, the heart of Edward, Lord Bruce of Kinloss, killed in 1613 near Bergen-op-Zoom in a duel with Sir Edward Sackville, afterward earl of Dorset.

Robert Pont (1524–1606), the Reformer, was born at Shirresmiln, or Shiresmill, a hamlet in Culross parish. Nearly all its old industries—the coal mines, salt works, linen manufacture, and the making of iron girdles—have disappeared, but its pleasant climate and picturesqueness make it a holiday resort.

Dunimarle Castle adjoins the site of the castle, where, according to tradition, Macbeth slew the wife and children of Macduff.

CULTIVATING MACHINERY: *see* AGRICULTURAL POWER AND MACHINERY; HARVESTING MACHINERY; TILLAGE MACHINERY.

CULTIVATION is the preparation of land for the reception of seed. Since the eradication of the natural vegetation either by burning or by laboriously removing trees and scrub with the axe is the first step in tillage, cultivation probably began on lands easiest to clear, such as the great Tigres-Euphrates or Nile river valleys where low rainfall precluded high vegetation except along the banks. The deep soils of these valleys, unleached by rains, were extremely fertile and easy to work with the crude implements of prehistoric man. The uniform temperatures and yearly inundations of flood water that supplied necessary moisture ensured successful crops. In time man learned to regulate the rivers so that the flood waters were stored and used for irrigation as needed. This made possible more extensive cultivation of adjoining lands.

At first only hoes and spades were used to turn the soil, but the antiquity of the plow shows that an elementary form was developed very early in conjunction with planting grains. From the evidence available, the plow probably originated in Mesopotamia, and spread east to the orient and west and north into the Mediterranean and central European countries, reaching the British Isles sometime before the Roman conquest. The early cylinder seals (*c.* 3500 B.C.) from Sumer, the paintings on Greek vases and the wall paintings of Egypt all portray plows made entirely of wood and pulled either by human or animal power, but plow points or soles of bronze and iron have been found among the artifacts of these peoples, indicating that metal was used to sheathe the parts receiving the greatest wear.

Because of the emphasis on irrigation the records from Mesopotamia and Egypt contain scant information on soil management. An Akkadian text (3200–2100 B.C.) refers to manuring, plowing and raking as essentials in preparing a seedbed, but similar details are lacking for Egypt of that date. A characteristic of primitive agriculture was the continued cropping of a field until the soil was exhausted; then fresh land was cleared and cropped and the old abandoned. However, where the silt-laden waters of a river yearly spread fresh sediment over a flood plain, soil depletion was negligible even without manuring.

As agriculture spread over the Mediterranean basin, new techniques of cultivation had to be developed to cope with the different soils, slopes and climatic conditions. On the eastern shores of the Mediterranean where there was little level land, the early Phoenicians were forced to till the mountainsides. Although their plows were primitive and inefficient, it was not long before the soils on their steep fields began to erode. Lack of rainfall during the growing season necessitated the development of some practice to husband the available moisture. The Phoenicians solved both problems by terracing and contour cultivation. Through their colonizing activities the Phoenicians carried their practices the length of the Mediterranean, and the tradition of the excellence of their agriculture was preserved in Roman literature.

The Greeks in turn left little written record of their system of cultivation. Many of their agricultural traditions are embodied in mythology; thus Zeus is credited with first harnessing oxen to the plow, and Hercules with river regulation and irrigation combined with manuring. Although alfalfa had been introduced, there is no indication of a definite crop rotation. Accounts from Hellenistic Egypt reveal that animals were pastured on the stubble following the harvest, and the government established a fixed rotation for the cleruchs and private individuals in which two years of grain were followed by one of rest or light cultivation (Glotz, *Le Travail dans le Grèce ancienne,* 1920).

Under the Romans, cultivation reached a fairly high state, and their agricultural literature records the progress of 300 years. Cato (234–149 B.C.) emphasized the importance of good plowing and manuring to provide a proper seedbed. The standard, however, was straight furrows rather than pulverization of the soil or regard for slope. Although Cato gave directions for making com-post of all farm wastes, he mentioned no rotation except the simple alternation of grain and fallow. By the time of Virgil (70–19 B.C.) alfalfa had been introduced into Italy, and a rotation of grain, legume and fallow was being practised. On level fields plowing and cross-plowing destroyed the weeds and formed a mulch to preserve moisture. Virgil described a hillside plow designed for contour plowing with two mouldboards. A Gallic plow of the same date was also equipped with wheels, but there is no proof that it was ever used in the Italian peninsula. Columella's *De re rustica* (1st century A.D.) summarized Roman knowledge and practice of soil management. The Romans were already describing and classifying soils according to structure, texture and acidity or alkalinity; and the necessity of fitting crop to soil type and of contour plowing on hilly fields was recognized generally. In addition to plowing fields two or three times to break up the clods and destroy weeds, green manures, dung and chalk or marl were used to add nutrients to the exhausted soils. Lowlands were drained by open and closed ditches and vineyards were terraced. The Romans made no great improvements in tillage implements. Handwork with mattocks preparatory to plowing was quite common, and a toothed harrow or a drag was frequently used after plowing to break up the lumps. From planting to harvest there was no further cultivation of a crop. Olive orchards and vineyards were exceptions, as they were cultivated several times during the growing season to remove weeds and aerate the soil.

There is evidence of grain culture in Britain as early as 2000 B.C., but there was no fixed field cultivation until the time of the Celts. They established a definite field pattern on the chalk hills and downs of southeastern England. Their rudimentary plow, similar perhaps to the modern caschrom, turned a furrow and gave their fields a square or rectangular shape. The introduction and spread of the two-oxen plow with its metal point or share increased the size of the field but did not alter its shape. Years of continued tillage caused the loosened soil to travel downhill and accumulate on the lower edge of the field forming in time a bank or lynchet. The large quantities of grain exported from Britain indicated that these fields may have been manured to keep up their fertility, if only by winter pasturing of cattle. Pliny referred to the marl pits and the use of chalk to counteract soil acidity, and potash in the form of wood ash may have been applied to the fields.

The Roman conquest of Britain did not affect the Celtic field system, but the subsequent Saxon invasions did. The Saxons cultivated the valleys with heavy eight-oxen plows and the Celtic square or rectangular fields gave way to the long, narrow acre-strips characteristic of the open fields. With the rise of the manors, cultivation settled into a fixed routine known as the three-field system, under which it stagnated until the 18th century. Although there were infinite variations over Europe, the usual pattern was the division of all the arable land of a manor into three parts, one for winter grains, one for spring grains and crops and one for fallow. To ensure a fair distribution, each serf was assigned acre-strips (the plowing unit) in all three fields. This excessive parcelling necessitated communal plowing, planting and harvesting. Bare fallow and lack of root crops and manure made crop yields extremely low. Peas and beans, the only legumes raised as field crops, were not used in rotations. No improvements were possible while the tillers of the soil were chained by custom to the inevitable alternation of crop and fallow. Only on the lands of the great monastic orders, whose adherents studied the Roman writers, were there any signs of improved cultivation.

In Spain where the Moors preserved the best agricultural traditions of the past, careful cultivation was the rule. Masters of irrigation and the use of composts, the Moors made up in thorough tillage what they lacked in efficient implements. The plowing cycle, or *qalib,* based on a knowledge of soil types, climatic conditions and on the use of a variety of legumes for rotations, called for a minimum of three plowings for each field before it was sown. Alfalfa, which the Moors introduced into Spain, was used largely as a fodder crop and not in rotations. By emphasizing thorough cultivation of the soil before and after planting, the Moors anticipated Jethro Tull (*q.v.*) by 500 years.

The secular lords of Christian Europe were introduced to Roman agricultural practices by Pietro de Crescenzi's *Opus ruralium commodorum* (1304), which marked the beginning of modern agricultural literature. Although there is evidence of a growing interest in agriculture and its improvement throughout the 16th and 17th centuries, Jethro Tull, an English farmer, was the first to emphasize the importance of thorough cultivation. From his observations of viticulture in France, he deduced that continuous stirring of the soil before and after sowing kept down weeds and permitted air, rain and dew to penetrate to the roots of the plants. As crops sown broadcast could not be cultivated, he invented a seed drill and, to eliminate hoeing by hand, a horse hoe or cultivator that could be drawn between the rows of the growing crop. Firmly convinced of the efficacy of tillage alone, he abolished fallows and made little use of barnyard manure. Although he planted turnips and sainfoin, he saw no need for rotations and, to prove his contentions, is said to have grown wheat on the same land for 13 successive years without fallow or manure and obtained heavier crops than his neighbours from one-third the seed. In spite of its fallacies, Tull's *New Horse-Houghing Husbandry* (1731) publicized the advantages of transferring the technique of garden cultivation to the cultivation of field crops. While most farmers continued the old routines, a few enlightened landowners applied his principles.

The continued improvement and cultivation did not depend upon tillage alone, but upon a recognition of the value of rotations and the use of manures to maintain soil fertility. The Dutch, long faced with the problem of insufficient land, early developed rotations to utilize every field every year for the production of food for man and beast. While a few English writers were cognizant of these practices, only in Norfolk, where the influx of Dutch had familiarized the local inhabitants with foreign crops and techniques, were they adopted to any extent. Here the cultivation of turnips for feed and the sowing of clover, sainfoin and alfalfa were fairly common before 1700. These importations resulted in a clearly defined system of cultivation peculiar to Norfolk and eminently suited to its climate and soils. Its most distinctive feature was the systematic rotation of crops, whereby grains were alternated with a cleaning or recuperative crop such as roots or clover. Thus the land was continuously occupied and bare fallow was eliminated. Because the rotation included feed crops, animal husbandry was coupled with crop cultivation to form the "new" or convertible husbandry. The fame of the Norfolk rotation, however, rested upon the prominence of men like Charles Townshend (1674–1738) and Thomas Coke (1752–1842), who practised it, and upon the widespread publicity Arthur Young gave it in his *Annals of Agriculture*. It was the Norfolk system combined with animal husbandry that established the supremacy of British agriculture.

The most important contributions of the 19th century to improved cultivation were the extension of drainage, the discovery of artificial fertilizers, the alliance of science with agriculture and the improvement of tillage implements. Once all land was occupied, farmers had to rely more and more upon intensive farming to increase production. The Norfolk system had pointed the way to full use of light sandy soils, but drainage was essential for intensive use of heavy clays. The relative merits of open, covered and deep drains had been discussed widely, but, until a machine to manufacture cheap tile was invented in 1845, not much capital was invested in drainage.

Meanwhile the appearance of artificial fertilizers widened the farmer's choice of manures, from vegetable and animal refuse produced on the farm, to superphosphates, nitrates, potash, etc., products of chemical research. The first Peruvian guano reached England in 1835, and nitrate of soda was introduced the same year, but commercial fertilizers did not appear on the market until the chemists had studied the chemical composition of soils and plant requirements. Although the first printed work on the subject (*Chemistry in its Applications to Agriculture and Physiology,* 1840) came from the German chemist, Justus von Liebig, Sir John Bennett Lawes, working independently, had already begun his experiments on the effects of various manures on different crops. Sir Joseph Henry Gilbert continued these experiments at Rothamsted for more than half a century. James Johnston and Augustus Voelcker popularized Liebig's ideas and aroused public interest in the value of artificial fertilizers. By analyzing the composition and value of fertilizing substances, preparing portable concentrates and experimenting on the time of growth at which they could be applied most profitably, these men provided farmers with a wide choice of fertilizers.

Symbolic of the times was the Royal Agricultural society's slogan, "Practice with Science." At first, agricultural science in the British Isles was largely a branch of chemistry. Through the work of the botanists on seed selection, the biologists on plant diseases and the entomologists on insect pests, agricultural leaders saw the value of a concerted attack upon agricultural problems, but comprehension of the interlocking roles of all the physical sciences for the solution of various phases of the same problem did not become general until after 1900.

Previous soil investigations carried out by geologists and chemists of various countries had emphasized kinds of soils, their relative fertility and types of crops suited to them, but the purely scientific study of soils was initiated by the Russians about 1870. V. V. Dokuchaiev advanced the theory that geographic location and climate determined the character of a soil rather than the parent rock. Because Russia contained vast areas of virgin soil with a wide variety of climatic and geographic factors, the Russians had an excellent opportunity to study the genesis and morphology of soils. K. D. Glinka, a pupil of Dokuchaiev, used this concept to build up a classification of soils based on their origin plus the climatic, geographic and vegetative factors contributing to their metamorphosis. Because their work was published in Russian it was not readily available until translations had been made into German and English and, consequently, remained unknown generally until the 20th century.

If the development of tillage implements had not kept pace with scientific advancement, farmers would have been unable to utilize these new techniques of cultivation. Light and efficient plows adapted to different types of soil had been patented. A wide range of harrows, scarifiers, digging tools and cultivators had come into general use. Seed drills were greatly improved and fertilizer attachments were developed. Rollers were used to consolidate the seedbed. Except for further refinements in the kinds of materials used, the type of motive power applied and more durable designs, the basic inventions of modern tillage equipment were already in use.

Cultivation in the 20th century has become increasingly scientific. Soil science has expanded from description and classification to the study of microorganisms essential to crop growth. The increased knowledge of plants and their requirements has led to specialization except in areas where agriculture is noncommercial and folkways persist. Weeds are controlled by clean seed and thorough tillage. Tractors have replaced animal power, and depth of plowing is determined by soil type and climate. Preparation of the seedbed is combined with fertilizing and sowing, so that a field is plowed, harrowed, fertilized, seeded and rolled in one operation. In England where ley farming superseded grain farming, the old rotations, like the Norfolk, were replaced by an alternation of a temporary ley of three or four years' duration followed by a short succession of cereals. Therefore, agricultural research has centred around the special plants, rotations and techniques of cultivation essential to pasture improvement. (*See* GRASS AND GRASSLAND.)

UNITED STATES

Before the European discovery of the Americas, the Indian tribes had achieved a stable agriculture based on corn (*Zea mays* and developed special techniques for cultivating it in accord with their environments. However, their agricultural tools were very primitive. The lack of draught animals prevented the development of the plow, so all tillage was done by hand. Only hoes with shell or stone blades, or hoes made of animal bones or horns, and planting sticks were used. Crop rotation was unknown, but fallowing and clean tillage were practised. Corn hills were frequently manured with fish, and where agriculture was intensive both human and animal manure were also utilized. In the semiarid and mountainous regions of Central and South America where there was little water or level land, the Indians built terraces to conserve soil and water. These structures varied from the Incan terraces and aqueducts skilfully faced with stone to the simple bench terraces and temporary diversion dams of the Hopi. Except for the technique of planting corn in hills, fertilizing it with fish and keeping it free of weeds, the Europeans did not adopt Indian practices, but rather attempted to introduce into the Americas the crops and techniques of their homelands. In the first century of European settlement, the struggle for existence and the difficulties of clearing virgin land and preparing it for crops, coupled with the lack of work stock and farming implements, prevented the colonists from utilizing at once the modes of cultivation current in Europe at the time of their migration.

Equipped only with spades, shovels, mattocks and hoes with which to prepare the land for sowing, the first farmers substituted corn for the European grains because it could be planted Indian fashion on fields not entirely cleared. As soon as draught animals were imported, plows began to be used wherever the condition of the land permitted. Although the seedbed was prepared by plowing, the colonists continued to use the Indian methods of planting. However, because of the scarcity of plows and animal power, many farmers had to rely on hand tools. In the southern colonies the adoption of the plow was retarded by the predominance of tobacco culture. The commercial importance of tobacco encouraged its rapid adoption as a cash crop. The spread of slavery ensured an adequate and unskilled labour supply, so there was little incentive to cut down on the manual labour involved in tillage. No attempt was made to maintain soil fertility for fresh land was abundant. Tobacco, however, was a soil-exhausting crop and clean tillage was a standard practice; consequently, fields were rapidly exhausted, eroded and abandoned. Thus, in spite of the care bestowed on the tobacco plant, its widespread cultivation led not to improved tillage but to soil wastage, an evil that was to harass the plantation system throughout its existence.

Throughout the 18th century, American agricultural practices continued to lag behind European practices. Difficulties of transportation and communication, lack of markets and isolation of the individual farmers offered little incentive for increasing production through improved cultivation. The apparently limitless supply of virgin land and its remarkable fertility encouraged profligate farming, for it was cheaper to clear new fields than to maintain the productivity of old ones. Usually, the same crops were grown year after year on poorly cultivated fields with little or no fertilizer and without systematic crop rotations. The growing crops received no cultivation except an occasional crossplowing to eradicate weeds. Cultivators, similar to Tull's horse hoe, were unknown generally, although a crude type may have been used between tobacco rows. Barnyard manure was regarded as a nuisance, and the widespread practice of letting cattle run at large prevented the accumulation of enough manure to be of real value. The rotation of crops was largely haphazard. Some farmers alternated cropland and pasture, maintaining each for four or more years; others alternated grain crops until the land was exhausted and then left it fallow for as long as 15 years before they thought it restored sufficiently to be planted again to grain. The fallow frequently was used as pasture as soon as volunteer weeds and bushes covered it.

Aside from slovenly practices, poor tillage implements thwarted any real efforts toward thorough cultivation. The first plows had to be imported, but by the 18th century most of them were fashioned by the farmers themselves or the village blacksmiths. These local products were not only poorly designed but also unwieldy. At best they merely skimmed the surface. The iron plating added to reinforce the mouldboard increased the friction, and the soft iron share was quickly dulled in heavy gravelly soils. While many farmers still used only the plow in preparing the seedbed, square and triangular harrows with wooden or iron teeth and crude wooden rollers were coming into more general use. Where the farmer lacked even these implements, he frequently made a drag of thick bushes or young trees with which to smooth the soil and cover the seed.

By the middle of the 18th century, the older areas of settlement were suffering from the extremely wasteful and destructive methods of tillage. A few farmers realized that the progressive mining of first one tract of soil and then another could not go on forever. This was an era of great improvement in England, and the work of Tull, Townshend and Coke was soon known to well-read individuals like Jared Eliot (1685–1763), author of the first American treatise on agriculture. While foreign observers were only critical, those directly concerned began to urge the adoption of improved English practices where fitting and careful experimentation with new crops, rotations and equipment, in an effort to raise the state of agriculture generally. Unfortunately, the isolated attempts that did meet with success had little effect upon the generality of farmers.

A few experiments were made with the introduction of potatoes and clover into rotations. Alfalfa was tried without much success. Some farmers alternated root, grain, and nitrogen-fixing crops in a six-year rotation, and wherever systematic rotations were practised the long fallow was reduced to one or two years. Another important innovation was sowing some kind of grass or clover on the fallow when it was to be pastured. English grasses and clovers had been introduced the previous century, but farmers did not fully realize their value or importance.

More attention was paid to manures and a variety of fertilizing substances was tried. In New England the farmers relied on fish and rockweed. In the middle colonies limestone and marl were used wherever local supplies were available. In the south a few farmers experimented with marl and cowpeas, but the reasons underlying their remedial qualities were not fully understood. Stock penning was a favourite device for securing manure for tobacco and other special crops. Swamp or creek mud was also advocated to ameliorate sandy soils. The most important fertilizing agent, however, was calcium sulphate popularly known as gypsum, plaster of Paris and land plaster. First used by the German farmers of Pennsylvania, it was tried by the agricultural leaders and extolled as a renovator of depleted soils. Where intensive agriculture prevailed, the refuse of potash manufactories, street sweepings and all other wastes were gathered up and used.

In the first half of the 19th century, improvement in cultivation techniques in the U.S. began to keep pace with European advancement. Progress along mechanical lines eventually surpassed that of Europe and, in the effort to cope with new problems arising from totally different physical and economic conditions, diverged from standard European practices. The major developments were better tillage implements, the introduction of commercial fertilizers and the beginning of scientific agriculture.

The first efforts toward better cultivation centred around improving plow designs so that they would answer the various uses expected of them. The rapid settlement of the west where the labour supply was inadequate intensified the need for more efficient equipment, and the necessity of increasing production on the poorer soils of the east also encouraged the adoption of improved implements. While some of the wealthy farmers had imported well-known European plows, U.S. designs dominated the scene because they were built in response to local requirements. The interest inventors took in designing new plow types to meet these needs is evident from the fact that more than 200 patents had been issued by 1850. As early as 1797 Charles Newbold had invented a cast-iron plow, but Jethro Wood's plow, first patented in 1814, embodying the concept of interchangeability of parts, set the pattern for subsequent plow manufacturers and marked the beginning of factory as distinct from hand production.

While the varieties of plows used throughout the U.S. had their European counterparts, the steel plow was a distinctly American contribution. Its importance in the agricultural development of the prairies cannot be overemphasized. When the settlers reached the prairies their first difficulty was in getting a plow strong enough to break up the tough sod and cut the matted root structure. After the sod disintegrated they discovered that the heavy iron breaking plows would not scour in prairie soils. Various remedies were tried without success until finally it was discovered that high grade steel would work admirably. According to Ardrey (*American Agricultural Implements,* p. 14), John Lane, in 1833, using a discarded steel saw blade made a plow that scoured satisfactorily. Other blacksmiths turned out plows using the same material, and in the '40s John Deere began the commercial production of steel plows. By 1850 the steel plow had largely displaced the cast-iron implement on the prairies, but where soil structure presented no problem cast iron continued to be used until the advent of the chilled iron plow.

Conterminous with the improvement of the plow was the development of cultivating machinery. The first cultivator was a shovel plow which served a variety of purposes besides stirring the soil between the rows of a growing crop. This was replaced in the '40s by a gang plow with two or more shovels, which in turn was superseded by the five- or six-tooth cultivator made of iron. The latter soon became the leading implement in the north and west. In the south the adoption of cultivating implements was extremely slow because the most important crops—corn, cotton and tobacco—continued to be cultivated by hand. The shovel plow replaced hand hoeing to some extent, and the cotton sweep, the skimmer and the scraper became the chief implements used for cultivating cotton after 1840.

There was little change in the thoroughness of cultivation 1800–50 in the west because extensive rather than intensive farming was the rule. In the east and south, soil erosion and exhaustion had become so pronounced that agricultural societies and periodicals endeavoured to awaken farmers to the importance of conserving the soil and maintaining its fertility through better tillage and crop practices. John Taylor (1753–1824) and later Edmund Ruffin (1794–1865), both leaders in agricultural improvement, urged farmers to use manures, legumes, green manures and rotations as remedies for depleted productivity. The erosion-control measures developed to hold the soil on sloping fields in areas of heavy rainfall included cover crops, strip cropping, hillside ditching, trenching and contour cultivation. The last three were especially designed to disperse and dispose of excess runoff. However, most of the farmers dismissed these painstaking practices in favour of the simpler, though expensive, expedient, commercial fertilizers. John Skinner of Baltimore, Md., had imported a few bushels of guano as early as 1824 and shipments had arrived in Boston, Mass., by 1830, but the guano craze did not become widespread until the '40s. The farmers, ever looking for a short-cut to increased production, tried Peruvian guano, Chilean nitrates, German potash and Carolina phosphates as each appeared on the market. While fertilizers seemed to increase productivity, they were not true remedies for soil deterioration caused by continuous cropping. The booming business in fertilizers led to many fraudulent practices, but, on the other hand, it encouraged some states to survey their natural resources in hopes of locating useful deposits and to appoint agricultural chemists to analyze fertilizers as well as soils.

The early development of agricultural science in the U.S. followed much the same pattern that it did in Europe. Actual field experiments on crops, plowing techniques and manures were largely carried on by individuals and supported by their private purses and enthusiasm. However, beginning in the 1830s, individual states allocated funds for agricultural and geological surveys in an effort to locate fertilizing deposits and to determine generally the land-use capabilities of the various types of soil. Although agricultural chemists were appointed to make soil and fertilizer analyses, no true soil investigations were undertaken. In the decade preceding the Civil War, the first agricultural colleges and experiment stations were organized, but co-ordinated attack upon agricultural problems was delayed for several decades.

The improvement of cultivation techniques and implements in the second half of the 19th century was affected by the Civil War and internal expansion. In the south the war completely disorganized systematic cultivation, but in the north it emphasized the value of improved tillage machinery in an expanding agriculture faced with an acute labour shortage. Because the south was predominantly agricultural, the disruption of the plantation system caused an economic depression that forestalled any major advance in cultivation until the 20th century. The lack of essential capital, equipment and labour in the 1870s further enmeshed the southern farmers in the vicious web of share cropping. With subsistence depending upon a cash crop, such as cotton, careful cultivation was impossible. A few far-sighted individuals realized that the south needed a complete revision of cropping techniques with more attention being paid to rotations and livestock, but the farmers continued to rely mainly on fertilizers to maintain soil fertility. As a result soil erosion continued to spread, laying waste thousands of acres. The one erosion-control practice that became quite common was terracing. In 1885, Priestly H. Mangum introduced the broad-base terrace whose chief advantage was that tillage operations could be performed over the entire structure. Plants like lespedeza that helped hold the soil were used on outlet channels to prevent cutting by storm water and for gully stabilization. For the most part tillage practices in the south lagged behind those of the other regions.

A new chapter in the western expansion of agriculture began after the Civil War, with the opening of the high plains, Rocky Mountain and intermountain regions to settlement through the homestead acts and the construction of transcontinental railways. Once again western migration became the popular panacea for agricultural ills in both the north and the south, and land abandonment in the older areas of cultivation continued throughout the 19th century.

This expansion of area under cultivation without a corresponding increase in farm labour supply forced the farmers to adopt farm machinery. The Oliver chilled-iron plow, patented in 1868, became a widespread favourite because of its adaptability and superiority in both material and design. Sulky and gang plows, rotary diggers and even steam tractors were invented and tried, but only the plows were of lasting importance. Seeding machines and cultivators, including harrows and rollers, were also improved, but the leading innovations were the spring-toothed and disk harrows first put on the market in 1877. Not until the 1890s, however, did the disk harrow become widespread.

In the rapid expansion of agriculture from the humid east to the semiarid west the farmers had no time to adjust their old techniques of cultivation to the new soils and climates that they encountered. As a result, a few prosperous years were followed by reversals. Gradually the farmers realized that diverse climatic, topographic and soil conditions were the factors complicating cultivation, and that new techniques would have to be developed to farm successfully the areas coming under the plow. West of the 100th meridian where the preservation of soil moisture was a major problem, dry farming was practised in an effort to conserve the scant rainfall. The subsurface packer invented by Hardy W. Campbell in 1885 enabled the farmer to establish a firm seedbed while leaving a dust mulch on the surface to entrap whatever rain there might be. As wheat was the main crop, turning plows were abandoned in favour of disk plows that cut up the old wheat stubble without exposing the light soils to wind erosion. Where irrigation farming prevailed, the effects of the irrigation water on soils presented still more problems. However, the farmers were not wrestling with their problems alone.

The public acceptance of the role of science in agriculture led to the establishment of institutions supported by state and federal funds. The federal department of agriculture was created as a separate agency in 1862, and the Land-Grant College act of the same year provided the basis for the founding of state agricultural colleges to educate and assist the farmer. The European concept of establishing experiment stations for agricultural research was introduced into the U.S. by Samuel W. Johnson, whose lectures and publications on soils, rotation of crops, fertilizers, methods of analysis, plant nutrition and food adulteration did much to popularize the experiment station as a research agency dealing with local problems. The passage of the Hatch act in 1887 secured the necessary funds for the establishment of agricultural experiment stations in each state. Through those institutions a co-ordinated attack was made upon U.S. problems that had no counterpart in European experience.

Cultivation in the 20th century became increasingly scientific and highly mechanized. The wide range of climatic and physiographic conditions under which the major crops were grown in the U.S. not only caused sharp regional differentiation in the methods of planting and tilling, but also delineated the number of variables governing successful tillage operations. The rapid development of the various agricultural sciences provided fresh approaches to tillage problems and the network of state and federal agencies provided the implementation, whereby the interrelations of climates, soils, methods of tillage, fertilizers, crops and rotations were investigated throughout the country.

The shift from horses and mules to tractors gave fresh impetus to mechanized farming. The clumsy tractor of 1910 gradually was replaced by lighter and more adaptable designs. Because tractors were capable of drawing heavier equipment, farmers were able to combine operations by using tandem arrangements of plows, harrows, rollers and seed and fertilizer drills. The use of tractors in turn led to further refinements in tillage implements, so that they would be more flexible. Research on tillage machinery was limited to determining what types of turning plows and disks were suited to southern crops and soils, the proper set and speed of operation of existing equipment and to developing special machinery to cultivate terraced land and to turn winter-legume cover crops.

However, plowing as a method of tillage was challenged by Edward H. Faulkner in his *Plowman's Folly* (1943). Viewing the plow as the root of all soil ills, Faulkner maintained that disking in a green cover crop or other crop residue would prevent soil erosion, increase soil moisture and provide organic matter in sufficient quantities so that fertilizing would be unnecessary. The ensuing controversy brought out that no one set of practices is equally applicable to all the crop regions of the U.S.; that disking and stubbling in have been practised in dry-farming areas for many years; that discarding the plow does not mean the soil is untilled; and that, far from destroying insect pests, in some instances mulching actually encouraged their increase. The contentions, however, focused public attention on the basic problems of soil management just as the dust storms of 1934–35 demonstrated the havoc resulting from improper tillage.

Soil erosion was not new, but until the dust storms blanketed the eastern cities, little interest was displayed even by the farmer in the amount of soil lost by improper tillage. The full effects of plowing vast acreages of submarginal land in the high plains to sow wheat were not felt until the early 1930s, when a series of dry years left the farmers nothing but a harvest of dust. A nation-wide survey revealed that some form of erosion was affecting all the agricultural regions from the citrus groves of California to the potato fields of Maine. The soil conservation service, established in 1935, set up demonstration areas and tested cropping and cultivating techniques to determine what practices would enable farmers not only to maintain soil fertility, but also to stabilize soils so that they would not erode beyond the geologic norm. The leading conservation practices included terracing, strip cropping, contouring, basin listing, cover crops, rotations and, where necessary, retiring land from cultivation. Where regular equipment was inadequate, new machines, such as the duck-foot cultivator, rod weeder, basin, or damming lister, and terracing machine, were developed. The funds available for research, the magnitude of the conservation program and the rapid acceptance of the program by the farming public deeply interested foreign countries in the soil conservation work of the U.S.

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CULVERIN, an early form of light gun, constructed of leather or bronze (from Fr. *couleuvre,* a serpent). Culverins were classified into the grand culverin, weight about 40cwt., bore about $5\frac{1}{2}$in., and throwing a shot of about 18 lb.; bastard culverin, weight 30cwt., bore 5in., weight of shot 10 lb.; and medium culverin, weight 15cwt., bore 4in., weight of shot 2lb. The name disappeared about 1732.

CULVERT. It is frequently necessary to make a passage for water under roads, railways, banks, canals, etc. The drain made to carry the water in such cases is called a culvert. It may be either flat or arched, and is usually built strongly of masonry or brickwork. The introduction of ferro-concrete affords a ready means of constructing culverts strongly and economically; a concrete arch for such work is sometimes made with reinforcing rods laid in spiral form. The derivation of the word is apparently from Fr. *couloir*, a water-way.

CUMAE, an ancient city on the west coast of Campania, Italy, about 12 m. W. of Neapolis, on a volcanic eminence, overlooking the plain traversed by the Volturno.

Strabo calls it (Gr. Κύμη) the oldest of the Greek colonies on the mainland of Italy or in Sicily. We find it in 721 B.C. founding Zancle (Messina) in Sicily, jointly with Chalcis; and it extended its power gradually over the coast of the gulf of Puteoli and the harbours of the promontory of Misenum. Puteoli itself (under the name Dicaearchia) was probably founded by Cumae. In the seventh century, according to the legends, Parthenope, whither the demos of Cumae had taken refuge after an unsuccessful rising against the aristocracy, was attacked by the latter and destroyed, but soon rebuilt under the name of Neapolis (New City, the present Naples) (*q.v.*). The most fertile portion of the Campanian plain was also under its dominion; the name "fossa Graeca" still lingered on in 205 B.C. to testify to its ancient limits. Cumae was now at the height of its power, and many fine coins testify to its prosperity. In 524 B.C. it was the object of a joint but unsuccessful attack by the Etruscans of Capua, the Daunians of the district of Nola, and the Aurunci of the Mons Massicus. A renewed Etruscan attack was repelled with the help of Hiero of Syracuse, who in the battle of Cumae of 474 B.C. drove the Etruscan fleet from the sea, and broke their power in Campania. The Samnites finally destroyed the Etruscan supremacy by the capture of Capua in the latter half of the fifth century (*see* CAPUA; CAMPANIA), and the Greeks of Cumae were overwhelmed by the same invasion. The beautiful series of Greek coins from the town now ended, and Oscan became its language (though in many respects the Greek character of the town survived) until about 180 B.C. when the Cumaeans addressed to Rome a request that they might be allowed to use Latin for public purposes. Cumae had already come under the supremacy of Rome, about 340, as Capua did, and was governed after 318 by the *praefecti Capuam Cumas*. In the Hannibalic wars it remained faithful to Rome. Under the empire it was a quiet country town, in contrast to the gay and fashionable Baiae, which, however, with the *lacus Avernus* and *lacus Lucrinus,* formed a part of its territory. Cicero's villa on the east bank of the latter, for example, which he called the *Academia,* was also known as Cumanum. In the Gothic wars the acropolis of Cumae was, except for Naples, the only fortified town in Campania, and it retained its military importance until it was destroyed by the Neapolitans in 1205, since which time it has been deserted.

The acropolis hill (269 ft. above sea-level), a mass of trachyte which has broken through the surrounding tufa, lies hardly 100 yd. from the low sandy shore. It is traversed by caves, which are famous in legend as the seat of the oracle of the Cumaean Sibyl, and a vaulted corridor leading to a large rectangular forecourt has been found, from which the oracular cave itself will no doubt be reached when the excavations are completed. The acropolis has only one approach, on the south-east; on all other sides it falls away steeply. Remains of fortifications of all ages run round the edge of the hill; some of the original Greek work, in finely hewn rectangular tufa blocks, exists on the east. The mediaeval line follows the ancient, except on the north-east, where it takes in a larger area. Within the acropolis stood the temple of Apollo, the remains of which, restored in Roman times, stand on the eastern and lower summit.

There are also various remains of buildings of the imperial period, and these are far more frequent on the site of the lower town (now occupied by vineyards) which lies below the acropolis to the south. The line of the city walls can be traced both on the east and on the west, though the remains on the east are insignificant, and on the west (the seaward side) only the scarping of the hill remains. To the south of the town, just outside the wall, is the amphitheatre. To the north of it is the point where the roads from Liternum (the Via Domitiana running along the sandy coast), Capua (a branch of the Via Campana), Misenum and Puteoli meet. The last passes through the Arco Felice, an arch of brick-faced concrete 63 ft. high which spans a cutting through the Monte Grillo, made by Domitian to shorten the course of the road, which had hitherto run farther north. The Grotto della Pace leads to the shores of Avernus. On the east side of Cumae are considerable remains of the Roman period. The cemeteries of Cumae extended on all sides of the ancient city, except towards the sea, but the most important lay on the north, between this temple and the Lago di Licola. Pre-Hellenic (ninth to eighth centuries B.C.) Greek, Samnite and Roman graves have produced many important objects, now in various museums.

See D. Randall MacIver, *The Iron Age in Italy* (Oxford, 1927), 160 *sqq.* (especially for the geometric pottery found here).

CUMANÁ, a city and port of Venezuela, capital of the State of Sucre, situated on the Manzanares river about 1m. above its mouth, 52ft. above sea-level and 180m. E of Carácas. It is the oldest existing European settlement on the South American continent, having been founded by Diego Castellon in 1523 under the name of Nueva Toledo. The city was almost totally destroyed by an earthquake in 1766, and also in 1797 and 1929; shocks were experienced in 1812 and 1853, when little remained of the original structures of the town. Slight shocks are very frequent, some of them severe enough to cause considerable damage to the buildings. The mean annual temperature is 83° and the climate is enervating. In colonial times the city was rich and prosperous and enjoyed a lucrative trade with the mother country Spain. Pop. (1941) 25,893. The products consist of coffee, cacao, brown sugar ("papelon"), tobacco, rum, coco-nut oil, divi-divi, fruits, cotton goods, dried fish, and furniture made from the fine native woods. There is excellent tobacco and cotton land along the shores of the bay and there are a good many settlements and small towns along the southern shore. The district is one of considerable promise for the future if the labour problem can be solved. A tramway connects the city with its port at the mouth of the Manzanares. In recent years several manufacturing enterprises have been established, among which are a coco-nut oil extraction plant, a textile factory, electric light plant and other utilities.

CUMANS or **COMANS,** one of the most important of the old Turkish races. Their origin is uncertain; they were probably closely akin to the Seljuk Turks, and perhaps identical with the Qun of Arabic chroniclers; in which case they were the western neighbours of the Seljuks, and preceded their westward march by a few years. They must have arrived on the confines of Europe about A.D. 1030. About 1050 they attacked the Ghuz, who were then living in the old lands of the Petchenegs (*q.v.*) between the Ural and the Volga. These they subdued and made their vassals. After 1120 they further combined with the Kipchak

State which had now come under a Mongolian dynasty. The new federation was known henceforth to Arabic and Chinese sources as Kipchak; to the Russians as Polovtsi; to the Greeks as Cumani, and to the Germans as Walwen, or Falven, these being attempts to reproduce the Slavonic name, which means "dwellers in the plains"; for the Cumans were not of pure Turkish race.

The Cuman federation destroyed the last remains of the Khasar State and took their lands. After the defeat of the Petchenegs by Jaroslav of Kiev, they extended their empire yet further westward, reaching the Dnieper in 1055. Soon their frontiers reached from the Volga to the Danube. For the next century, the history of Kiev is practically one of continual Cuman wars. Sometimes treaties, and even marriage alliances were concluded; but the Cumans seem to have taken these treaties lightly, and bands of them constantly harassed the Slavonic peasants. At this time the Cumans were partly Mohammedan, but still largely pagan. "We worship one God, who is in the sky," they told the first missionaries to them, "and beyond that we know nothing; for the rest, we have abominable habits." As to these, the "Chronicle of Nestor" states: "Our Polovtsi too have their own habits; they love to shed blood, and boast that they eat carrion and the flesh of unclean beasts, such as the civet and the hamster; they marry their mothers-in-law and daughters-in-law, and imitate in all things the example of their fathers." These Cumans wore short kaftans, and shaved their heads, except for two long plaits. They seem to have been purely hunters and warriors, leaving the cultivation of the soil to their subject tribes of Slavs. Cumania, as south Russia was called, possessed thriving towns, and traded in slaves, furs and other products; but the trade was probably in the hands of Greeks and Genoese; the funeral monuments attributed to the Cumans (pyramids or pillars, each surmounted by a male figure bearing in his hand a drinking-cup) were probably not their work. The early westward raids of the Cumans, as when they invaded Hungary in 1071–72 and Byzantine territory in 1086 and 1094, allied with the Petchenegs, were not made in force, and were defeated. After the break-up of Kiev they grew stronger; at the opening of the 12th century they were the allies of the terrible Bulgarian Tsar Kalojan, whose wife was a Cuman. With him they were engaged in annual wars against Byzantium and against the Crusaders, although the alliance had to be renewed annually, for at the approach of summer the Cumans always retired to their own steppes to enjoy their booty. The growing power of Hungary was already a danger to them; the King of Hungary made several campaigns into Moldavia and Wallachia from 1223 on, coupling these wars with the more pacific methods of Catholic propaganda. By 1228 he already had enough converts to found a bishopric in Moldavia.

Break-up of the Cuman Empire.—The conquerors of the Cumans were to come, however, from the East. In 1228 the Mongols attacked them on the Volga, destroying many and driving others into Georgia, where they were attacked and wiped out. In 1238 they were crushingly defeated near Astrakhan. Many of them were slain, many more absorbed in the conquerors' hordes. Some, who were sold as slaves to the Sultan Malek-el-Saleb, became the founders of the Boharib dynasty of Mameluke sultans in Egypt, and subsequently avenged their earlier defeat, and inflicted on the Mongols their first check. Large numbers of Cumans crossed the Danube in leather boats, and took refuge in Bulgaria. Their army is still heard of as a separate force here in 1256, and the Cumans played a very large, if not a preponderating part in Bulgarian history up to the Turkish conquest. The two chief Bulgarian dynasties of this period, the Terterovske and the Sismanovske, were Cuman, and much of the population of north Bulgaria must also have been Cuman. Jireček believes the so-called "Gagauz" of north-east Bulgaria, the Dobruja and Bessarabia (Turkish-speaking orthodox Christians) to be descendants of the Cumans. The Gagauz are being rapidly Bulgarized to-day.

Another group of Cumans, consisting of 40,000 warriors with their families, or at least 200,000 souls in all, under their Khan Kuthen, took refuge in Hungary in 1239, promising to adopt Christianity in return for protection. This protection was the occasion of the declaration of war on Hungary by the Mongols who claimed the Cumans as their vassals. They were received with honour by King Bela of Hungary, and a commission was appointed to settle with them. There was, however, much friction between the Cumans and the Magyars. The former, who were still nomad tent-dwellers, felt cramped in their new life; the latter complained of depredations against their fields and their women. The Cuman women, on the other hand, were too ugly to attract the Magyars. The Cumans were eventually settled in the most fruitful parts of the Alföld, between the Danube and the Theiss, in the districts henceforward known as Greater and Lesser Cumania. When the Mongols invaded Hungary, they drove before them many Cuman prisoners as their vanguard. This caused the belief that the Cumans of Hungary had turned against their hosts, and a mob of infuriated Magyars broke into the royal palace and murdered Kuthen. His followers, who were assembling loyally enough to fight the Mongols, thereupon turned on the Magyars, and a party of them after devastating much of south Hungary and Styria, retired with their booty to the Balkans. Some of his followers settled in the district of south Serbia where a village still bears the name of Cumanovo; others rejoined their compatriots in Bulgaria.

King Bela married his son to a Cuman woman, and King Ladislaus of Hungary (1272-90) was known as the Cumanian. He favoured the Kunok (as the Cumans were known in Hungary) to such an extent that there appeared a danger that the land might relapse into heathendom, and a crusade was preached against them; but after his death their importance diminished. Many of them were created nobles, the rest remained free peasants, enjoying special privileges and immunities. Until 1715 they did military service in lieu of all taxation, and had the right of migrating at will. They retained their individuality until late in the 18th century, when they were completely Magyarized. The last speaker of Cuman as a living language died in 1770. Many Cumans doubtless left Hungary with the Turks.

The Cumans were notoriously prolific, and it certainly cannot be doubted that they form a much larger element of the population of Hungary and Bulgaria, perhaps also Rumania, than is generally recognized. They were a talented race. They produced a dynasty in Egypt and two in Bulgaria, and intermarried with the kings and princes of Kiev, Serbia and Hungary. Matthias Corvinus himself is said by some authorities to have been of Cuman origin.

Their language has been preserved in the so-called *Codex Cumanicus,* which was once in the possession of Petrarch, and is now in the library of St. Mark in Venice. This interesting 14th century document contains an imperfect Cuman lexicon, a number of hymns, and a collection of riddles in Cuman. The language is clearly an east Turkish dialect.

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(C. A. M.)

CUMBERLAND, DUKES AND EARLS OF. The earldom of Cumberland was held by the family of Clifford (*q.v.*) from 1525 to 1643, when it became extinct by the death of Henry, the 5th earl. The 1st earl of Cumberland was Henry, 11th Lord Clifford (1493–1542), a son of Henry, 10th Lord Clifford (*c.* 1454–1523). Created an earl by Henry VIII. in 1525, Henry remained loyal during the great rising in the north of England in 1536, and died on April 22, 1542. His son and successor, Henry, the 2nd earl (*c.* 1517–70), married Eleanor (d. 1547), a daughter of Charles Brandon, duke of Suffolk, and Mary, daughter of King Henry VII.; he had the tastes of a scholar rather than a soldier, and died early in 1570. By his first wife, Eleanor, he left an only daughter, Margaret (1540–96), who married Henry Stanley, 4th earl of Derby, and who in 1557 was regarded by many as the rightful heiress to the English throne. By his second wife he left two sons and a daughter; his elder son George succeeding to the earldom in 1570, and his younger son Francis succeeding his brother in 1605. George, 3rd earl of Cumberland (1558–1605), was born on Aug. 8, 1558, and married Margaret (*c.* 1560–1616), daughter of his guardian, Francis, 2nd earl of Bedford. He commanded the "Bonaventure" against the Spanish Armada, and from this time until his death on Oct. 30, 1605, was mainly engaged in fitting out and leading plundering expeditions, some of which, especially the one undertaken in 1589, gained a large amount of booty. The earl left no sons, and his barony was claimed by his only daughter Anne (1590–1676), the wife successively of Richard Sackville, 3rd earl of Dorset, and of Philip Herbert, 4th earl of Pembroke and Montgomery; while his earldom was inherited by his brother Francis (1559–1641). A long law-suit between the new earl and the countess Anne over the possession of the family estates was settled in 1617. The 5th earl was Francis's only son Henry (1591–1643), who was born on Feb. 28, 1591, and was educated at Christ Church, Oxford. He was a supporter of Charles I. during his two short wars with the Scots, and also during the Civil War until his death on Dec. 11, 1643. He left no sons; his earldom became extinct; his new barony of Clifford, created in 1628, passed to his daughter Elizabeth (1618–91), wife of Richard Boyle, earl of Cork and Burlington; and the Cumberland estates to his cousin Anne, countess of Dorset and Pembroke.

In 1644 the English title of duke of Cumberland was created in favour of Rupert, son of Frederick V., elector palatine of the Rhine, and nephew of Charles I. Having lapsed on Rupert's death without legitimate issue in 1682, it was created again in 1689 to give an English title to George, prince of Denmark, who had married the lady who afterwards became Queen Anne. It again became extinct when George died in 1708, but was revived in 1726 in favour of William Augustus (1721–65) third son of George II. As this duke was never married the title lapsed on his death in 1765, but was revived in the following year in favour of Henry Frederick (1745–90), son of Frederick, prince of Wales, and brother of George III. Having again become extinct on Henry Frederick's death, the title of duke of Cumberland was created for the fifth time in favour of Ernest Augustus, who was made duke of Cumberland and Teviotdale in 1799. In 1837 Ernest became king of Hanover, and on his death in 1851 the title descended with the kingdom of Hanover to his son King George V., and on George's death in 1878 to his grandson, Ernest Augustus (b. 1845). In 1866 Hanover was annexed by Prussia, but King George died without renouncing his rights. His son, Ernest (1845–1923), was known as the duke of Cumberland. He married Princess Thyra of Denmark, and inherited the duchy of Brunswick-Lüneburg in 1884, but was prevented from becoming reigning duke by a federal decision, inspired by Prussia in 1885, and repeated and strengthened in 1907, when it was decreed that no member of the house should assume the throne of Brunswick-Lüneburg. The duke never formally renounced the throne of Hanover, and the hostility between his family and the Hohenzollerns continued until reconciliation was accomplished by the marriage of his son, Ernest Augustus, to Princess Victoria Louisa of Prussia, daughter of the emperor William II. The old duke had resigned (1906) his rights in favour of his son. The son was permitted on his marriage to succeed to the duchy of Brunswick, but in 1918 was compelled, with other German princes, to abdicate.

CUMBERLAND, RICHARD (1631–1718), English philosopher and bishop of Peterborough, the son of a citizen of London, was born in London on July 15, 1631. He was educated in St. Paul's school, and at Magdalene college, Cambridge, and in 1667 was presented to the rectory of Allhallows at Stamford.

At the age of 40 he published his earliest work, entitled *De legibus naturae disquisitio philosophica, in qua earum forma, summa capita, ordo, promulgatio, et obligatio e rerum natura investigantur; quin etiam elementa philosophiae Hobbianae, cum moralis tum civilis, considerantur et refutantur* (1672). It appeared during the same year as Pufendorf's *De jure naturae et gentium,* and was highly commended in a subsequent publication by Pufendorf, whose approbation must have had the effect of making it known on the continent. Having thus established a solid reputation, Cumberland next prepared a work on a very different subject—*An Essay towards the Recovery of the Jewish Measures and Weights, comprehending their Monies; by help of ancient standards, compared with ours of England* (1686).

In 1691 he became bishop of Peterborough. He died on Oct. 9, 1718.

The philosophy of Cumberland is expounded in the treatise *De legibus naturae.* Its main design is to combat the principles of Hobbes.

He defines the laws of nature as "immutably true propositions regulative of voluntary actions as to the choice of good and the avoidance of evil, and which carry with them an obligation to outward acts of obedience, even apart from civil laws and from any considerations of compacts constituting government." This definition, he says, will be admitted by all parties. Some deny that such laws exist, but they will grant that this is what ought to be understood by them. There is thus common ground for the two opposing schools of moralists to join issue.

The existence of such laws may, according to Cumberland, be established in two ways. The inquirer may start either from effects or from causes. Cumberland prefers that from causes to effects, as showing more convincingly that the laws of nature carry with them a divine obligation. In the prosecution of this method he expressly declines to have recourse to what he calls "the short and easy expedient of the Platonists," the assumption of innate ideas of the laws of nature. He cannot assume, he says, that such ideas existed from eternity in the divine mind, but must start from the data of sense and experience, and thence by search into the nature of things discover their laws. It is only through nature that we can rise to nature's God. His attributes are not to be known by direct intuition. But the Cambridge Platonists have his support in their battle with Hobbes, and he grants that ideas might be both born with us and afterwards impressed from without.

Cumberland's ethical theory (*see* ETHICS, HISTORY OF) is summed up in his principle of universal Benevolence, the one source of moral good. "No action can be morally good which does not in its own nature contribute somewhat to the happiness of men." The theory is important in comparison (1) with that of Hobbes, and (2) with modern utilitarianism.

1. Cumberland's Benevolence is, deliberately, the precise antithesis to the Egoism of Hobbes. His method was the deduction of the propriety of certain actions from the consideration of the character and position of rational agents in the universe. He argues that all that we see in nature is framed so as to avoid and reject what is dangerous to the integrity of its constitution; that benevolence of all to all is what in a rational view of the creation is alone accordant with its general plan; that both man's body and his mind show him to be designed for the pursuit of common good rather than his own private advantage. The whole course of his reasoning proceeds on, and is pervaded by, the principle of final causes.

2. To the question, What is the foundation of rectitude? he replies, the greatest good of the universe of rational beings. He may be regarded as the founder of English utilitarianism, but his system goes to the opposite extreme from what is known as the selfish system, by absorbing individual in universal good.

Nor did he restrict good to the pleasures of sense; a point in which his views were abandoned by the utilitarians, but revived later by Mill. The doctrine of right reason, regarded as a purely derivative function of the mind which lies only in germ in Cumberland, will be found in full flower in Hartley, Mackintosh and later associationists.

BIBLIOGRAPHY.—The care of Cumberland's posthumous publications devolved upon his domestic chaplain and son-in-law, Squier Payne, who soon after the bishop's death edited *"Sanchoniato's Phoenician History,* translated from the first book of Eusebius, *De praeparatione evangelica:* with a continuation of Sanchoniato's history of Eratosthenes Cyrenaeus's Canon, which Dicaearchus connects with the first Olympiad. These authors are illustrated with many historical and chronological remarks" (1720). The preface, moreover, contains an account of the life, character and writings of the author, which was likewise published in a separate form. The sequel to the work was likewise published by Payne—*Origines gentium antiquissimae; or Attempts for discovering the Times of the First Planting of Nations: in*

several Tracts (1724). Editions of the *De legibus naturae* (Lübeck, 1683 and 1694); English versions by J. Maxwell (1727) and John Towers (1750); French translation by Jean Barbeyrac (1744); James Tyrrell (1642–1718), grandson of Archbishop Ussher, published an abridgment of Cumberland's views in *A Brief Disquisition of the Laws of Nature according to the Principles laid down in the Rev. Dr. Cumberland's Latin Treatise* (1692; ed. 1701). For biographical details *see* also Cumberland's *Memoirs* (1807), i. 3–6; *Pepys' Diary*. For his philosophy, *see* E. Albee, *Philosophical Review*, iv. 3 (1895), pp. 264 and 371; F. E. Spaulding, *R. Cumberland als Begründer der englischen Ethik* (1894); and text-books on ethics.

CUMBERLAND, RICHARD (1732–1811), English dramatist, was born in the master's lodge of Trinity college, Cambridge, on Feb. 19, 1732. He was the great-grandson of the bishop of Peterborough; and his father, Dr. Denison Cumberland, became successively bishop of Clonfert and of Kilmore. His mother was Joanna, the youngest daughter of the great scholar Richard Bentley, and the heroine of John Byrom's once popular little eclogue, *Colin and Phoebe*. Cumberland was educated at Westminster School and Trinity College, Cambridge, where he took his degree as tenth wrangler in 1750. He had just begun to read for his fellowship, when he was offered, and accepted, the post of private secretary to the earl of Halifax, first lord of trade and plantations in the duke of Newcastle's ministry. In 1761 he accompanied his patron (who had been appointed lord-lieutenant) to Ireland as Ulster secretary and subsequently held other Government positions. In 1780 he was sent on a confidential mission to Spain, the expenses of which he strove in vain to recover, and soon after retired on an allowance of less than half-pay. He died in London on May 7, 1811.

Cumberland is remembered by his plays, and, to some extent, by his *Memoirs* (1806–07), which include a long account of his Spanish mission and reminiscences of politicians and of Garrick, Foote and Goldsmith. Cumberland was a good observer of men and manners; but the uneasy self-absorption which Sheridan immortalized in the character of Sir Fretful Plagiary in *The Critic* is apparent enough in this autobiography.

Cumberland's plays, published and unpublished, have been computed to amount to fifty-four. About 35 of these are regular plays, to which have been added 4 operas and a farce; and about half of the whole list are comedies. The best known of them belong to sentimental comedy. He first essayed sentimental comedy in *The Brothers* (1769). The theme of this comedy is inspired by Fielding's *Tom Jones;* its comic characters are the jolly old tar Captain Ironsides, and the henpecked husband Sir Benjamin Dove. The epilogue paid a compliment to Garrick, who helped the production of Cumberland's second comedy *The West-Indian* (1771), which was afterwards translated into German by Boden; Goethe acted in it at the Weimar court. *The Fashionable Lover* (1772) is a sentimental comedy of the most pronounced type.

Among his later plays may be mentioned *The Natural Son* (1785), *The Imposters* (1789), a comedy of intrigue; *The Jew* (1794), a serious play; *The Wheel of Fortune* (1795), in which John Kemble found a famous part in the misanthropist Penruddock, who cannot forget but learns to forgive (a character declared by Kotzebue to have been stolen from his *Menschenhass und Reue*), and a *Hint to Husbands* (1806), which, unlike the rest, is in blank verse. *The Carmelite* (1784), a romantic domestic drama in blank verse, in the style of Home's *Douglas,* furnished some effective scenes for Mrs. Siddons and John Kemble as mother and son. His posthumously printed plays (published in 2 vols. 1813) include *Brutus* (afterwards amalgamated with other plays on the subject into a very successful tragedy for Edmund Kean by Payne); *Tiberius in Capreae;* and *The False Demetrius* (on a theme which attracted Schiller). Cumberland translated the *Clouds* of Aristophanes (1797), and altered for the stage Shakespeare's *Timon of Athens* (1771), Massinger's *The Bondman* and *The Duke of Milan* (both 1779). Cumberland's novel, *Henry,* was printed in Ballantyne's Novelists' Library (1821), with a prefatory notice of the author by Sir Walter Scott.

A so-called *Critical Examination* of Cumberland's works and a memoir of the author based on his autobiography, by William Madford, appeared in 1812. An excellent account of Cumberland is included in "George Paston's" *Little Memoirs of the Eighteenth Century* (1901). Hettner well characterizes Cumberland's position in the history of the English drama in *Litteraturgesch. d. 18 Jahrhunderts* (2nd ed., 1865), i. 520. Cumberland's portrait by Romney (whose talent he was one of the first to encourage) is in the National Portrait Gallery.

CUMBERLAND, WILLIAM AUGUSTUS, Duke of (1721–1765), son of King George II. and Queen Caroline, was born on April 15, 1721, and when five years of age was created duke of Cumberland. After an unsuccessful attempt at a naval career, he joined the army in 1742, becoming a major-general in December. In 1743, he shared in the glory of Dettingen (June 27), and after the battle was made lieutenant-general. In 1745, having been made captain-general of the British land forces at home and in the field, the duke was again in Flanders as commander-in-chief of the allied British, Hanoverian, Austrian and Dutch troops. Advancing to the relief of Tournai, which was besieged by Marshal Saxe, he unsuccessfully engaged that great general in the battle of Fontenoy (*q.v.*) on May 11.

He was recalled from Flanders to quell the Jacobite rising headed by Prince Charles Edward (1745–46). Carlisle having been retaken, Cumberland retired to London, till the news of the defeat of Hawley at Falkirk roused fresh fears. The duke was appointed commander of the forces in Scotland, and proceeded to Aberdeen to prepare his army. On April 15, 1746 he fought the decisive battle of Culloden. His stern measures for the suppression of Jacobitism which followed earned him his title of "Butcher" Cumberland.

He was rewarded by being voted an income of £40,000 per annum in addition to his revenue as a prince of the royal house. In 1747 he again opposed the still victorious Marshal Saxe in Flanders, and received a heavy defeat at the battle of Lauffeld, or Val, near Maestricht (July 1747). When war broke out afresh in 1757 Cumberland was placed at the head of a motley army of allies to defend Hanover. At Hastenbeck, near Hameln, on July 26, 1757, he was defeated by the superior forces of D'Estrées (*see* Seven Years War), and finally, in September, capitulated at Klosterzeven, agreeing to disband his army and to evacuate Hanover. His disgrace was completed on his return to England by the king's refusal to be bound by the terms of the duke's agreement. Retiring into private life, the duke did much to displace the Bute ministry and that of Grenville, and endeavoured to restore Pitt to office. Public opinion, which had originally turned against him after his harsh treatment of the Scotch, now set in his favour, and he became almost as popular as he had been in his youth. He died on Oct. 31, 1765.

See A. N. Campbell Maclachlan: *William Augustus, Duke of Cumberland* (1876); E. Charteris: *William Augustus . . . his early life and times* (1913); *William Augustus . . . and the Seven Years War* (1925); and Cumberland: Dukes and Earls of.

CUMBERLAND. The north-westernmost county of England, bounded north by Scotland, with the boundary deflected north of the Esk-Liddell streams so as to include Solway Moss in England, east by Durham and Northumberland leaving the pass between Pennines and the Cheviots in the latter county, south-east by Westmorland giving the upper Eden to that county, south by Lancashire, which possesses the southward-opening Coniston and Windermere areas of the English Lake District, and west by the Irish Sea. It thus consists essentially of the Carlisle plain and those portions of the Lake District which focus upon it or upon the west coastal strip. Area 1,520.5 sq.mi.

Physical and Geological Features.—The great physical and geological feature is the famous mountain dome with its radial lakes and this will be described briefly here though it extends into Westmorland eastwards and Lancashire southwards. The geological history has analogies with that of North Wales. Ordovician deposits were overlaid by lava and ashes and these in turn were covered by Silurian rocks. The area was folded in a north-north-west direction during the Caledonian mountain-building period, was reduced and acquired a girdle and probably a cover of Carboniferous rocks, was depressed again, acquired a girdle of New Red Sandstone, and, Marr suggests, a covering of Chalk-period deposits. Later, probably during the Alpine mountain-building period, the present dome was uplifted with a drainage scheme first developed on a now vanished cover. The Saddleback (2,847 ft.), Skiddaw (3,053 ft.), Bassenthwaite, Crummock Water, and the West Ennerdale area shows the smoothed surface of Ordovician rocks typically pressed into slates. To the south of a great fault the volcanic rocks or Borrowdale series give rugged features; they lagged behind the slates in the northward Caledonian folding Sca Fell Pike (3,210 ft.) and Helvellyn (3,118 ft.) are the most outstanding masses. The two sections are separated broadly by the Penrith-Keswick road and a line continuing this westward. There are some volcanic rocks (Carrock Fell) northeast of Skiddaw. The volcanic series gives place southward to Silurian rocks along a line from the lower Duddon across the upper part of Windermere to the vicinity of Shap in Westmorland. The scenery to the south becomes smoother and the transition is, in the west, not far from the county boundary. The volcanic series contains intrusive igneous rocks in the west, and at Shap. The dome has been radially eroded and fault lines have added complexities as also have the glaciers of the Pleistocene Ice Age. The Derwent, Caldew, Eamont, Lowther, Kent, Leven, Crake, Duddon, Esk, Irt and Ehen spread like the spokes of a wheel, mostly from the central volcanic zone and their valleys contain the many long lakes, usually with morainic dams, that name the district. Derwentwater, Bassenthwaite, Buttermere, Crummock Water, Ennerdale and Wastwater are the largest in Cumberland, with Ullswater on the Westmorland border. As in north Wales there are also high tarns at the heads of valleys.

A fault running east-northeast from Maryport cuts off the dome from the Carlisle plain which has many faults around it and possesses a floor of Permian, Triassic and Liassic rocks. The Pennine fault runs along the east side of the Eden valley and throws up Carboniferous limestone and other rocks of that period to form the high ground on the north and northeast of the county. Cross Fell (2,930 ft.) is outstanding and the volcanic intrusion of the Whinsill may be traced northward from it.

The west coast strip exposes Carboniferous limestone, with remnants of scarps facing towards the dome, followed by coal measures some of which are worked under the sea. Ironstone also occurs. To the southwest Triassic sandstones form the frame of the dome. The present dips of these rocks are sufficient to carry them on over the whole dome and Marr thinks they once covered it. Like northwest Wales, Cumberland was affected in the Pleistocene Ice Age not only by local ice sheets but also by ice sheets spreading down the Irish sea from Scotland. A moraine with south Scottish rocks can be traced at S. Bee's Head, in the Isle of Man, and in north Ireland.

Early Settlement.—The great circles of unhewn stone are a feature of Cumberland. That at Swineside, near Millom, still has 22 stones standing, its diameter is about 25 yards. Another, $1\frac{1}{2}$ mi. from Keswick on the old Penrith road, retains 38 stones and is about 38 yards in diameter; it encloses a group of 10 stones one of which is 7 ft. high. Long Meg and her Daughters, near Addingham church, has 67 stones and a diameter of more than 100 yards. Near the enclosure is a stone 18 ft. high. Tumuli have been found on many of the lower hills, notably near Heskfell (south), Penrith and Bewcastle Fells (north). A number of bronze-age finds have been made.

The district was conquered by Agricola in A.D. 80 and he built a wall from Solway to Tyne. This was superseded by the great wall of Hadrian built A.D. 121 from Wallsend in Northumberland to Bowness-on-Solway in Cumberland, a distance of $73\frac{1}{2}$ mi. In post-Roman times the county shared in the activities of Celtic Christianity which had its centre in the northwestern islands. Crosses with Celtic and Scandinavian characteristics occur at Gosforth, Bewcastle and elsewhere. The battle of Ardderyd (573) resulted in the consolidation of Cumberland with the kingdom of Strathclyde. About 670–680 the Angles of Northumbria conquered the district between the Solway and the Mersey and kept it until the Danish invasion of the 9th century. In 875 the kingdom of the Cumbri is referred to, but without any indication of its extent, and the first mention of Cumberland to denote a geographical area occurs in 945, when it was ceded by Edmund to Malcolm of Scotland. At this date it included the territory north and south of the Solway from the Firth of Forth to the Duddon. In 1000 it was once more a stronghold of the Danes, whose influence is clearly traceable in place names, the Scandinavian names being mostly on the higher ground and the Saxon names in the lowlands. At the time of the Norman invasion Cumberland was a dependency of the earldom of Northumbria, but its history at this period is very obscure, and no notice of it occurs in Domesday. In 1092 William Rufus captured Carlisle, repaired the city, built the castle, sent Englishmen to till the land and placed the district under the lordship of Ranulf Meschines. The district was again captured by the Scots in the reign of Stephen, and on its recovery in 1157 was made to include the great barony of Coupland. At this date the district was described as the county of Carlisle, and the designation county of Cumberland is not adopted in the sheriff's accounts until 1177. The administrative divisions were known as bailiwicks, in 1278.

Border warfare was a feature of Cumbrian life until, and even after, the union of England and Scotland. Families like the Tilliols, the Lucies, the Greystokes and the Dacres were famous on the English side. Many of the parish churches have towers for defense, as the church at Burgh-on-the-Sands near Carlisle. Carlisle was the headquarters of the English army under Edward I. In the Wars of the Roses the prevailing sympathy was with the Lancastrian cause. In 1542 the Scots suffered a disastrous defeat at Solway Moss. After the union of the crowns of England and Scotland in 1603, the countries hitherto known as "the Borders" were called "the Middle Shires." On the outbreak of the Civil War of the 17th century the northern counties rose for the king. In 1645 Carlisle was captured by the parliamentary forces, but in April 1648 it was retaken and did not finally surrender until the autumn of 1648. Cumberland was one of the first counties to welcome Charles II; in 1715 it was associated with the rising, and Carlisle was the chief seat of operations in 1745. With the Romantic revival in English poetry, the Lake district became a centre of literary interest gathering around the names of Wordsworth, Coleridge, Southey, Ruskin and others.

Industries and Occupations.—About $52\frac{2}{3}\%$ of the total area of the county (1,503 sq.mi., excluding water) was under cultivation in 1939, and over one-third was in rough grazings. Stock farming, especially for sheep, of which 749,622 were raised in 1939, is the main rural occupation, though cattle are important, with a total of 199,496 in the same year. The principal crop is oats (43,110 ac.), followed by turnips and swedes (15,806 ac.) and potatoes (4,812 ac.). Rough Fell sheep are favoured in the hills and they are crossed with larger ones in the lowlands. Long after the Norman conquest Cumberland remained one of the most densely forested regions of England, and much of the low-lying land is still well wooded. The oak, ash and birch are the principal natural trees, while sycamores have been planted for shelter round many farmsteads. Plantations of larch are numerous, and extensive afforestation has been carried out. Much land was formerly held by "statesmen" *i.e.*, "estatesmen," a class of sturdy small holders. The National Trust owned 14.1 sq.mi. in Cumberland in 1942, including the principal peaks and the Derwentwater.

The industries of Cumberland have been from earliest times connected with its fisheries and mineral wealth. The mines of Alston and the iron mines about Egremont were worked in the 12th century. The Keswick copper mines were worked in the reign of Henry III, and the black-lead mine in the 18th century. Coal mining is referred to in the 15th century and, after the revival of the mining industries in the 16th century, rose to great importance. The saltpans about the estuaries of the Esk and the Eden were a source of revenue in the 12th century. In modern times the iron and steel manufacture has centred in Workington, pig iron is produced mainly at Millom, and coal is mined about Whitehaven, Workington, Maryport, Aspatria and Cockermouth. Iron ore is raised at Cleator Moor, though on a larger scale in the south around Millom. Pencils are made at Keswick, gypsum is worked at Hesket and exists in quantity at Whitehaven, while cobalt, antimony and manganese are sometimes obtained. Granite and limestone are extensively quarried. Cotton is manufactured at Carlisle.

The decline in the iron, steel and coal industries, due to the fall in home demand and the loss of foreign markets following World War I, combined with an absence of other industries, led to severe depression in the West Cumberland industrial region in the 1930s. A government investigation showed that in mid-1934, out of an insured male population of 33,800, there were 10,500 unemployed. In intensity, unemployment ranged from 28.2% in Harrington to 61.2% in Maryport. Cleator Moor and Maryport became partially derelict and the condition of several other towns was serious. Industrially West Cumberland's main activities revealed a remarkable interdependence, but, since the iron ore mining was unlikely to afford more employment in the future and the iron and steel industry could offer no prospect of absorbing its unemployed, the outlook was far from promising. Accordingly, the whole area—consisting of the towns of Alston, Aspatria, Cleator Moor, Cockermouth, Haltwhistle (Northumberland), Harrington, Maryport, Millom, Whitehaven and Workington—was scheduled for assistance under the Special Areas act of 1934.

Steps taken towards economic recovery and stability followed policy for the Special areas as a whole The Cumberland Development council was formed in late 1935 to promote particularly the area's industrial potentialities and its great possibilities as a tourist centre. Under the council an industrial survey was completed in 1938, and a comprehensive publicity campaign was undertaken. Rapid results were hindered, however, by the inaccessibility of the area, though its small size made it susceptible to measures which in larger regions would scarcely have been adequate. Thus, though a trading estate was impracticable, the West Cumberland Industrial Development company, which was formed instead in Aug. 1937, with powers similar to those of the trading estate companies, met with considerable success in its efforts to attract new industry. By the end of Sept. 1938, two new factories had been completed at Maryport and a third was being built; extensive factory space had been newly equipped at Cleator Moor; a large leather factory was almost completed at Millom; and at Whitehaven the erection of a factory for silk weaving and finishing had been begun. In addition, plans had been formulated for improving the amenities of the area. Of 15 undertakings which had been granted financial assistance by the Special Areas commissioner at the same date, eight had received it in the form of "inducements" under the Amending act of 1937, and of these, five were to occupy factories provided by the development company.

Apart from purely industrial measures, the most important works, which were finally undertaken after severe initial setbacks, were in connection with the improvement of Whitehaven and Maryport harbours, but the factor of supreme importance to the future of the area as a whole, *i.e.*, greatly improved transport facilities, particularly by road, was still under discussion, mainly because of the extent and cost of the necessary works.

Unemployment was directly relieved by the transference of workers to more prosperous localities through the ministry of labour—about 4,000 had been transferred by Sept. 30, 1938—by settlement schemes, administered by the Land Settlement association, and by the provision of "sub-economic" employment in the shape of group holdings (under the same association) and allotments. The progress of group holdings was slow because of the difficulty of obtaining suitable properties, and by Sept. 30, 1938, only 15 groups with 155 holdings were in operation. Land settlement suffered similarly at first, but eventually four estates aggregating 2,136 ac. were acquired in the county (the largest two near Carlisle) with accommodation for 224 families, and at the end of Sept. 1938, 115 families, or 551 persons had been settled on them. Public works undertaken by the local authorities, aided by grants from the commissioner, provided additional employment. The placing of government contracts in the area and the reopening of some works also contributed to the fall in the number of wholly unemployed men to 6,860 in mid-September 1938, the total number of unemployed persons in the area at that time being 9,933 or 28.8% of the insured population. (*See* also GLAMORGANSHIRE.)

The chief ports are Whitehaven, Workington and Maryport. The L.M.S.R. enters the county near Penrith and passes through Carlisle. This is the western route to Scotland. There are branch lines with connections to Maryport, Cockermouth, Keswick, Egremont, Chester and Workington. The L.N.E.R. connects Carlisle with Newcastle. Motorbus traffic has facilitated travel. There were 2,350 miles of roads in the county in 1943.

Population and Administration.—The area of the administrative county is 1,513.4 sq.mi. with an estimated pop. of 194,900 in 1938. However, the suitability of the county as a reception area for evacuees in World War II had the effect of raising the population 11% between Sept. 1939 and Feb. 1941. The county contains five wards, corresponding to hundreds, and the Derwent division. The county town is the city of Carlisle, a county borough. The municipal boroughs are Whitehaven and Workington and the urban districts Cockermouth, Keswick, Maryport and Penrith. Cumberland is in the northern circuit, and assizes are held at Carlisle. It has one court of quarter sessions and 12 petty sessional divisions. Carlisle has a separate commission of the peace and court of quarter sessions. Cumberland returned three members for the county to the parliament of 1290, and in 1295 returned in addition two members for the city of Carlisle and two members each for the boroughs of Cockermouth and Egremont. Carlisle now returns one member and four others are returned respectively by the Northern, Penrith and Cockermouth, Whitehaven and Workington divisions of the county.

In 685 Carlisle and district were annexed by Egfrith of Northumbria to the diocese of Lindisfarne, to which it continued subject, until the Danish invasion of the 9th century. In 1133 Henry I created Carlisle (*q.v.*) a bishopric. In 1856 the diocese was extended so as to include the whole of Cumberland except the parish of Alston (in the diocese of Newcastle), the whole of Westmorland and the Furness district of Lancashire. The parish of Firbank, in Westmorland, is in the diocese of Bradford.

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CUMBERLAND, the second largest city of Maryland, U.S.A., on the Potomac river, in the north-western part of the State; the county seat of Allegheny county. It is on Federal highways 40 and 220; has an aeroplane landing field, Mexico Farms; and is served by the Baltimore and Ohio, the Cumberland and Pennsylvania, the Pennsylvania, and the Western Maryland railways. The population in 1930 was 37,747 (91% native white), and was 39,483 (97.3% native white) in 1940, federal census. The city is 635 ft. above sea-level, and is surrounded on three sides by mountain scenery. A deep gorge of great beauty, called "The Narrows," forms a natural gateway to the west. Cumberland has a large trade in coal, of which the county mines about 1,500,000 tons a year. The manufacturing industries include artificial silk, rubber tires, glassware, groundshafting, firebrick, lumber products and beer. The railroad shops in Cumberland are capable of repairing and building all types of equipment. Cumberland is a retail and wholesale centre for western Maryland and large sections of West Virginia and Pennsylvania. The first settlement here was made in 1750, and in 1754 Col. James Imes built Ft. Cumberland at Wills creek as a defence against the French and their Indian allies. From this fort Gen. Braddock started on his disastrous expedition of July 9, 1775. A town was laid out in 1763 and incorporated in 1815. In 1850, when the population was 6,073, it was chartered as a city, and in 1910 a commission form of government was adopted.

CUMBERLAND, a town in Providence county, Rhode Island, U.S.A., in the northeastern part of the state, on the Blackstone river and served by the New York, New Haven and Hartford railroad. The population in 1940 (federal census) was 10,625. Within its borders are nine villages, which manufacture cotton goods and silk. At Lonsdale, a village on the river, William Blackstone, the first permanent white settler in Rhode Island, built his residence "Study Hall" about 1635. Cumberland was originally part of Rehoboth, and then of Attleboro (Mass.). In 1747, by royal decree, it was annexed to Rhode Island and the town was incorporated. Because of the variety of minerals within its borders it was named after Cumberland, England. In 1867 part of it was set off as the town of Woonsocket.

CUMBERLAND GAP, a pass in the Cumberland mountains on the border between the States of Kentucky and Tennessee, U.S.A., about 45 m. north-east of the city of Knoxville, Tennessee. The altitude of the pass, which was an important strategic point in the Civil War, is 1,648 feet.

CUMBERLAND MOUNTAINS, the westernmost of the three great divisions of the Appalachian uplift in the United States, composed of many small ranges of mountains (of which Cumberland mountain in eastern Kentucky is one). It extends from Pennsylvania to Alabama, attaining its greatest height (about 4,000ft.) in Virginia. The plateau is rich in a variety of mineral products, of which coal is the most abundant; beautiful marbles are also quarried in this region. The plateau has an abrupt descent, almost an escarpment, into the great Appalachian valley on its east, while the west slope is deeply and roughly broken. The whole mass is eroded in Virginia into a maze of ridges. Cumberland mountain parts the waters of the Cumberland and Tennessee rivers. This range and the other ranges about it are perhaps the loveliest portion of the whole plateau. The peaks here and in the Blue Ridge to the east are the highest of the Appalachian system. The Cumberland range is noted for its immense caverns and subterranean streams. Cumberland gap, crossing the ridge at 1,648ft. above sea level, where Kentucky, Virginia, and Tennessee meet, is a gorge about 500ft. deep. The mountains, river, and gap were all discovered by a party of Virginians in 1748, and named in honour of the victor of Culloden, William, duke of Cumberland. Afterwards the gap gained a place in American history as one of the main pathways by which emigrants crossed the mountains to Kentucky and Tennessee. During the Civil War it was a position of great strategic importance, as it afforded an entrance to eastern and central Tennessee from Kentucky, which was held by the Union arms; and it was repeatedly occupied in alternation by the opposing forces throughout the struggle.

CUMBERLAND RIVER, a large southern branch of the Ohio river, U.S.A., rising in the highest part of the Cumberland plateau in southeast Kentucky, and emptying into the Ohio in Kentucky (near Smithland) after a devious course of 688 mi. through that state and Tennessee. It drains a basin of somewhat more than 18,000 sq.mi. At the Great Falls, in Whitley county, (Ky.), it drops precipitously 63 ft. Above the falls it is a mountain stream, of little volume in the dry months. It descends rapidly at its head to the highland bench below the mountains and traverses this to the falls, then flows in rapids (the Great Shoals) for about 10 mi. through a fine gorge with cliffs 300–400 ft. high and descends between bluffs of decreasing height and beauty into its lower level. Save in the mountains its gradient is slight, and below the falls, except for a number of small rapids, the flow of the stream is equable. Timbered ravines lend charm to much of its shores, and in the mountains the scenery is most beautiful.

Below Nashville the stream is about 400 to 500 ft. wide, and its high banks are for the most part of alluvium, with rocky bluffs at intervals. At the mouth of the river lies Cumberland island, in the Ohio. During low water of the Ohio the Cumberland discharges around both ends of the island, but in high water of the Ohio the gradient of the Cumberland is so slight that its waters are held back, forming a deep quiet pool that extends about 20 mi. up the river. Commerce on the Cumberland was once of great importance, it being navigable for light-draught boats through about 500 mi. under favourable conditions—Burnside, Pulaski county, 518 mi. from the mouth, being the head of navigation. A system of locks and dams below Nashville was planned in 1846 by a private company, which accomplished practically nothing. Since 1832 the federal government has expended more than $6,000,000 on canalization and open channel projects. During the Civil War, Fort Donelson on the Cumberland, and Fort Henry near by on the Tennessee were erected by the Confederates, and their capture by Flag-officer A. H. Foote and Gen. Grant (Feb. 1862) was one of the decisive events of the war.

CUMBERLAND ROAD: *see* NATIONAL OLD TRAILS ROAD.

CUMBRAES, THE, two islands forming a parish and part of the county of Bute, Scotland, lying in the Firth of Clyde, between the southern shores of Bute and the coast of Ayrshire. Great Cumbrae island, about 1½ mi. W.S.W. of Largs, is 3¾ mi. long and 2 mi. broad, and has a circumference of 10 mi. and an area of 3,200 ac. or 5 sq.mi. Its highest point is 417 ft. above the sea. There is some fishing and a little farming, but the mainstay of the inhabitants is the custom of the visitors who crowd every summer to Millport, which is reached by steamer from Largs, and from Fairlie in the summer. This town (pop. 1938, 1,508) is well situated at the head of a fine bay and has a climate that is both warm and bracing. Its chief public buildings include the cathedral, erected in Gothic style on rising ground behind the town, the college connected with it (not now used as such), a picturesque seat belonging to the marquess of Bute, who owns the island, and a marine biological station. The cathedral, originally the collegiate church, was founded in 1849 by the earl of Glasgow and opened in 1851. In 1876 it was constituted the cathedral of Argyll and the Isles. Millport enjoys exceptional facilities for boating and bathing, and there are also two good golf courses. Little Cumbrae island lies to the south, separated by the Tan, a strait half a mile wide. It is 1¾ mi. long, barely 1 mi. broad, and has an area of almost a square mile. Its highest point is 409 ft. above sea level. On the bold cliffs of the west coast stands a lighthouse. Robert II is said to have built a castle on an islet off the east shore, which was demolished by Cromwell's soldiers in 1653. The remains of the tower can be seen. The population of the two islands, omitting Millport, was 82 in 1931.

CUM DIVIDEND: *see* DIVIDENDS.

CUMIN or **CUMMIN** (*Cuminum Cyminum*), an annual herbaceous plant of the family Umbelliferae, probably a native of western Asia, but scarcely known at the present time in a wild state. It was early cultivated in Arabia, India and China, and in the countries bordering the Mediterranean. Its stem is slender and branching, and about a foot in height; the leaves are deeply cut, with filiform segments; the flowers are small and white. The fruits, the so-called seeds, which constitute the cumin of pharmacy, are fusiform or ovoid in shape and compressed laterally; they are two lines (one-sixth inch) long, are hotter to the taste, lighter in colour, and larger than caraway seeds, and have on each half nine fine ridges, overlying as many oil-channels or vittae. Their strong aromatic smell and warm bitterish taste are due to the presence of an oil. Total annual world production is about 2,000 tons. Principal use is in spice manufactures. The drug is used in veterinary practice. Cumin is exported from Algiers, Morocco, India, Malta, Syria and Mexico.

CUMMERBUND, a girdle or waistbelt (Hindostani *kamarband,* a loin-band). In the east the principle of health is to keep the head cool and the stomach warm; the turban protects the one from the sun, and the cummerbund ensures the other against changes of temperature. In India the cummerbund consists of many folds of muslin or bright-coloured cloth.

CUMMING, JOSEPH GEORGE (1912–1868), English geologist and archaeologist, was born at Matlock in Derbyshire on Feb. 15, 1812. He was educated at Oakham grammar school, and Emmanuel college, Cambridge, taking the degree of M.A., and entering holy orders in 1835.

In 1841 he was appointed vice-principal of King William's college, Castletown, in the Isle of Man, and this position he held until 1856. During this period his leisure time was devoted to a study of the geology and archaeology of the island. The results were published in a classic volume, *The Isle of Man; its History, Physical, Ecclesiastical, Civil and Legendary* (1848). He was vicar of St. John's Bethnal Green, London, at the time of his death on Sept. 21, 1868.

CUMMINGS, BRUCE FREDERICK: *see* BARBELLION, W. N. P.

CUMMINS, ALBERT BAIRD (1850–1926), American politician, was born at Carmichaels, Pa., on Feb. 15, 1850. He was educated at Waynesburg (Pa.) college, studied surveying, and was at first engaged in railway work. He then took up law, was admitted to the bar of Illinois in 1875, and for three years practised in Chicago. In 1878 he went to Des Moines, where he attained great distinction in his profession, and ten years later was a member of the Iowa house of representatives. He was chairman of the Republican State committee (1892–96), candidate for the U.S. senate in 1894 and 1900, member of the Republican National committee (1896–1900) and a delegate to the Republican National convention on four occasions. He was elected governor of Iowa in 1902 and re-elected for two succeeding terms. In 1908 he was elected to the U.S. senate to fill the unexpired term of Senator Allison, and was re-elected three times, serving continuously for 18 years until his death, which occurred at Des Moines, on July 30, 1926. He opposed the nomination of Taft in 1912, but did not leave his party. He was specially identified with measures concerning trusts and railways, and took a leading part in drafting the Esch-Cummins act, under which the government in 1920 returned to private control the railways of the United States. When Vice-President Calvin Coolidge succeeded to the presidency in 1923 Cummins served as president of the senate until the succeeding vice-president, C. G. Dawes, assumed office in 1924.

CUMNOCK AND HOLMHEAD, small burgh, Ayrshire, Scotland, on the Lugar, 33¾ mi. S. of Glasgow by road, with two stations (Cumnock and Old Cumnock) on the L.M.S.R. Pop. (est. 1938) 4,053. Area, .26 sq.mi. It is in the parish of Old Cumnock (1931 pop. 5,637). Coal and ironstone are extensively mined in the neighbourhood, and the industries include iron works and the manufacture of electrical switchgear. When Alexander Peden (1626–1686), the persecuted Covenanter, died, he was buried in the Boswell aisle of Auchinleck church; but his corpse was borne thence by a company of dragoons to the foot of the gallows at Cumnock, where they buried it. After the Revolution the inhabitants out of respect for the "Prophet's" memory abandoned their then burying ground and turned the old place of execution into the present cemetery. A monument was erected in his memory. Five miles southeast lies the civil parish of New Cumnock (pop. 6,420) at the confluence of Afton Water and the Nith, with a station on the L.M.S.R. Two miles northwest of Cumnock is Auchinleck (pronounced Affleck), with a station on the same railway. Coal and iron mining and stone quarrying are carried on. It is the seat of the Boswell family, three of whom are well known—Lord Auchinleck, the judge (who dubbed Dr. Johnson "Ursa Major"), his son James, the biographer, and his grandson Sir Alexander, the author of "Gude nicht and joy be wi' you a'," "Jenny's Bawbee," "Jenny dang the weaver," and other songs and poems, who perished in a duel. Pop. of Auchinleck civil parish (1931) 6,626.

CUMONT, FRANZ VALÉRY MARIE (1868–), Belgian historian of religion, was born on Jan. 3, 1868, at Alost. After studying at Ghent, Bonn, Berlin, Vienna and Paris, he was from 1892 to 1910 professor in Ghent university, and from 1899 to 1912 curator of the Brussels Royal museum.

His chief publications are: editions of Philo's *De aeternitate mundi* (1891) and of the *Acts of S. Dasius* (1897); *Textes et monuments relatifs aux mystères Mithra* (1894–1901, Eng. trans. 1903); *Les Réligions orientales dans le paganisme romain* (1906, Eng. trans. 1911); *Recherches sur le manichéisme* (1908–12); *Astrology and Religion among the Greeks and Romans* (1912); *Études syriennes* (1917); *After Life in Roman Paganism* (1922); *Imp. Caesaris F. C. Iuliani Epistulae, Leges, Poematia, Fragmenta varia* (with Bidez 1922); and *Fouilles de Doura Europos, 1922–23*, etc. (2 pts. 1926).

CUMULATIVE PREFERENCE SHARE, a share which carries with it the right, not only to a preferential dividend, but to a lien upon future profits for any or all arrears of deferred or unpaid preferential dividend. That is to say, if the cumulative preference dividend for any period cannot be paid, the unpaid dividend accumulates to the credit of the holder of the share, and must be paid before any other dividend is paid in any succeeding year. The equivalent term in the United States is cumulative preferred stock.

CUNARD, SIR SAMUEL, Bart. (1787–1865), British civil engineer, founder of the Cunard line of steamships, was born at Halifax, Nova Scotia, on Nov. 21, 1787. In conjunction with Messrs. Burns of Glasgow and Messrs. MacIver of Liverpool, proprietors of rival lines of coasting steamers between Glasgow and Liverpool, he formed a company to carry out the British government's proposal to substitute steam- for sailing-vessels in the trans-Atlantic mail service. The first voyage of a Cunard steamship was successfully made by the "Britannia" from Liverpool to Boston, U.S.A., between July 4, and 19, 1840. Cunard was created a baronet in 1859. He died on April 28, 1865.

CUNARD WHITE STAR LINE. This British steamship company takes its name from Samuel Cunard (*q.v.*) who, in 1839, secured the contract from the British admiralty for the carriage of mails by steamship to Canada and the United States.

The Cunard Atlantic service was inaugurated on July 4, 1840, when the "Britannia," a wooden paddle-wheel steamer, sailed from Liverpool for Halifax, N.S., and Boston, completing the passage in 14 days 8 hours at an average speed of $8\frac{1}{2}$ knots.

In the first 43 years of the company's existence noteworthy links in the chain of development were the "Persia" (1856), the first iron Cunard liner, the "Scotia," 3,871 tons (1862), in her day the largest steamer in the world; the "Gallia," 4,800 tons (1879), regarded as the grandparent of the modern liner; the "Servia," 7,392 tons (1881), the first steel Cunard liner and larger and faster than any boat then in commission, and the "Aurania" (1883), the first liner to be fitted with suites of rooms.

From 1884 onwards, the rate of progress made was more rapid than ever. The "Umbria" and "Etruria" launched in that year were sister ships of more than 8,000 tons and an instantaneous success.

The achievements of the "Umbria" and "Etruria" were eclipsed by the commissioning of the first Cunard twin-screw steamers "Campania" and "Lucania" (1893) whose speed of 22 knots made them the ships of the day. The "Caronia" (19,687 tons) and the "Carmania" (19,524 tons) were added to the fleet in 1905. The latter was the first Cunard liner to have turbine engines.

The "Lusitania" (31,550 tons) and "Mauretania" (31,937 tons) were commissioned in 1907. Their construction followed the signing of an agreement in 1903 between the Cunard company and the government to meet the competition of the recently formed International Mercantile Marine Company of America.

In 1909 the company strengthened its Mediterranean freight services by the purchase of three steamers. In 1939 these services were maintained by four 2,400-ton steamers, "Bactria," "Bantria," "Bosnia" and "Bothnia."

An important development took place in 1911 when the company re-entered the Canadian trade by acquiring the Thomson Line. In addition three new vessels for this service were ordered.

The "Aquitania" (44,768 tons) was commissioned in May 1914.

Immediately after the Armistice the company ordered 13 new vessels amounting to a gross tonnage of 214,000 tons. This new fleet included five 20,000 ton liners for the New York service and six 14,000 ton vessels for the Canadian trade. The express service was transferred to Southampton and maintained by the "Berengaria" (ex "Imperator"), "Aquitania" and "Mauretania."

The company had also acquired other interests, the chief of which were the Commonwealth & Dominion Line (Port Line) engaged in the Australian and New Zealand trade and Thos. & Jno. Brocklebank engaged in the Indian trade.

In 1930 the construction of the "Queen Mary" (81,235 tons) was begun at Clydebank. The ordering of this vessel was due to the rapid progress in naval architecture and marine engineering which made it possible for two ships of sufficient size and speed to maintain the company's express service to New York instead of three ships hitherto found necessary. In Dec. 1931, owing to the world-wide economic depression, work on the "Queen Mary" was suspended and it was not until April 1934 that it was restarted.

In Feb. 1934 the agreement between the Cunard Steamship company, White Star Line (*q.v.*) and the government was reached. As a result of this agreement the North Atlantic assets of the Cunard and White Star companies were merged while the government agreed to advance to the merger company £9,500,000 to enable the "Queen Mary" to be completed and a sister ship constructed.

The "Queen Mary" was launched by Her Majesty Queen Mary on Sept. 26, 1934, and made her first voyage to New York on May 27, 1936. In the same year construction of the second ship (the "Queen Elizabeth") began at Clydebank.

An important development in the company's services took place in 1937 when work was begun at Birkenhead on the construction of a new 35,000-ton liner.

Designed for the company's intermediate services and to supplement when necessary the express service, this new vessel was launched on July 28, 1938, and named "Mauretania," in this way perpetuating the name of her famous predecessor which had been sold for breaking up in 1935.

The new "Mauretania" was commissioned in 1939 and made her maiden voyage from Liverpool to New York on June 17.

The launching of the "Queen Elizabeth" by Her Majesty the Queen took place on Sept. 27, 1938.

This great vessel—more than 1,030 ft. in length and with a gross tonnage of 85,000 tons—made a successful maiden voyage to New York city in March 1940, secretly and without passengers, to evade the German submarines.

CUNAXA, BATTLE OF, 401 B.C. This battle is more famous in its sequel—The "Retreat of the Ten Thousand" under Xenophon—than in itself. Cyrus the Younger, seeking to seize the Persian throne from his brother Artaxerxes, had advanced from Sardis and at Cunaxa, beside the Euphrates, he met his brother's army. Cyrus' force was leavened with some 12,800 Greek mercenaries, under Clearchus. These he placed on his right, the post of honour, next the river. On the other side Artaxerxes with his personal guard cavalry was, according to custom, in the centre, where also the cavalry of the satrap Tissaphernes were placed. On either flank of this cavalry centre stood Artaxerxes' infantry and beyond them again on the two wings were the troops of the other two satraps who were present. The right extended beyond the flank of Cyrus' left. But Cyrus appears to have had an acute grasp of the fact, abundantly attested later in Alexander's invasion, that the resisting power of a Persian army lay in its royal link. For this reason Cyrus wished Clearchus with his Greeks to advance obliquely against the enemy's centre, where Artaxerxes was, for, "if we are victorious in that quarter, our object is fully achieved." As events proved, such a move would probably have decided the battle and a throne. But Clearchus demurred, on the ground that by such a lateral march he would expose his flank, at present protected by the river. The Greeks, therefore, advanced straight to their front and their superior training and armour enabled them easily to rout the opposing Persian left. Unhappily, instead of turning inwards to roll up the enemy's line they pressed straight on in pursuit of their immediate opponents. Meanwhile on the other flank, Artaxerxes' more extended right had naturally lapped round Cyrus' left. Cyrus, however, in default of Clearchus' help, put his conception into execution by charging with 600 cavalry at the enemy's centre. He is said to have penetrated far enough to wound Artaxerxes with his own hand, but was then himself slain. On his fall his own army proved his insight right by dispersing—all save the Greeks. These returned from the pursuit to a battle they believed won and found lost, but even then, a handful adrift among enemy masses in a strange land, they were too formidable for Artaxerxes to dare an attack, except by the subsequent treachery which led to the murder of their leaders and Xenophon's (*q.v.*) opportunity to earn immortal fame.

See Xenophon, *Anabasis.*

CUNDINAMARCA, a department of the eastern plateau of Colombia, South America, pop. (1938) 1,174,607, composed chiefly of Indians and mestizos. A considerable part of its area consists of plateaus from 8,000 to 9,000 ft. above sea level, enjoying a temperate climate and producing the fruits and cereals of the temperate zone, and another important part lies in the valley of the Magdalena and is tropical in character. The slopes between these two regions are celebrated for the excellence of their coffee.

The capital of the department, Bogotá, population (1938 est.) 325,658, is also capital of the republic. Other important towns are Facatativá, pop. (1938) 9,779, situated on the western margin of the *sabana* of Bogotá, 25 mi. N.W. from the capital by rail; and Girardot, pop. (1938) 22,557, connected by rail and a section of the Pan-American highway with the capital.

CUNEIFORM. This name was first applied by Engelbert Kämpfer, at the beginning of the 18th century, to those rock inscriptions from Persia, and to inscriptions on brick and stone from Babylon, which are distinguished by the use of characters made up of triangles or wedge-shaped incisions. This kind of writing was still practised in Babylonia in the first century B.C. Copies accurate enough to allow of study, were used by Karsten Niebuhr in 1774–78, who distinguished three kinds of cuneiform writing, found in three columns in the inscriptions, and divined that one was alphabetic in character. It has since been proved that some of the consonants include the value of a short vowel.

DECIPHERMENT

Old Persian.—Niebuhr drew up an alphabet of one class of inscriptions (that contained in the first column), consisting of 42 characters (whereas there are in fact only 32), and considered this kind of writing Persian.

The number of correct values assigned was gradually increased, many names were correctly ascertained, and the division of words rendered certain by the recognition of the fact that a diagonal wedge was used as a word-divider. In 1837, Rawlinson sent his decipherments of the Persian rock-inscriptions at Elvend and Bisitun (Behistun) to the Royal Asiatic society, and, with the final revision of his work in 1846, the main part of the Old Persian inscriptions of the Achaemenian period became intelligible and the period of decipherment in that branch ended.

Elamite.—The sense of the inscriptions in the two languages that precede Old Persian in these trilingual inscriptions was known from the decipherment of the Old Persian; and it was not difficult to identify certain series of characters in them with the proper names given in the Old Persian. The simpler writing of the two was that in the second column. This writing is not alphabetic, but the majority of the signs are syllabic; thus there are signs representing *sha, shi, shu,* and *ish* which represent the series of simple syllables composed of the consonant *sh* and a vowel, while other signs represent syllables compounded of two consonants and a vowel; *e.g., man, pan, par.* A few signs signify words in themselves and are therefore called ideograms; divine names are marked by prefixing a sign not intended to be sounded; and a perpendicular or a horizontal stroke marks nouns of different kinds. The second column inscriptions were not therefore difficult to arrange into words, and the sense of the words was accurately known in most cases. Rawlinson with his translation of the Old Persian version of the Bisitun inscription was able to supply certain passages broken in the third column, from the intact second column. By 1890 the main ascertainable facts were finally decided. The inscriptions found at Susa during spasmodic excavations, and afterwards by the great French expedition, finally proved that the language of the second column of the Achaemenian inscription was the latest form of the tongue spoken by the people of Elam, and in 1897, Hüsing gave it the name New Elamite. The history of the language covers some 2,000 years, and the decipherment of the earlier stages is mainly due to the text publications of the French expedition by Father Scheil. Unfortunately the sense of these earlier inscriptions can only be approximately decided. The language is classed in the amorphous group generally called "Caucasian."

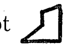
Babylonian.—The language of the third column of the Achaemenian inscriptions was Babylonian; the characters employed being those on bricks and other objects from the site of Babylon. The decipherment of this language was accomplished when in 1851 Rawlinson published 112 lines of the Babylonian version of the Bisitun inscription, with a transcription, and a nearly complete translation. In this memoir 150 signs were assigned values, and certain of these had more than one phonetic value. The language was unquestionably Semitic, and the words could be frequently compared with Hebrew and Arabic; the characters were in part ideograms, in part syllables (individual signs being occasionally polyphonous), and in part used to denote the character of a word, such as a personal name, a profession, a bird and so forth. The language was called by universal consent, Assyrian, since the bulk of the inscriptions then published came from Assyria. Subsequent studies have resulted in a slight change in the nomenclature. Most of the Assyrian royal inscriptions use, as a literary language, the classical Babylonian Semitic language, called by themselves Akkadian. But the Assyrians spoke, and sometimes wrote a language distinct from, but closely related to, Akkadian, and the term Assyrian is now best reserved for that distinctive language, while the Babylonian tongue is termed Akkadian.

Sumerian.—A certain number of inscriptions from Babylonia, especially those of early date, proved to be in a language which was not a Semitic language, to which the name Sumerian is now given. Cuneiform writing was actually invented by the people who spoke Sumerian. The decipherment of this language offered no particular difficulties so far as the characters and phonetic values were concerned, as these were obtained from the Semitic texts and vocabularies. But the language itself is peculiar in structure and cannot at present be allocated to any known family with certainty; the interpretation of unilingual texts from Babylonia in the early period is not often in doubt so far as the main sense goes, but in detail there are still considerable uncertainties.

Urartaean.—Cuneiform inscriptions exist in Armenia in the neighbourhood of Lake Wān and over a very wide area, from Erzerum in the north to the neighbourhood of Lake Urmia in the south. These inscriptions are not all in the Akkadian employed by Assyrian kings, but in another language, which had a nominative case that ended in—*s,* and an accusative in—*n;* the kings' names were in certain cases unquestionably those given by Assyrian inscriptions as kings of Urartu. For the most part the texts are records of buildings and of the construction of canals and other means of irrigation. Modern scholars are inclined to consider this language one of a group known as "Caucasian" to which family Georgian belongs. Various names have been applied to it: "Vannic," since the kingdom in which it was spoken centred round Lake Wān or Van, "Chaldian," because the mention of "Chaldian gods" in the inscriptions may show that the people called themselves "Chaldians," and the Greek writers mention Χαλδιοί in this area, and "Urartaean" because the kingdom was called Urartu by the Assyrians.

Hittite.—The fragments of clay tablets found at various sites in the neighbourhood of Boghaz Keui at the end of the 19th century bore texts in a language clearly similar to, or the same as, that in which a king of Arzawa wrote about 1380 B.C. to the Pharaoh of Egypt, Amenhotep IV, the heretic Ikhnaton. At Boghaz Keui in 1907 a great archive of tablets was unearthed written in various languages, including Akkadian. These Akkadian documents made it clear that Boghaz Keui was the capital of those kings of the Hittites who were engaged in great wars with Egypt in the 14th and 13th centuries B.C.; the library discovered included a certain number of vocabularies, which gave the meaning of the native "Hittite" words in Akkadian. This basis would not have been sufficient to decipher the language, had not the scribes who wrote Hittite texts used both Sumerian and Akkadian words as "ideograms"; that is, they wrote foreign words in cuneiform, but pronounced them in their own language. The meaning of sentences being approximately certain, words in the Hittite language can be ascertained to have certain approximate senses. Hrozny showed that in certain remarkable respects the verb conjugations and the noun declensions corresponded to the *centum* languages of the Indo-European group. But the vocabulary of the Hittites has for the most part no relation to Indo-European; only a few roots can be equated with Indo-Germanic. Whether the Hittite written in cuneiform is the same language as that expressed in pictographic script commonly called "Hittite" because it also was used at Boghaz Keui, is not known.

Other Languages.—Cuneiform was widely employed all over western Asia in the second millennium B.C. Palestinian, Syrian and Phoenician princes wrote to their Egyptian overlord on cuneiform tablets, and sometimes explained isolated Babylonian words by the native "Canaanite" words, which are closely related to Hebrew. One tablet contains Egyptian words spelled phonetically and explained by Babylonian words. On Hittite tablets of a magical and religious character incantations and spells are often given in languages of Asia Minor other than Hittite, designated as the "Luvian," "Bala" and other unknown names. One of these languages is called "Hurrian," and was spoken by a people whose political power centred about the valley of the Khabur. This language is only dialectically distinguishable from that in which the letter of Dushratta, the king of Mitanni, to the Pharaoh Amenhotep IV is couched. Now this language was probably the speech of the Subaraeans, for the names of men called "Subaraean" demonstrably contain the same elements. The exact interpretation of the Subaraean and Hurrian languages is not yet possible owing to the paucity of material.

History of Cuneiform Writing.—The earliest was pictographic, and the simplest objects were truly drawn; a head, foot, sledge, man in a hut, various kinds of pots, reeds, can all be clearly distinguished. The only extant tablet with the pictographic signs upon it is made of stone, which offers no difficulty for drawing such pictures, and may date from about 3,500 B.C. on an approximate estimate. The only other writing material in Babylonia, where this pictographic writing seems to have originated, is clay. The clay was specially selected, and the shape made in the earliest times resembled that of a square cushion with rounded corners. Though wet clay will take lines from a fine point, it is impossible to draw objects in full detail successfully, and clay tablets inscribed shortly after the date of the pictographic tablet show conventional linear forms of the signs which sometimes leave the nature of the original picture in doubt. These linear forms were immediately adopted for use on stone; but they cannot have been in use long on clay because an easier method was at hand. Instead of drawing the point of the stilus across the surface, the point was pressed in, and a sharp edge depressed in the required direction, with the effect that the head of the line assumed a slightly triangular shape, so that | became ▼ and — became ►—. This characteristic, the wedge-shape, from which the writing received its name cuneiform, became inseparable from the writing and was copied by the masons in stone inscriptions. Hence through this development the human foot  came to be represented by .

The earliest writing was in columns read downwards, and from right to left, and this custom was retained in certain cases till the reign of Hammurabi; but the custom of writing horizontally from left to right, which entailed turning the signs on one side, was introduced before 2600 B.C., and was universal later. This resulted in the picture of a man's head facing right  becoming a recumbent head .

The exact method of the scribes in writing on clay tablets is not known, and the explanation which follows is conjectural. In shaping the clay the thumb and fingers were used on less important documents, but marks were never left on finely made tablets. The shape of the tablets varied in different periods, the square tablets being succeeded by long rectangular shapes; the large tablets used in the third millennium were abandoned for general use, but are occasionally found in use for long literary texts. The building inscriptions which were placed as records in the foundations of temples and palaces by kings were generally written on hollow barrel cylinders. The Assyrians who added to the account of the building a long preamble containing the military exploits of the reign, also used a prism shape, with four to ten sides, which was inscribed down the length. These cylinders and prisms always had a fine clay surface put over a rough core.

The stilus was in general made of a reed, and the fibre marks may be seen in roughly written business documents. It has been claimed that a very early bone object found at Kish is a stilus. In the very finest writing some hard material must have been employed, possibly even metal. The point of the instrument was perhaps formed by cutting a square stem obliquely. The stilus was held in the right hand, and the kinds of wedges required, ▼, ►—, ◣, ►——, ◀, were obtained by a manipulation with the fingers, the different edges being used. The blunt edge of the stilus was round, and in the earliest times circles and semi-circles were made by it to indicate numerals. An unexplained difficulty is that tablets are inscribed on obverse and reverse. When the tablet was turned, in such a way that the bottom of the obverse became the top of the reverse, the inscribed surface, still wet, would be likely to suffer from any pressure, but this was avoided by some unknown means. Some of the finest tablets from Ashurbanipal's library, and some prisms, are pierced with round holes; the exact purpose is not known.

The development in power of expression accompanied the change in methods of writing. The pictograph, besides denoting the object depicted, had indicated allied ideas; thus the picture of the human foot could also mean "to stand" or "to go" and other verbs of motion. The sign thus came to have the sound of these words associated with it. These sounds were later used as syllabic values, and used to write words not capable of being expressed by a single sign. Another development was the use of compound signs; "food" in "mouth" formed the picture sign "to eat." The polyphony of the signs was both increased and reduced by the assumption of a single form by signs originally distinct, and by the distinction into different forms of a single sign. When the cuneiform signs were adopted for the expression of the Semitic language, still more syllabic values were added to various signs, since the Semitic words for various picture signs were sometimes treated as syllabic values. Even so it is not possible to give a full account of the origin of all values.

The syllabary evolved by this process consisted of some thousands of signs, but in practice the number necessary could be, and was very considerably reduced. The almost endless "ideograms" were used by the learned scribes for writing documents only intended for their own eyes; to simplify the reading of them an elaborate system of phonetic complements was introduced. Commercial documents and more especially letters, were written with simple syllables, and for this purpose about 150 common signs and ideograms sufficed. In this form the writing was borrowed by other countries.

The two main schools of cuneiform were both derived from the particular style of writing of the Sumerian scribes of the 3rd dynasty of Ur about 2300–2150 B.C. At that time the writing was introduced into Assyria. In the north, a tendency to make the signs square in appearance developed about 2000 B.C., and thenceforward the Assyrian forms of signs are markedly different in many cases from the Babylonian. In both cases simplification took place, but the Babylonian preferred a cursive form.

In Elam, cuneiform was adopted at a very early period and was used at the same time as an indigenous form of writing in the third millennium. In the second millennium cuneiform signs were written in cursive forms peculiar to the country; when exactly the peculiar forms and limited number of signs used in the second column of the Achaemenian inscriptions were adopted is not known, the date may approximately be the 7th or early 6th century. The Persian cuneiform was a separate invention, based only on the use of wedges. Some scholars affirm that the Persian alphabet must have been known before the time of Darius I, the Great, but there is no definite proof of this. All the inscriptions in this cuneiform alphabet extant are royal, and there is no literary or commercial document so written extant; it is to be doubted whether it was ever used except for monumental purposes. The one example of a clay tablet was intended for the use of masons.

Spread of Cuneiform Writing.—The objects delineated in the early pictographic script prove that its originators were inhabitants of the marsh lands at the head of the Persian gulf. From there it spread to Elam at the end of the 4th millennium. It was first used to express a Semitic language at some time after 3000 B.C., and was regularly so used from 2500 B.C. onwards. It was introduced into Assyria and Asia Minor about 2300 B.C. Between 1500–1200 B.C. there were cuneiform scribes in several Hittite towns in Asia Minor, in nearly every important city in Syria and Palestine and at the Egyptian court. About the same time the Assyrians introduced it into their provinces east of the Tigris, at such places as Arrapha, for ordinary use; the earlier examples of cuneiform writing in the Zagros range, which date from about 2800 B.C., onwards, are confined to royal monumental inscriptions. The kings of Van borrowed Assyrian cuneiform about the 9th century B.C. for their own monuments and clay tablets prove that it was in ordinary use. In the time of the Assyrian empire, 800–600 B.C., cuneiform was used in all the provinces of western Asia. The Achaemenian kings continued and developed the practice of writing in their home lands, and the Seleucid dynasty which followed them had royal inscriptions written in it, and encouraged Greeks to study early cuneiform documents, for there are tablets which give translations of the cuneiform signs into Greek characters.

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CUNEO, a town and episcopal see of Piedmont, Italy, the capital of the province of Cuneo, 55 mi. by rail south of Turin, 1,722 ft. above sea level. Cuneo lies on the railway from Turin to S. Dalmazzo di Tenda, whence the road goes on to Airole which is 8 mi. N. of Ventimiglia by rail. In 1937 it became a station on the new direct railroad from Turin to Nice. It is also a junction for Mondovi and Saluzzo, and has steam tramways to Borgo S. Dalmazzo, Boves, Saluzzo and Dronero. Pop. (1936) 18,852 (town); 35,321 (commune). Its name ("wedge") is due to its position on a hill between two streams, the Stura and the Gesso. Cuneo was founded about 1120 by refugees from local baronial tyranny, who, after the destruction of Milan by Barbarossa, were joined by Lombards. In 1382 it swore fealty to Amadeus VI, duke of Savoy. It was a fortress, and was ceded by the treaty of Cherasco (1796), with Ceva and Tortona, to the French. In 1799 it was taken by the Austrian and Russian armies, and, in 1800, after the victory of Marengo, the French demolished the fortifications.

CUNIBERT, SAINT (*c.* 590–663), bishop of Cologne, was educated at Trèves, where he became archdeacon. After becoming bishop of Cologne in 623, he assisted at the synods of Reims (625) and of Clichy (626). At the court of the Merovingians, especially under Sigebert III (d. 656), he exercised great political influence. He encouraged missions to the Frisians.

CUNITZ, MARIA (*c.* 1610–1664), Silesian astronomer, was the eldest daughter of Dr. Heinrich Cunitz of Schweinitz, and the wife (1630) of Dr. Elias von Löven, of Pitschen in Silesia—both of them men of learning and distinction. From her universal accomplishments she was called the "Silesian Pallas," and the publication of her work, *Urania propitia* (Oels, 1650), a simplification of the Rudolphine tables, gained her a European reputation. It was composed at the village of Lugnitz, close by the convent of Olobok (Posen), where, with her husband, she had taken refuge at the outbreak of the Thirty Years' War, and was dedicated to the emperor Frederick III. She died at Pitschen on Aug. 24, 1664.

CUNLIFFE, WALTER, 1ST BARON (1855–1920) English banker, was born in London on Dec. 4, 1855, the son of Roger Cunliffe, a banker of the City of London. He was educated at Harrow and Trinity college, Cambridge, and became a banker in the City in 1880, establishing in 1890 the merchant banking business of Cunliffe Bros. He became a director of the Bank of England in 1895, deputy-governor in 1911, and governor in 1913, an office which he held until 1918. He was raised to the peerage as Baron Cunliffe of Headley in Dec. 1914. Lord Cunliffe was associated with the working out of all the chief financial problems during World War I, and in 1917 accompanied A. J. Balfour on his financial mission to the United States. He died at Epsom on Jan. 6, 1920.

CUNLIFFE-LISTER, SIR PHILIP (1884–), British statesman, was born on May 1, 1884, at Ayton, Yorkshire. The youngest son of Lt.-Col. Yarburgh G. Lloyd Greame, he assumed by royal warrant the name of Cunliffe-Lister in Dec. 1924. He was educated at Winchester and University college, Oxford, and was called to the bar in 1908. During World War I he served with the King's Royal Rifle corps, attaining the rank of major. Elected Conservative member for Hendon in 1918, he was chairman of the labour committee of the war cabinet, and served on other important government committees. He was parliamentary secretary to the Board of Trade and of the Overseas Trade department in the Lloyd George Coalition government; was president of the Board of Trade 1922–23, 1924–29 and 1931; and colonial secretary 1931–35; and secretary of state for air 1935–38. He was created Viscount Swinton in Nov. 1935.

CUNNINGHAM, ALEXANDER (*c.* 1655–1730), Scottish classical scholar and critic, was born in Ayrshire. It is probable that he completed his education at Leyden or Utrecht. He was tutor to the son of the first duke of Queensberry, through whose influence he was appointed professor of civil law in the University of Edinburgh until 1710, when he left England for The Hague, where he resided until his death. He is chiefly known for his edition of Horace (1721) with notes, mostly critical, which included a volume of *Animadversiones* upon Richard Bentley's notes and emendations. Cunningham also edited the works of Virgil and Phaedrus (together with the *Sententiae* of Publilius Syrus and others).

Life by D. Irving in *Lives of Scottish Writers* (1839).

The above must not be confused with ALEXANDER CUNNINGHAM, British minister to Venice (1715–1720), a learned historian and author of *The History of Great Britain* (from 1688 to the accession of George I), originally written in Latin and published in an English translation after his death.

CUNNINGHAM, ALLAN (1784–1842), Scottish poet and man of letters, was born at Keir, Dumfriesshire, on Dec. 7, 1784, and died on Oct. 30, 1842. He began life as a stone mason's apprentice. His father was a neighbour of Burns at Ellisland, and Allan with his brother James visited James Hogg, the Ettrick Shepherd, who became a friend to both. Cunningham contributed some songs to Roche's *Literary Recreations* in 1807, and in 1809 he collected old ballads for Robert Hartley Cromek's *Remains* *of Nithsdale and Galloway Song;* he sent in, however, poems of his own, which the editor inserted, even though he may have suspected their real authorship. In 1810 Cunningham went to London and in 1814 became clerk of the works in the studio of Francis Chantrey, retaining this employment till the sculptor's death in 1841. Some of Cunningham's songs hold a high place among British lyrics. "A Wet Sheet and a Flowing Sea" is a famous sea-song although written by a landsman; and many other of his songs will bear comparison with it.

Cunningham had five sons and one daughter. JOSEPH DAVEY CUNNINGHAM (1812–1851) entered the Bengal Engineers, and is known by his *History of the Sikhs* (1849). SIR ALEXANDER CUNNINGHAM (1814–1893) also entered the Bengal Engineers; attaining the rank of major-general; he was director general of the Indian Archaeological survey (1870–85), and wrote an *Ancient Geography of India* (1871) and *Coins of Medieval India* (1894). PETER CUNNINGHAM (1816–1869) published several topographical and biographical studies, of which the most important are his *Handbook of London* (1849) and *The Life of Drummond of Hawthornden* (1833). FRANCIS CUNNINGHAM (1820–1875) joined the Indian army, and published editions of Ben Jonson (1871), Marlowe (1870) and Massinger (1871).

The works of Allan Cunningham include *Lives of the Most Eminent British Painters, Sculptors and Architects* (1829–33); *Traditionary Tales of the Peasantry* (1822); the *Songs of Scotland, Ancient and Modern* (1825); *Biographical and Critical History of the Literature of the Last Fifty Years* (1833); an edition of *The Works of Robert Burns,* with notes and a life containing a good deal of new material (1834); and *Life, Journals and Correspondence of Sir David Wilkie,* published in 1843. An edition of his *Poems and Songs* was issued by his son, Peter Cunningham, in 1847.

CUNNINGHAM, WILLIAM (1805–1861), Scottish theologian and ecclesiastic, was born at Hamilton, Lanarkshire, on Oct. 2, 1805, and educated at the University of Edinburgh. In 1834 he received the charge of Trinity college parish, Edinburgh. In the stormy discussions which preceded the Disruption, he was a powerful advocate of the cause of the Free Church. On its formation in 1843 Cunningham was appointed professor of Church history and divinity in the New college, Edinburgh, of which he became principal in 1847 in succession to Thomas Chalmers. In 1859 he was appointed moderator of the General Assembly. He died on Dec. 14, 1861. He was one of the founders of the Evangelical Alliance. The Cunningham theological lectureship at the New college, Edinburgh, was endowed in 1862.

See Rainy and Mackenzie, *Life of Cunningham* (1871).

CUNNINGHAM, WILLIAM (1849–1919), British economist, was born at Edinburgh on Dec. 29, 1849. He was educated at Edinburgh, Tübingen and Cambridge. He was university lecturer in history from 1884 to 1891, when he was named professor of economics at King's college, London, a post which he held until 1897. He was lecturer in economic history at Harvard university (1899), and Hulsean lecturer at Cambridge (1885). He became vicar of Great St. Mary's, Cambridge, in 1887, and was made a fellow of the British academy. In 1906 he was appointed archdeacon of Ely. He died at Cambridge on June 10, 1919. Dr. Cunningham's *Growth of English Industry and Commerce during the Early and Middle Ages* (1890) and *Growth of English Industry and Commerce in Modern Times* (1882; 3rd ed., 1903) are standard works of reference on the industrial history of England. He also wrote *The Use and Abuse of Money* (1891); *Alien Immigration* (1897); *Western Civilization in its Economic Aspect in Ancient Times* (1898), and *in Modern Times* (1900); and *The Case against Free Trade* (1910), written in support of Joseph Chamberlain's tariff policy. Cunningham's work on the historical side of economics marked the beginnings of a new tendency. A bibliography of his work will be found in his *Progress of Capitalism in England* (1916).

CUNNINGHAME GRAHAM, ROBERT BONTINE (1852–1936), Scottish writer, eldest son of William Cunninghame Graham of Ardoch and Gartmore, was educated at Harrow. He spent much of his youth cattle-farming in the Argentine, and travelled widely in Paraguay, Mexico, Spain and Morocco. A Spanish grandmother made the Spanish language and national temperament singularly congenial, and his writings are throughout coloured by these early experiences. Cunninghame Graham sat as M.P. for North Lanarkshire from 1886–92, and took an active part in Labour politics, being closely associated with John Burns and Keir Hardie in their early days, and in 1928, as an ardent nationalist, identified himself with the Scottish national movement.

Characteristic of his varied writings, essays, travel notes, biography and stories, all of which are original in matter and brilliant in expression, are these: *Mogreb-el-Acksa* (1898); *A Vanished Arcadia* (1901); *Success* (1902); *Hernando de Soto* (1903); *Faith* (1909); *A Brazilian Mystic,* a life of Antonio Conselheiro (1920); and a biography of his ancestor, *Doughty Deeds of Robert Graham, 1735–97* (1925); *Pedro de Valdivia, Conqueror of Chile* (1926). *See* also L. Chaundy, *A Bibliography of the First Editions of the Works of Robert Bontine Cunninghame Graham.*

CUNO, WILHELM (1876–1933), German statesman, was born on July 2, 1876, at Suhl. He entered the civil service and was employed from 1907 in the treasury. During World War I he was in charge of the imperial grain office until July 1916; he was then Batocki's chief assistant in the food department until Nov. 1917, when he became a director of the Hamburg-Amerika line. At the end of 1918 he succeeded Ballin as president and general director. Dr. Cuno always took an active part in national politics, although he never stood for parliament. As a result of the murder of Erzberger on Aug. 26, 1921, and of Rathenau on June 24, 1922, which had shaken national confidence, a ministerial crisis, inspired by the socialist distrust of Herr Stinnes, resulted in the resignation of the Wirth government on Nov. 14. Dr. Cuno then formed a non-party cabinet, in which there were no social democrats, with Dr. von Rosenberg as foreign minister, the chief task being the direction of national opposition to the French in the Ruhr. A financial crisis following the disastrous fall of the mark obliged Dr. Cuno to resign on Aug. 12, 1923, and he then returned to the presidency of the Hamburg-Amerika shipping company. It is perhaps worth noting that the idea of a pact, which eventually developed under Dr. Cuno's successors into the Locarno Pact, was already mooted by him during his chancellorship (*see* E. C. Reventlow, *Minister Stresemann als Staatsmann, etc.* [1925]).

CUP, a drinking vessel, usually in the form of a half sphere, with or without a foot or handles. The footless type with a single handle is preserved in the ordinary tea-cup. The cup on a stem with a base is the usual form used in the celebration of the eucharist, to which the name "chalice" is generally given. (*See* DRINKING VESSELS.)

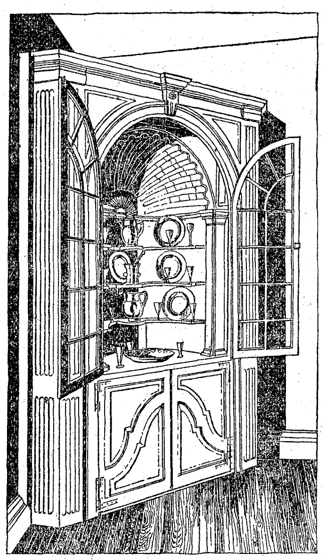
CUPAR, a royal and small burgh, and the capital of the county, Fifeshire, Scotland, 11 mi. W. by S. of St. Andrews by the L.N.E. railway. Pop. (est. 1938) 5,004. It is situated on the left bank of the Eden, in the east of the Howe (Hollow) of Fife, and is sometimes termed Cupar-Fife to distinguish it from Coupar-Angus in Perthshire. The Mercat cross stands at "the Cross" in the main street, where it was set up in 1897, having been removed from Hilltarvit, an eminence in the neighbourhood of Cupar, on the western slope of which, at Garliebank, the truce was signed between Mary of Guise and the lords of the Congregation. The town received its charter in 1356 from David II, and being situated between Falkland and St. Andrews was constantly visited by Scottish sovereigns, James VI holding his court there for some time in 1583. The site of the 12th-century castle, one of the strongholds of the Macduffs, thanes or earls of Fife, is occupied by a public school. On the esplanade in front of Macduff castle, still called the Playfield, took place in 1552 one of the first recorded performances of Sir David Lindsay's *Ane Satyre of the Three Estaits* (1540); his *Tragedy of the Cardinal* (1547), referring to the murder of Beaton, being also performed there.

The chief industry is the manufacture of linen, and tanning and coach-building are carried on. There is a beet-sugar factory. The town has some repute for its fine printing.

To the northeast is the parish of Dairsie, where one of the few parliaments that ever met in Fife assembled in 1335. The castle in which the senate sat was also the residence for a period of

Archbishop Spottiswood, who founded the parish church in 1621. Two miles and a half north of Dairsie is situated Kilmany, which was the first charge (1803–15) of Thomas Chalmers. David Hackston, the Covenanter, who was a passive assister at the assassination of Archbishop Sharp, belonged to this parish, his place being named Rathillet. After his execution at Edinburgh (1680) one of his hands was buried at Cupar, where an inscription records his death. To the west of Kilmany lies Creich, where Alexander Henderson (1583–1646), the Covenanting divine and diplomatist, and John Sage (1652–1711), the non-juring archbishop of Glasgow, were born. In the upper Old Red Sandstone of Dura Den, a ravine on Ceres burn, 2½ mi. E. of Cupar, have been found great quantities of fossils of ganoid fishes.

CUPBOARD, a fixed or movable closet usually with shelves. As the name suggests, it is a descendant of the credence or buffet, the characteristic of which was a series of open shelves for the reception of drinking vessels and table requisites. After the word lost its original meaning—and down to the end of the 16th century we still find the expression "on the cupboard"—this piece of furniture was, as it to some extent remains, movable, but it is now most frequently a fixture designed to fill a corner or recess. With the exception of a very few examples of fine ecclesiastical cupboards which partook chiefly of the nature of the armoire in that they were intended for the storage of vestments, the so-called court-cupboard is perhaps the oldest form of the contrivance. The derivation of the expression is somewhat obscure, but it is generally taken to refer to the French word *court,* short. This particular type was much used from the Elizabethan to the end of the Carolinian period. It was really a sideboard with small square doors below, and a recessed superstructure supported upon balusters. Of these many examples remain. Less frequent is the livery cupboard, which appears usually to have been placed in bedrooms, so that a supply of food and drink was readily available when a very long interval separated the last meal of the evening from the first in the morning. The livery cupboard was often small enough to stand upon a sideboard or cabinet and had an open front with a series of turned balusters. It was often used in churches to contain the loaves of bread doled out to poor persons under the terms of ancient charities. They were then called dole cupboards; there are two large and excellent examples in St. Alban's abbey, Hertfordshire. The butter, or bread and cheese cupboard, was a more ordinary form, with the back and sides bored with holes, sometimes in a geometrical pattern, for the admission of air to the food within. The corner cupboard, which is in many ways the most pleasing and artistic form of this piece of furniture, originated in the 18th century, which, as we have seen, was the golden age of the cupboard. It was often of oak, but more frequently of mahogany, and had either a solid or a glass front. The older solid-fronted pieces are fixed to the wall half-way up, but those of the somewhat more modern type, in which there is much glass, usually have a wooden base with glazed superstructure. Most corner cupboards are attractive in form and treatment, and many of them, inlaid with satinwood, ebony, holly or box, are extremely elegant.

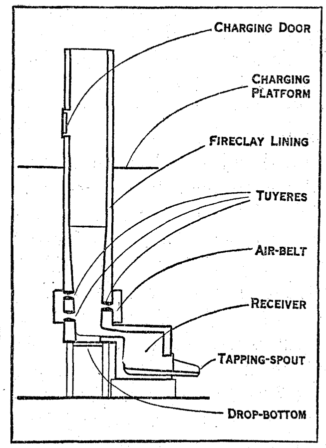


BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

18TH-CENTURY CORNER CUPBOARD

CUPID, the Latin name for the god of love, Eros (*q.v.*). Cupid is generally identical with Amor (*Cupido,* "desire"). The idea of the god of love in Roman poetry is due to the influence of Alexandrian poets and artists, in whose hands he became a mischievous boy with essentially human characteristics. His usual attribute is the bow. For the story of Cupid and Psyche, *see* PSYCHE.

CUPOLA, in metallurgy, a tall tubular structure built of steel plates and lined with firebrick. It is employed in iron foundries to melt pig and scrap for the castings, or pig-iron in steel works for the Bessemer converter. Dwarf cupolas for small requirements are about 2 ft. 6 in. in diameter and 10 ft. high, melting from 10 to 15 cwt. per hour, while on a large scale the dimensions may reach 9 ft. and over 40 ft. respectively, having a capacity of 30 tons per hour. A bed charge of coke is first laid at the bottom and then alternate layers of iron and coke, which are thrown through the charging-door, the furnacemen standing on the charging-platform. Supplies are brought up by a crane or a cupola-hoist. Blast to furnish means for increasing the combustion is sent in from a fan or blower, through tuyeres communicating with the interior of the furnace, these being made with flaring mouths to soften the force. An air-belt generally surrounds the tuyere zone, so as to conduct the air to the tuyeres in an adequate amount at uniform pressure. The molten metal is either tapped directly from the cupola, or flows into a receiver, which keeps it hot, and ready for drawing off supplies as required. This is the type shown in the diagram. Some cupolas are solidly built at the bottom, but a better style is with drop-bottom, which has hinged doors kept up by a catch. At the end of the melting process the catch is released, from a safe distance, and the doors fall and with them the slag, residue of iron and unburned coke, the two latter items being put in again at the next blow. A spark-arrester is fitted on the top of a cupola when there is risk of fire to adjacent buildings, or the flying grit is objectionable. A large cupola is more economical to work than a small one, hence the consumption of coke varies in different cases, from 1¼ cwt. to 4 cwt. per ton of iron melted; this relation is termed the melting-ratio. (*See* IRON AND STEEL.)



THE CUPOLA FURNACE, EMPLOYED IN IRON FOUNDRIES TO MELT PIG AND SCRAP FOR CASTINGS, OR PIG IRON. IN STEEL WORKS, FOR THE BESSEMER CONVERTER

In architecture, cupola is primarily a dome-shaped covering for a building or room, especially when the curvature is slight; thus, in fortifications, a low, flat turret resembling an overturned saucer, in which guns are mounted. By extension the term has come to mean a lantern (*q.v.*) crowning a dome as well as the dome itself, and hence any small, lantern-like form, projecting above the roof of a building.

CUPPING, a method, now obsolete, whereby blood was drawn to some cutaneous region by the partial vacuum within a heated cupping glass (dry cupping). In wet cupping the skin was incised. In both instances, as in the action of leeches, there was local abstraction of a small quantity of blood which was held to relieve subjacent inflammation.

CUPRA, the name of two ancient Italian *municipia* in Picenum.

(1) Cupra Maritima (Civita di Marano near the modern Cupra Marittima), on the Adriatic coast, 48 mi. S.S.E. of Ancona, erected in the neighbourhood of an ancient temple of the Sabine goddess Cupra, which was restored by Hadrian in A.D. 127. The remains of what was probably the forum of the town were discovered. The nature of the forum was indicated by the fragments of a calendar and of a statue of Hadrian which were unearthed. Some statuettes of Juno were also among the finds, as well as an inscription of a water reservoir erected in 7 B.C. The more ancient Picene town appears to have been situated near the hill of S. Andrea, a little to the south, where pre-Roman tombs were discovered.

(2) Cupra Montana, 10 mi. by road S.W. of Aesis (mod. Jesi). The village, formerly called Massaccio, has resumed the

ancient name. Ruins, perhaps of baths, and remains of subterranean aqueducts have been discovered near the church of S. Eleuterio.

CUPRESSACEAE: *see* GYMNOSPERMS.

CUPRITE, a mineral consisting of cuprous oxide, Cu_2O, crystallizing in the cubic system, and forming an important ore of copper, of which it contains 88.8%. The name cuprite (from Lat. *cuprum,* copper) was given by W. Haidinger in 1845; earlier names are red copper ore and ruby copper, which at once distinguish this mineral from the other native copper oxide—cupric oxide—known as black copper ore or melaconite. Well-developed crystals are of common occurrence; they usually have the form of the regular octahedron, sometimes in combination with the cube and the rhombic dodecahedron. The colour is cochineal-red, and the lustre brilliant and adamantine to submetallic in character; crystals are often translucent, and show a crimson red colour which on prolonged exposure to light becomes dull and opaque. The streak is brownish red. Hardness $3\frac{1}{2}$; specific gravity 6.0; refractive index 2.85.

Compact to granular masses also occur, and there are two curious varieties—chalcotrichite and tile-ore—which require special mention. Chalcotrichite (from Gr. χαλκός, copper, and θρίξ, τριχός hair) or "plush copper ore," is a capillary form with a rich carmine colour, and silky lustre: the delicate hairs are loosely matted together, and each one is an individual crystal enormously elongated in the direction of the edge of the cube. Tile-ore (Ger. *Ziegelerz*) is a soft earthy variety of a brick-red to brownish-red colour; it contains admixed limonite, and has been formed by the alteration of chalcopyrite (copper and iron sulphide).

Cuprite occurs in the reduction zone of copper bearing lodes; and is of secondary origin.

Beautifully crystallized specimens were formerly found in Cornwall; they also occur in the copper mines of the Urals, in Arizona and elsewhere. (L. J. S.)

CURAÇAO or **CURAÇOA,** a Dutch West Indian island 40 mi. from the north coast of Venezuela, in 12° N. and 69° W., 40 mi. long from northwest to southeast; average width 10 mi.; area 210 sq.mi. It is flat, with southwest hills rising to 1,200 ft. There are deeply indented natural harbours, the chief of which is that of St. Anna on the southwest coast. Curaçao consists chiefly of diorite and diabase, and is surrounded by coral reefs. Streams are few and rainfall scanty, averaging only 16 in. per annum. The plains are largely arid but glens produce maize, beans, pulse, etc. Salt, phosphates and cattle are exported. The commerce is with U.S.A. and Venezuela. Curaçao liqueur was originally made on the island from an orange, *Citrus Aurantium curassuviensis.* Willemstad (pop. [1939] 31,264), on the harbour of St. Anna, has houses in the Amsterdam style, and the narrow channel separating it from its western suburb of Overzijde and the waters of the Waigat, which intersect it, recall the Dutch canals. The entrance of the Schottegat or Inner harbour is protected by forts. The Negroes speak *Papaimento,* composed of Spanish, Dutch, English and native words. Curaçao gives its name to the government of the Dutch West Indies, which include Aruba, west of Curaçao, area 69 sq.mi. and pop. (1941) 31,522; Buen Ayre, 20 mi. N.E., area 95 sq.mi. and population (1941) 5,556; St. Eustatius, Saba and part of St. Martin. The governor is assisted by a council of four, and a colonial council of 13. Curaçao island had a population (estimated Dec. 31, 1941) of 68,217 and the entire colony of Curaçao had 109,592 inhabitants.

PANAMA-HAT WEAVING, AN IMPORTANT INDUSTRY IN CURAÇAO

The chief industry is oil refining, the crude petroleum being imported from oil fields of the Lake Maracaibo basin of Venezuela.

Imports of Curaçao and the other islands (1936), 197,012,376 guilders; exports, 201,512,618 guilders.

Curaçao was discovered by Hojeda about 1499 and occupied by the Spaniards in 1527. The Dutch have held it since 1634, except during 1798 and from 1806 to 1814, when it was held by Great Britain. In 1940 it was occupied by Allied troops.

See Wynmalen, "Les Colonies néerlandaises dans les Antilles," *Revue Colon. Internat.* ii., p. 391 (1887); K. Martin, *West-Indische Skizzen* (Leyden, 1887); De Veer, *La Colonie de Curaçoa* (Les Pays Bas, 1898). Also several articles on all the islands in *Tijdschrift v.h. Ned. Aardr. Genootschap; Encyclopaedie van Nederlandsch-Indië* (1914–17).

CURAÇAO, a delicate fruit liqueur; it was originally made in the Dutch West India island of Curaçao—hence its name. At first it enjoyed a great vogue because of its distinctive flavour, being made from the peel of a special variety of orange known as the Curaçao orange—*Citrus Aurantium curassuviensis.* Later, when the manufacture of the liqueur had extended to Holland as an industry, the ordinary variety of oranges were used. The orange peel is well soaked in water and then distilled with spirit and water, sweetened, and flavoured with Jamaica rum. The alcoholic strength of Curaçao ranges from 36 degrees to 40 degrees. There are two kinds, the dry and the sweet, the former being the stronger of the two. Epicures regard a liqueur glass of *Curaçao sec* as a most agreeable digestive after a substantial repast. There are now many brands of Curaçao on the market, and no longer is the industry confined to Holland. Pommeranzen is a variety of Curaçao made at Riga. The well-known "Grand Marnier" is another variety of Curaçao made with fine brandy. (J. V. M.)

CURARE (obsoletely and/or primitively: curari, wourara, wourari, wourali, urari, curara, urirarery, etc.), a non-specific term used by certain South American Indians to designate a group of varying but related arrow-poisons; in pharmacognosy and medicine specifically a form of curare like that discovered by Gill, 1938, used in human beings. The crude drug is a resinous appearing, dark-brown to black mass of a sticky to hard consistency and has an aromatic, tarry odour. It is frequently prepared, primitively, as a decoction (though often, also, as a cold concoction). The types of curare most often studied have each contained several ingredients, variously grouped, from: A. (of primary importance) Loganiaceae (Strychnos *spp.*); Menispermaceae (Chondodendron, Cissampelos, Sciadotenia, Telitoxicum, Elissarrhena, Anomospermum *spp.,* etc.) and B. (of secondary, and even rare, use) Piperaceae (Piper *spp.*); Annonaceae (Annona); Leguminosae (Lonchocarpus); Rutaceae (Erythrochiton); Moraceae (Ficus); Rubiaceae (Psychotria); Solanaceae (Capsicum); Aristolochiaceae (Aristolochia *spp.*).

Different curares contain one or more of the following complex basic alkaloids: curin(e), curarine, tubo-curarine, paracurarine, protocurarine, the recently isolated phenolic alkaloids, protocuradine and neo-protocuradine (King), and others.

Curare is used for the artificial induction of flaccidity in striated muscles; by refinements in the drug and a carefully controlled technique of administration, attempts are made to avoid respiratory embarrassment or other unwanted side-reactions. This curarization is now employed for relief of spastic paralysis (by reducing to normal the tonus of hyperinnervated muscles), in the reduction of fractures and dislocations (by eliminating muscle pull during setting or reduction), and in other fields where a state of profound muscular relaxation or even immobility is desirable. Another of its most publicized uses is as an adjunct in the shock-therapy treatment and cure of schizophrenia (dementia praecox), and various affective mental disorders, the manic-depressive psychoses, especially involutional melancholia (Bennett, Menninger, Woolley, Stewart, etc.). The standardized curare is claimed to lessen incidence of vertebral fractures.

However, with curare's federal acceptance, the drug is most widely used as an adjuvant in general inhalation anaesthesia (Griffith, Cullen, Smith, Cole, Baird, etc.), especially in abdominal surgery, in which field, frequently combined with cyclopropane gas, it is becoming the method of choice because it produces profound surgical relaxation (comparable only to that seen in spinal anaesthesia) with only a minimal concentration of anaesthetic agent. From this there is prompt post-anaesthetic recovery and a radical reduction of the possibilities of post-operative pneumonias and other complications. S. M. Smith observes that "curare . . . appears to be one of the greatest aids introduced into the field of anaesthesiology." The drug is also being successfully employed as a needed relaxant in oral intubation, general endoscopy (oral, rectal, etc.), various tetanic seizures, lumbar and sacro-iliac manipulations, and, latterly, owing to its quickly reversible action, as a definite diagnostic sign in myasthenia gravis.

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CURASSOW, a group of gallinaceous birds forming one of the subfamilies of *Cracidae* (*Cracinae*), which includes the finest game birds of S. America. They are large heavy birds, with short wings, long broad tail and strong bill. The hind toe is placed on a level with the others, unlike the majority of gallinaceous birds. With the exception of one species found north of Panama, the curassows are confined to S. America, east of the Andes, and not extending south of Paraguay. They live in small flocks, and are arboreal. Their nests are neat structures, made of slender branches interlaced with blades of grass, and lined with leaves. They feed on fruits, seeds and insects. They are often tamed but have never been thoroughly domesticated. Their flesh is white and delicate.

Crax globicera, found in Mexico, is about 3 ft. in length, of a glossy black except for the white abdomen and tail coverts. In common with the other species its head bears a crest of feathers curled forward at the tips, which can be raised or depressed at will. The female is reddish brown. In one species (*C. incommoda*) the greater part of the black plumage is beautifully varied with narrow bars of white. The galeated curassow (*Pauxi galeata*) has a large blue tubercle, resembling a hen's egg in size and shape, situated at the base of the bill, and much larger in the male.

CURATE, properly a presbyter who has the cure of souls within a parish (from the Lat. *curare*, to take care of). The term is used in this general sense in the English Book of Common Prayer; and in continental Europe the cognate term (Fr. *curé*, Ital. *curato*, Span. *cura*, etc.) is applied to parish priests.

The term is now used almost exclusively, in English-speaking countries, to signify an unbeneficed clergyman who is assistant to a parish priest. This usage, which hardly goes back further than the early 19th century, was at first restricted to the Church of England, and to the Roman Catholic Church in Ireland; but has now become general in both churches, though the more exact title "assistant curate" is used by Anglican bishops in licensing such persons. The term "perpetual curate" denotes, in the Church of England, the incumbent of a parish where the tithes are impropriate (*i.e.*, transferred to lay hands) and no vicarage has been endowed; but an act of parliament was passed in 1868, authorizing perpetual curates to style themselves vicars (*see* VICAR), and the former name has fallen into desuetude.

CURATOR, in Roman law the "caretaker" or guardian of a spendthrift (*prodigus*) or of a person of unsound mind (*furiosus*), and, more particularly, one who takes charge of the estate of an *adolescens*, *i.e.*, of a person *sui juris*, above the age of a *pupillus*, 14 or 12 years, according to sex, and below the full age of 25. Such persons were known as "minors," *i.e.*, *minores viginti quinque annis*. While the tutor, the guardian of the *pupillus*, was said to be appointed for the care of the person, the curator took charge of the property. The term survives in Scots law for the guardian of one in the second stage of minority, *i.e.*, below 21, and above 14, if a male, and 12 if a female. Under the Roman empire the title of curator was given to several officials who were in charge of departments of public administration. In modern usage "curator" is applied chiefly to the keeper of a museum, art collection, public gallery, etc., but in many universities to an official or member of a board having a general control over the university, or with the power of electing to professorships. In the University of Oxford "curators" are nominated to administer certain departments, such as the University chest.

CURB MARKET or **STREET MARKET,** a name given to any stock market which either now transacts or originally transacted its business in the open, presumably in the streets or upon the curbs. At the outset, the curb markets of the various cities were entirely unorganized and operated only through the custom of a number of brokers meeting at certain places. Now they are well organized exchanges, most of them well housed.

The London Street Market operated in 'Change alley for almost a century. It is known that a street market existed in Paris in 1720, for records show that a part of the rue Quincampoix was roped off at the time of the Mississippi Bubble to protect the street traders from the general public. In Boston the curb market operated in Exchange place for years before going into its present building.

New York Curb Exchange had its origin before the Civil War when its meeting place was located in Wall street, near Hanover street. During the war it functioned in William street, between Exchange place and Beaver street. In those days trading began at 8 A.M. and continued until 6 P.M. or later and, at night, was carried on in the corridors of uptown hotels. From 1880 to 1900, it was carried on at all hours in front of the Mills building in Broad street, but after 1900 was reduced to a regular session from 10 A.M. to 3 P.M. Later the open air traders located opposite 44 Broad street, just south of Exchange place. A more closely knit organization was formed in 1908, known as "The New York Curb Agency."

The present Exchange, under the name of the "New York Curb Market," or "Market Association," was organized as a voluntary association in 1911. The official title was changed to "New York Curb Exchange" in 1929. Main functions of the Curb Exchange are:

(a) To provide a primary market for introducing the securities of such industrial, metal, oil, public utilities or other corporations as are eligible for listing under the listing requirements of the exchange.

(b) To furnish a temporary primary market for the preliminary issue of securities of well known established companies which are being reorganized or are issuing additional stock, usually represented by "rights."

(c) To provide a market for issues in the formative or growth period of their corporate existence.

(d) To provide a market for such active stocks or bonds which, for various reasons, are not listed on any other exchange.

The Exchange is governed by a Board composed of 32 Governors, classified as follows:

Class A: to be composed of 15 regular members of the Exchange.

Class B: to be composed of 12 associate member partners or non-member partners of regular or associate member firms doing business for the public.

Class C: to be composed of three representatives of the public not engaged in the securities business.

Class D: to be composed of the Chairman of the Board and the President of the Exchange.

In addition to regular memberships, there are associate memberships available to members of the New York Stock Exchange and to members of firms, or executive officers of corporations, engaged in the business of buying and selling securities as brokers or dealers.

The New York Curb Exchange does not deal in, or quote any securities listed on the New York Stock exchange, though many securities originally traded in on the Curb are later "graduated" and admitted to the New York Stock Exchange. Approximately 50% of the stocks listed on the New York Stock Exchange today were formerly dealt in on the New York Curb Exchange. In 1939 there were about 1,100 stock issues and 350 bond issues dealt in on the Curb Exchange, which is a large factor in the financial activities of the "Street." It is housed in its own building at 86 Trinity place.

CURCI, CARLO MARIA (1810–1891), Italian theologian, was born at Naples. He joined the Jesuits in 1826, and became one of the first editors of their *Civiltà Cattolica.* He wrote a preface to Gioberti's *Primato* (1843), but dissented from his *Prolegomena.* After the events of 1870, Curci, at Florence, delivered a course on Christian philosophy, and in 1874 began to publish several scriptural works. In his edition of the New Testament (1879–80) he criticizes the Italian clergy for their neglect of the Scriptures. He attacked the political action of the Vatican, and in his *Il Moderno Dissidio tra la Chiesa e l'Italia* (1878) advocated an understanding between the Church and State. This was followed by *La Nuova Italia ed i Vecchi Zelanti* (1881), another attack on the Vatican policy, and by his *Vaticano Regio* (1883), in which he accuses the Vatican of trafficking in holy things and of worldliness. His early work among the poor and prisoners at Naples drew him also in the direction of Christian Socialism.

He was condemned at Rome and cast out of the Jesuits, but finally he accepted the decrees against him and retracted "all that he said contrary to the faith, morals and discipline of the Church."

Shortly before his death, on June 8, 1891, he was readmitted to the Society of Jesus.

CURECANTI NEEDLE, a natural pyramid of granite in southwestern Colorado, in the Black Canyon area; some 800 or 900ft. high, at the mouth of Blue creek, a small stream that joins the Gunnison from the south.

CUREL, FRANÇOIS, Vicomte de (1854–1928), French dramatist and academician, was born in the city of Metz on June 10, 1854.

He was educated at the École Centrale as a civil engineer, the family wealth being derived from smelting works. But for the war of 1870 and the consequent separation of Lorraine from France, Curel might have become an ironmaster. As it was, he turned to literature. His first publications were, *L'Été des fruits secs* (1885) and *Le Sauvetage du grand duc* (1889). In 1891 three pieces were accepted by Antoine for the Théâtre Libre. The list of his plays includes *L'Envers d'une sainte* (1892); *Les Fossiles* (1892), a picture of the prejudices of the provincial nobility; *L'Invitée* (1893), the story of a mother who returns to her children after 20 years' separation; *L'Amour brode* (1893), which was withdrawn by the author from the Théâtre Français after the second representation; *La Figurante* (1896); *Le Repas du lion* (1898), dealing with the relations between capital and labour; *La Fille sauvage* (1902), the history of the development of the religious idea; *La Nouvelle Idole* (1899), dealing with the worship of science; and *Le Coup d'aile* (1906). In a collected edition of his works (1914) he explains his literary creed. He succeeded Paul Hervieu at the Academy in 1918. He had already broken his silence in 1914 with *La Danse devant le Miroir,* and after the World War he wrote two dramas treating the moral and psychological conditions arising out of the war and post-war conditions: *Terre inhumaine* (1923; Eng. vers. *No Man's Land*), and *La Viveuse et le Moribond* (1926). Curel died on April 26, 1928.

See P. Blanchart, *F. de Curel: son oeuvre* (1924).

CURES, a Sabine town between the left bank of the Tiber and the Via Salaria, about 26m. from Rome. According to the legend, it was from Cures that Titus Tatius led to the Quirinal the Sabine settlers, from whom the whole Roman people took the name Quirites. It was also renowned as the birthplace of Numa. It appears as the seat of a bishop in the fifth century, but seems to have been destroyed by the Lombards in A.D. 589. The site consists of a hill with two summits, round the base of which runs the Fosso Corese: the western summit was occupied by the necropolis, the eastern by the citadel, and the lower ground between the two by the city itself. A temple, the forum, the baths (second century, A.D.) etc., were excavated in 1874–77, but nothing is now visible on the site.

CURETES is said to mean "young men" (Gr. Κουρῆτες Κούρητες). (1) A people who fight the Calydonians in the quarrel arising out of the boar-hunt. (*See* Meleager.) Later writers placed them in Aetolia, Acarnania, or Chalcis. (*See* Homer, *Iliad,* ix., 529 ff.; Strabo, x., 3, 1; schol. Hom., *loc. cit.*)

(2) Certain daimones connected with the cult of Rhea and regularly conceived as the attendant band (*thiasos*) of the infant Zeus. In historical times they had a certain amount of cult in various parts of the Greek world, which comprised Pyrrhic dances (*i.e.,* war-dances in armour). In cult, art and literature they are frequently confused with the Corybantes (*q.v.*), but their proper home is Crete, and their proper function attendance on Zeus and his mother Rhea. Names of several of them point to these facts, as *Kres* (Cretan), *Labrandos* (he of the double axe, *labrus,* a very old Cretan and Asiatic sacred symbol, *cf.* the Carian *Zeus Labrandeus*). The legend states that when Zeus was born in, or conveyed in infancy to, Crete, they danced and clashed their weapons to drown his cries (*see* Zeus). A highly interesting hymn in their honour has been discovered at Palaikastro in Crete; the worshippers call on Ζεὺς Κοῦρος and his attendants to bring all manner of fertility.

It is a not improbable supposition that the original Curetes were the human worshippers of Ζεὺς Κοῦρος *i.e.,* that the κοῦροι (adolescent lads) worshipped a god supposed to be of their own age, a variant of the "infant" Zeus of Crete; that the object of their worship was the increase of fertility, vegetable and animal; and that, although the hymn is of Hellenistic date, the rite itself may go back to Minoan times. (For further speculations *see* Miss Harrison's *Themis.*) It is also possible that the *Curetes* who fight the Calydonians are in their origin nothing but the young warriors of the neighbouring states. The text of the hymn is best given in Powell, *Collectanea Alexandrina* p. 160 (1925); other texts are cited in Immisch.

Bibliography.—Immisch in Roscher's *Lexikon,* art. "Kureten und Korybanten"; J. E. Harrison, *Themis,* p. 1 foll. (2nd ed., 1927); M. P. Nilsson, *Minoan-Mycenaean Religion,* p. 472 foll. (1927).

CURETON, WILLIAM (1808–1864), English orientalist, was born at Westbury, Shropshire. Educated at the free grammar school of Newport, and at Christ Church, Oxford, he took orders in 1832, became chaplain of Christ Church, sub-librarian of the Bodleian, and, in 1837, assistant keeper of mss. in the British Museum. He was afterwards appointed select preacher to the university of Oxford, chaplain in ordinary to the Queen, rector of St. Margaret's, Westminster, and canon of Westminster. He was elected F.R.S. and a trustee of the British Museum, and was also honoured by several Continental societies. He died on June 17, 1864.

Cureton edited, with notes, an English translation of the Epistles of Ignatius to Polycarp, the Ephesians and the Romans, from a Syriac ms. that had been found in the monastery of St. Mary Deipara, in the desert of Nitria, near Cairo, and other important Syriac mss.

See an introduction by Dr. W. Wright to *Ancient Syriac Documents relative to the earliest Establishment of Christianity in Edessa, etc.* (1864).

CURETUS, a tribe of South American Indians, inhabiting the country between the rivers of Japura and Uaupés, northwestern Brazil.

CURFEW, Curfeu or Couvre-feu, a signal, as by tolling a bell, to warn the inhabitants of a town to extinguish their lights and fires or cover them up and retire to rest. This was a common practice throughout Europe during the middle ages. In mediaeval Venice the Barbers' Quarter was exempt, doubtless because they were also surgeons and their services might be needed during the night. The curfew originated in the fear of fire when most cities were built of timber. Its use is obvious, as the household fire was usually made in a hole in the middle of the floor, under an opening in the roof through which the smoke escaped. The custom is said to have been introduced into England by

William the Conqueror; but as there is good reason to believe that the curfew-bell was rung each night at Carfax, Oxford (*see* Peshall, *Hist. of Oxford*), in the reign of Alfred the Great, it would seem that all William did was to enforce more strictly an existing regulation. The absolute prohibition of lights after the ringing of the curfew-bell was abolished by Henry I. in 1100. The practice of tolling a bell at a fixed hour in the evening, still extant in many places, is a survival of the ancient curfew. In 1848 the curfew was still rung at Hastings, Sussex, from Michaelmas to Lady-Day, and this was the custom too at Wrexham, North Wales.

On April 2, 1918, the British Board of Trade with a view to economy in the consumption of coal, introduced the "Curfew Order," by which all restaurants, etc., had to extinguish their lights at 10 P.M.; no lighting was to be used in theatres after 10.30 P.M., and no shop fronts were to be lighted. This order was rescinded on Dec. 23, 1918.

On Aug. 31, 1920, in consequence of the prevailing disorder, the military authorities in Belfast instituted the Curfew law, by which all citizens were required to remain within doors from 10.30 P.M. to 5 A.M. This order, save for two brief intervals, remained in force throughout Northern Ireland until Dec. 1924.

CURIA, a section of the Roman people, an ancient division traditionally ascribed to Romulus, who divided the people into three tribes, and subdivided each of these into ten *curiae,* each of which contained a number of families (*gentes*). It is more probable that the *curiae* were not artificial creations but natural associations of families, artificially regulated to serve a political purpose. The names of *curiae* suggest a local origin for the groups; but, as membership was hereditary, the local tie grew weak with successive generations. Each *curia* was organized as a political and religious unit. Politically it had no activities beyond a vote in the *Comitia Curiata* (*see* COMITIA), determined by a majority of the members (*curiales*). But as a religious unit the *curia* had more individual activity. There were sacrifices performed in common, but each *curia* had its own *sacra,* conducted by a *curio* assisted by a *flamen curialis.*

The thirty *curiae* comprised the whole Roman people; for citizenship depended on membership of a *gens* (*gentilitas*) and every member of a *gens* was *ipso facto* attached to a *curia.* They therefore included plebeians as well as patricians (*q.v.*) from the date at which plebeians were recognized as citizens. But, just as the full rights of *gentilitas* were only gradually granted to plebeians, so it is probable that a plebeian did not immediately exercise all the rights of a *curialis.* It is unlikely that plebeians voted in the *Comitia Curiata* till early in the republican period; it is certain that they did so in Cicero's time. A plebeian was first elected *curio maximus* in 209 B.C. The curia soon ceased to have any political importance, but its religious importance survived during the principate.

The term *curia* was applied to the common shrine of the *curiales,* and then to other places of assembly. Hence the ancient senate house at Rome was known as the Curia Hostilia. The *curia* was adopted as a state division in municipal towns; and the term was often applied to their senates (*see* DECURIO).

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In mediaeval Latin the word *curia* was used in the general sense of "court." It was used of "courts" in the sense of solemn assemblies summoned by the king (*curiae solennes*); of courts of law, whether developed out of the imperial or royal *curia* (*see* HOUSEHOLD, THE ROYAL) or not. Sometimes *curia* means jurisdiction, or the territory over which jurisdiction is exercised; whence its use for the court-yard of a house, or for the house itself; *e.g.,* Hampton Court. The word Curia is now only used of the papal court of Rome (*see* CURIA ROMANA).

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CURIA REGIS: *see* HOUSEHOLD, THE ROYAL.

CURIA ROMANA, in the strict canonical sense, the group of departments and persons used by the Roman pontiff in the exercise of his supreme and universal power over the Catholic Church; in this sense it consists of the Roman congregations, the tribunals of the Roman Curia, and the offices of the Roman Curia. These departments, which act in the name and by the authority of the pope, are collectively known as the Apostolic (or Holy) See. In a wider sense, the Roman Curia is understood also to embrace the whole body of dignitaries and officials who are attached to the person of the pope. It includes, therefore, both the *famiglia pontificia* (headed by the two palatine cardinals, the cardinal datary and the cardinal secretary of state) and the *cappella pontificia* (the entourage of the pope at solemn liturgical functions).

In pre-Constantine times the pope was chiefly assisted by the Roman clergy and by neighbouring bishops; for instance, the seven Roman deacons were entrusted with the care of the poor. From Constantine up into the middle ages important and difficult affairs were handled by the Roman synods, either provincial or (later) general. In the mediaeval period the popes began increasingly to avail themselves of the assistance of the cardinals; the deliberative functions of the synods were taken over by the papal consistory, an assemblage of cardinals presided over by the pope; individual cardinals were set over particular spheres of business; for instance, the cardinal chancellor and the cardinal camerlengo, and with them were associated other cardinals. The first, however, authoritatively to organize a permanent system of agencies for the dispatch of all ecclesiastical business was Sixtus V, by the constitution *Immensa* on January 22, 1587 (1588). He established fifteen congregations, most of them designed to assist the pope in the spiritual affairs of the Church, but a few for the administration of the papal states. His organizational pattern, retouched by Clement VIII, Gregory XV, Urban VIII, Clement IX and Pius VII, remained substantially in existence up to the 20th century. But it had gradually become an unwieldy, confused, and inefficient structure.

Consequently, Pius X, by the constitution *Sapienti Consilio* of June 29, 1908, proceeded to a general reorganization of the Roman Curia—congregations, tribunals and offices. In this constitution he declared that the competency of these various organs was not always clear, and that their functions were badly arranged; that certain of them had only a small amount of business to deal with, while others were overworked; that strictly judicial affairs, with which the congregations had not to deal originally, had developed to an excessive extent, while the tribunals, the Rota and the Signatura, had nothing to do. He consequently withdrew all judicial affairs from the congregations, and handed them over to the two tribunals, now revived, of the Rota and the papal Signatura. All affairs concerning the discipline of the sacraments were entrusted to a new congregation of that name. The competency of the remaining congregations was modified, according to the nature of the affairs with which they deal, and certain of them were amalgamated with others; general rules were laid down for the expedition of business and regarding personnel; in short, the work of Sixtus V was adapted to later conditions. The ordinations of the *Sapienti Consilio,* and of its annexed *Ordo servandus in ss. congregationibus, tribunalibus et officiis romanae curiae,* were received, with some small changes, into the *Code of Canon Law,* promulgated on Sept. 15, 1917.

The Roman Congregations.—There are eleven: the Holy Office, the Consistorial Congregation, the Congregations of the Sacraments, of the Council, of Religious, for the Propagation of the Faith, of Sacred Rites, of Ceremonies, of Extraordinary Ecclesiastical Affairs, of Seminaries and Universities, for the Oriental Church. A twelfth, the Congregation of the Basilica of St. Peter, is not considered as such by the code.

Each congregation is headed by a prefect. The pope himself holds the prefecture of three: the Holy Office, the Consistorial Congregation, and the Congregation for the Oriental Church. These are actually directed by a cardinal secretary, who is assisted by a prelate called the *adsessor.* The prefects of the remaining congregations are cardinals, and each is assisted by a secretary, a prelate, often a titular archbishop. Only cardinals are members of the congregations themselves; but there are a number of major and minor officials, and each congregation also has its "consultors." The competence of the congregations is administrative and disciplinary. They have no judicial power, but must send cases requiring judicial decision to the competent tribunal; nor have they any strict legislative power, which is reserved to the pope. The functions of each are defined by the code (canons 247–57); collectively, they extend to: care for the faithful observance of the laws of the Church, the issuance of instructions to clarify, explain, or confirm the law, the practical application of legal prescriptions to particular cases, the concession of faculties *secundum vel praeter ius,* the granting of dispensations, the application of disciplinary measures, the resolution of doubts, questions and controversies in disciplinary (nonjudicial) form. The authority of the congregations, within the limits of their own competence, is supreme and universal; it is also ordinary, but vicarious (it is possessed by the congregation in virtue of law, but exercised by it in the name and by the authority of the pope). They do not, however, share in the fullness of the papal power nor in the pope's infallibility; their acts as such are their own, and are by nature reformable, unless they have been confirmed in specific form by the pope.

Tribunals and Offices of the Roman Curia.—The tribunals are assemblies of cardinals and prelates, which deal with judicial cases. There are three: the Sacred Penitentiary, the Roman Rota, and the Apostolic Signatura. The offices of the Roman Curia are five in number: the Apostolic Chancery, the Apostolic Datary, the Apostolic Camera, the Secretariate of State, and the Secretariate of Briefs and Latin Letters. Their functions are rather ministerial.

Permanent Papal Commissions.—Though not strictly elements of the Roman Curia, these may be mentioned here. They are eight in number. The chief ones are the Commission for Biblical Studies, established by Leo XIII, and the Commission for the Authentic Interpretation of the Code of Canon Law, established by Benedict XV.

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CURICÓ, a province of central Chile, lying between the provinces of Colchagua and Talca and extending from the Pacific to the Argentine frontier. Area 2,215 sq.mi.; population (1940) 81,185.

The eastern and western sections are mountainous and are separated by the fertile valley of central Chile. The mineral resources, though undeveloped, are said to include copper, gold and silver.

Cattle, wheat and wine are the principal products, but Indian corn and fruit also are produced. On the coast are important salt-producing industries.

The climate is mild and the rainfall more abundant than in the northern part of the valley, and the effects of this are to be seen in the better pasturage. Irrigation is used to a large extent.

The principal city, Curicó, is on the Mataquito river, 114 mi. S. of Santiago by the Chilean Central railway, which crosses the department. The city stands on the great central plain, 748 ft. above sea level, and in the midst of a comparatively well-cultivated district. It was founded in 1742 by José de Manso and is one of the more cultured and progressive provincial towns of Chile. Pop. (1940) 19,532.

CURIE, PIERRE (1859–1906) and **MARIE** (1867–1934), French physicists. Pierre Curie was born in Paris on May 15, 1859, and educated at the Sorbonne, where he later became professor of physics. His early researches were on piezo-electricity, the magnetic properties of bodies at different temperatures and other topics. He was chiefly known for his work on radio-activity carried out jointly with his wife, Marie Sklodowska, to whom he was married in 1895. Marie Sklodowska was born in Warsaw on Nov. 7, 1867, and received her early scientific training from her father, Dr. Sklodowski. She became involved in the students' revolutionary organization and found it advisable to leave Warsaw. Mlle. Sklodowska went first to Cracow, then under Austrian rule, and later to Paris, where she took a science degree at the university.

After the discovery of the radio-active properties of uranium by Henri Becquerel in 1896 M. and Mme. Curie began their researches into radio-activity (*q.v.*) and in 1898 obtained polonium and radium from pitchblende which they had subjected to a very laborious process of fractionation. In subsequent years they did much to elucidate the properties of radium and its transformation products. In 1903 they were awarded the Davy medal of the Royal Society and in the same year the Nobel prize for physics was divided between them and Henri Becquerel. The same year Mme. Curie submitted the results of her researches in her doctorate thesis presented to the university. She then became *chef de travaux* in the laboratory at the department of the Sorbonne created for her husband. Prof. Curie, who was elected to the Academy of Sciences in 1905, was run over by a dray and killed instantly in Paris on April 19, 1906. His widow succeeded him as professor at the Paris university and in 1911 was awarded the Nobel prize for chemistry. Her classic *Traité de Radioactivité* was published in 1910. Mme. Curie did much to help the establishment of the radio-activity laboratory in her native city. In 1921 President Harding, on behalf of the women of the United States, presented her with a gramme of radium in recognition of her services to science. On a second visit to the United States, in 1929, Mme. Curie received from the hands of President Hoover a gift of $50,000 from American friends of science to purchase radium for the use of the laboratory in Warsaw.

CURIE, a unit of measurement for radium emanation. It is named in honour of Marie Curie, the discoverer of radium. It is defined as the quantity of radium emanation, known also as radon, in equilibrium with one gram of radium. This unit is subdivided into the millicurie and the microcurie, representing the amounts of emanation in equilibrium with a milligram and a microgram of radium respectively. These units are used in measuring the dosage in the therapeutic use of radium.

CURIO, GAIUS SCRIBONIUS, Roman statesman and orator, son of a distinguished orator of the same name, flourished during the 1st century B.C. He was tribune in 90 B.C., and served in Sulla's army in Greece against Archelaus, general of Mithridates, and as his legate in Asia, where he was commissioned to restore order in the kingdoms abandoned by Mithridates. In 76 he was consul, and as governor of Macedonia (75–73), defeated the Dardanians, being the first Roman general to penetrate as far as the Danube. On his return he was granted a triumph. During the discussion as to the punishment of the Catilinarian conspirators he supported Cicero, but he spoke in favour of P. Clodius (*q.v.*) at his trial for sacrilege (61). This led to a violent attack on the part of Cicero, but it does not appear to have interfered with their friendship. Curio was a vehement opponent of Caesar. He was pontifex maximus in 57, and died in 53.

See Orelli, *Onomasticon* to Cicero; Florus iii. 4; Eutropius, vi. 2; Val. Max. ix. 14, 5; Quintilian, *Instit.*, vi. 3, 76; Dio Cassius, xxxviii. 16.

His son, GAIUS SCRIBONIUS CURIO, was first a supporter of Pompey, but after his tribuneship (50 B.C.) went over to Caesar, by whom he was said to have been bribed. When it was demanded that Caesar should lay down his imperium before entering Rome, Curio proposed that Pompey should do the same, adding that, if the rivals refused to do so, they ought both to be declared public enemies. His proposal was carried by a large majority, but a report having spread that Caesar was on the way to attack Rome, the consuls called upon Pompey to undertake the command of all the troops stationed in Italy. Curio's protest to the people was disregarded, whereupon he fled to Ravenna to Caesar. He was commissioned by Caesar to take a message to the senate, but met with so hostile a reception that he hurried back by night to Caesar. It was now obvious that civil war would break out. Curio collected troops in Umbria and Etruria for Caesar, who sent him to Sicily as propraetor in 49. After some successes against the Pompeians, Curio crossed over to Africa, where he was defeated and slain by Juba, king of Numidia. Curio possessed great ability; Cicero, as an old friend of his father, took an interest in him and seven of Cicero's letters (*Ad. Fam.* ii. 1–7) are addressed to him.

See Orelli, *Onomasticon* to Cicero; Livy, *Epit.* 109, 110; Caesar, *Bell. Civ.* ii. 23, for Curio's African campaign; Appian, *Bell. Civ.*, ii. 26–44; Vell. Pat. ii. 48. *See* also Rice Holmes, *The Roman Republic* (1923) chaps. xii. and xviii. and vol. iii. Part ii. pp. 421–28.

CURITIBA (also CURITYBA and CORITYBA), capital of the state of Paraná, Brazil, on an elevated plateau (3,120 ft. above sea level) 65 mi. west of its seaport Paranaguá, with which it is connected by a railway, remarkable for the engineering difficulties overcome and for the beautiful scenery through which it passes. Pop. (1940) 101,204; *municipio* 142,873. There is a large foreign element in the population, Germans preponderating. The city has a temperate, healthy climate, and is surrounded by a region which produces maté, coffee, timber, sugar and fruits. Maté is the principal export.

CURLEW, the name given to several birds allied to the snipes, sandpipers and plovers.

The common curlew (*Numenius arquata*) of the snipe family, *Charadriidae,* is about 2 ft. long, drab coloured above, mottled with dark brown, and white beneath. The bill is 5 to 7 ins. long and is curved; the legs are long and the build of the bird slender and graceful. It inhabits most of Europe, breeding on heaths and moors and haunting the mud flats of the sea-shore and estuaries in winter. In Scotland it is called the "whaup." The eggs are laid in a rough nest on the ground; they are usually four in number and brownish-green with cinnamon markings. The food consists of worms, crustaceans, small molluscs, insects and also berries.

The lesser curlew or whimbrel (*N. phaeopus*) resembles the last in habits and appearance, but is smaller. Three American species, *N. longirostris, N. hudsonicus* and *N. borealis* (the last now extinct) are extremely similar but distinguished by the rufous colouring of the axillary feathers—a feature also characterizing the American godwits (*Limosa*). The genus *Numenius* is almost cosmopolitan.

The stone curlew, Norfolk plover or thick-knee (*Oedicnemus crepitans*) has a sweeter voice. It is a summer visitor to England, where it occurs mainly in the "Breck" country of Norfolk and Suffolk. On the mainland it extends across Europe to N. Africa and India, keeping mainly to the open chalk-country. It is the largest of the plovers and lays its two stone-coloured eggs on the ground. The bill is short, the legs long and thickened on the upper part of the tarsus. The eye is very large. The hind toe is absent, the plumage drab, rendering the bird invisible at a short distance. It feeds on snails, insects, worms, frogs and other small animals. Like its namesake, it is exceedingly wary. Other species are found in Africa, Australia and America. It has a peculiar form of courtship, and strange social dances in autumn. *See* COURTSHIP OF ANIMALS.

CURLING, a game in which the players propel large rounded stones upon a rink or sheet of ice, towards a mark called the tee. Where the game originated is not precisely known; but it has been popular in Scotland for three centuries at least. Some writers, looking to the name and technical terms of the game, trace its invention to the Netherlands. Curling was called "kuting" in some parts of Lanarkshire and Ayrshire. Cornelis Kilian (1528–1607) in his *Teutonic Dictionary* gives the term *khuyten* as meaning a pastime in which large globes of stone like the quoit or discus are thrown upon ice. Camden, when describing the Orkney Islands in 1607, tells us that one of them supplies "plenty of excellent stones for the game called curling"; and incidental references to it as a game played in Scotland are made by several authors during the first half of the same century.

If the game be not indigenous to Scotland it certainly owes its development to that country, and in the course of time it has come to be the national sport. It was played at first with very rude engines—random whin boulders fashioned by nature alone, bored through to let in the thumb of the player, having been the primitive channel stones. In course of years the rough block was superseded by a symmetrical object usually made of whinstone or granite, beautifully rounded, brilliantly polished, and supplied with a convenient handle.

Although curling boasts a literature of its own and songs innumerable, yet it has received but the scantiest notice from such important Scottish writers as Scott and Burns, or from contemporary literature in general. In 1834 an "Amateur Curling Club of Scotland" was formed but came to nothing. The "Grand Caledonian Curling Club," which began its existence on Nov. 15, 1838, and which, under its present title of "The Royal Caledonian Curling Club," is regarded in all parts of the world as the mother-club and legislative body, even in Canada, where, however, curling conditions differ widely from those of Scotland. Special rules have been made to suit local conditions. Starting with 28 allied clubs the Royal Club grew so rapidly that there were 500 such in 1880 and 720 in 1903. It was under the auspices of the Royal Caledonian that a body of Scottish curlers visited Canada and the United States in the winter of 1902–1903, and, while victory remained with the home players under their own climatic conditions, the visit did much to bring together the lovers of the game on both sides of the Atlantic. The assumption of the title "Royal" in place of "Grand" was due to the visit of Queen Victoria and the prince consort to Scotland in 1842, on which occasion they were initiated into the mysteries of the game on the polished floor of the drawing-room in the Palace of Scone; and the prince consort, who was presented with a pair of curling-stones, consented to become patron of the club. Subsequent patrons of the club have been Edward VII (as prince of Wales and as King), George V, Edward VIII who, as prince of Wales, had in 1925–26 been president of the club, and George VI. The club's main duties are to further the interests of the game, to revise the laws and to arrange the important matches, especially the grand match, played annually between the Scottish clubs north of the Forth and Clyde canal and those south of it. In the first of these matches (1847) only 24 rinks took part (a rink is composed of four players); in 1903 there were 386. In 1927 there was an entry of 600 clubs.

Glossary.—Baugh ice, rough or soft ice. *Bonspiel,* a match between several clubs. *Burn,* see *Mar. Chap and Lie,* to strike out a stone and lie in or near its place. *Chipping,* striking a stone of which a small part can be seen. *Crack an egg on a stone,* touch it very slightly. *Crampit,* an iron plate fitted with spikes which the player stands upon to deliver the stone. *Draw,* to play gently to a certain spot. *Drive,* to strike. *Drug ice,* soft bad ice. *Fill the port,* to block the interval between two stones. *Guard,* a stone that covers and protects another. *Hack,* a hollow cut in the ice for the player's foot, used in place of a crampit. *Hog,* a stone that stops short of the *hog-score,* a line drawn one-sixth of the length of the rink from the tee. *Head,* an innings, both sides delivering all their stones once. *House* (also boardhead or parish), the large circle round the tee. *In-wick,* gaining a good position by rebounding off another stone. *In-turn,* to make one turn to the right. *Lie shot,* the stone resting nearest the tee. *Mar,* to interfere with a stone while running. *Out-turn,* to make the stone twist to the left if a right-hand player; if left-handed it is the reverse. *Out-wick,* to strike a stone on the edge so as to drive it towards the tee. *Pat-lid,* a stone that lies on the tee. *Peels,* equal scores. *Raise,* to promote a "friendly" stone nearer the tee. *Rink,* the space in which the game is played; also the members of a side. *Running Shot,* to deliver the stone with great force, so as to scatter the stones. *Sole,* is the part of the stone in contact with the ice and on which it runs; also to deliver the stone. *Soop,* to sweep. *Spiel,* a match between members of the same club. *Tee,* the mark in the centre of the house or rings, against which it is the curler's object to lay the stone. The tee may be any kind of mark; a small iron plate with a spike in it is often used.

The Rink and Implements.—The rink is marked out in the ice, which should be very hard and smooth; in curling language "keen and clear." To keep it swept every curler carries a broom. Good "sooping," or sweeping, is part of the curler's art, and is performed subject to strict rules and under the direction of the skip, or captain; its importance lying in the fact that the progress of a stone is retarded by the ice-dust caused by the play or thin snow. Apart from the broom and the crampit, which replaces the hack, the game requires no further implement than the stone. The two flat sides, or soles, are so shaped that one is serviceable for keen ice and the other for ice that is soft, rough or "baugh." The handle can be fitted to either side, as the case demands. The cost of a pair of stones is not less than £3, generally more. In the intense cold of Canada and the United States iron is considered by some players as serviceable as stone. "Irons" are not used much in Canada now, except in Quebec, Montreal and eastern Ontario. Even these are light compared with the earlier rough boulder-stones, some of which weighed over 115 lb., although the very early ones were much lighter. The modern stone took shape at the beginning of the 19th century. The ancient stones had no handles, but notches were hewn in them for finger and thumb, and, as their weight varied from 5 to 25 lb., it is probable that they were thrown after the manner of quoits. Channel-stones, stones rounded by the action of water in a river bed, were the favourites, while the shape was a matter of individual taste, oblong and triangular stones having been common. The soles were artificially flattened. During the next period we find the heavy boulder-stones, unhewn blocks fitted with handles and probably used at shorter distances, 70 or 80 lb. being no uncommon weight. The rounded stone, made on scientific principles, did not appear until about 1800. Even then it was of all shapes and sizes, with and without handles, and not uncommonly made of wood. The stones of today are named after the places in which they are quarried, Ailsa Craigs, Burnocks, Carsphairn Reds and Crawfordjohns being some of the best-known varieties. The stones are quarried and never blasted, as the shock of the explosion is apt to strain or split the rock.

The Game.—Curling is practically bowls played on the ice, the place of the "jack" being taken by a fixed mark, as at quoits, called the tee, to which the curler aims his stone; every stone that finally lies nearer than any of the opposing stones counting a point or "shot." As each side has four players, each playing two stones, it is possible for one side to score eight points at a "head" or innings; but in practice it is found wiser, when a good shot has been made, to play some or all following stones to such positions as will prevent opposing stones from disturbing the stone lying near the tee. Stones thus placed are called "guards." Strategic matters like this are decided by the skip, or captain, of the rink, who plays last, and whose will is law. The "lead," or first player, is expected to play quietly up the rink, leaving his stone as close to the tee as possible, but on no account beyond it. He is followed by the "lead" of the other side, who, instructed by his skip, will either try to drive away the first stone, if well placed, or put his own stone in a better position. When the skip's turn comes he is "skipped," or directed, by another player, appointed by himself, usually the third player. When all sixteen stones have been delivered the players cross over, the scores are counted, and the game proceeds from the other end of the rink. If a stone fails to cross the "hog-score" it is a "hog" and is removed from the rink, unless it has struck another stone in position. Stones that pass the back-score or touch the swept snow on either side are also removed. By a cleverly imparted twist a stone may be made to curve round a guard and either drive away an opposing winner or find a favourable lie for itself. This, the equivalent of "bias" in the game of bowls, is the height of scientific play. If the situation seems desperate a very hard throw, a "thunderin' cast," may succeed in clearing away the opponents' stones from the neighbourhood of the tee. Different methods are adopted in delivering the stone, but in all of them a firm stand should be taken in the hack or on the crampit, and the stone swung, either quietly, or, if the skip calls for a "thunderin' cast," vigorously; but care must be taken to avoid striking the ice with the stone so as to crack or "star" the ice. A smooth gliding delivery is preferable.

Abridged Rules.—Tees shall be 38 yd. apart, and with the tee as centre a circle having a radius of 7 ft. shall be drawn. In alignment with the tees, lines, to be called *central lines,* are drawn from the tees to points 4 yd. behind each tee, and at these points *foot scores* 18 in. long shall be drawn at right angles, on which, at 6 in. from central line, the heel of the crampit shall be placed. All matches shall be of a certain number of heads, or shots, or by time, as agreed. Every rink of players shall be composed of four a side. No shoes likely to break the ice may be worn.

The skips opposing each other shall settle by lot, or in any other way they may agree upon, which party shall lead at the first head, after which the 4 side which has won the last head shall lead.

All curling stones shall be of a circular shape. No stone shall be of a greater weight than 44 lb. imperial, or of greater circumference than 36 in., or of less height than one-eighth part of its greatest circumference.

No stone shall be substituted for another, except under rules 10 (in case of a stone being broken) and 14 (a wrong stone being played shall be replaced by the stone which ought to have been played) after a match has begun, but the sole of a stone may be reversed at any time during a match.

Should a stone happen to be broken, the largest fragment shall be considered in the game for that end—the player being entitled afterwards to use another stone or another pair.

If a played stone rolls over, or stops, on its side or top, it shall be put off the ice. Should the handle quit the stone in delivery, the player must keep hold of it, otherwise he shall not be entitled to replay the shot.

Players, during the course of each end, to be arranged along the sides of the rink, anywhere skips may direct; and no party, except when sweeping according to rule, shall go upon the middle of the rink, or cross it, under any pretense whatever. Skips alone to stand at or about the tee—that of the playing party having the choice of place, and not to be obstructed by the other.

If a player should play out of turn, the stone so played may be stopped in its progress, and returned to the player. Should the mistake not be discovered till the stone be at rest, or has struck another stone, the opposite skip shall have the option of adding one to his score, allowing the game to proceed, or declaring the end null and void. But if another stone be played before the mistake has been discovered, the head must be finished as if it had been properly played from the beginning.

The sweeping shall be under the direction and control of the skips. The player's party may sweep the ice anywhere from the hog-score to the tee, and behind it—the adverse party having liberty to sweep behind the tee, and in front of any of their own stones when moved by another, and till at rest. When snow is falling or drifting, the player's party may sweep the ice from tee to tee. Skips to have full liberty to clean and sweep the ice behind the tee at any time, except when a player is being directed by his skip.

If in sweeping or otherwise, a *running* stone be marred by any of the party to which it belongs, it may, at the option of the opposite skip, be put off the ice; if by any of the adverse party, it may be placed where the skip of the party to which it belongs shall direct. If otherwise marred, it shall be replayed.

Every player to be ready to play when his turn comes, and not to take more than a reasonable time to play. Should a player play a wrong stone the stone which ought to have been played shall be put in its place.

No measuring of shots allowable previous to the termination of the end. Disputed shots to be determined by the skips, or, if they disagree, by the umpire, or, when there is no umpire, by some neutral person chosen by the skips. All measurements to be taken from the centre of the tee, to that part of the stone which is nearest it. No stone shall be considered without a circle, or over a line, unless it clear it;—and in every case, this is to be determined by placing a square on the ice, at the circle or line.

Skips shall have the exclusive regulation and direction of the game for their respective parties, and may play last stone, or in what part of it they please; and, when their turn to play comes, they may name one of their party to take charge for them.

If any player shall speak to, taunt or interrupt another, not being of his own party, while in the act of delivering his stone, one shot shall be added to the score of the party so interrupted.

If from any change of weather after a match has been begun, or from any other reasonable cause, one party shall desire to shorten the rink, or to change to another one, and, if the two skips cannot agree, the umpire shall, after seeing one end played, determine whether the rink shall be shortened, and how much or whether it shall be changed, and his decision shall be final. Should there be no acting umpire, the two skips may call in any neutral curler to decide, and his powers shall be equal with those of the umpire.

See *Annual* of the Royal Caledonian Curling club, Edinburgh.

The United States as compared with Scotland has few curling organizations and these originally were found where a group of Scotsmen had gathered. In 1924 an indoor artificial ice rink for curling was built at Boston and in the same year, another artificial ice plant was installed at Detroit. Curling has been played for about a century. Though it does not receive the enthusiasm it enjoys in Canada, winter carnivals in Minnesota, New Hampshire and Maine usually include a curling event in their sporting programs. The game is played with the same general rules as apply in Scotland. In the last 15 years, an organization of curling teams consisting of members of golf clubs such as St. Andrews in Yonkers, N.Y., Brookline, Mass. and clubs of other communities have been active in holding annual curling tournaments each winter.

Canada in 1943 had over 30,000 registered curlers. In 1807 curling was first played in Quebec City, the birthplace of curling on the North American continent. Some early settlers from Scotland brought curling stones with them but found additional stones unobtainable; this led to the substitution of "irons," weighing say 60 lb., still used in Montreal, Quebec and eastern Ontario. Elsewhere "stones" are in general use. In 1925 artificial ice indoor rinks were found practical in Ontario and in 1936 matched stones of uniform weight, 40 lb., with black and white handles for the opposing teams; these usually are the property of the club. This is a great boon to the game which can be played from November to April. An indoor rink with five sheets of artificial ice requires about 30,000 ft. of $1\frac{1}{4}$ in. pipe. In 1927 an annual competition for the Canadian championship was inaugurated with teams from the nine provinces. Some contestants travelled more than 2,500 miles to Toronto, the competitive point. Manitoba has been the most successful. There are many women's curling clubs. (T. Re.)

CURLL, EDMUND (1675–1747), London bookseller, is remembered for his long quarrel with Pope over the anonymously published *Court Poems* (1716). Pope took his revenge by immortalizing Curll in the *Dunciad.* Curll became notorious for his indecent publications, so much so that "Curlicism" was regarded as a synonym for literary indecency. In 1716 and again in 1721 he had to appear at the bar of the house of lords for publishing matter concerning its members. In 1725 he was convicted of publishing obscene books, and fined in 1728 for publishing *The Nun in her Smock* and *De Usu Flagrorum,* while his *Memories of John Ker of Kersland* cost him an hour in the pillory. When Curll in 1735 announced the forthcoming publication of *Mr. Pope's Literary Correspondence,* his stock, at Pope's instigation, was seized. It has since been proved that the publication was really instigated by Pope, who wanted an excuse to print his letters, as he actually did (1737–41). In his 40 years of business Curll published a great variety of books; a list of his publications contains 167 standard works. He died Dec. 11, 1747. *See* the *Life of Pope,* by Sir Leslie Stephen, and R. Straus, *The Unspeakable Curll* (1927).

CURRAGH, an open level stretch of ancient crown land, area over 4,800 acres, Co. Kildare, Eire. The right of pasturage is possessed by the landowners of the district. The *Liber Hymnorum* (10th century) says the king of Leinster granted it to St. Bridget, who is credited with having made it a common. The downs of Kildare seem to have been a meeting place from time immemorial. *Cuirrech* (lat. *cursus*) means race course and it is said that races occurred there as early as the 1st century A.D. Aenach Colmain (Curragh fair) or Aenach Life (fair on the Liffey plain) is often mentioned in the Irish Annals. It has seen many fights and gatherings of troops and has long had a military training camp; it is the principal horse-racing ground in Ireland. At the camp, on March 20, 1914, Gen. Hubert Gough and other officers offered their resignations as a protest against being sent to enforce the acceptance of Home Rule by Northeast Ulster.

CURRAN, JOHN PHILPOT (1750–1817), Irish politician and judge, was born on July 24, 1750, at Newmarket, Cork, where his father, a descendant of one of Cromwell's soldiers, was seneschal to the manor-court. He was educated at Middleton, and Trinity college, Dublin; and in 1773, having taken his M.A. degree, he entered the Middle Temple. In 1774 he married; but the marriage proved unhappy, and Mrs. Curran finally eloped. In 1783 Curran was appointed king's counsel; and in the same year he was presented to a seat in the Irish house of commons. But finding that he differed radically in politics from the gentleman from whom he had received his seat, he expended £1,500 in buying another to replace that which he occupied. He spoke vigorously on behalf of Catholic emancipation, and strenuously attacked the ministerial bribery which prevailed. This led him into two duels, one with the attorney general, the other with the secretary of state, Maj. Hobart. The union caused him the bitterest disappointment; he even talked of leaving Ireland, either for America or for England.

Curran's fame rests most of all upon his speeches on behalf of the accused in the state trials between 1794 and 1803, the most notable being those in defense of Hamilton Rowan, Lord Edward Fitzgerald and Wolfe Tone. Curran came under suspicion on the arrest of Robert Emmet, but on examination before the privy council was acquitted. In 1806, on the death of Pitt and the formation of the Fox ministry, Curran received the post of master of the rolls, with a seal in the privy council, though he had desired a position of greater political influence. For eight years, however, he held this office. He then retired on a pension of £3,000, and the three remaining years of his life were spent in London, where he became one of the most brilliant members of the society which included Sheridan, Erskine, Thomas Moore and William Godwin. He died at his house in Brompton on Oct. 14, 1817.

See *Curran and His Contemporaries,* a most entertaining work, by Charles Phillips, a personal friend of Curran (1818), and the *Life of Curran,* by his son, W. H. Curran (1819; with additions by Dr. Shelton Mackenzie, New York, 1855). *See* also *Curran's Speeches* (1805, 1808, 1845); Wm. O'Regan, *Memoirs of Curran* (1817); Letters to Rev. H. Weston (1819); and T. Moore's *Memoirs* (1853).

CURRANT. The currants of northern Europe and America —so-called from a resemblance of dried black currants to the fruit of one variety of the grapevine, *Vitis vinifera,* cultivated chiefly in Greece and California (*see* GRAPE)—are derived from *Ribes sativum, R. rubrum* and *R. petraeum,* deciduous shrubs of the family Saxifragaceae and indigenous to Britain, northern and central Europe and Siberia. There are at least 100 species of currants. The Rocky mountains in North America are especially rich in species. The common black currants of Europe are all derived from *Ribes nigrum,* a native of northern Europe and of northern and central Asia. A few relatively unimportant black currants of America are derived from *R. americanum* and *R. odoratum,* natives of North America. *Ribes sanguineum,* a native of the western coast of North America, is the flowering currant of northern Europe and *R. aureum* is the chief American flowering currant. The currant seems to have been cultivated first sometime before 1600 in the Netherlands, Denmark, and around the Baltic sea. Bushes were taken to settlements in America early in the 17th century. Most varieties growing in America originated in America. Fay, Wilder, Red Cross, Diploma, Perfection, London Market and Victoria are the chief red varieties. Red Lake and Cascade are promising new sorts. Important red currant varieties of England are Earliest of Fourlands, Laxtons Perfection, Fay, Rivers Late, Houghton Castle and Prince Albert. The black currant is extensively cultivated in Europe and to a lesser extent in Canada. Important black currant varieties of England are Baldwin, Boskoop, Seabrook, Laxton and Daniels September, and of Canada Climax, Kerry, Elipse, Clipper and Saunders. Both red and black currants are used for making tarts, pies, jams, jellies, etc. Black currants are also used in lozenges, for flavouring, and are occasionally fermented. It is extremely high in vitamins C and P. In 1934 the acreage in England of black currants was reported as 9,500 ac., and of red and white as 3,100 ac. In 1939 the acreage in the United States was 2,300 ac., nearly all red currants with a crop value of $334,000.

Currants succeed best in cool, moist northern climates. They are cultivated from Maryland to Kansas northward and are hardy far north in Canada, northern Scandinavia and the U.S.S.R.

Two leaf diseases, cane blight and anthracnose limit the culture of currants south of Maryland and Kansas.

Clay and silt soils are preferred for growing currants. They are propagated almost entirely by means of cuttings made from vigorous shoots of the current season's growth. The cuttings, 8 to 12 in. long, are usually taken in the autumn and set in the nursery immediately or buried in sand till spring and then set 3 to 6 in. apart with not over two buds left above ground. In the plantation they are set 4 to 5 ft. apart in rows 6 to 8 ft. distant. Under intensive cropping currants are planted under grapes, peaches, cherries, apples and pears because they stand shade better than do most plants.

The currants and gooseberries are the chief agencies in the spread of the white-pine blister rust, a destructive disease of the five-leaved pines in Europe and America. The common garden black currant is the favourite host of the blister rust. Because the white pine is one of the most valuable timber trees of the United States the black currant has been declared a menace and is not grown in most of the United States. Furthermore, the culture of all currants and gooseberries has been prohibited in many sections of the United States. The Viking red currant (called Red Dutch in Norway) is a vigorous variety immune to the blister rust and has been tested in northern United States for its horticultural value. The Red Holland variety of Germany is also immune to this disease. In 1943 good-fruited immune hybrids between a blister rust-immune species from Siberia and the common black currant were reported by the Canadian Experiment station at Ottawa. The currant maggot, for which there is no known control, infects the fruit so badly in parts of western North America that this fruit is not grown. The attacks of the currant worm may defoliate the plants in the spring unless controlled by using powdered hellebore, diluted 5 to 12 times with flour or air-slaked lime, or as a spray, with 1 oz. to 1 gal. of water.

The black currant is subject to the attacks of a mite, *Phytoptus ribis,* which destroys the unopened buds. The infested buds, recognized by their swollen appearance, should be picked off and burned. Reversion has been found to be a virus disease and is controlled by destroying affected plants. (G. M. D.)

CURRENCY. The term "currency" has no generally accepted meaning. It has been used variously to designate a part or the whole of the circulating medium or money of a country. Hugh Vance, one of the first writers to use the term, asserted in 1740 that the word was in common use in the colonies. He stated that it included silver, paper money, tobacco in Virginia and sugar in the West Indies; that it was "more especially that most general commodity, for which contracts are usually made." By the end of the 18th century the word was frequently used in both Great Britain and the United States, and it is clear that writers were thereby referring to all forms of hand-to-hand circulating media, more particularly to coins and bank notes. Adam Smith often used the term "common currency" in *The Wealth of Nations* (1776) evidently with this meaning in mind. During the first third of the 19th century the term was used in this sense, but with the additional inclusion of government paper money.

Most writers have not stated explicitly whether they use the term "currency" synonymously with "money"; but one may infer that many do. Samuel Jones Loyd (later Lord Overstone) and George Warde Norman asserted (1840) that they did so use the terms. A few have made it clear that they do not. Thus George Guthrie asserted (1860) that "bank-notes are not money more than cheques or bank-bills are. . . . . The only real money or cash in this country is gold." Nevertheless, he included bank notes as part of the currency. Similarly J. F. Johnson stated (1905) that "in the United States gold alone is money"; but included United States notes, bank notes, silver dollars and subsidiary coins as part of the stock of currency, and apparently, also demand deposits.

During the 1830s it was recognized by numerous writers, both British and U.S., that demand deposits, against which cheques might be drawn, serve the same purposes, and have the same relationship to the price level, as hand-to-hand money. Many of these men, therefore, included demand deposits as a part of the currency. Robert Torrens wrote (1837) that "the currency, or general medium of exchange, is composed of two distinct and different elements, namely:—of the circulating money, consisting of coin and bank notes; and of the credit money, consisting of all those deposits and credits which stand in the books of the bankers, and which are available in effecting purchases and payments." Similarly Irving Fisher wrote (1911) as follows: "Currency includes any type of property right which, whether generally acceptable or not, does actually, for its chief purpose and use, serve as a means of exchange. Circulating media are of two chief classes: (1) money; (2) bank deposits. But while a bank deposit transferable by cheque is included as circulating media, it is not money. A bank note, on the other hand, is both circulating medium and money." A further extension of the meaning of the term "currency" is sometimes encountered. Thomas Tooke asserted (1826) that "currency is that medium, whether consisting of gold, notes, bills, or credit, by which the purchase of commodities is effected." While a number of other writers have also taken the position that bills and credit in all forms have the same significance as coin and bank notes, few have explicitly included them in the term "currency."

While there was some reason for Tooke's position at the time he wrote, since bills were actually used as a means of payment in Lancashire, it would not be justified to include credit instruments as a part of the currency today. Nevertheless, they have an important monetary significance. Such "near moneys" as government short-term securities (treasury bills), mercantile bills, and in fact all high-grade liquid securities are in demand as a substitute for cash in "cash" balances of the public, since they can be converted into cash quickly if the latter is needed, and they yield an income which is not obtained if cash itself is held. This tendency to substitute securities for cash increases the velocity of circulation of money, which has the same effect as an increase in its quantity. It is manifest from what has been said above that past and current usage will support about equally well the use of the term "currency" to include all of the hand-to-hand circulating media, such as coins, bank notes and government paper money, but excluding bank deposits, or, to include deposits as well. In what follows it will be used in the first of these two senses, and the terms "money" and "circulating medium" will be used in the latter sense.

History.—Historically the constituent elements of the currency have varied greatly in both the United States and Great Britain. Before the advent of commercial banking in the latter country in the 17th century, the currency consisted exclusively of coins. In the American colonies, however, numerous experiments were made with various types of paper money, so that the actual currency consisted of coins and paper, with, in the early days, some use of tobacco in the south. Following the development of banking in Great Britain, and consequent upon the establishment of the first commercial bank in the United States in 1782, bank notes became an important element in the currency of both countries.

From about 1830 to 1844 there was much controversy in Great Britain between the so-called currency and banking schools. The former group of writers held that the existing mixed metallic and paper (bank-note) currency should vary with exports and imports of gold precisely as would a purely metallic currency. By this they meant that an outflow of gold should immediately cause a contraction of the currency and thus reduce prices, or contrariwise with an inflow. Thus international equilibrium would be automatically restored. Failure so to control the stock of currency, they asserted, would permit the banks to continue to expand their loans and the quantity of circulating medium after an outflow of gold had set in. This development, they believed, would eventually lead to an undermining of the reserve position of the banks, and therefore to a violent contraction and commercial "revulsion." Most of these writers either ignored or greatly underestimated the importance of deposits as an element in the stock of money.

The banking school saw better the influence of deposits, and contended that to control the currency alone would not achieve the result desired by their opponents. But in addition they denied that an immediate contraction of the stock of money was to be desired upon the beginning of an outflow of gold. International gold movements frequently were due, they asserted, to the requirement of making some specific and limited payment, rather than to a fundamental condition of disequilibrium. To contract the currency, therefore, they claimed, would be unnecessary in these cases and would needlessly worsen domestic business conditions. Moreover, they held that the banks could not unduly expand the quantity of money—that they were controlled by the "needs of business." This latter doctrine is still debated but appeared to have no foundation in theory or history.

In the political field the currency school won the argument; and the note-issuing privilege of the banks was severely limited by Peel's Act of 1844. In its economic aspects, however, the difference of opinion has not yet been satisfactorily resolved. There is in truth a difficult problem of public policy presented when an outflow or inflow of an international money takes place. It may or may not be the consequence of a fundamental condition of disequilibrium; but, if it is, the international position then requires a change in the domestic price level and a shift of production from domestic to international commodities, or the contrary, depending upon the direction of the gold flow. In any case the change in the stock of money causes an unwelcome disturbance of domestic economic affairs. If it involves a reduction in domestic prices, as will be the case when the flow of gold is outward, there may develop a considerable amount of unemployment.

In the United States there arose contemporaneously a point of view quite similar to that of the currency school in England. Many writers contended that the currency should consist only of "hard" money, that is, coin. Nevertheless, partly because the federal government was then supposed not to have the constitutional authority to interfere with the issuance of notes by state-incorporated banks, no legislation comparable with Peel's act was passed in the United States. However, the Independent Treasury Act of 1846 provided for maintaining governmental sub-treasuries for keeping the funds which formerly had been deposited in various banks. This act also required the treasurer to accept and to pay out only coin. In this way it was believed that the proportion of "hard" money to bank notes would be increased. The act may have had some slight influence in this direction.

No important legal limitation of the privilege of note issue was instituted in the United States until the passage of the National Bank act in 1863, and of the act of 1865. The former act provided for incorporation of national banks which might issue notes, but only against the security of federal government bonds. The latter act levied a tax of 10% per annum on the note issues of state-incorporated banks. The intent and effect of this tax was to eliminate entirely the notes of state banks.

The currency of the United States was made yet more complicated by the issuance of United States notes (greenbacks) during the Civil War, and of gold and silver certificates, the former appearing in 1866, and the latter in 1880. Federal reserve notes were provided for in the act of 1913 and after that date they became the major form of currency. The general circulation of gold coin and certificates was discontinued in 1934, while the quantity of silver certificates greatly increased after that date in consequence of the Silver Purchase act of that year. The privilege of issuing notes by the national banks was discontinued in 1935.

In Great Britain the composition of the currency also changed after 1914, although it was not so complicated as in the United States. The issuance of currency notes by the treasury was authorized at the outbreak of World War I, and the volume of these notes rose rapidly to a maximum of approximately £320,000,000 in Dec. 1920. Gold coins disappeared from circulation. The issues of the Bank of England also increased during these years, but their quantity did not become so great as that of the currency notes. The return to gold in 1925 did not affect the composition of the currency, since the Gold Standard act permitted the Bank of England to redeem its obligations in bullion rather than coin.

The Currency and Bank Notes Act of 1928 amalgamated the currency notes and the Bank of England issues by making the outstanding currency notes an obligation of the bank, and transferring to the latter an equal amount of assets. This act increased the note issues of the bank from approximately £180,000,000 to £419,000,000 and the uncovered or fiduciary issues from about £20,000,000 to £260,000,000. The suspension of the gold standard in 1931 likewise did not affect the composition of the currency, because gold coins had not been in circulation since 1914.

Quantity.—In the absence of commercial banking, the determination of the quantity of currency under a purely metallic standard would be a relatively simple matter. The volume of currency and the price level would be simultaneously determined by the richness of ore reserves, the technology of mining and of ore reduction, the industrial demand for the money metal, the volume of transactions requiring payment in money, and the velocity of circulation of the currency. In a country in which fractional-reserve banking obtains, the problem is much more complicated. If the reserves of the banks consisted of currency the preceding factors would be partial determinants under a metallic standard; but, in addition, the relative demand of the public for currency and for deposits, and the reserve ratio of the banks would become important determinants. If, for example, the public desired to hold the same amount of cash in the form of currency as in deposits, if the reserve ratio of the banks were 25%, and if the amount of currency (consisting of coin only) were 100 units, then the currency in the hands of the public would be 80 units, and that in the reserves of the banks 20 units. Deposits would then be four times the amount of reserves, or 80 units, that is, they would be equal to the amount of currency in the hands of the non-banking public. The total quantity of money in the cash balances of the public would therefore be 160 units.

If we assume all the above conditions to be the same except that the demand of the public for currency is one-sixth of its demand for deposits, then the currency outside the banks will be 40 units, and the reserves of the banks 60 units. Thus there will be 240 units of deposits, or six times the amount of currency in the hands of the public. However, in this second case the total amount of money (280 units) will be much larger than in the first case. This will cause the price level to be higher, and mining of the money metal to be more costly, since higher prices will mean higher wage rates for miners and higher costs of mining materials. Thus the output of the money metal will be actually lower than in the first case, so that if 100 units of coined money would be provided in the first case, mining would be so much curtailed in the second that, in fact, less than 100 units would be provided. The consequence would be that the price level would be higher than in the first case, the total quantity of money greater and the quantity of currency in the hands of the non-banking public smaller; but the price level would not be so high, or the quantity of money and of currency so great, as we have assumed in the arithmetic example in the second case. Equilibrium would be reached at some level which cannot be determined without making precise assumptions as to ore reserves, volume of transactions, and the other relevant factors.

If we vary our second case by assuming that the reserve ratio is 10% instead of 25%, while the demand for currency continues to be equal to the demand for deposits, then the amount of currency in the hands of the general public will be 90.9 units, while the reserves of the banks will be 9.09 units. We shall therefore have 90.9 units of deposits, and the total amount of money in the cash balances of the public (currency plus deposits) will be 181.8. This is a larger amount of money than the 160 units of the first case, and consequently the statements concerning our second case also apply here. If a country is not on a metallic standard the quantity of currency and of money in the final analysis will depend upon action by the legislature. In this case, however, the legislature will need some guide to its action. Various such guides have been suggested, such as a constant quantity of money, a constant product of the quantity of money and its velocity per capita, and a stable price level. While there is no unanimity of opinion on this subject, a stable price level probably comes nearest to general acceptance. It will still be true, however, that all of the above determinants, except the conditions of mining, will be factors in determining how much currency the legislature can provide consistently with its announced policy.

A further complication arises if the reserves of the banks consist not of currency, but of deposits with a central bank. This, in fact, is the usual condition in industrial nations. If a nation is on the gold standard there will still be a relationship between the quantity of currency and of money, the output of gold, and the price level; but it will be tenuous and uncertain. The action of the central bank in increasing or decreasing the reserves of the "member" banks by means of open-market operations will be an important consideration. This factor has not in the past been so predictable and reliable as is to be desired. If the central bank is itself not required to redeem its obligations in gold or other legal tender, the uncertainty in monetary policy may in fact not be significantly greater than it will be under the gold standard and the absence of an established monetary policy. Moreover, it is at least conceivable that monetary policy could be more definite without than with a gold standard, since there would be no danger that the exhaustion of reserves would intervene to put a stop to an expansion that was desirable. However, the relative merits of a gold and a paper standard is a much debated question.

It should not be inferred from the preceding statements that the velocity of circulation of currency is stable. It is, in fact, notoriously unstable, and the consequence is that there has been witnessed in the past marked fluctuations in the price level for this reason as well as because of variations in the quantity of money, and therefore also fluctuations in the volume of employment and production. A definite monetary policy of offsetting changes in velocity by changes in the opposite direction in the quantity of money should do much to stabilize the price level and employment; but no nation has as yet adopted a policy of this kind. Such data as are available indicate that prior to about 1850 the volume of currency exceeded that of deposits in the United States; and, while the data are less conclusive for Great Britain, the same relationship probably obtained in the latter country. This ratio fell during the second half of the 19th century, but rose again somewhat during the 1930s. In 1944 it stood, very roughly, at about one to five in both Great Britain and the U.S., if both time and demand deposits are included.

The fact that the volume of currency exceeded that of deposits before 1850, and the failure to understand fully the significance of deposits, doubtless explain the central place assigned to the currency in the currency-banking school controversy in Great Britain, and the demand for a "hard" money in the United States. In recent years, but particularly after about 1920, the tendency has been to put more emphasis on the need for controlling the volume of deposits, and to consider, rightly, the volume of currency as a matter of secondary importance—except in so far as it may influence, by way of bank reserves, the volume of deposits. (*See* also the articles on MONEY; QUANTITY THEORY OF MONEY; BANKING AND CREDIT; INFLATION AND DEFLATION; and GREENBACKS.)

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CURRENCY, PRIMITIVE. Among peoples of primitive culture is found a strange diversity of objects commonly termed "money" or "currency." These are of two main kinds, one comprising articles of practical use, the other those of which the primary purpose is ornament. The rock salt of Abyssinia, the hoes of the Dinka and Shilluk of the upper Nile, the iron and cloth of central and west Africa, the brilliant red feather bands of Santa Cruz, the dentalium shell strings of California and British Columbia, the wampum of the eastern American tribes, the tridacna-shell armlets and large stone axe blades of eastern New Guinea, the sperm-whale teeth of Fiji and the *fê* or "millstone money" of the Caroline islands have all been termed "money." Certain of these things are currency in the true economic sense; others have been dubbed so through loose definition of terms and use.

Well known among "native money" are the strings of shell disks so characteristic of the Melanesian islands, as the *diwara* of New Britain, the *rongo* of Malaita or the *sapisapi* of east New Guinea. Much work is involved in their manufacture, and their value varies according to their length and colour. Red disks are worth more than white, the shell from which they are obtained being more rare. These strings, whether in coils or made up into necklaces, form most important items of wealth to the native, and pass freely from hand to hand in settlement of social obligations.

But according to precise terminology such objects can hardly be correctly described as currency or money. In any economic system, however primitive, an article can only be regarded as true money when it acts as a definite and common medium of exchange, as a convenient stepping-stone in obtaining one type of goods for another. Moreover, in so doing it serves as a measure of values, allowing the worth of all other articles to be expressed in terms of itself. Again, it is a standard of value with reference to past or future payments, while as a store of value it allows wealth to be condensed and held in reserve. Strings of shell disks and similar articles are certainly a form of condensed wealth, and act as a store of value. But they do not consistently perform any other function of money. They may pay for canoes or be traded against one another, but they do not facilitate every-day exchanges, as those of food or implements, nor are market values of other commodities expressed in them. The use of such articles is largely ceremonial; individual pieces often have names and unique histories, and are connected with the fortune of special persons and clans. In general, the economic system of the Pacific island native, considered apart from the effects of white contact, has not been shown capable of accommodating and utilizing a fully-fledged circulating medium in its system of production and exchange; references to native "money" or "currency" therefore cannot be accepted at face value.

With African tribes the case is different. The use of hoes or cattle as true money is dubious, but it is clear that such objects as iron bars (often in the form of conventionalized spear-heads or knives), cowrie shells, salt and cloth serve as definite media of exchange and as common measures, standards and stores of value. This may be due to external influence, particularly to that of Arab traders. The cowrie (*Cypraea moneta*) is one of the most striking forms of native currency. Ranging in west Africa from the Sahara to the Gulf of Benin, taking in the whole basin of the Niger-Benue, and including also the upper Congo-Lualaba area, its economic sphere centres especially in Timbuktu, the district of the middle Niger, and the country around Lake Tchad. Sometimes the shells are strung on a cord, sometimes kept loose in a leather bag, and transactions of all kinds, from simple village marketing to buying and selling on a large scale, are accomplished through this medium. In recent times the cowrie has often served as the small change for a European currency. With the change in economic conditions and ideas consequent upon the arrival of the white man, objects previously not employed as actual currency may begin to extend their function and assume that position.

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CURRENT ASSETS, also known as *liquid, quick, working* or *floating assets,* are assets consisting of cash and other items which can readily be converted into cash without serious depreciation in values. Ordinarily this group of assets includes cash, accounts receivable, notes receivable, accrued interest receivable and merchandise inventories. It is generally assumed that current assets will be converted into cash during the current operations of the business. Usually this will occur within from three months to six months following the date of the accounts, although in some cases an entire year might be required. While some concerns, notably those that manufacture repair parts, have a sufficient stock of such parts to last for a three to five year period, it is customary even in such instances to include these valuations in the inventory accounts. The amount involved in the inventory of the repair parts is usually small as compared with the inventories of finished products, work in process and raw materials. In the preparation of the balance sheet of an organization, current assets are usually listed first. It is to these assets that current creditors of the business must look for satisfaction of claims. If the balance sheet is to be used for credit purposes, the prospective creditor will be most interested in this group of assets so that he may reasonably determine the ability of the debtor to discharge his obligation at maturity. *Net current assets* is a term used to signify the excess of current assets over current liabilities. (G. L. C.)

CURRENT BALANCE. A current balance, or current weigher, measures an electric current by balancing the force of attraction or repulsion between two or more coils which carry the current against the force of gravity on a known mass. In the current balance described by Lord Rayleigh in 1882 a coil suspended from one pan of a balance and carrying the current in a clockwise direction is repelled by the upper fixed coil in which the current is counter-clockwise and attracted by the lower coil in which the current is clockwise. The resulting force on the moving coil is balanced by adding a small weight to the opposite pan. The current in absolute amperes is computed from the force on this weight, the number of turns of wire on the coils, their radii, and their distance apart.

The current balance is now used only by national standardizing laboratories for determining the ratio between the absolute ampere and the international ampere, the latter being the unit in which instruments for measuring electric current are certified. In 1940 in both England and the United States, 1 international ampere = 0.99985 absolute ampere. (*See* INSTRUMENTS, ELECTRICAL.)

(H. L. Cs.)

CURRENT LIABILITIES, a financial and accounting term used to designate short-term obligations; *i.e.*, obligations which mature within a period of one year. This classification of accounts normally includes such items as accounts payable, notes payable, acceptances payable, accrued interest payable, salaries and wages accrued, and other items of like character. In the preparation of a balance sheet, it is customary to segregate current liabilities and list them first in the liability section so that prospective creditors may more readily determine the relation of current liabilities to current assets (*q.v.*).

CURRIE, SIR ARTHUR WILLIAM (1875–1933), Canadian soldier and administrator, was born at Napperton, Ont., on Dec. 5, 1875, commanded the 1st Canadian Division, 1914–17, and the Canadian Corps in France, 1917–18. Currie was given the C.B. in 1915, K.C.M.G. 1917, K.C.B. 1918 and G.C.M.G. 1919; he also received French and Belgian decorations. In 1920 Sir Arthur Currie became principal of McGill university, Montreal.

CURRIE, SIR DONALD (1825–1909), British shipowner, was born at Greenock on Sept. 17, 1825. By a fortunate chance he attracted the notice of the chief partner in the newly-started Cunard steamship line, who found him a post in that company. In 1849 the Cunard company started a service between Havre and Liverpool to connect with their trans-Atlantic service. Currie was appointed Cunard agent at Havre and Paris, and secured for his firm a large share of the freight traffic between France and the United States. About 1856 he returned to Liverpool, where till 1862 he held an important position at the Cunard company's headquarters. In 1862 he established the Castle line of sailing-ships between Liverpool and Calcutta. In 1864 Currie found it profitable to substitute London for Liverpool as the home port of his vessels, and himself settled in London. In 1872 he started the Castle Line of steamers between England and South Africa, which after 1876 divided the South African mail contract with the older Union Line, and was finally amalgamated with the latter under the title Union Castle Line in 1900. Currie's intimate knowledge of South African conditions caused him to be entrusted by the home Government with the negotiations in the dispute concerning the ownership of the Kimberly diamond-fields. He introduced the two Transvaal deputations which came to England in 1877 and 1878 to protest against annexation, and though his suggestions for a settlement were disregarded by the Government of the day, the terms on which the Transvaal was subsequently restored to the Boers agreed, in essentials, with those he had advised. Entering politics, he was returned to parliament in 1880 as Liberal member for Perthshire, but, though a strong personal friend of Gladstone, he disagreed with him on the Home Rule question, and from 1885 to 1900 represented West Perthshire as a Unionist. In 1881 he was knighted, and in 1897 was created G.C.M.G. He died at Sidmouth on April 13, 1909.

CURRIE, JAMES (1756–1805), Scottish physician and editor of Burns, son of the minister of Kirkpatrick-Fleming, in Dumfriesshire, was born there on May 31, 1756, and died at Sidmouth on Aug. 31, 1805. He spent some years in America before he studied medicine and became physician (1783) of Liverpool infirmary. Among other pamphlets Currie wrote *Medical Reports on the Effects of Water, Cold and Warm, as a Remedy in Fevers and Febrile Diseases* (1797), which had some influence in promoting the use of cold water affusion, and contains the first systematic record in English of clinical observations with the thermometer. But he is best known for his edition (1800), long regarded as the standard, of Robert Burns.

CURRIER. One who dresses and prepares leather already tanned. The currier pares off roughness and inequalities, makes the leather soft and pliable, and gives it the necessary surface and colour. It is of interest to note that the word "curry," which describes the work of the currier, also means to dress a horse by grooming with a comb.

The word curry crops up in many telling phrases. The saying "to curry favour," to flatter or cajole, is a 16th century corruption of "to curry favel," *i.e.* a chestnut horse. A chestnut or fallow horse seems to have been taken as typical of deceit.

CURRIER & IVES, American lithographers whose prints of events and scenes in the United States of the middle and latter part of the 19th century are much sought after. NATHANIEL CURRIER (1813–1888) was born in Roxbury, Mass., was apprenticed to a lithographer at 15 and at the age of 22 set up for himself, first at Philadelphia and then in New York. In 1835 a disastrous fire swept lower New York. Four days later Currier produced a lithograph entitled "Ruins of the Merchants' Exchange" which the public bought eagerly. A few years later the steamship "Lexington" was burned in Long Island Sound with the loss of 100 lives. Within three days Currier had lithographed the burning ship, supplying a full description of the catastrophe. The success of the lithograph was instant. JAMES MERRITT IVES (1824–1895), an artist, was employed by Currier, at first as a bookkeeper; but later he became a partner. For over a generation Currier & Ives turned out lithographs, which the public eagerly bought, on the events of the day, disasters on land and sea, death beds, Indian and frontier scenes, Biblical scenes, and social caricatures. In the later years of the 19th century the newspapers and the photograph supplanted lithographs, and the prints were no longer made. Years later they began to be in demand by collectors, and prints that originally sold for a dollar or two each were bought for hundreds or even thousands of dollars.

CURSOR, LUCIUS PAPIRIUS, Roman general, five times consul and twice dictator. In 325 B.C. he was appointed dictator to carry on the second Samnite War. After the disaster of the Caudine Forks (*q.v.* 321 B.C.) Cursor to some extent wiped out the disgrace by compelling Luceria (which had revolted) to surrender. In 309, when the Samnites again rose, Cursor was appointed dictator for the second time, and gained a decisive victory at Longula. His son of the same name, also a distinguished general, completed the subjection of Samnium (272).

CURSOR MUNDI, an English poem in the northern dialect dating from the early 14th century. It is a religious epic of 24,000 lines "over-running" the history of the world as related in the Old and New Testaments. The author explains his reason for undertaking the work. Men desire to read old romances of Alexander, Julius Caesar, Greece, Troy, Brut, Arthur, and others. But better than tales of love is the story of the Virgin; therefore in her honour he will write this book. He writes in English so that those who know no French may understand. The history is treated under seven ages. The first four include the period from the creation of the world to the successors of Solomon; the fifth deals with Mary and the birth and childhood of Jesus; the sixth with the lives of Christ and the chief apostles, and with the finding of the holy cross; and the seventh with Doomsday. Four short poems follow, more in some mss. The bulk of the poem is written in rhyming couplets of short lines of four accents, and maintains a fair level throughout. The narrative is enlivened by many legends; and the numerous transcripts of it prove that it was able to hold its own against profane romance.

Of the author nothing is known. The date of the book was placed by Dr. J. A. H. Murray (*The Dialect of the Southern Counties of Scotland*, 1873, p. 30) in the last quarter of the 13th century, and the place of writing near Durham.

Cursor mundi was edited for the Early English Text Society in 1874–93 by Dr. R. Morris in parallel columns from four mss.

CURTAIN, a screen of any textile material, running by means of rings fixed to a rod or pole. Curtains are now used chiefly to cover windows and doors, but for many centuries every bed of importance was surrounded by them, and sometimes, as in France, the space thus screened off was much larger than the actual bed and was called the *ruelle*. The curtain is very ancient—indeed the absence of glass and ill-fitting windows long made it a necessity. Originally single curtains were used; it would appear that it was not until the 17th century that they were employed in pairs. Curtains are made in an infinite variety of materials and styles; when placed over a door they are usually called *portières*. In fortification the "curtain" is that part of the enceinte which lies between two bastions, towers, gates, etc.

CURTAIN FIRE, a barrier of shells fired so as to burst along a certain line just in front of one's own infantry to protect them from enemy attack, or in rear of the hostile infantry to prevent their retreat or the arrival of reinforcements (from O.Fr. *courtine*). Curtain fire is alternatively termed "barrage fire" (from Fr. *barrage*, a barrier).

CURTANA, the pointless sword of mercy, known also as Edward the Confessor's sword, borne at the coronation of the kings of England between the two pointed swords of temporal and spiritual justice.

CURTEA DE ARGEŞ, an old city in the department of Argeş, Rumania, on the right bank of the Argeş, where it flows through a valley of the lower Carpathians, terminus of a branch railway from Piteşti. Pop. (1930) 6,831. Tradition says it was founded early in the 14th century by Prince Radu Negru, succeeding Câmpulung as capital of Walachia. Hence its name *Curtea*, "the court." It contains a few ancient churches, and was created a bishopric at the close of the 18th century.

The cathedral, the most famous Rumanian building, stands in monastery grounds 1½ mi. north of the city. Mausoleum-like, it is built in Byzantine style, with Moorish arabesques; it is oblong, with a many-sided annex at the back. A central dome is fronted by two smaller cupolas; while a broader and loftier secondary dome springs from the annex.

The archives of the cathedral were plundered by Magyars and Muslims, but several inscriptions, Greek, Slav and Rumanian, were left. One tablet names the founder, Prince Neagoe Bassarab (1512–21); another says Prince John Radu completed the work in 1526; a third describes repairs executed in 1681 by Prince Şerban Cantacuzino; a fourth, the restoration in 1804, by Joseph, the first bishop. The cathedral was reconstructed 1875–85, and reconsecrated in 1886.

CURTESY: *see* COURTESY.

CURTILAGE, the area of land which immediately surrounds a dwelling-house and its yard and outbuildings. In feudal times every castle with its dependent buildings was protected by a surrounding wall, and all the land within the wall was termed the curtilage; but the modern legal interpretation of the word, *i.e.*, what area is enclosed by the curtilage, depends upon the circumstances of each individual case, such as the terms of the grant or deed which passes the property, or upon what is held to be the amount of land usual or necessary for the site of the house, etc. The importance of the word in modern law depends on the fact that the curtilage marks the limit of the premises in which housebreaking can be committed.

CURTIN, ANDREW GREGG (1817–1894), American political leader, was born at Bellefonte, Centre county, Pa., on April 22, 1817. He graduated from the law department of Dickinson college in 1837 and was admitted to the bar in 1839. Entering politics as a Whig, he was chairman of the Whig State central committee in 1854, and from 1855 to 1858 was secretary of the commonwealth. In Oct. 1860 he was elected governor of Pennsylvania on the Republican ticket.

During the Civil War he was one of the closest advisers of President Lincoln, and one of the most efficient, energetic and patriotic of the "war governors" of the north. He organized the famous "Pennsylvania Reserves," by means of which the state was always able to fill at once its required quota after each successive call. In equipping and supplying troops he showed great resourcefulness, and his arrangements for caring for the widows and children of Pennsylvania soldiers killed in battle and for the sick and wounded were copied throughout the north. He was re-elected governor in 1863 and served until Jan. 1867. He was U.S. minister to Russia from 1869 until 1872. He returned to America and took part in the Liberal Republican revolt against President U. S. Grant. Later he joined the Democratic party and was a representative in congress from 1881 to 1887. He died at his birthplace, Bellefonte, Pa. on Oct. 7, 1894.

See William H. Egle, *Life and Times of Andrew Gregg Curtin* (Philadelphia, 1896), which contains chapters written by A. K. McClure, Jno. Russell Young, Wayne MacVeagh, Fitz John Porter and others; and Oberholtzer, *Since the Civil War*.

CURTIS, CHARLES (1860–1936), American politician, was born in North Topeka, Kan., on Jan. 25, 1860. He received a common school education, studied law, was admitted to the bar in 1881, began practice in Topeka, and in 1884–88 served as county attorney. Entering politics, he was elected in 1893 Republican representative in congress, and was re-elected continuously until 1907, when he was chosen United States senator, serving until 1913. He was again elected senator for the terms 1915–21, 1921–27 and 1927–33. At the Republican national convention in 1928 he was nominated for the vice-presidency. On Nov. 6, 1928, he, with Herbert Hoover, was elected by the overwhelming majority of 444 to 87 electoral votes, but four years later he was defeated even more decisively. He died Feb. 8, 1936.

CURTIS, CHARLES GORDON (1860–), American inventor, was born at Boston, Mass., April 20, 1860. He was educated at Columbia university (C.E., 1881; LL.B., 1883; M.S., 1907), and practised as a patent lawyer for eight years. He organized the C. and C. Electric Motor Co., and also the Curtis Electric Manufacturing Co., of which latter concern he was president. He invented the Curtis steam turbine, of high efficiency with a new method of controlling speed, the land rights of which he sold to the General Electric Co.

CURTIS, CYRUS HERMANN KOTZSCHMAR (1850–1933), U.S. philanthropist and publisher, was born in Portland, Me., June 18, 1850, the son of Cyrus Libby Curtis and Salome Ann Cummings Curtis. As early as 1863, he began publishing in Portland a local weekly called *Young America*. When fire destroyed his plant, he moved to Boston, where he worked as a messenger, an advertising solicitor and as publisher of *The People's Ledger*, a magazine. He moved to Philadelphia in 1876 and continued there the publication of the magazine. In 1879 he founded *The Tribune and Farmer*, from the women's section of which he formed a new magazine, *The Ladies' Home Journal*. In 1890, Curtis organized the Curtis Publishing company. Seven years later he purchased *The Saturday Evening Post* and in 1911 *The Country Gentleman*. In 1913, he purchased the *Philadelphia Public Ledger* and a year later began publication of the *Evening Public Ledger*. He bought the *Evening Telegraph* for its Associated Press membership, which he transferred to the *Evening Public Ledger*. Later he purchased the *Philadelphia Press* and the *North American*, both morning newspapers, and merged them with the Curtis papers. In 1924, he obtained possession of the *New York Evening Post*; in 1930, the *Philadelphia Inquirer*. He died June 7, 1933.

CURTIS, GEORGE TICKNOR (1812–1894), American lawyer, legal writer and constitutional historian, was born in Watertown, Mass., on Nov. 28, 1812. He graduated at Harvard in 1832, was admitted to the bar in 1836, and practised in Worcester, Boston, New York and Washington, appearing before the U.S. supreme court in many important cases, including the Dred Scott case, and the "legal tender" cases. In Boston he was for many years the U.S. commissioner, and in this capacity, despite his own opposition to slavery, ordered the return to his owner of the famous fugitive slave, Thomas Sims, in 1852. He was the nephew of George Ticknor, the historian of Spanish literature, and his association with his uncle was influential in developing his scholarly tastes. He is best known as the author of *A History of the Origin, Formation and Adoption of the Constitution of the United States, with Notices of its Principal Framers* (1854), republished, with many additions, as *The Constitutional History of the United States from their Declaration of Independence to the Close of their Civil War* (1889–96). This history may be said to present the old Federalist or "Webster-Whig" view of the formation and powers of the Constitution; and it was natural that Curtis should follow it with a voluminous *Life of Daniel Webster* (1870), a most valuable biography of that statesman. In his later years Curtis, like so many of the followers of Webster, turned towards the Democratic Party; and he wrote, among other works of minor importance, an exculpatory life of President James Buchanan (1883) and two vindications of Gen. George B. McClellan's career (1886 and 1887). He died in New York on March 28, 1894.

In addition to the works above mentioned he published: *Digest of the English and American Admiralty Decisions* (1839); *Rights and Duties of Merchant Seamen* (1841); *Law of Patents* (1849); *Equity Precedents* (1850); *Commentaries on the Jurisprudence, Practice and Peculiar Jurisdiction of the Courts of the United States* (1854–58); *Creation or Evolution* (1887); and a novel, *John Chambers* (1889).

His brother, BENJAMIN ROBBINS CURTIS (1809–1874), also an eminent jurist, was born on Nov. 4, 1809, in Watertown, Mass., graduated at Harvard in 1829, studied law at Cambridge and at Northfield, Mass., where, after his admission to the bar in 1832, he practised law for two years, and then in Boston in 1834–51. In 1851 he was appointed to the Supreme Court of the United States, where he gained his greatest fame by his dissenting opinion in the Dred Scott case, in which he argued that the Missouri Compromise was constitutional, and that negroes could become citizens. His argument was immediately published as an anti-slavery document. In 1857 he resigned from the Supreme Court and resumed his private practice. In 1868 he was one of the counsel for President Andrew Johnson in his impeachment trial. He died at Newport R.I., on Sept. 15, 1874. He prepared *Decisions of the Supreme Court* and a *Digest* of its decisions down to 1854.

A Memoir of Benjamin Robbins Curtis, with Some of his Professional and Miscellaneous Papers, edited by his son, Benjamin R. Curtis, was published at Boston in 1879, the *Memoir* being by George Ticknor Curtis.

CURTIS, GEORGE WILLIAM (1824–1892), American man of letters, was born in Providence, R.I., U.S.A., Feb. 24 1824, of old New England stock. The most significant factor in his early life was his two years' stay with his brother James as a boarder at the Brook Farm community and school. Then came two years, passed partly in New York, partly in Concord in order to be near Emerson and to combine intellectual with outdoor occupation. After four years spent in Europe, Egypt and Palestine, Curtis returned to America in 1850, handsome, attractive, accomplished, ambitious of literary distinction. He joined the staff of the New York *Tribune,* to which, as to the *Courier and Enquirer,* he had sent some letters from Europe. He became a popular lecturer. He set himself to work on a volume published in the spring of 1851 under the title of *Nile Notes of a Howadji,* which was followed in 1852 by *The Howadji in Syria.* He wrote much for *Putnam's Magazine,* of which he was an associate editor; and a number of volumes, composed of charming essays written for that publication, for his department, "The Lounger," in *Harper's Weekly,* and for *Harper's Monthly,* where he was long associated with "The Easy Chair," came in rapid succession from his pen. The chief of these were the *Potiphar Papers* (1853), a satire on the fashionable society of the day; and *Prue and I* (1856), a fancifully tender and humorous study of life. These, the Howadji books and *Lotus Eating* (1852) appeared in a uniform edition in 1856. In 1856 Curtis married Miss Anna Shaw. For years he was obliged to sacrifice much of his home life that he might, by lecturing, pay off the debts he had assumed voluntarily after the failure of *Putnam's Magazine.*

In the period just preceding the Civil War other interests were subordinated to those of national concern. He made his first important speech on current questions at Wesleyan university in 1856. He engaged actively in the presidential campaign of that year, and was soon recognized not only as an effective public speaker but as one of the ablest and most trustworthy leaders of public opinion. In 1863 he became political editor of *Harper's Weekly,* and as such his writing was clear, direct and forcible. Although he never became a mere partisan, his service to the Republican Party was such that he was offered nominations of distinction and was given his choice of the chief missions under President Hayes. He refused them all, feeling that he could be of more service to the country as editor and public speaker. In 1871 he was appointed by President Grant chairman of the commission on civil service reform. From then until his death, he led this movement, and to his sound judgment, his vigorous presentation of the evils of the corrupt political patronage system and his untiring efforts, progress in the reform is mainly due. He was president of the National Civil Service Reform League and of the New York Civil Service Reform Association. In 1884 in refusing to support the nomination of James G. Blaine as candidate for the Presidency, he broke with the Republican Party, and became the typical Independent in politics. In 1890 he was made chancellor of the University of New York, having been a member of the board of regents from 1864. He died at New Brighton, Staten Island, N.Y., Aug. 31, 1892. (C. E. N.)

BIBLIOGRAPHY.—See *George William Curtis,* by Edward Cary, in the "American Men of Letters" series (1894), an excellent biography; "An Epistle to George William Curtis, 1874" and "Postscript, 1887" in James Russell Lowell's *Complete Poetical Works; George William Curtis,* a commemorative address delivered before the Century Association, Dec. 17, 1892, by Parke Godwin (1893); *Orations and Addresses by George William Curtis,* edited by Charles Eliot Norton (1894), and *Early Letters of George Wm. Curtis to John S. Dwight, Brook Farm and Concord,* edited by G. W. Cooke (1898). A number of his literary and social essays were published in book form posthumously. W. M. Payne refers to him in his *Leading American Essayists* (1910).

CURTIS PUBLISHING COMPANY, THE, an American publishing company with headquarters in Philadelphia. Its publications consist of *The Saturday Evening Post* (general-weekly), the *Ladies' Home Journal* (women's monthly), the *Country Gentleman* (agriculture-monthly), and *Jack and Jill* (young children-monthly). *The Saturday Evening Post* was founded in 1728 by Benjamin Franklin, under the name of the *Pennsylvania Gazette,* and has been published continuously since that time, except for a few weeks during the British occupancy of Philadelphia during the Revolutionary War. The *Ladies' Home Journal* was founded by Cyrus H. K. Curtis in 1883. The *Country Gentleman* is the oldest agricultural periodical in America, and was established in the year 1831. *Jack and Jill* was established in Nov. 1938. The net paid circulation of all four magazines in 1939 was the highest in their history, the average circulation of the *Post,* during the first six months of that year, being 3,117,805, the *Journal* 3,185,376, the *Gentleman* 2,054,292, and *Jack and Jill* 125,845.

The Curtis Publishing Company has been the originator of many innovations in the publishing business. It developed the first organized research into commercial problems; it developed the four-colour wet printing process; invented and developed the parallel folder in magazine work, and developed, for the first time practically, the almost instantaneous drying of printing inks in fine quality work. It originated the first magazine circulation department, and has been a pioneer in many forms of modern management. Its buildings in Philadelphia are open for public inspection. (W. D. F.)

CURTIUS, ERNST (1814–1896), German archaeologist and historian, was born at Lübeck on Sept. 2, 1814. After travelling in Greece he became, in 1844, an extraordinary professor at the University of Berlin, and in the same year was appointed tutor to Prince Frederick William (afterwards the Emperor Frederick III.)—a post which he held till 1850. In 1874 he concluded an agreement by which the excavations at Olympia (*q.v.*) were entrusted exclusively to Germany. Curtius died at Berlin on July 11, 1896.

His best-known work is his *History of Greece* (1857–67, 6th ed. 1887–88; Eng. tran. by A. W. Ward, 1868–73) now superseded (*see* GREECE: *History, Ancient,* § Bibliography). His other writings are chiefly archaeological. The most important are: *Die Akropolis von Athen* (1844); *Naxos* (1846); *Peloponnesos, eine historisch-geographische Beschreibung der Halbinsel* (1851); *Olympia* (1852); *Die Ionier vor der ionischen Wanderung* (1855); *Attische Studien* (1862–65); *Ephesos* (1874). His collected speeches and lectures were published under the title of *Altertum und Gegenwart* (5th ed. 1903 *et seq.*).

A full list of his writings will be found in L. Gurlitt, *Erinnerungen an Ernst Curtius* (1902); *see* also article by O. Kern in *Allgemeine deutsche Biographie,* xlvii. (1903), to which may be added F. Curtius, *Ernst Curtius, ein Lebensbild in Briefen* (1903); T. Hodgkin, *Ernst Curtius* (1905).

His brother, GEORG CURTIUS (1820–1885), philologist, was born at Lübeck on April 16, 1820. He held philological appointments at Prague, Kiel and Leipzig. He died at Hermsdorf on Aug. 12, 1885. His philological theories exercised a widespread influence. The more important of his publications are: *Die Sprachvergleichung in ihrem Verhältniss zur classischen Philologie* (1845; Eng. tran. by F. H. Trithen, 1851); *Sprachvergleichende Beiträge zur griechischen und lateinischen Grammatik* (1846); *Grundzüge der griechischen Etymologie* (1858–62, 5th ed. 1879); *Das Verbum der griechischen Sprache* (1873). The last two works have been translated into English by A. S. Wilkins and E. B. England. From 1878 till his death Curtius was general editor of the *Leipziger Studien zur classischen Philologie.* His *Griechische Schulgrammatik,* first published in 1852, has passed through more than 20 editions, and has been edited in English. In his last work, *Zur Kritik der neuesten Sprachforschung* (1885), he attacks the views of the "new" school of philology.

Opuscula of Georg Curtius was edited after his death by E. Windisch (*Kleine Schriften,* 1886–87). For further information consult articles by R. Meister in *Allgemeine deutsche Biographie,* xlvii. (1903), and by E. Windisch in C. Bursian's *Biographisches Jahrbuch für Alterthumskunde* (1886).

CURTIUS, ERNST ROBERT (1886–), German scholar, was born at Thann, Alsace, on April 14, 1886. From 1913–19 he taught at the University of Bonn, from 1920–24 at Marburg, was professor of French history and romance philology at Heidelberg from 1924 to 1929, when he returned to Bonn.

Among his works are: *Die literarischen Wegbereiter des neuen Frankreichs* (1919); *Maurice Barrès und die geistigen Grundlagen des französischen Nationalismus* (Bonn, 1921); *Balzac* (Bonn, 1923); *Französischer Geist im neuen Europa* (1925); *Die Literarästhetik des Mittelalters,* in *Zeitschrift f. rom. Philologie* (1938).

CURTIUS, MARCUS, a legendary hero of ancient Rome. It is said that in 362 B.C. a deep gulf opened in the forum, which the seers declared would never close until Rome's most valuable possession was thrown into it. Then Curtius, recognizing that nothing was more precious than a brave citizen, leaped, fully armed and on horseback, into the chasm, which immediately closed. The spot was afterwards covered by a marsh called the Lacus Curtius. Two other explanations of the name Lacus Curtius are given: (1) a Sabine general, Mettius Curtius, hard pressed by Romulus, leaped into a swamp which covered the valley afterwards occupied by the forum; (2) in 445 B.C. the spot was struck by lightning, and enclosed as sacred by the consul, Gaius Curtius.

BIBLIOGRAPHY.—*See* Livy i. 12, vii. 6; Dion Halic. ii. 42; Varro, *De lingua Latina,* v. 148; Ch. Hülsen, *The Roman Forum* (Eng. trans. of 2nd. ed., J. B. Carter, 1906); O. Gilbert, *Geschichte und Topographie der Stadt Rom im Altertum,* i. (1883), 334–38.

CURTIUS RUFUS, QUINTUS, biographer of Alexander the Great. Modern authorities regard him as a rhetorician who flourished during the reign of Claudius (A.D. 41–54). His work (*De rebus gestis Alexandri magni*) originally consisted of ten books, of which the first two are entirely lost, and the remaining eight are incomplete. The work is uncritical, and shows ignorance of geography, chronology and military matters.

There are numerous editions and an English translation by P. Pratt (1821).

CURUCANECAN, a tribe or small group of tribes of South American Indians, regarded on very insufficient evidence as constituting an independent linguistic stock. They have been extinct since the early part of the 19th century. The Curucanecas lived in the extreme north-east corner of the present province of Chiquitos in eastern Bolivia, in about 16° S. lat. They appear to have been similar to and may have been linguistically related to the Corabecas (*see* CORABECAN), Coravecas, Curuminacas and other nomad hunting tribes of this region.

See A. D'Orbigny, *L'Homme Americain* (Paris, 1839).

CURULE, the epithet applied in Rome to the chair of office, *sella curulis* (Lat. *currus,* "chariot"), used by the "curule" or higher magistrates, and by the emperors. This chair seems to have been originally placed in the magistrate's chariot. It was inlaid with ivory or made of it, had curved legs but no back, and could be folded up like a camp-stool. (*See* CONSUL, PRAETOR and AEDILES.)

CURVE. A curve is most easily thought of as the path of a point moving continuously as to both position and direction, except at special points where discontinuities of any kind may occur. Formerly the word *line* was used to include both curves and straight lines; in modern use it always means a straight line, and is a particular case of the more general term *curve.*

A curve may also be thought of as given in its entirety, a single infinity of points. This point of view is the one adopted by mathematicians in the study of continuous curves. (*See* TOPOLOGY.)

In either case, the idea becomes more definite when we regard all the points of the curve, whether given successively or simultaneously, as obeying some sort of *law.* If we adopt the device of co-ordinates (*see* ANALYTIC GEOMETRY), the law is expressed by one or more equations between the co-ordinates, involving certain functions of them which vanish. The curve is said to be *algebraic* or *transcendental* according to the nature of its equations in Cartesian co-ordinates. If it is algebraic, it has only a finite number of exceptional points, but a transcendental curve can have an infinite number (for an example, *see* article CURVES, SPECIAL) and if its equation involves one of the highly discontinuous functions known to modern analysis it may lose all or nearly all of the properties usually associated with the idea of curve.

If P is an ordinary point of a plane curve, and Q is a neighbouring point, then as Q moves up to P, the chord PQ tends to a definite limit called the *tangent* at P. The line through P perpendicular to the tangent is the *normal.* Three points P,Q,R of the curve determine a circle, whose limit as Q and R tend to P is the *circle of curvature* at P. The more sharply the curve bends, the smaller is this circle, and the reciprocal of its radius is the *curvature* at P, and is equal to the rate of rotation of the tangent (or normal) per unit length of arc described by P. The centre of curvature is also the limit of the intersection of adjacent normals.

In the immediate neighbourhood of P, to a first approximation the curve can be replaced by the tangent, and to a second approximation by the circle of curvature.

By the principle of duality (*q.v.*) a curve can also be regarded as the envelope of its tangents; we may think of the tangent as a line moving continuously in one plane according to some law; its intersection with a neighbouring tangent has a definite limit, which is the point of contact. Thus the tangent replaces the point as the element which generates the curve, and the point of contact replaces the tangent.

Curves in Space.—A *twisted curve* is one which does not lie wholly in one plane. If P,Q,R,S are four neighbouring points of the curve, the planes PQR, QRS are in general distinct. The limit of PQR as Q and R tend to P is the *osculating plane* at P. The normal is the perpendicular to the tangent in the osculating plane, and the common perpendicular to the tangent and normal is the *binormal.* The circle of curvature, limit of the circle PQR, lies in the osculating plane; but its centre is not the limit of intersection of adjacent normals, for these, lying in different osculating planes, do not meet in general. The four points P,Q,R,S determine a sphere through the circles PQR, QRS, the limit of whose centre is the *centre of spherical curvature* at P.

It is useful to think of the tangent, normal and binormal as a rigid frame of rectangular axes, with P as origin, moving forward and rotating as P describes the curve with unit velocity. At any moment, the angular velocity of the frame about the binormal is the curvature, and that about the tangent is the *torsion;* there is no instantaneous rotation about the normal.

The *degree* of an algebraic plane curve is that of its equation, and is the number of its intersections with a general line of the plane; and its *class* is the number of its tangents through a general point. The degree of an algebraic twisted curve is the number of its points that lie in a general plane; and its class is the number of its osculating planes through a given point, and it has another important characteristic, the *rank,* which is the number of its tangent lines that meet a general line.

In space, the figure dual to a curve locus is a singly infinite set of planes obeying some given law. These form a *developable* surface. Any plane of the set with any other one determines a line, and with any other two it determines a point. As the second and third planes tend to coincide with the first, this point has a definite limit, whose locus is a curve associated with the developable surface, called its *edge of regression.* The limit of the line is its tangent, and the original plane is its osculating plane. Conversely, the osculating planes of a given curve form the associated developable, of which the curve is the edge of regression.

For the equation of a transcendental curve, there is often a simple expression in polar or other co-ordinates (for example, *see* article CURVES, SPECIAL: *Euler's Spiral, Cardioid, Trisectrix of Maclaurin*). In other cases (see *Cycloid* in the same article), the simplest form gives each co-ordinate in terms of a common parameter. The parametric expression is often useful for algebraic curves also. For example, by a proper choice of a system of homogeneous co-ordinates (*see* CO-ORDINATES) any twisted cubic can be represented by $x:y:z:w = 1:t:t^2:t^3$.

Yet another form of expression is in terms of the length of any arc and the angle between the tangents at its extremities; this is called the *intrinsic equation,* since it depends on no frame of reference unconnected with the curve (see *Catenary,* in the article CURVES, SPECIAL).

Degenerations and Intersections.—The equation of a plane algebraic curve k of degree n in Cartesian or homogeneous co-ordinates contains $\frac{1}{2}(n+1)(n+2)$ coefficients, whose $\frac{1}{2}n(n+3)$ ratios are the independent parameters of the curve, regarded as a member of the whole plane family of curves of degree n. Any special type can be obtained by making restrictions on these parameters, *e.g.,* the conditions for the three types of conic. (*See* CONIC SECTION.)

For certain sets of values of the parameters, the left-hand side of the equation falls into factors, each of which by itself gives a separate curve. The product vanishes whenever any factor vanishes by itself, and the equation is satisfied by the co-ordinates of a point on any one of these curves, and so represents their aggregate. In many cases it is convenient still to regard this as a single curve, which is then said to be *degenerate.* Thus a pair of intersecting lines is a degenerate conic. A curve which does not break up is said to be *proper.*

In the plane, any aggregate of curves can be regarded as a degenerate curve, of degree equal to the sum of their separate degrees. In space this is not so unless the components satisfy certain conditions of incidence: a pair of skew lines is not a degenerate conic.

A conic and a line meeting it twice, and therefore lying in its plane, form a degenerate plane cubic; a conic and a line, not in its plane, but meeting it once, form a degenerate twisted cubic; a conic and a line not meeting it, but meeting its plane in a point not lying on the conic, cannot be regarded as a single degenerate curve.

The common points of two curves of degrees n_1, n_2 are those whose co-ordinates satisfy both equations, and their number is n_1n_2, equal to that of the solutions of the eliminant. This continues to hold if one or both of the curves break up. In any case, we must reckon imaginary and infinite solutions as corresponding to intersections of the same natures. The points at infinity of the plane must be considered to lie on a line with which the curve k has n intersections, real or imaginary.

A point of k at infinity lies on a branch stretching to infinity; the tangent at a point retreating along this branch may tend to a limiting position not wholly at infinity, its one point at infinity being that point through which the branch of k passes. Such a tangent is called an *asymptote* (*q.v.*), and k has in general n of them; their directions are given by the terms of highest degree in its Cartesian equation. But it may happen that the limit of the tangent is the line at infinity itself; then there is no corresponding linear asymptote.

Now an asymptote has only one point at infinity, the same towards whichever end of the line we retreat; thus a curve approaches its asymptote at both ends, and in general on opposite sides, as viewed from the finite part of the plane. This appears strange at first sight; but two parallel lines have a simple intersection at infinity, and the second lies on the same side of the first at both ends. A curve touches its asymptote at infinity, having two intersections with it there; so if it and a given parallel to the asymptote lie on the same side of the asymptote at one end, they must lie on opposite sides at the other.

Singularities.—The interest of any curve depends largely on its exceptional points, where the ordinary properties fail. A *singular point* of a curve k is one where there is not a unique, definite tangent. The simplest is an ordinary *double point* or *node* O, where two separate branches of k cross without touching. Here there is not one definite tangent, but two, one belonging to each branch. A moving point describing k comes to O twice, on different occasions and in different directions. A general line l, passing near O but not through it, meets k in two points near O, one on each branch, both of which tend to O when l moves so as to pass through O. If l is ultimately one of the tangents at O, three such intersections are absorbed, two on the branch touched, and one on the other.

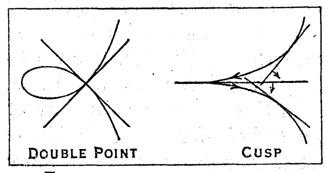


FIG. 1.—SINGULAR POINTS

In general, the *multiplicity* s of a singular point O is the number of intersections with a general line absorbed there. Through O there are always s lines, distinct or coincident, on which more than s intersections are absorbed, and which are the tangents at O. If the s tangents are distinct, the multiple point O is *ordinary.* If O is s_1-fold on one curve and s_2-fold on another, it absorbs just s_1s_2 of their points of intersection if they have no common tangent at O; if they touch, it may absorb any greater number.

If any of the s tangents coincide, O is an *extraordinary* singularity. The simplest is a *cusp* of first species, a variety of double point, which may be thought of as the limit of a loop drawn together to its node.

There is only one branch of k at O, and one distinct tangent meeting k in three coincident points at O. A point P describing k continuously comes to rest at O and reverses its direction of motion; for this reason a cusp is often called a *stationary point.* The tangent at P rotates in the same sense without reversal.

A cusp is something like the path of an engine running past catch-points to rest, and backing on to another pair of rails; that is, running down on one branch of a Y and backing up on the other.

A set of different but corresponding singularities presents itself when a curve is regarded as an envelope. A *singular tangent* is one which has not a unique, definite point of contact. The line singularity which answers to an ordinary double point is a *double tangent,* with two distinct, definite points of contact, each a simple point of the curve. That which answers to a cusp is an *inflexion,* when the two points of contact coincide, and the tangent meets the curve in three coincident points. A tangent describing the envelope comes to rest and reverses its direction of rotation, but a point describing the curve goes on without reversing, for the inflexion is a simple point of the curve.

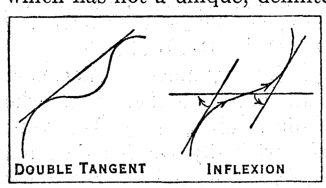


FIG. 2.—SINGULAR TANGENTS

Every singularity of a curve, which is of higher multiplicity or more complicated nature than the four elementary kinds described above, is, from a great many points of view, equivalent to a certain set of distinct double points, cusps, double tangents and inflexions, and can usually be regarded as the limit of this set when certain points and lines come to coincide. Thus a triple point can arise from three double points.

Transformations; Genus.—Two curves, whether plane or twisted, are said to be *in 1, 1 correspondence,* or *transformations* of each other, or *represented upon* each other, if each ordinary point of either corresponds to one and only one point of the other. If the co-ordinates of the first point are given, those of the second are one-valued and therefore rational functions of these, and the equations expressing this are rationally reversible, so that the co-ordinates of the first point are also expressible as rational functions of those of the second. Any curve can be thus transformed into a plane curve having no multiple points except ordinary double points, or into a twisted curve having no singular points at all.

A plane curve of given degree n cannot have more double points or cusps than $\frac{1}{2}(n-1)(n-2)$, or their equivalent, without breaking up. Thus the only nodal conic is a pair of lines. A proper cubic can have one node; if it had two, the line joining them would have four intersections with the cubic, which is impossible: the curve would break up into the line and a conic through the two points. The number

$$\rho=\tfrac{1}{2}(n-1)(n-2)-\delta-\kappa$$

by which the equivalent number $\delta+\kappa$ of double points and cusps falls short of this maximum is called its *deficiency* or more usually its *genus*. The fundamental property of the genus is that it is unaltered by any 1, 1 transformation of the curve.

If $\rho=0$, the curve is *rational* or *unicursal*, and can be transformed into a line. The co-ordinates of its general point can be expressed as rational functions of a single parameter, the coordinate of the corresponding point on the line.

A 1, 1 correspondence is set up between a twisted curve k and its projection k' from any vertex V upon any plane. The singularities of k' are the projections of those of k, and, in addition, a certain number of ordinary double points lying on rays through V which meet k in two distinct points. These are called *apparent double points* of k, and their number is one of its essential characteristics, for it reduces the genus, being an additional number of singularities of k', whose genus is the same as that of k.

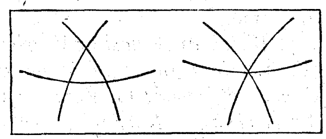


FIG. 3.—TRIPLE POINT AS LIMIT OF THREE DOUBLE POINTS

Plucker's Equations.—All plane curves other than lines and conics possess singularities of some sort. If they are free from multiple points, they are bound to have definite numbers of double tangents and inflexions, or their equivalent in higher singular tangents. If multiple points are present, the numbers of multiple tangents are reduced. Between the degree n, class n', and the equivalent numbers δ, κ, δ', κ' of double points, cusps, double tangents and inflexions there exists a remarkable set of relations known as *Plücker's equations*, by which any three of the six numbers can be calculated in terms of the other three:

$$n'=n(n-1)-2\delta-3\kappa$$
$$\kappa'-\kappa=3(n'-n)$$
$$2(\delta'-\delta)=(n'-n)(n'+n-9)$$

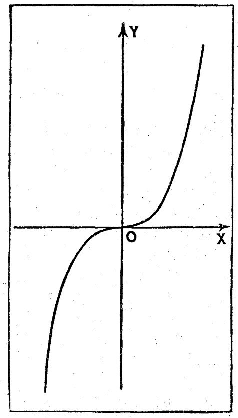
Thus the cubic with no node is of class 6 and has no double tangents and 9 inflexions; the nodal cubic is of class 4 with 3 inflexions; and the cuspidal cubic is of class 3 with one inflexion. The quartic with no singular points has 28 double tangents and 24 inflexions.

The points of contact of the n' tangents which can be drawn to k from any point P of the plane are the intersections, other than the multiple points of k, with a certain derived curve of degree $n-1$, called the *first polar* of P with regard to k. This passes through each double point of k, meeting it in two points there, and touches k at each cusp, meeting it in three points there. The first of Plücker's equations expresses that the total number of intersections of k with the first polar is $n(n-1)$.

BIBLIOGRAPHY.—The best-known English text-book is G. Salmon's *Treatise on the Higher Plane Curves* (translated into German and French). Full references are given in the *Encyklopädie der mathematischen Wissenschaften*, Band iii. (H. P. HU.)

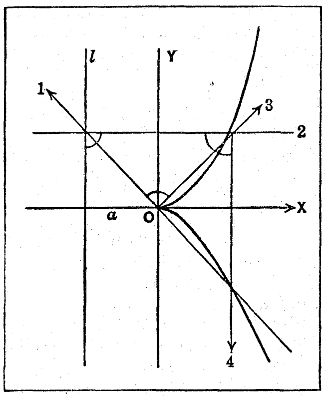
CURVES, SPECIAL. Partly due to the studies of the Greeks in pure geometry, but largely to the influence of analytic geometry (*q.v.*), there have been developed a large number of special curves which have received names which are more or less generally recognized. Such curves may be classified in various ways—curves in a plane or in a space of three dimensions; algebraic and non-algebraic; alphabetically; chronologically; etc. For reference purposes, however, it has seemed best to give an initial alphabetical list with references to the numbers of the sections, and then to arrange the sections roughly in the order: plane algebraic curves according to degree followed by plane transcendental curves, general classes of curves, and curves of double curvature, inserting figures to show the general shapes of the most important plane curves considered.

1. *Cubical Parabola* (F. *Parabole Cubique;* G. *Kubische Parabel*), $y=ax^3+bx^2+cx+d$, or $y=ax^2(x-e)$, one of the canonical forms of cubics studied by Newton and a particular case of the *Pearls of Sluze.* The name is usually applied to the special case $y=ax^3$ (*see* fig.) which was first discussed by Leibniz (1675) who sought that curve for which the subnormal is always inversely proportional to the ordinate. It was used ($a=1$) by Monge (1815) to solve every equation of the form $x^3-px-q=0$.



Cubical Parabola (Sec. 1)

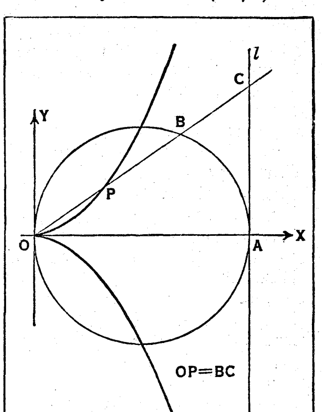
2. *Semi-cubical Parabola* or *Neil's Parabola* (F. *Parabole Sémi-cubique* or *Parabole de Neil;* G. *Semi-kubische Parabel*), $x^3=ay^2$, was the first algebraic curve rectified (Neil, 1659). It is the evolute of a parabola. Evolutes of parabolas and the lines of curvature of Enneper's minimal surface are the only cubics algebraically rectifiable (Raffy, *L'Interm. d. Math.*, 1894, p. 106). In 1687 Leibniz proposed the problem to find the plane curve down which a particle may descend under the action of gravity so as to describe equal vertical spaces in equal times, the initial velocity of the particle not being zero. Huygens found the curve at once to be a semi-cubical parabola, cuspidal tangent vertical, and thus it is called an *Isochrone* or *Isochronous Curve* (F. *Courbe* [or *Ligne*] *Isochrone;* G. *Isochrone* or *Gleichzeitenkurve*), that is a curve down which a particle may descend under the action of any assigned forces so as to describe equal vertical spaces in equal times. For construction of points of the curve *see* figure.



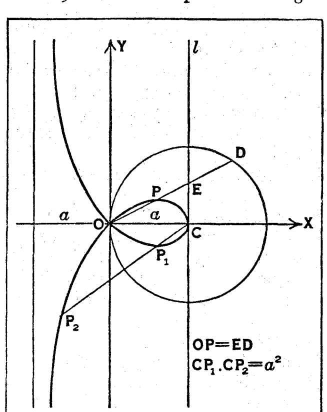
Semi-cubical Parabola (Sec. 2)

3. *Cissoid of Diocles* (F. *Cissoïde de Diocles;* G. *Kissoide des Diokles*), $y^2=x^3/(2a-x)$, or $r=2a\tan\theta\sin\theta$, a curve invented by Diocles (*c.* 100 B.C.) to solve the problem of the duplication of the cube. The area between the curve and its asymptote is three times that of the generating circle. Its polar reciprocal with respect to a circle with centre at its cusp is a *semi-cubical parabola.* $OP=BC$, $OA=2a$; *see* fig.

4. *Strophoid* (F. *Strophoïde;* G. *Strophoid*), if *oblique* (F. *oblique;* G. *skräge*), $r=a\sin(\alpha-2\theta)/\sin(\alpha-\theta)$, was first considered by Barrow (1670). When $\alpha=90°$ the strophoid is *right*



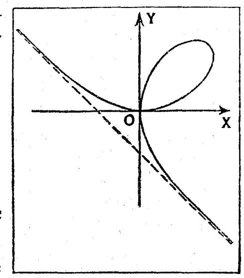
Cissoid of Diocles (Sec. 3)



Strophoid (Sec. 4)

(F. *droite;* G. *gerade*), $r=a\cos 2\theta/\cos\theta$ or $y^2=x^2(a-x)/(a+x)$ (*see* fig.). Let g be the generator of a circular cone and t a tangent perpendicular to this generator. Any plane, p, through t will intersect the cone in a conic. The locus of the foci of the conics as p rotates about t, is a strophoid (Casali, 1757); if a cylinder replaces the cone we get a *right strophoid.*

5. *Folium of Descartes* (F. *Folium de Descartes;* G. *Cartesisches Blatt* or *Descartessches Blatt*), $x^3+y^3=3axy$, a curve with asymptote $x+y+a=0$, first discussed by Descartes in 1638 (*see* fig.). The *Hessian Curve* of a folium of Descartes is another folium of Descartes.

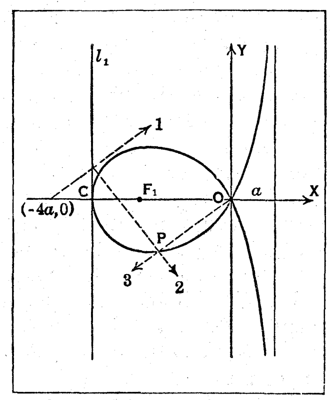


Folium of Descartes (5)

6. *Trisectrix of Maclaurin* (F. *Trisectrice de Maclaurin;* G. *Maclaurins Trisektrix*),

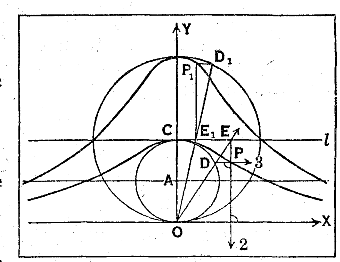
$$x(x^2+y^2)=a(y^2-3x^2), \text{ or}$$
$$y^2=x^2(3a+x)/(a-x),$$

or $r=a\sec\theta-4a\cos\theta=2a\sin 3\theta/\sin 2\theta$ (*see* fig.), first studied by Maclaurin (1742) who showed that it could be used to solve the problem of trisection of an angle. Referred to the focus $(-2a, 0)$ as origin the polar equation of the trisectrix may be written $r=a/\cos(\theta/3)$. Maclaurin noted that the curve goes over into a *folium of Descartes* by an affine transformation, showing that the general shape of the two curves is the same.



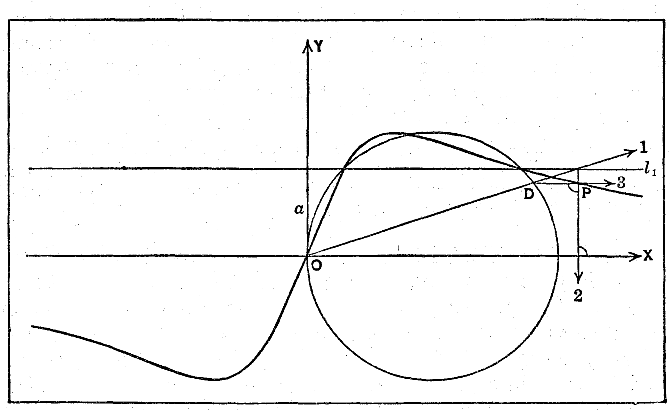
Trisectrix of Maclaurin (Sec. 6)

7. *Witch of Agnesi* or *Versiera* (F. *Versiera* or *Agnésienne* or *Courbe d'Agnesi;* G. *Versiera* or *Agnesische Kurve*), $yx^2=a^2(a-y)$, discussed, and named versiera, by Maria Agnesi (1748), but earlier treated by Fermat (before 1666), and Grandi (1703) who also named it versiera. The area between the curve and its asymptote $y=0$ is four times that of the generating circle. If each of the ordinates of the versiera be doubled, we get the *Pseudo Versiera* (locus of P_1), $yx^2=a^2(2a-y)$ first treated by J. Gregory (1658), and later discussed by Leibniz (1674) in deriving his formula $\pi/4=1-1/3+1/5+1/7+ \ldots$ (*See* the figure.)



Witch of Agnesi or Versiera (Sec. 7)

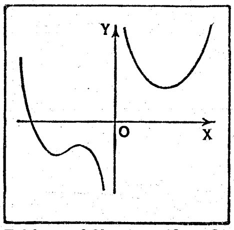
8. *Serpentine* (F. *Sérpentine* or *anguinée;* G. *Serpentine* or *Schlangenkurve*) $x^2y+aby-a^2x=0(ab>0)$ (*see* fig.), associated with the name of Newton (1701) who called it *anguinea.* L'Hospital and Huygens recognized (1692) that the serpentine could be used as an auxiliary for rectification of the *logarithmic curve.* Consider the intersection of a cylinder of revolution and a hyperbolic paraboloid with a common tangent plane intersecting the hyperbolic paraboloid in



Serpentine (Sec. 8)

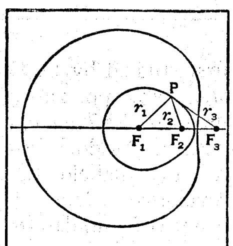
two lines (one of them a generator of the cylinder) making an angle of 45° with one another at the point where the intersection of the planes of symmetry of the surface meets it. The curve of section is a *horopter* (F. *Horoptère;* G. *Horopterkurve*) discovered in his studies in physiological optics by Helmholtz (1867, Eng. trans. vol. 3, 1925) and whose projection on the tangent plane is a *versiera,* and on a plane of symmetry through the axis perpendicular to this plane is a serpentine. The tangents to the horopter intersect the plane, through the point of contact of the tangent, perpendicular to the axis, in a *cardioid.*

9. *Trident of Newton* or *Parabola of Descartes* (F. *Trident de Newton* or *Parabole de Descartes;* G. *Newton's Tridens* or *Cartesische Parabel*). Trident is the name applied by Newton (1701) to the cubic curve $xy=cx^3+dx^2+ex+f$ one form of which is indicated in the figure. Newton observed that exactly this curve was used by Descartes (1637) to construct a curve of the sixth degree; hence the name *Parabola of Descartes.*



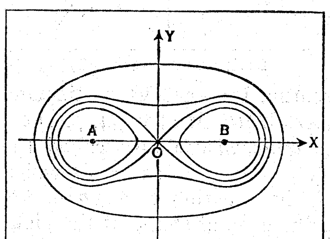
Trident of Newton (Sec. 9)

10. *Cartesian* or *Cartesian Ovals* (F. *Cartésienne* or *Ovales de Descartes;* G. *Cartesische Kurve* or *Cartesische Ovalen*) have been studied by many mathematicians such as Descartes (1637), Newton, Quetelet, Chasles, Cayley, Darboux (for bibliography see *Bull. Sc. Math.* (2) v. 6, 1882, pp. 40–49 and *L'Interm. d. Math.,* v. 3, 1896, p. 239). The Cartesian is the locus, two ovals, of points, *P,* whose distances from two fixed points (foci, distance *c* between them) satisfy a linear non-homogeneous relation $r_1+mr_2^2=a$, or a linear homogeneous relation $r_1 \pm m_2r_2 \pm m_3r_3=0$, where r_3 is the distance of *P* to a third focus collinear with the other two (Chasles, 1837). Hence the equation in rectangular co-ordinates may be written: $[(x^2+y^2)\cdot(1-m^2)+2m^2cx+a^2-m^2x^2]=4a^2(x^2+y^2)$. When $m=\pm 1$ the locus becomes an ellipse or hyperbola as it should; when $m=a/c$ we get the *Limaçon of Pascal* for which two foci coalesce at the node. For different forms of cartesians *see* Cayley, *Coll. Math. Papers,* v. 2, pp. 369, 374.



Cartesian Ovals (Sec. 10)

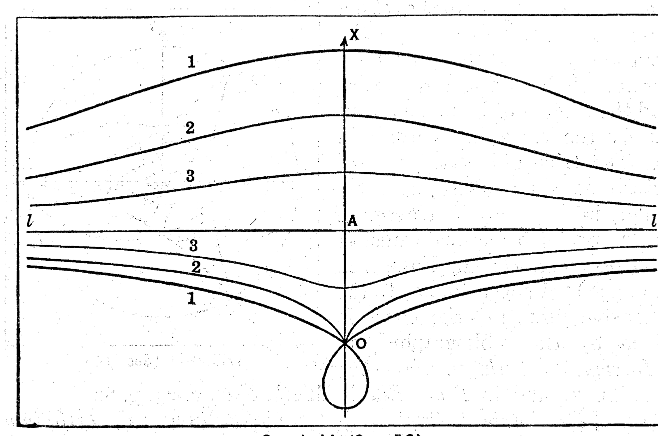
11. *Cassinian* or *Cassinian Ovals* or *Cassinian Ellipse* (F. *Cassinienne* or *Cassinoide* or *Ellipse de Cassini;* G. *Cassinische Kurve*), first conceived by Giovanni Domenico Cassini (1680) in connection with a study of the relative motions of the earth and sun, is the locus of a point moving such that the product of its distances from two fixed points *A* and *B* (*see* fig.) is a constant, c^2. Hence the equation $(x^2+y^2)^2-2a^2(x^2-y^2)+a^4-c^4=0$. When $c>a$ the curve consists of two loops; when $c=a$ the cassinian becomes the *lemniscate of Bernoulli;* these, as well as two cases of $c<a$ are illustrated in the figure. The section of an anchor ring by a plane parallel to the axis (*spiric lines of Perseus,* no. 58) and at a distance from it equal to the radius of the generating circle is a cassinian, the form of which varies with the ratio of the distance of the centre of the generating circle from the axis to the radius of the generating circle (Comte, 1843, in part). When this ratio is 2 the section is the *lemniscate of Bernoulli.*



Cassinian Ovals (Sec. 11)

12. *Lemniscate of Bernoulli* (F. *Lemniscate de B.;* G. *Bernoulli'sche Lemniskate*) sometimes called, because of its connections with the hyperbola a *hyperbolic lemniscate,* has for equation $(x^2+y^2)^2=a^2(x^2-y^2)$ or, in polar form, $r^2=a^2\cos 2\theta$. The curve was first imagined by Jacques Bernoulli (1694). It may be found (on eliminating *z*) as an orthogonal projection of the curve of section of the paraboloid $2(x^2+y^2)=a^2-2\sqrt{2az}$, and the cylinder $8(y^2+z^2)=a^2$.

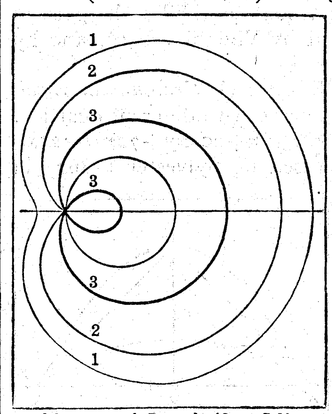
13. *Conchoid* [from the Greek meaning shell form] (F. *Conchoïde;* G. *Konchoide* or *Muschellinie*) was a curve invented by a Greek mathematician, Nicomedes (*fl.* about 225 B.C.), who devised for it a mechanical construction and applied it to find two mean proportionals between two line segments, and hence to solve the famous problem of the duplication of a cube. The curve may also be used to solve the problem of the Trisection of an Angle, since both problems can be reduced to a νεῦσις (Heath, *Hist. Gr. Math.,* v. 1, p. 235). Pappus (*c.* 300) called the conchoid of Nicomedes the *Cochloid,* its original name, but Proclus (*c.* 460) employs the term conchoid. It is generated as follows: Let *O* be a fixed



Conchoid (Sec. 13)

point (*see* fig.), called the pole, on the line *OX* perpendicular at *A* to the fixed straight line, or base, *l.* Let any line through the pole meet *l* in *B,* on this line mark off $BP=BP'=a$, a constant. The locus of *P* and *P'* is the conchoid. Its equation may be written (if $OA=b$): $r=a+b\sec\theta$; the corresponding rectangular equation is $(x-b)^2(x^2+y^2)-a^2x^2=0$. The three types of the curve illustrated in the figure seem to have been recognized by Nicomedes. This curve is sometimes called the *conchoid of a line.*

14. *Limaçon of Pascal* (F. *Limaçon de Pascal;* G. *Pascal'sche Schneckenlinie* or *Kreiskonchoide*) named by Roberval, Étienne Pascal (father of Blaise) having discovered it. The reason for the other part of the name is that one half the curve with a loop (the form first discussed) has a fancied resemblance to a snail. The curve was discussed by Roberval as early as 1650 when it was considered as a *conchoid of a circle;* if a rod (length $2b$) is constrained so to move that its middle point described the circle (diameter $2a$) while it is always directed to a fixed point on the circle the ends of the rod will trace out a limaçon whose equation may be written: $(x^2+y^2-2ax)^2=b^2(x^2+y^2)$, or $r=b+2a\cos\theta$. Three forms of the curve are shown in the figure: (1) $b>2a$, (2) $b=2a$; a *cardioid;* (3) $b=a$, which Roberval showed might be used for trisecting an angle.

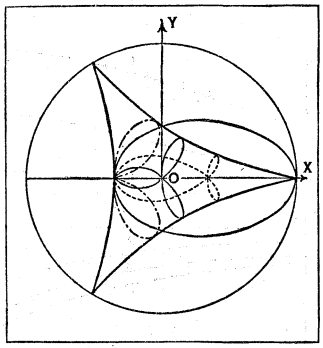


Limaçon of Pascal (Sec. 14)

15. *Cardioid* (F. *Cardioïde;* G. *Kardioide* or *Herzlinie*) is an *epicycloid* traced by a point on a circle rolling on an equal fixed circle (*see* fig. Sec. 14), or by a point on the circumference of a circle double the size of the fixed circle and rolling on it with internal contact (*see* fig. Sec. 25). It was first conceived, in part, as a *conchoid of a circle,* with respect to a point on its circumference as pole, by a Dutch mathematician J. Koërsma (*Bibl. Univ. et Hist.,* v. 12, 1689); and completely by Ozanam (1691) as an epicycloid. Its present English name originated with Castillon (1741). Its cartesian, polar, and Cesàro intrinsic equations are: $(x^2+y^2-2ax)^2=4a^2(x^2+y^2)$; $r=2a(1+\cos\theta)$; $s^2+9R^2=(8a)^2$. Referred to the centre of the fixed circle as origin, the parametric equations of the curve may be written: $x=a(2\cos\theta-\cos 2\theta)$, $y=a(2\sin\theta-\sin 2\theta)$; and since it has three cusps (two imaginary) its trilinear equation may be written $X^{-\frac{1}{2}}+Y^{-\frac{1}{2}}+Z^{-\frac{1}{2}}=0$, which is the same for all tricuspidal quartics, for example, the *tricuspid,*

into which the cardioid may be projected by a real bilinear transformation (*Annals of Math.*, s.2, v. 4, p. 97).

16. *Tricuspid* (F. *Tricuspide* or *Hypocycloïde à Trois Rebroussements* or *Hypocycloïde de Steiner;* G. *Hypozykloide mit* 3 *Rückkehrpunkten* or *Steiner'sche Kurve*), generated by a point on the circumference of a circle rolling inside a fixed circle three times as large, has equations: $x=a(2\cos\theta+\cos 2\theta)$, $y=a(2\sin\theta-\sin 2\theta)$; or $(x^2+y^2-12ax+9a^2)^2+4a(2x-3a)^2=0$; and $9s^2+R^2=64a^2$ where a is the radius of the rolling circle. (*See* fig.) The area of the tricuspid is twice that of its inscribed circle; its length is $16a$; and the lengths of its tangents cut off by the curve are constantly $4a$. The tricuspid was first conceived, as a unicursal quartic by Euler, in 1745, in the treatment of a problem in catacaustics (*Correspondance*, ed. Fuss, vol. 1, p. 352). A suggestion as to the extensive literature the curve is given by the bibliographies in *L'Interm. d. Math.*, v. 3, p. 166; v. 4, p. 7; and in *Proc. Edinb. Math. Soc.*, v. 23, p. 80.

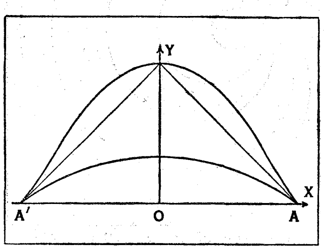


Tricuspid (Sec. 16)

17. [1] *Simple Folium,* [2] *Double Folium,* [3] *Trifolium* (F. [1] *Folium simple* or *Courbe ovoïde,* [2] *Folium Double,* [3] *Trifolium;* G, [1] *Einfaches Folium* or *Einblatt,* [2] *Doppelte Blatt Kurve* or *Zweiblatt,* [3] *Dreiblatt*). The *pedal* of the *tricuspid* (*see* fig. sec. 16) with respect to a point $(b, 0)$ on the X-axis has for its equation, if the origin is at the vertex,

$[(x-b)^2+y^2]\,[y^2+x(x-b)]=4a(x-b)y^2$, which on transferring to the origin to $(b,0)$, becomes: $(x^2+y^2)\,[y^2+x(x+b)]=4axy^2$; or in polar coordinates, $r=-b\cos\theta+4a\cos\theta\sin^2\theta$. When $b=4a$ we have the *simple folium* $r=-4a\cos^3\theta$; when $b=0$, the *double folium,* $r=4a\cos\theta\sin^2\theta$; when $b=a$, the *trifolium,* $r=a\cos\theta(4\sin^2\theta-1)$, or $r=-a\cos 3\theta$ if the origin is transferred to O. When $b=2a$ we have the *trifolium* $r=-2a\cos\theta\cos 2\theta$. The *simple folium* was used by Kepler (1609) to exhibit the path of the planet Mars and was discussed by Viviani (1647), and by Maclaurin (1720).

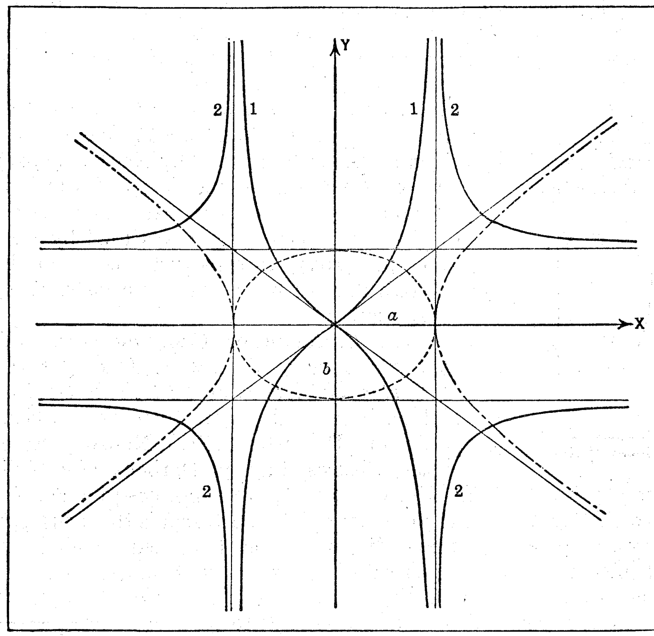
18. *Bicorn* or *Cocked Hat* (F. *Bicorne;* G. *Kremhut* or *Zweihornkurve*). This term has been applied to two different quartics: (1) To $2y^4-9y^3-17y^2+125y-xy^3-29xy^2+205xy+72x^2y-27x^3-25x^2=0$ named bicorn, and discussed by Sylvester (1864) in his treatment of Newton's rule for the discovery of imaginary roots. Cayley discussed it also at length in his eighth memoir on quantics (1867). The curve has an ordinary cusp $(-76\tfrac{23}{27}, -41\tfrac{2}{3})$, and a node-cusp $(-1, 1)$. (2) To $(x^2+2ay-a^2)^2=y^2(a^2-x^2)$ or $y=(a^2-x^2)/[2a\pm(a^2-x^2)^{\frac{1}{2}}]$, referred to as a *cocked hat* in *Educational Times,* Feb. 1896. This is a curve of the sixth class with three distinct nodes, two of them cusps $(\pm a, 0)$, and hence deducible by a cremona transformation from a conic. The curve (*see* fig.) is symmetrical to the Y-axis, and meets it at $(0, a/3)$, $(0, a)$. For a neat construction of points on the curve see *L'Interm. d. Math.*, v. 3.



Bicorn or Cocked Hat (Sec. 18)

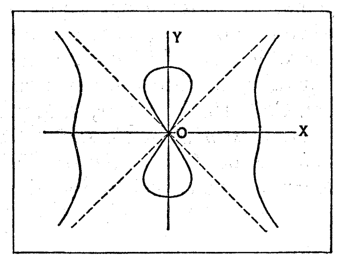
19. *Bullet-Nose Curve* (F. *Puntiforme;* G. *Kohlenspitzenkurve*) a unicursal quartic curve with three points of inflexion, discussed by P. H. Schoute (1885). Through the points of intersection of a tangent to a hyperbola $(x^2/a^2-y^2/b^2=1)$ with the axes, parallels to the axes are drawn. The locus of their point of intersection, P, is the curve $a^2/x^2-b^2/y^2=1$ which, for want of an English name, has been called *bullet-nose curve.* The six points of contact of tangents drawn to the *bullet-nose curve* from any point not on the curve is a conic, a result true also for the unicursal *Cross Curve* (F. *Cruciforme;* G. *Kreuzkurve*), $a^2/x^2+b^2/y^2=1$, derived from the ellipse $x^2/a^2+y^2/b^2=1$ in exactly the same way as the bullet-nose curve was derived from the hyperbola. It has an isolated point at the origin, and it is the polar reciprocal of the *evolute* of the ellipse with respect to the circle $x^2+y^2=a^2-b^2$.

20. *Devil's Curve* (F. *Courbe du diable;* G. *Teufelkurve*) is one name which has been applied to the curve $y^4+my^2-x^4+nx^2=0$,



Bullet-Nose Curve (Sec. 19)

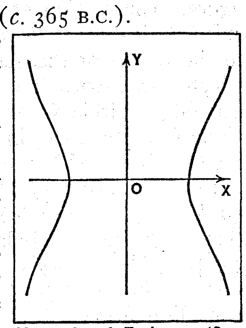
first studied by G. Cramer (*Introd. a l'analyse d. lignes courbes alg.*, 1750, pp. 19–25), for the case $m=-96$, $n=100$. Another name is *devil on two sticks* (*Amer. Math. Mo.*, v. 1, p. 275); both names doubtless originated from the fact that a section of the toy diabolo (a surface of revolution, long popular in France) is similar to the central portion of the curve (*Amer. Math. Mo.*, v. 34, p. 365). The form of the equation usually discussed is that in which $m=-96a$, $n=100a^2$. With special reference to the case $m=-1$, $n=2$ (*see* fig.) it has been shown that the curve is an excellent example for use in presenting the theory of Riemann surfaces and Abelian integrals (*Amer. Math. Mo.*, v. 34, p. 199).



Devil's Curve (Sec. 20)

21. *Eight Curve* (F. *Huit;* G. *Achterkurve*) also called the *Lemniscate of Gerono,* $x^4=a^2(x^2-y^2)$, or $r^2=a^2\cos 2\theta\cos^4\theta$ which may be compared with $r^2=a^2\cos 2\theta$, the equation of a *lemniscate of Bernoulli,* in order to determine the general shape of the eight curve. It is a particular case of *Virtual Parabolas* studied by *Grégoire St. Vincent* (1647) and of the *Besace* (wallet) of Cramer (1750). It may also be found as a projection of *Viviani's windows* (1692) or of the *horse fetter* of Eudoxus (*c.* 365 B.C.).

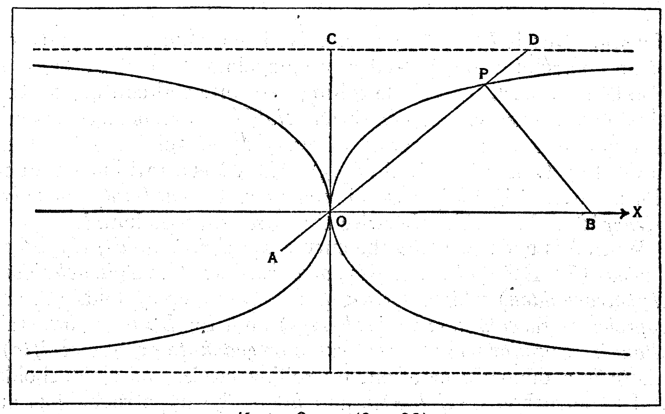
22. *Kampyle of Eudoxus* (F. *Kampyle d'Eudoxe;* G. *Kampyla* [*Kurve*] *des Eudoxus*), $a^2x^4=b^4(x^2+y^2)$ or $ar\cos^2\theta=b^2$ (*see* fig.). This equation together with that of the circle $r=a\cos\theta$ enables one to find two mean proportionals between a and b and hence to solve the problem of the duplication of the cube. The most remarkable of all ancient solutions of this problem was that of Archytas of Taras (*c.* 380 B.C.) who found these mean proportionals from the intersection of three surfaces of revolution: the anchor ring $x^2+y^2+z^2=a(x^2+y^2)^{\frac{1}{2}}$, the cylinder $x^2+y^2=ax$, and the cone $x^2+y^2+z^2=a^2x^2/b^2$ $(a>b)$. The first and last of these surfaces intersect in a curve called the *Curve of Archytas* whose projection on the XY-plane is the one whose equation has been given above. It is by no means certain



Kampyle of Eudoxus (Sec. 22)

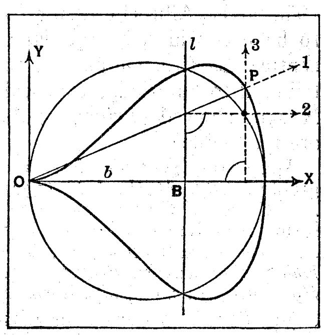
that Eudoxus (a pupil of Archytas) used the curve here associated with his name; we know that he solved the problem by means of lines of a "curved or bent form"; kampyle is an adaptation of the Greek word for "curved" (*cf.* Heath. *Hist. Greek Math.*, v. 1, pp. 249–251).

23. *Kappa Curve* (F. *Cappa;* G. *Kappa Kurve*) also known as *Gutschoven's curve* was conceived by G. van Gütschoven, a pupil



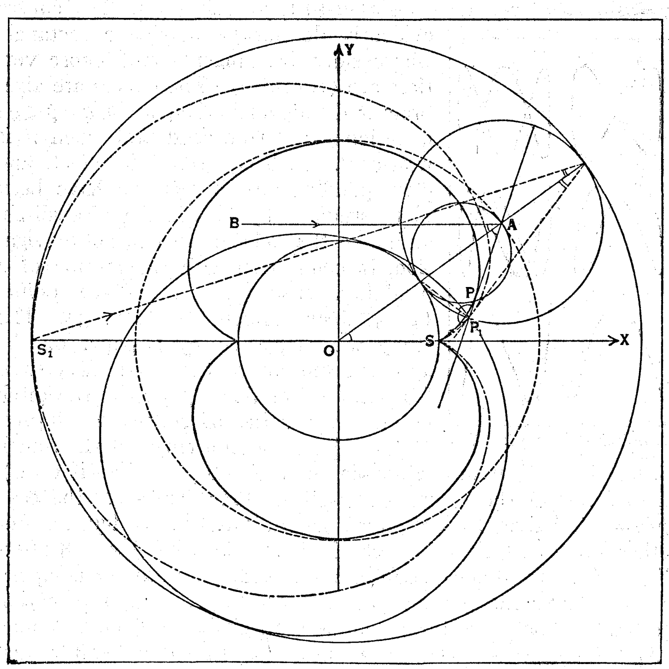
Kappa Curve (Sec. 23)

of Descartes, at least as early as 1662. To take a line l meeting the Y-axis in C, and parallel to the X-axis (*see* fig.) and at a distance a from it. From the origin O, draw any line to meet l in D. On OD mark off $OP=CD$. The locus of P is the Kappa curve (Barrow, 1670). Let the perpendicular to OP at P meet OX in B, then PB is always equal to a. Hence the curve may also be thought of as a *glissette*, the locus of the vertex of a right angle OPB, B sliding on OX, $PB=a$, and PA always passing through O (Gutschoven and Newton). Hence the equations of the curve may be written: $r=a\cot\theta$; or $y^2(x^2+y^2)=a^2x^2$. Other constructions include one by Jean Bernoulli.



Pear-shaped quartic (Sec. 24)

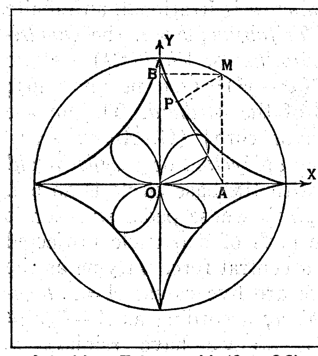
24. *Pear-shaped quartic* (F. *Quartique piriforme* or *Piriforme* or *Toupie;* G. *Birnförmige Kurve 4. O.*), $b^2y^2=x^3(a-x)$, was studied by De Longchamps (1886). Since it is a projection (stretch) of the special case, $a=b=1$, of Bonnet (1844), whose area is equal to one-half that of the generating circle, diameter equal to a, its area is readily found to be $\pi a^3/8b$ where $OB=b$ (*see* fig.).



Nephroid (kidney-shaped) (Sec. 25)

25. *Nephroid* (*kidney-shaped*) F. *Néphroïde* or *Épicycloïde de Huygens;* G. *Nierenkurve* or *Nephroide*), an epicycloid traced by a point on the circumference of a circle rolling on a fixed circle of double its radius, has equations: $x=a(3\cos\alpha-\cos 3\alpha)$, $y=a(3\sin\alpha-\sin 3\alpha)$, or $(x^2+y^2-4a^2)^3=108a^4y^2$, or: $(r/2a)^{\frac{2}{3}}=(\sin\frac{1}{2}\theta)^{\frac{2}{3}}+(\cos\frac{1}{2}\theta)^{\frac{2}{3}}$. The curve was studied and imagined in its completeness, as a catacaustic of a circle for parallel rays, by Huygens and Tschirnhausen (1678–90). Jacques Bernoulli showed (1692) that the nephroid is a cardioid *catacaustic* for a luminous cusp (*see* fig.); indeed this nephroid is generated as an envelope of a diameter of the circle generating the *cardioid* (*see* fig.). The name nephroid has been also applied (*Proc. Lond. Math. Soc.*, v. 10, p. 228) to the curve $r=a(1+2\sin\frac{1}{2}\theta)$, which was used to describe a regular heptagon.

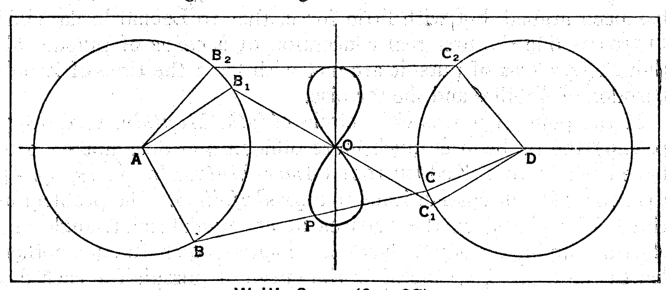
26. *Astroid* or *Tetracuspid* (F. *Astroïde;* G. *Astroide* or *Vierspitzige Hypokykloide*), the curve generated by a point on the circumference of a circle rolling inside a fixed circle four times as large, is of the sixth degree and fourth class, and with four cusps. Its equation may be written $(x^2+y^2-a^2)^3+27a^2x^2y^2=0$ or $x^{\frac{2}{3}}+y^{\frac{2}{3}}=a^{\frac{2}{3}}$ (Hermann, 1715), and $4(R^2+4s^2)=9a^2$. The curve was first discussed, by Jean Bernoulli (1691–92, *Opera Omnia*, v. 3, p. 449), who found its equation and its length between two cusps ($3a/2$), by considering the curve as the envelope of a line segment ($AB=a$) sliding with its ends (*see* fig.) on the co-ordinate axes. Let parallels to the axes, through A and B, meet in M; the perpendicular from M on AB meets it in P, on the astroid.



Astroid or Tetracuspid (Sec. 26)

27. *Cayley's Sextic* (F. *Sextique de Cayley;* G. *Cayley's Sextik*), $4(x^2+y^2-ax)^3=27a^2(x^2+y^2)^2$ or $r=4a\cos^3(\theta/3)$, first found by Maclaurin (1718), and indeed as a cardioid pedal, was so named because a detailed study of the curve was first given by Cayley.

28. *Watt's Curve* (F. *Courbe de Watt;* G. *Watt'sche Kurve*) is the sextic curve generated by a point P of the side BC of a three-bar linkage AB, BC, CD, the points A and B remaining fixed while the others vary (*see* fig.). If O is the middle point of AD, and $AO=a$, $AB=CD=b$, $BP=PC=c$, the polar equation of the locus of P is $r^2=b^2-[a\sin\theta\pm(c^2-a^2\cos^2\theta)^{\frac{1}{2}}]^2$, θ varying from 0 to π. If the end of a piston rod is fastened at P to the bar BC it will move up and down approximately in a straight line ("parallel motion") while B and C describe circles. In 1784 this device was patented by James Watt, the inventor of the modern condensing steam-engine. Watt's curve becomes a *lemniscate of Bernoulli* when $c=a$, and $b=\sqrt{2^a}$, For references to the extensive literature of Watt's curve see *L'Interm. d. Math.*, v. 4, p. 184 *seq.*, and *Bull. d. Sc. Math.*, 1883, p. 145 *seq.*



Watt's Curve (Sec. 28)

29. *Pearls of Sluze* (F. *Perles de Sluze;* G. *Perlkurven*). Pearls is the name (due to Pascal) of the curves studied by Sluze (1657–58) and defined by the equation $y^n=k(a-x)^px^m$, where m, n, and p are positive integers. The *cubical parabola* and the *pear-shaped quartic* are special cases considered by Sluze and Huygens

in the course of considerable correspondence connected with pearls of Sluze.

30. *Lamé Curves* (F. *Courbes de Lamé* or *Storoïdes;* G. *Lamé'sche Kurven*) is the name applied to the family $(x/a)^n+(y/b)^n=1$, discussed by G. Lamé (1818), which are algebraic when n is rational, and transcendental otherwise. Particular cases are: parabola ($n=\frac{1}{2}$), *cross curve* ($n=-2$), *evolute* of a central conic ($n=\frac{2}{3}$), and *astroid* ($n=\frac{2}{3}$, $a=b$). Lamé curves with the same exponent, n, and tangent to one another at the same point P, have the same radius of curvature at P (Fouret, 1890). A number of other general results have been found, and many varieties of the curves considered.

31. *Rhodoneae* (F. *Rhodonacées* or *rhodonées* or *rosaces;* G. *Rosenkurven*), curves $r=a\cos k\,\theta$ or $r=a\sin k\theta$, so named by Guido Grandi (1723, 1728) because of their fancied resemblance to roses. They are epitrochoids generated by a circle of radius $(k-1)a/2(k+1)$ rolling on a circle of radius $ka/(k+1)$, the generating point of the rolling circle being distant a from its centre. When k is an integer there are k or $2k$ petals of the rose-curves according as k is odd or even. When k is rational there are a finite number of petals, and when k is irrational, an infinite number. When $k=3$ we have the *Trifolium;* $k=2$, the *Quadrifolium* (F. *Quadrifolium;* G. *Quadrifolium* or *Vierblatt*) a sextic curve $r=a\cos 2\theta$, or $(x^2+y^2)^3=a^2(x^2-y^2)^2$ (*see* fig. no. 26); $k=\frac{1}{3}$, the first positive focal *pedal* of the *cardioid.* The inverse of a Rhodonea is an *Épi* [ear, as of corn] (G. *Ährenkurve*) $r\cos k\theta=a$. The polar reciprocal of an *epicycloid* or a *hypocycloid* with respect to a circle concentric with the base circle is an épi. This curve is also one of *Cotes's Spirals* whose pedal equation is $1/p^2=A+B/r^2$, which occur as the path of a particle projected in any manner under the action of a central force varying as the inverse cube of the distance. There are five cases: $A=0$, *logarithmic spiral;* $B=1$, *hyperbolic spiral;* according as $A+B/r^2=n^2(1/a^2)\pm(1/r^2)$, $n^2(1/r^2)-(1/a^2)$, do we have $r\sinh n\,\theta=a$, $r\cosh n\,\theta=a$. These five cases are discussed by Cotes in his *Harmonia Mensurarum,* 1722, pp. 30–35. But $r\cosh n\,\theta=a$ defines what is usually known as *Poinsot's Spiral* (F. *Spirale de Poinsot;* G. *Poinsot'sche Spirale*) which is mentioned by this eminent geometer as a *herpolhode* in his celebrated "new theory," 1834–51, of the rotation of bodies.

32. *Curve of Pursuit* (F. *Courbe* [or *Ligne*] *de Poursuite* or *Courbe du Chien;* G. *Verfolgungskurve* or *Hundekurve*). If a point A describes a known curve, the curve described by a point P, the motion of which is always directed towards A, A and P moving with uniform velocities, is a curve of pursuit. If A moves along a straight line, which may be taken, as the Y-axis, the equation of the locus of P is found to be of the form $y=\frac{1}{2}[cx^{m+1}/(m+1)+1/(m-1)(cx^{m-1})]$ if $m>1$ or $m<1$; and $y=\frac{1}{2}[(cx^2/2)-\frac{1}{2}\log x]$, if $m=1$. Various forms of these curves are given in Teixeira's work mentioned below, and in J. Luterbacher, *Diss.* Bern, 1900. The problem of the curve of pursuit first formulated and solved by Bouguer in 1732, was as here. It has been argued, but with little force, that to Leonardo da Vinci (1510) is due the first real conception of a *curve* of pursuit, although *problems* of pursuit are met with **from the time** of Zeno's parodox of Achilles and the tortoise.

If the point A moves on a circle (*Math. Monthly,* v. 1, 1859, p. 249) the problem is much more difficult and does not seem to have been finally solved till 1921 (*Amer. Math. Mo.,* v. 28, pp. 54, 91, 278). The discussion leads to a *quadrifolium.* The problem of three dogs placed at the vertices of an equilateral triangle and starting simultaneously with equal velocities, to chase one another, led to the *logarithmic spiral* as the curve of pursuit for each dog (*Nouv. Corresp. Math.* v. 3, 1877, pp. 175, 280). This problem is generalized in *Johns Hopkins Univ. Circ.,* 1908, p. 135.

33. *Epicycloid, Hypocycloid* (F. *Épicycloïde, Hypocycloïde;* G. *Epizykloide, Hypozykloide*). The epicycloid (hypocycloid) is the curve traced out by a point on the circumference of a circle which rolls without slipping on the exterior (interior) of a fixed circle. If a is the radius of the fixed circle, b the radius of the rolling circle, and h the distance from its centre of the tracing point, the equations of the epicycloid may be written (if h is set equal to b):

$$x=(a+b)\cos\phi-h\cos[(a+b)\phi/b],\quad y=(a+b)\sin\phi-h\sin[(a+b)\phi/b] \qquad (1);$$

and of the hypocycloid:

$$x=(a-b)\cos\phi+h\cos[(a-b)\phi/b],\quad y=(a-b)\sin\phi-h\sin[(a-b)\phi/b],$$

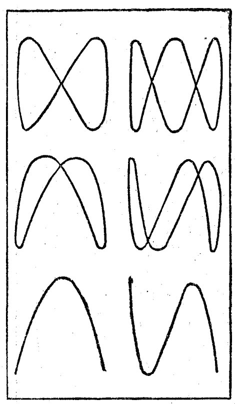
if $b<a$. But if $b>a$, they correspond once more to equations of an epicycloid; and indeed any epicycloid defined by (1) can also be generated by a circle rolling with internal contact on the outside of a fixed circle, *e.g.,* the *cardioid* (*see* fig., no. 25). There is a similar double generation of every hypocycloid, a fact first noticed by Daniel Bernoulli (1725). If $a:b$ is a rational number the curves are algebraic and unicursal, *e.g.,* the *cardioid, nephroid, tricuspid* and *astroid;* otherwise they are transcendental.

When h is not equal to b the curves are *Epitrochoids, Hypotrochoids* (F. *Épitrochoïdes, Hypotrochoïdes;* G. *Epitrochoiden, Hypotrochoiden*) which, for $h<b$, are *curtate* epicycloids (F. *accourcies* or *raccourcies;* G. *verkürzte*) and, for $h>b$, *prolate* (F. *allongées* or *rallongées;* G. *gestreckte* or *gedehnte* or *geschweifte*). There is a double generation, by rolling circles, of epitrochoids and hypotrochoids. If $b=\frac{1}{2}a$, and $h\neq b$, the hypotrochoid is an ellipse (W. Wallace, 1839); when $h=b$, the point traces out the diameter of the fixed circle (Nasîr Eddin, about 1250), a result of importance in connection with certain machines. The *limaçon of Pascal* is an example of both a curtate and prolate epitrochoid. When in (1) $h=a+b$ we get the equation of a *rhodonea,* which is always an epitrochoid or hypotrochoid (Suardi, 1752; Ridolfi, 1844).

The artist Albrecht Dürer seems to have been the first (1525) to have considered a special case of an epicycloid. In the 17th century LaHire, Desargues, Leibniz, Réaumur and Newton contributed to knowledge concerning the curves; among other things Newton showed (*Principia*) that all epicycloids and hypocycloids are rectifiable.

Apart from general references given below *see* E. Wölffing's bibliography, *Bibl. Math.* (2), (1901) and R. A. Proctor, *Cycloid and . . . Cycloidal Curves* (London, 1878); and for many other beautiful forms of cyclic curves *see* C. Taylor, *Curves Formed by the Action of . . . Geometric Chucks,* 2 vols. (London, 1874, 1875); T. S. Bazley, *Epicycloidal Cutting Frame* (London, 1872); and R. E. Moritz, *Cyclic-Harmonic Curves* (*Univ. Wash. Publs. in Math.,* 1923).

34. *Bowditch Curves* or *Lissajous Curves* (F. *Courbes* [or *Figures*] *de Lissajous;* G. *Lissajous-Kurven* or *Lissajoussche Kurven*). These are curves defined by the equations $x=a\sin(m_1u+n_1)$, $y=b\sin(m_2u+n_2)$, or $x=a\sin(nt+c)$, $y=b\sin t$ (1). The curves evidently do not lie outside a rectangle whose sides are tangents and whose vertices are ($\pm a$, $\pm b$). The curves are algebraic and unicursal when $n=p/q$ ($p<q$) is rational and transcendental when n is irrational. Such equations, in effect, and corresponding curves seem to have been first studied by Nathaniel Bowditch, author of the well-known book on navigation, in connection with the motion of a pendulum suspended from two points (1815, *Mem. Amer. Acad.,* v. 3). The study was suggested by a paper on the apparent motion of the earth as viewed from the moon. When $p=q$ the Bowditch curves are a series of concentric ellipses. If $p/q=\frac{1}{2}$ we obtain a curve of the fourth order (if $c\neq 0$) with one double point, and a parabola (if $c=0$). Two forms of these curves as well as three forms for the case $p/q=\frac{1}{3}$ (all given by Bowditch) are indicated in the figures. For other forms *see* Geiger and Scheel, *Handbuch d. Physik,* v. 8 (Berlin, 1927) and Melde, *Lehre von d. Schwingungskurven* (Leipzig, 1864). These curves are also met in acoustics; an approximation to some of the curve forms having been given by Thomas Young (*Phil. Trans.,* 1800). They were, however, studied in detail by Lissajous (1857–58) whose name was consequently connected with


Bowditch Curves (Sec. 34)

them. They occur, thirdly, in discussion of *geodesic lines* on Liouville surfaces (*Enzyk. d. Math. Wiss.*, v. 3, pt. 3, 1927). And finally they are members of a group of curves studied by W. F. Rigge (*Harmonic Curves,* Omaha, Neb., 1926, the Hagen pendulum illustrations being especially interesting). If with equations (1) we consider $z=b\cos t$ we have that every Bowditch curve is the orthogonal projection of a *sine curve* developed on a right circular cylinder (see *Handbuch,* l.c.). For Lissajous curves in space *see* Melde (l.c.), E. H. Comstock and C. S. Slichter (*Trans. Wisconsin Acad.*, v. 11, [1898]), and Zambiasi, *Le figure di Lissajous* (1903).

35. *Sinusoidal Spirals* (F. *Spirales Sinusoïdes;* G. *Sinus-spiralen*), $r^n=a^n\cos n\theta$, where n is a positive or negative rational number. Particular cases are: line ($n=-1$), circle ($n=1$), parabola ($n=-\frac{1}{2}$), equilateral hyperbola ($n=-2$), *lemniscate of Bernoulli* ($n=2$), *cardioid* ($n=\frac{1}{2}$), *logarithmic spiral* ($n=0$, Haton de la Goupillière, 1857), *Cayley's sextic* ($n=\frac{1}{3}$), and *Tschirnhausen's cubic* ($n=-\frac{1}{3}$) first shown by Tschirnhausen (1690) to be a *catacaustic* of a parabola for rays perpendicular to its axis of symmetry. This curve has also been called *cubique de l'Hôpital,* and *Trisektrix von Catalan.* The equation of this curve as well as those of all other nodal cubics such as the *strophoid, trisectrix of Maclaurin,* and *folium of Descartes,* can be expressed in the form $X^{\frac{1}{3}}+Y^{\frac{1}{3}}+Z^{\frac{1}{3}}=0$, where X, Y, Z are linear functions of x and y which when set equal to zero are the equations of tangents at the points of inflection of the cubic. Sinusoidal spirals were first studied by Maclaurin (1718, 1720) who showed: (*a*) that their positive and negative *pedals* are again sinusoidal spirals; (*b*) that a body will trace out a sinusoidal spiral if acted on only by a force, in the direction of the pole, inversely proportional to the power $2n+3$ of its distance from the pole. For example, the *lemniscate of Bernoulli* is traversed by a body acted on by force directed to the double point and inversely proportional to the seventh power of the distance of this point from the moving body.

36. *Cycloid* (F. *Cycloïde;* G. *Cykloide* or *Zykloide* or *Radlinie*), $x=a(\phi-\sin\phi)$, $y=a(1-\cos\phi)$, one of the most celebrated of all special curves, is the locus of a point on the circumference of a circle rolling along a straight line (*see* fig. A). Its Cesàro intrinsic equation is $R^2+s^2=16a^2$, where a is the radius of the rolling circle. Sir Christopher Wren discovered (1658) that the length of a single arch is four times the diameter of the generating circle. Its area above the base line is three times that of the generating circle, a result approximated by Galileo Galilei (*c.* 1599) on weighing pieces of paper cut in the forms of the circle and cycloid (a name given by Galilei). But the first exact derivation of the area was due to Roberval (1634). The discovery by Huygens (1673) that the evolute of a cycloid is an equal cycloid led to his construction of the *isochronal* pendulum (*see* no. 2) generally known as the cycloidal pendulum. The cycloid is a *tautochrone* (Huygens, 1673) and a *brachistochrone* (Jean Bernoulli, 1696, *see* nos. 48, 56). In 1639 Galilei recommended the form of the cycloid for arches of bridges.

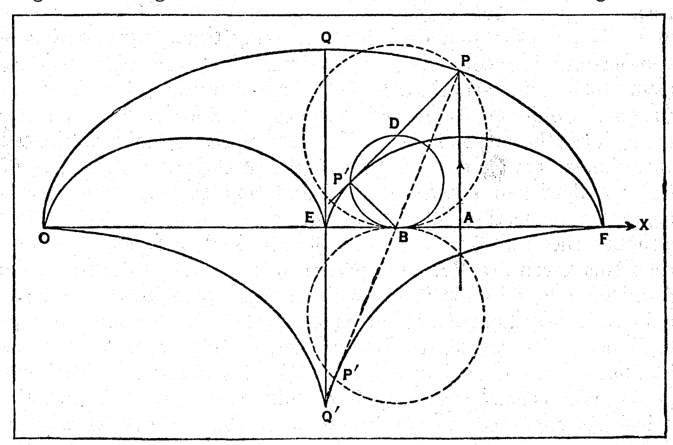


Fig. A.—Cycloid (Sec. 36)

If the tracing point P_1 of the rolling circle generating the cycloid be not on the circumference but at a distance h from the centre of the rolling circle the equations of the locus are: $x=a\theta+h\sin\theta$, $y=a-h\cos\theta$, which define *Trochoids* which are ($h<a$) *curtate,* or *curtate cycloids,* or ($h>a$) *prolate,* or *prolate cycloids* (*see* fig. *b*). Roberval found (1634) the area of such curves, and Descartes, Pascal, Wallis and Jean Bernoulli derived other results. The parallel projection of a *helix* on a plane perpendicular to its axis is a cycloid (ordinary, curtate or prolate) according as the inclination of the projecting rays is equal to, less than, or greater than the pitch of the helix (Guillery, 1847; Montcula found the result for the ordinary cycloid, 1799).

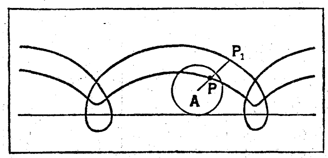


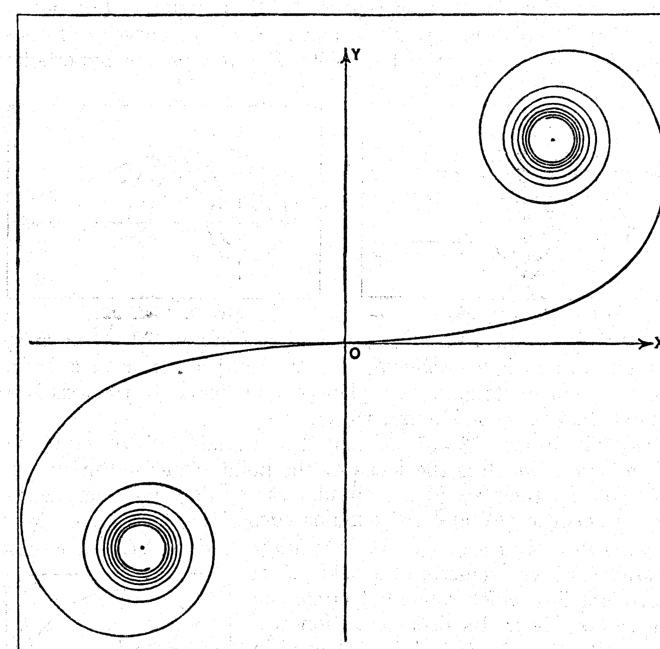
Fig. B.—Cycloid (Sec. 36)

For a bibliography of the literature of cyclic curves *see* E. Wölffing, *Bibl. Math.* (3), v. 2, p. 235 *seq.*, and S. Günther *Bibl. Math.* (2), v. 1, p. 8, *seq.; see* also general references.

37. *Euler's Spiral* or *Clothoid* or *Cornu's Spiral* (F. *Clothoïde* or *Spirale de Cornu* or *Spirale de Fresnel;* G. *Klothoide*) is the curve defined by the equations

$$x=\frac{a}{2^{\frac{1}{2}}}\int_0^v\frac{\sin v\,dv}{v^{\frac{1}{2}}},\quad y=\frac{a}{2^{\frac{1}{2}}}\int_0^v\frac{\cos v\,dv}{v^{\frac{1}{2}}}$$

with asymptotic points at $(\pm a\pi^{\frac{1}{2}}/2^{\frac{3}{2}}, \pm a\pi^{\frac{1}{2}}/2^{\frac{3}{2}})$, and hence the name clothoid suggesting the spinner among the Fates (*see* fig.). The intrinsic equation of the curve is $Rs=a^2$, showing that the radius of curvature of any point of the curve is inversely proportional to the length of arc to that point from some point of reference. All of these results (for half the curve) were found by Euler in his *Methodus inveniendi lineas curvas* . . . , (1744) and in a paper presented to the Academy at St. Petersburg in 1781 wherein he determined the asymptotic points. The curve originated in the consideration of an elastic spring. The similar problem of an elastic lamina was considered earlier (1694) by Jacques Bernoulli but there is no indication that he had any conception, as Euler had, of the real form of the curve. In the 19th century, through discoveries by Fresnel in connection with the diffraction of light, Euler's spiral, and integrals (for which there are many tables) became of special interest.



Euler's Spiral or Clothoid or Cornu's Spiral (Sec. 37)

Euler's spiral is advocated by many writers as a *Transition Curve* for railways; *see,* for example, A. L. Higgins, *The Transition Spiral* (London, 1921). For different values of m the intrinsic equation $Rs^m=a^2$, represents a *clothoid,* a *logarithmic spiral,* the *involute of a circle,* and a straight line. For a bibliography of Euler's spiral see *Amer. Math. Mo.*, v. 25, pp. 276–282.

38. The family of curves $r^m=a^m\theta$, for which the pedal equation is $p^2(m^2r^{2m}+a^{2m})=m^2r^{2m+2}$ (Sacchi, 1854) includes four notable curves: (*a*) *Spiral of Archimedes* ($m=1$) (F. *Spirale d'Archimède;* G. *Archimedische Spirale*); (*b*) *Fermat's Spiral* ($m=2$); (*c*) *Hyperbolic* [or *Reciprocal*] *Spiral* ($m=-1$) (F. *Spirale Hyperbolique;* G. *Hyperbolische Spirale*); (*d*) *Lituus* ($m=-2$) (F. *Lituus* or *Trombe;* G. *Lituus* or *Krummstab*).

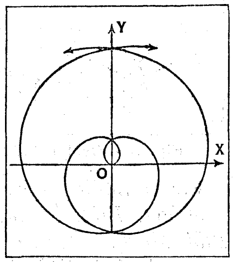


Fig. A. (Sec. 38)

(*a*) This spiral, $r=a\theta$, in which the length of the radius vector is proportional to the angle, is discussed at length in the book on spirals by Archimedes (*c.* 225 B.C.) and it seems that it was used by him to solve the problem of squaring the circle. The subnormal of the spiral is always equal to *a*. Archimedes gave, in effect, the quadrature of the curve, as $a^2\theta/6$ (*see* fig.). The spiral is the pedal of the *involute of a circle* with respect to its centre (Maxwell, 1849). The orthogonal projection of the line of section of a helicoid and a cone of revolution with coincident axes, on a plane perpendicular to the axis, consists of two equal spirals of Archimedes (Pappus, *c.* 330; *see* F.G.M., *Exercices de Géom. Descr.,* 4th ed., Tours, 1909, p. 811, *seq.*).

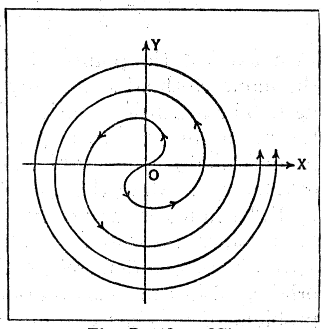


Fig. B. (Sec. 38)

(*b*) The spiral $r^2=a^2\theta$ was discussed by Fermat (1636) and has the form in the figure. Its inverse with respect to its pole is a *lituus.*

(*c*) The hyperbolic spiral, $r\theta=a$, the consideration of which originated with Varignon (1704), was also studied in the 18th century by Jean Bernoulli (1710–13) and Roger Cotes (1722). The subtangent of the curve is of constant length, *a.* If through a point P (r,θ) of the hyperbolic spiral $r\theta=a$, a line PP_1, of length r, be drawn parallel to the axis, the locus of P_1 is a *cochleoid.* The conical projection of a *helix,* from a point of its axis, on a plane perpendicular to the axis is a hyperbolic spiral (T. Olivier, 1833).

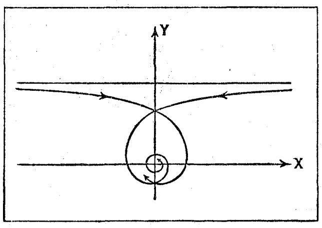


Fig. C. (Sec. 38)

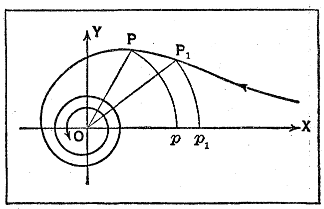
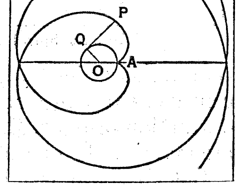


Fig. D. (Sec. 38)

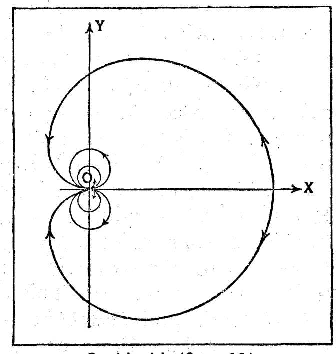
(*d*) The lituus, $r^2\theta=a^2$, originated in a study by Cotes (1722) of the curve which is the locus of the point P moving in such a manner that the area of the circular sector POp (*see* fig.) comprised between OX and OP remains constant.

39. *Involute of a Circle* (F. *Développante du cercle;* G. *Kreisevolvente*) is the roulette of a point, P, on a straight line which rolls on a circle centre O (*see* fig.). Its pedal equation with respect to O is $r^2=p^2+a^2$, its Whewell intrinsic equation $2s=a\psi^2$ and its Cesàro intrinsic equation $R^2=2as$. Its parametric equations are $x=a(\cos\phi+\phi\sin\phi)$, $y=a(\sin\phi-\phi\cos\phi)$. The involute of a circle is the locus of the pole of a *logarithmic spiral* rolling on a concentric circle (Maxwell, 1849). The involute of a circle seems to have been conceived in 1693, when Huygens was considering clocks without pendulums which might be of service on sea-going vessels (Huygens, *Oeuvres,* v. 10, 1905, p. 514). In this connection he originated an apparatus in which the involute plays an essential rôle. In 1891 it became desirable to enlarge the dome of the Royal Observatory at Greenwich; for various reasons the new dome was made, for the most part, in the form of a surface generated by the revolution of an arc of an involute of a circle (*Mo. No. R. Astr. So.,* v. 51).



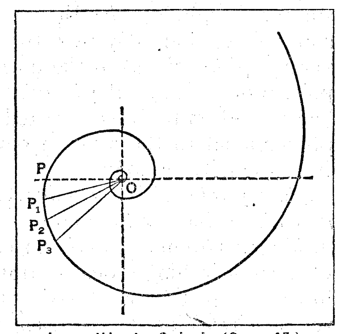
Involute of a circle (Sec. 39)

40. Cochleoid [snail form] (F. *Cochléoïde;* G. *Kochleoide* or *Schneckenhauslinie* or *Schraubenkurve*), $r=a(\sin\theta)/\theta$ (*see* fig.), was first considered as a quadratrix of a circle in an anonymous paper in the *Phil. Trans.* (1700). The curve was considered again in correspondence of Goldbach and Daniel Bernoulli (1726) as the locus of the ends of equal arcs measured from the common point of contact of a series of tangent circles. The points of contact of parallel tangents to the cochleoid lie on a *strophoid* having the pole for double point (Teixeira, 1909). The projection of a cylindrical *helix* from one of its points on a plane perpendicular to its axis is a cochleoid.



Cochleoid (Sec. 40)

41. *Logarithmic* [or *Equiangular* or *Logistic*] *Spiral* (F. *Spirale Logarithmique* [or *Équiangle* or *Logistique*]; G. *Logarithmische Spirale*) was first discussed by Descartes (1638), in connection with a problem in dynamics, as the curve cutting radii vectores from a fixed point O under a constant angle ϕ. If P (r,θ) is any point on the curve and s is its length from O to P, Descartes observed that $s=r$const., and hence rectified a curve for the first time (*see* no. 2). Loria claims this honour for Torricelli (*Accad. d. Lincei, Rendiconti cl. d. sc. fisiche, matem. e nat.* v. 6 (2), 1897, p. 318). The intrinsic pedal and polar equations of the curve are: $R=as$, $p=r\sin\phi$, and $r=ke^{c\theta}$ (1) where $c=\cot\phi$. The form of the curve depends on c and is wholly independent of k. The lengths of radii vectores making equal angles with one another are in geometric progression. That the pole was an asymptotic point seems to have been first noticed by Torricelli (1646). Collins (1675), and Jacques Bernoulli, to whom the name logarithmic spiral is due ("equiangular spiral" originated with Cotes, 1714), noticed (1691) the analogous generations of this spiral and of the *loxodrome,* and that the latter is a stereographic projection of the former seems also due to Collins, although the result was first published by Halley (1696). Among theorems given by Bernoulli (1691–93) are the following: the *pedal* of a logarithmic spiral with respect to its pole is a logarithmic spiral; its *evolute* is an equal spiral with the same asymptotic point; its *catacaustic* for rays emanating from the pole as luminous point is an equal spiral. The discovery of such "perpetual renascence" delighted Bernoulli, who requested that the spiral be engraved on his tomb with the inscription *Eadem mutata resurgo.* That an attempt was made to grant the request may be seen at his tomb in the cloister of the cathedral at Basle. If the surface generated by the revolution of a *logarithmic curve* about its asymptote intersect a helicoid with the asymptote as axis the orthogonal projection of the curve of section of the surface on a plane perpendicular to the axis is a logarithmic spiral (Chasles, 1837). Sir John Leslie seems to have been the first (1821) to suggest, what was later established, that the septa of the nautilus are in form logarithmic spirals. The curve has also been discussed in connection with arrangements of florets in sun-flowers, pine cones and other growths. The most complete historical summary of the extensive literature of the logarithmic spiral is given by R. C. Archibald in an appendix to J. Hambidge, *Dynamic Symmetry* (New Haven, 1920).

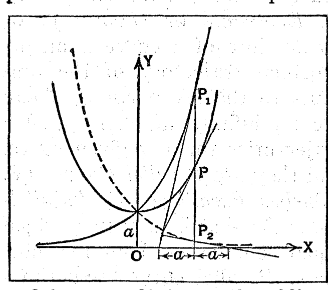


Logarithmic Spiral (Sec. 41)

42. *Frequency Curve* or *Probability Curve* or *Normal Curve of Errors* (F. *Courbe de Probabilité* or *Courbe de Possibilité;* G. *Wahrscheinlichkeitskurve* or *Fehlerkurve*) is the name usually applied to the bell-shaped curve whose cartesian equation is $y=(a/\sqrt{\pi})e^{-mx^2}$ (1). This curve originated, in essence, with DeMoivre (1733, see *Isis,* v. 8, p. 671 *seq.,* and *Biometrika,* v. 16, p. 402 and v. 17, p. 201), although it has been connected more particularly with the names of Laplace and Gauss (see *Trans. Connecticut Acad.,* v. 4). The equation has been developed on various hypotheses the statement of which may be found in works on probability and statistics. Among many tables giving the area, ordinate, and other information, for such curves as the particular case of (1), when $a=\frac{1}{2}^{\frac{1}{2}}$, $m=\frac{1}{2}$, are J. W. Glover's, *Tables of Appl. Math.* (1923). The term *Frequency Curves* is applied to a great variety of curves; *see,* for example, W. P. Elderton, *Frequency Curves and Correlation,* 2nd ed. (1927).

43. *Logarithmic* [or *Logistic*] *Curve* (F. *Logarithmique* or *Logistique;* G. *Logarithmische Kurve* [or *Linie*] or *Exponentialkurve,* or *Logistika*) is the curve defined by the equation $x=a\log(y/m)$ or $y=me^{x/a}$ and consisting of a single branch (for a summary of considerable discussion in this regard *see* Salmon, *Higher Plane Curves,* 3rd ed., p. 286) with the axis of X as asymptote (*see* fig. in no. 44, locus of P_1, where $m=a$). The curve originated with a problem and discussion about 1640 and then and later in the 17th century (that of the discovery of logarithms) in connection with the names of Torricelli, James Gregory, Craig, Huygens and others. The characteristic property of the curve as then found was: whatever m may be, the subtangent is constantly equal to a (*see* fig.). The area between the curve, the asymptote and an ordinate is equal to that of a rectangle with sides respectively equal to the abscissa and subtangent (Torricelli, Huygens).

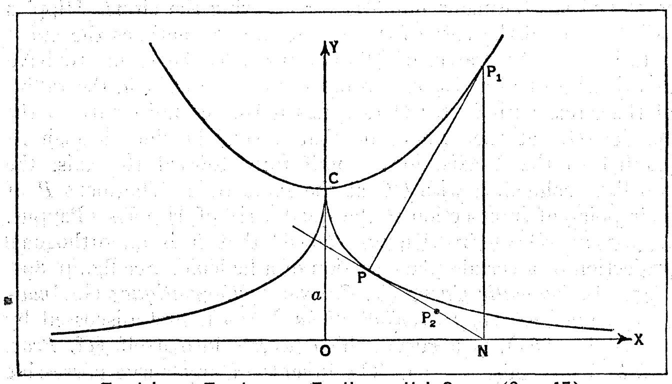
44. *Catenary* or *Chainette* (F. *Chaînette;* G. *Kettenlinie*) is the form (Galilei thought it a parabola) which a perfectly flexible, inextensible chain will assume when suspended by its ends and acted upon by gravity alone. Its equation, determined in 1691 by such mathematicians as Huygens and Leibniz, can be written $y=\frac{1}{2}a(e^{x/a}+e^{-x/a})=a\cosh(x/a)$. Points on the curve may be readily determined from logarithmic curves (*see* fig.). The tangents at P, P_1, P_2 are concurrent. If s represents the length of the catenary measured from its vertex on the Y-axis to any point P, $y^2=s^2+a^2$, and $s=a\sinh(x/a)$. The Cesàro intrinsic equation is $aR=s^2+a^2$, which is a particular case of the equation $aR=s^2+c^2$ which defines curves named by Cesàro (1886) *Alysoid* (F. *Alysoïde;* G. *Alyseiden*). If two opposite edges of a thin inextensible and perfectly flexible rectangular piece of cloth are fixed parallel to each other, and the cloth is exposed to a uniform current of air moving at right angles to the plane which contains the two fixed edges of the cloth the form of equilibrium of the cloth (which is the form of the cross section of a sail filled by wind) is a catenary, or, as Jean and Jacques Bernoulli (1692–95) called it a *Velaria* (sail curve, G. *Segelkurve* or *Seilkurve*). If the catenary is revolved about the X-axis we obtain a catenoid, which is the only minimal surface of revolution, a surface discussed by Euler as early as 1744, and illustrating important principles in the calculus of variations.



Catenary or Chainette (Sec. 44)

Since a catenary may be regarded as a roulette of the focus of a parabola rolling along a straight line, it has been called also a *parabolic catenary.* Similar roulettes of an ellipse and of a hyperbola lead to an *elliptic catenary* and a *hyperbolic catenary.* The corresponding surfaces of revolution are called respectively *Unduloid* and *Nodoid* (*see* A. G. Greenhill, *Elliptic Functions,* 1892). Delaunay showed (1891) that surfaces of revolution of constant mean curvature are of the three types here mentioned.

45. *Tractrix* or *Tractory* or *Equitangential Curve* (F. *Tractrice* or *Tractoire* or *Courbes aux Tangents Égales;* G. *Zuglinie* or *Traktrix* or *Traktorie*) being equitangential (PN$=a$, *see* fig.) is defined by the equations $y(1+y'^2)=a^2y'^2$ or $x=a(\cos u+\log\tan[u/2])$ and $y=a\sin u$; and $R^2+a^2=a^2e^{2s}/a$. In 1692 Huygens considered this curve in detail and hence the name *Traktorie von Huygens* has been used; it was later studied,



Tractrix or Tractory or Equitangential Curve (Sec. 45)

among others, by Leibniz and Jean Bernoulli. The tractrix (*see* fig.) is the orthogonal trajectory of circles of radius a with centres on the X-axis (Liouville, 1850). The evolute of the tractrix (locus of P), is the catenary (locus of P_1)

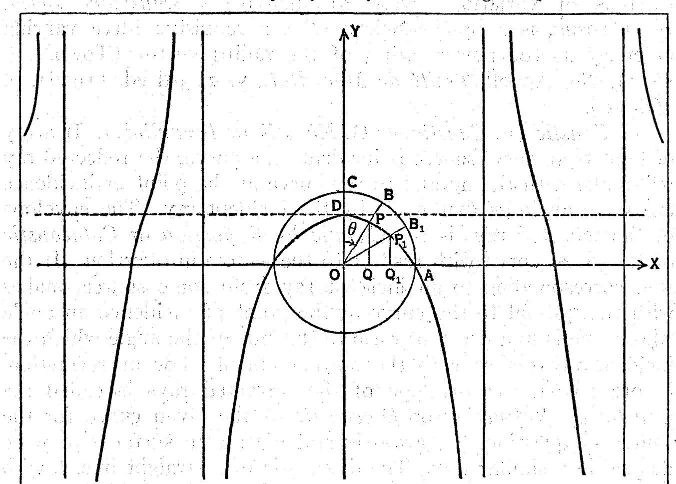
$$y=(a/2)(e^{x/a}+e^{-x/a}).$$

The projection N, of P_1, on the X-axis is the end of the tangent PN, which is constantly equal to a. The intersecting surface of constant negative curvature generated by revolving the tractrix about its asymptote is called a pseudosphere (Beltrami, 1865), and its volume is one half that of the sphere of radius $OC=a$ (Huygens, 1692). The "surface of Dini" is a helicoid with the tractrix as meridian curve (Dini, 1865).

If on the tangent PN to the tractrix a point P_2 is taken (*see* fig.) such that $NP_2=b$, a constant, the locus of P_2 as P traces out the tractrix is the *Syntractrix* (F. *Syntractrice;* G. *Syntraktrix*) defined by $x+(b^2-y^2)^{\frac{1}{2}}=a\log\{[b+(b^2-y^2)^{\frac{1}{2}}]/y\}$, and whose intrinsic equation, when $b=2a$, may be written

$$R=(a/4)(e^{s/a}+e^{-s/a}).$$

This equation differs but slightly from $R=(a/2)(e^{s/a}+e^{-s/a})$ which defines a *Catenary of uniform strength* (F. *Chaînette*



Quadratrix of Hippias (Sec. 46)

d'Égale Résistance; G. *Kettenlinie gleichen Wiederstandes* or *Longitudinale*). Thomson and Tait give the equation of this curve (*Nat. Phil.,* §573; also Coriolis, 1836), in which linear density or cross section is so arranged as to be proportional to the tension, as $e^{y/a}=\sec(x/a)$, which may be written $\tanh\frac{1}{2}(y/a)=\tan^2\frac{1}{2}(x/a)$. The curve was first discussed by Gilbert (1826) in his memoir on suspension bridges. It is the curve which with its *catacaustic,* for parallel rays, encloses the minimum area (Dunkel, *Washington Univ. Studies,* v. 8, 1921).

46. *Quadratrix of Hippias* (F. *Quadratrice de Dinostrate;* G. *Quadratrix des Dinostratus*), $y=x\cot(\pi x/2a)$, $r\sin\theta=(2a/\pi)\theta$, a curve invented by Hippias of Elis (*c.* 430 B.C.) and used (by him, apparently) for trisecting an angle (it may be used for dividing an angle into any number of equal parts), but also employed (as the name implies) for squaring the circle. Hippias may have used the curve for this purpose. Sometimes the curve is called the Quadratrix of Dinostratus since he seems to have used it as a quadratrix (*c.* 350 B.C.). Suppose $OA=a$, the radius of the circle with center O (*see* figs.), rotates uniformly to the position OC at the same time that a straight line through A, parallel to the Y-axis, moves uniformly toward the axis, the two lines coinciding with OC at the same time. The locus P of their point of intersection is the quadratrix of Hippias (Pappus, *c.* 300); $OD=2a/\pi$. Pappus showed that it is an orthogonal projection of a certain plane section of a helicoid. *See* fig., p. 895.

47. *Anallagmatic Curve* (F. *Courbe anallagmatique;* G. *Anallagamatische Kurve, Unveränderliche Kurve*), first discussed by Moutard (1864), is a curve which inverts into itself (cf. *Proc. Edinb. Math. Soc.,* v. 20). The inverse of any curve possessing a line of symmetry is, in general, anallagmatic. Since bicircular quartics (which include the *limaçon, cardioid, cartesian, cassinian*), as well as the *strophoid,* the *trisectrix of Maclaurin* and the *cissoid,* are the inverses of conics, they are thus anallagmatic. In particular, the cartesian is anallagmatic with respect to any of its foci, the power of inversion being the product of the distances of this focus to the other two foci; for the *strophoid* its vertex is the centre of inversion, and the power of inversion is the square of the distance of the vertex to the double point; so also for the *trisectrix of Maclaurin.* The inverse of an anallagmatic curve is anallagmatic.

48. *Brachistochrone* (F. *Brachistochrone* or *Brachystochrone;* G. *Brachistochrone* or *Linie schnellsten Falles*) is the curve along which a body moves from one point A to another B, under the action of an assigned accelerating force, in the least time possible. The problem when gravity was the accelerating force was proposed by Jean Bernoulli (1696) as a challenge to mathematicians. Leibniz, Newton, Jacques Bernoulli, and L'Hospital responded with solutions, that the curve was a *cycloid.* That there is one and only one cycloid arc with the required property was not shown till the 19th century, when an important necessary condition, unstated by Bernoulli, and other things in the theory of the calculus of variations, were formulated. A *sinusoidal spiral,* $r^n=a^n\cos n\theta$, is a brachistochrone for a repulsive force varying inversely as the power $2n+3$ of the radius vector (Townsend, 1875). *See* Appell, *Traité de Méc. Rat.,* v. 2, 3rd ed. (1909), p. 460, *seq.*

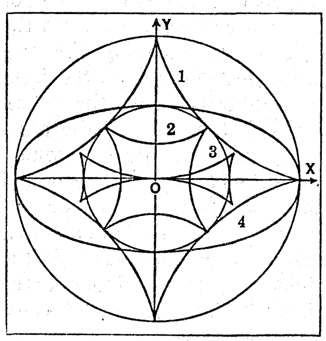
49. *Caustic* (F. *Caustique;* G. *Kaustik* or *Brennlinie*). If a ray of light from some source is incident on a curve, the reflected ray will make with the normal to the curve at the point of incidence the same angle as that made by the incident ray. The envelope of the reflected rays is the *Caustic by Reflection* or *Catacaustic* of the given curve with respect to the source in question. If the ray, corresponding to an incident ray from some source, makes with the normal to the curve at the point of incidence an angle whose sine is in a constant ratio to the sine of the angle which the incident ray makes with the normal (Snell's law of refraction, before 1626), the envelope of the refracted rays is called the *Caustic by Refraction* or *Diacaustic* of the given curve for the source in question. Catacaustic and diacaustic surfaces may be defined in a similar way. The diacaustic of a straight line, l, with respect to a source, S, is the evolute of an ellipse with foci at S and the reflection of S in l (Gergonne, 1820). The diacaustic of a circle is, in general, the evolute of a *cartesian* (Sturm, 1824). If the source is at an infinite distance the incident rays are parallel. The idea of caustic curves originated with Huygens and Tschirnhausen about 1678 and was developed, among others, by Jean and Jacques Bernoulli and by L'Hospital before the end of the century. About 1822 it was discovered by Quetelet that the caustic (C'), of a given curve (C), for a finite source S, is the evolute of a curve (C''), called *Secondary Caustic,* which is the envelope of the circles with centres on (C) and passing through S; or the evolute of a curve (C''), which is similar to the *pedal* of (C) with respect to S, but of double its linear dimensions. Some samples of special curves as catacaustics are as follows:

Curve	Source of rays	Catacaustic
Circle . . .	pt. on circumference	*Cardioid* (Jean and Jacques Bernoulli, 1692, *see* fig. no. 25).
Circle . . .	pt. not on circumference	*Limaçon* (St. Laurent, 1826).
Tschirnhausen's cubic . .	focus	*Semi-cubical parabola* (Archibald, 1900).
Cardioid . .	cusp	*Nephroid* (Huygens, 1678, *see* fig. no. 25).
Cissoid . .	ordinary focus	*Cardioid* (T. Lemoyne, 1919).
Quadrifolium .	centre	*Astroid* (Brocard, 1919).
Logarithmic spiral	pole	*Logarithmic spiral* (Jacques Bernoulli, 1692).
Circle . . .	parallel	*Nephroid* (Huygens, 1678, *see* fig. no. 25).
Parabola . .	rays perp. to axis	*Tschirnhausen's cubic* (Tschirnhausen, 1690).
Cycloid arch .	rays perp. to base	Two *cycloid* arches (Jean Bernoulli, 1692, *see* fig. no. 36[a]).
Tricuspid . .	parallel rays	*Astroid* (Köstlin, 1888).
Logarithmic curve $y=a\log x$. .	rays parallel to X-axis	*Catenary* (R. Heath, 1887).

See F. Bösser, *Zeit. f. Math. u. Phys.,* v. 15, pp. 170–206; Geiger and Scheel, *Handbuch d. Physik,* v. 18 (1927); R S. Heath, *Treatise on Geometrical Optics* (1887); Brocard and Lemoyne's work mentioned below; G. F. Childe, *Reflected Ray Surfaces* . . . (Cape Town, 1857); bibliography in *L'Intermed. d. Math.* (1894), p. 190, and (1895), pp. 208, 321.

50. *Evolute* (F. *Développée;* G. *Evolute* or *Krümmungsmittelpunktslinie* or *-kurve*). This is the envelope of all the normals to a curve of the locus of the curve's centres of curvature. A curve and its evolute have the same foci. The deficiency of the evolute is the same as that of the primitive curve. For other general properties of such curves *see* Salmon, *Higher Plane Curves,* 3rd ed., 1879, p. 82 *seq.* Evolutes of *Epicycloids* and *Hypocycloids* (e.g., *cardioid, nephroid, tricuspid, astroid*) are curves of the same type. So also for the *cycloid* and *logarithmic spiral,* but the evolute of a parabola is a *semi-cubical parabola;* of a *tractrix,* a *catenary;* of a *Cayley's Sextic,* a *nephroid.*

If the evolute be regarded as the original curve, a curve of which it is the evolute is called an *Involute* (F. *Développante;* G. *Evolvente* or *Involute*); or an involute of a curve is an orthogonal trajectory of the tangents to the given curve. There are an infinite number of such trajectories for any given curve, and they are *Parallel Curves* (F. *Courbes Parallèles;* G. *Parallelkurven*); that is, any two cut off equal lengths on common normals. Parallel curves sometimes have a very different appearance, for example, *Cayley's Sextic* and the *nephroid.* The accompanying figure shows: (*a*) two parallel curves, 3, 4, of an *astroid,* 2, one of them an oval, and also (*b*) the evolute, 1, of this astroid.



Evolute (Sec. 50)

The conception of evolutes and involutes originated with Huygens in his celebrated *Horlogium Oscillatorium* (1673). The principles underlying the determination of such envelopes, as well as those connected with caustics by Tschirnhausen (1682), were developed into a theory by Leibniz (1692–94), who was the first to consider parallel curves.

51. *Inverse Curves* (F. *Courbes Inverses;* G. *Inverse Kurven*).

If through a point O, called the centre of inversion, a line is drawn to any point P_1, of a curve C_1, and on OP_1, a point P_2 is taken such that $OP_1 \cdot OP_2 = k^2$, a constant, P_1 and P_2 are inverse points. As P_1 traces the curve C_1, P_2 traces its inverse curve C_2. If the power is $-k^2$ the points P_1 and P_2 are on opposite sides of O. The first examples of this transformation were given by Quetelet (1825). (*See* also no. 47.) Some examples of curves and their inverses are as follows:

Curve	Pole	Inverse
Central conic	focus	*Limaçon*
Central conic	centre	*Cassinian*
Hyperbola, rectangular	centre	*Lemniscate of Bernoulli*
Hyperbola, rectangular	vertex	*Strophoid*
Trisectrix of Maclaurin	double point	Hyperbola
Trisectrix of Maclaurin	focus	*Tschirnhausen cubic*
Strophoid	double point	Hyperbola
Cissoid	cusp	Parabola
Parabola	focus	*Cardioid*
Spiral of Archimedes	pole	*Hyperbolic spiral*
Logarithmic spiral	pole	*Logarithmic spiral*
Cochleoid	pole	*Quadratrix of Hippias*
Lituus	pole	*Fermat's spiral*
Rhodonea	pole	*Épi* or *Cotes's spiral*

52. *Isoptic Curve* (F. *Courbe isoptique* or *Ligne isoptique;* G. *Isoptische Kurve* or *Kurve gleichen Gesichtswinkels*). The locus of the points of intersection of tangents to a given curve (or a pair of curves) meeting at a constant angle is an isoptic curve of the given curve, or curves. When the constant angle is right the isoptic curve is said to be the *Orthoptic Curve* (F. *Courbe Orthoptique;* G. *Orthoptische Kurve*). The isoptic curve of an epicycloid is an epitrochoid (Chasles, 1837); of a *cycloid* a curtate or prolate cycloid (LaHire, 1704); of a *sinusoidal spiral* another sinusoidal spiral. The orthoptic curve of a *tricuspid* is a circle; of an *astroid,* a *quadrifolium;* and of a *cardioid,* a circle and a *Limaçon of Pascal,* which suggests that the isoptic curve of Chasles's theorem should be one or more *epitrochoids;* indeed the number of such epitrochoids is only finite if the radius of the base of the given epicycloid is commensurable with that of the rolling circle (Duporcq, *L'Interm. d. Math.,* 1896, p. 291). The orthoptic curve of two confocal conics is a concentric circle (Chasles).

53. *Pedal* or *Pedal Curve* (F. *Courbe pédale* or *Podaire;* G. *Fusspunktkurve*). The pedal (C_1) of a curve (C), with respect to a point O, is the locus of the feet of the perpendiculars from O on the tangents to (C). Maclaurin first introduced (1718) the idea of positive and negative pedals of a curve with respect to a point; (C_1) is the pedal or first positive pedal of (C), or (C) is the first negative pedal of (C_1). If (C_2) is, with respect to the same point, the first positive pedal of (C_1), it is the second positive pedal of (C); and so on. Some examples of pedals are as follows:

Curve	Point	Pedal
Circle	any point in plane	*Limaçon*
Circle	point on the circumference	*Cardioid*
Parabola	foot of directrix	*Right strophoid*
Parabola	any point of directrix	*Strophoid*
Parabola	reflexion of focus in directrix	*Trisectrix of Maclaurin*
Parabola	vertex	*Cissoid*
Equilateral hyperbola	centre	*Lemniscate of Bernoulli*
Cissoid	ordinary focus	*Cardioid*
Epicycloid, Hypocycloid	centre	*Rhodonea*
Cardioid	cusp	*Cayley's sextic*
Tricuspid	cusp	*Simple folium*
Tricuspid	vertex	*Double folium*
Tricuspid	centre	*Trifolium*
Astroid	centre	*Quadrifolium*
Logarithmic spiral	pole	*Logarithmic spiral*
Involute of circle	centre of circle	*Spiral of Archimedes*

For the *sinusoidal spirals* $r^n = a^n \cos n\theta$ the k^{th} pedal, positive or negative, with respect to the pole, is

$$r^{n/(1+kn)} = a^{n/(1+kn)} \cos\theta n/(1+kn).$$

From this, many results can be stated; for example: the fifth negative pedal of a *cardioid* is a *Tschirnhausen cubic;* the fourth positive pedal of a parabola is a *cardioid.* The term *tangential pedal curve* is sometimes used to distinguish it from *normal pedal curve* where normals play the same rôle as tangents in the above discussion.

54. *Radial* or *Radial Curve* (F. *Courbe radiale;* G. *Radiale*). From a fixed point lines are drawn equal and parallel to the radii of curvature at successive points of a given curve; the locus of the extremities of these lines is the radial curve corresponding to the given curve (Tucker, 1864). The degree of the radial of an algebraic curve is that of the curve's *evolute.* The following are some examples (c=curve, r=radial): c—*catenary,* r—*kampyle of Eudoxus;* c—*catenary of uniform strength,* r—a straight line; c—*tractrix,* r—*kappa curve;* c—*cycloid,* r—circle, c—*epicycloid* of n cusps, r—*rhodonea* of n petals; c—*tricuspid,* r—*trifolium;* c—*astroid,* r—*quadrifolium.*

55. *Roulette* (F. *Roulette;* G. *Rollkurve* or *Roulette*). When a curve rolls, without slipping, on a fixed curve or straight line, any fixed point, P, in the plane of the rolling curve describes a curve called a roulette. The term is also sometimes applied (still limiting motion to that in a plane) to: (*a*) the envelope of a fixed line in the plane of the rolling curve; (*b*) the locus of a variable point, such as the centre of curvature of the point of contact of the rolling curve. If O is the point of contact of rolling and fixed curves, OP is normal at P (P, fixed) to the curve traced by P (Descartes). If any curve roll on an equal curve, corresponding points of the curves being in contact, the roulette of any point is a curve similar to a certain pedal of the fixed curve and of double its linear dimensions (Maclaurin, 1720); in particular *Cayley's Sextic* is generated by the cusp of a *cardioid* rolling, with corresponding points in contact, on an equal cardioid (Maclaurin). The roulette of the vertex of a parabola rolling on a fixed equal parabola is a *cissoid of Diocles.* The *cycloid, epicycloids, epitrochoids* and *hypocycloids* are examples of roulettes. Every *rhodonea* can be generated as the roulette of a circle on a circle (Suardi, 1752, and Ridolfi, 1844). The *hyperbolic spiral* whose equation is $r=a/\theta$ rolled on a *logarithmic curve* whose equation is $y=a\log(x/a)$ traces the axis of y or the asymptote (Maxwell, 1849). The pole of a *hyperbolic spiral* rolling on a straight line traces out a *tractrix* (Demoulin, 1891). A *helix* rolls on a straight line to which it is always tangent while its axis moves in a plane; any point of the helix traces out a cycloid (Besant, 1870). References may be given to J. C. Maxwell's second published paper in 1849 (*Scientific Papers,* vol. i.) and to W. H. Besant's *Notes on Roulettes and Glissettes* (2nd ed., Cambridge, 1890). Among *Glissettes* (F. *Glissettes;* G. *Gleitkurven*) are the curves: (*a*) traced out by points, (*b*) enveloped by a fixed line, in the plane of a curve which is made to slide between given points, or straight lines, or curves, or to glide so as always to be tangent to a line at a fixed point. The envelope-glissette of a given line segment sliding between lines at right angles is an *astroid.* The point glissette of the focus of a parabola sliding between two lines at right angles is an *épi* or *Cotes's spiral* whose equation may be written $r\sin 2\theta = a$. An *involute of a circle* slides on a straight line, always touching it at the same point; the glissettes of a point and a straight line are respectively a *trochoid* and an involute of a *cycloid* (Besant).

56. *Tautochrone* (F. *Tautochrone* or *Courbe Tautochrone;* G. *Tautochrone* or *Gleichzeitkurve*). This is a curve along which a particle acted on by assigned forces will arrive in the same time at a given point whatever initial point is taken on the curve. When gravity is the accelerating force Huygens showed (*Horlogium Oscillatorium,* 1673) that the inverted *cycloid* with axis vertical was the tautochrone. The converse problem was solved by Newton (*Principia,* 1687, bk. 3, sec. 10). The problem of the tautochrone was notably discussed by Jean Bernoulli (1718), and Euler (1726–72), and Lagrange (1767, *Oeuvres,* v. 2, 1868, p. 317). The *astroid* is a tautochrone for a force perpendicular to a line and proportional to the cube root of the distance to this line (Jullien, 1855). The *cardioid* is a tautochrone for a repulsive force varying as the distance, situated on the axis at one-quarter

of the distance from the focus to the vertex (Purkiss, 1864). A similar result holds for all *epicycloids* (Purkiss). (*See* C. Ohrtmann, *Das Problem der Tautochronen; ein historischer Versuch.*)

57. *Clélies* (F. *Clélies;* G. *Cleliakurven* or *Clelien*). Let ϕ be the longitude, and θ the colatitude, of any point P on a sphere of radius a. If this point is moved such that $\theta=m\phi$, m being a constant, the locus described by P is a clélie, discussed by Guido Grandi (1728). When $m=1$ we have *Viviani's Windows.* In cartesian co-ordinates the equations may be written

$$x=a\sin m\phi\cos\phi,\quad y=a\sin m\phi\sin\phi,\quad z=a\cos m\phi.$$

The projection of this curve on the XY-plane is the *rhodonea,* $r=a\sin m\phi$.

Grandi applied the name clélies also to curves defined by the equations $a\sin\theta=b\sin m\phi$, $a\sin\theta=a-b\sin m\phi$. The projection of the first curve on the XY-plane is $r=b\sin m\phi$ again a rhodonea. The projection of the second curve on the XY-plane is represented by the equation $r=a-b\sin m\phi$ which is a *conchoid* of the same rhodonea.

58. *Horse Fetter* or *Hippopede* (F. *Hippopède;* G. *Hippopede* or *Pferdefessel*) is a term applied to two different curves discussed by the Greeks (*cf.* Heath, *Hist. Greek Math.*, v. 1, pp. 332–334; v. 2, pp. 204–206). (*a*) The horse-fetter of Eudoxus (fl. *c.* 365 B.C.) is the curve described by a planet about the zodiac circle in his theory of concentric spheres, and it is the curve of section of a circular cylinder and tangent sphere (Schiaparelli, *Scritti s. storia d. Astronomica Antica,* part 1, t. 2, p. 40 *seq.*). Let the centre, O, of the sphere, of radius, a, be the origin; the axis of y the line through O and B, the point of contact of cylinder and sphere; the axis of z parallel to the generator of the cylinder, then the equations of the horse-fetter are: $x^2+y^2+z^2=a^2$, $x^2+(y-b)^2=(a-b)^2$, where b is the distance of the axis of the cylinder from O. Because of its form, the curve has been called a *spherical lemniscate.* Its projection in the YZ-plane is part of the parabola $z^2+2by-2ab=0$. The YZ-plane and XY-plane are planes of symmetry and B is a double point. The stereographic projection of the horse-fetter with respect to the point $(0, a, 0)$ is the hyperbola $(a-b)z^2-bx^2=ab^2$. When $b=a/2$ the horse-fetter, which Eudoxus introduced into geometrical discussion, becomes part of *Viviani's curve.*

(*b*) The plane curve hippopede, referred to by Proclus, appears to be one of the *spiric lines of Perseus* (*c.* 75 B.C.), that is one of the curves formed by a plane section of an anchor ring parallel to its axis. When the plane is tangent to the anchor ring internally, the section is a hippopede whose equation is

$$(x^2+y^2)^2+4c(c-a)(x^2+y^2)=4c^2x^2.$$

If the distance of the plane from the axis is equal to the radius of the generating circle of the ring ($c=2a$) the hippopede is a *lemniscate of Bernoulli.*

59. *Loxodrome* or *Rhumb Line* or *Spherical Helix* (F. *Loxodromie;* G. *Loxodrome* or *Rhumblinie*) is usually defined as the curve cutting the meridian of a sphere at a constant angle; it is a double spiral having the north and south poles for asymptotic points. The curve was first conceived by Pedro Nunes (1550). If the constant angle is β, ϕ is the longitude and θ the colatitude of a point on the loxodrome its equation may be written

$$x=\sin\phi\cos\theta,\qquad y=\sin\phi\sin\theta,\qquad z=\cos\phi,$$

where $\theta=-\tan\beta\log\tan(\phi/2)$. The orthogonal projection of this curve on the XY-plane is $r(e^{h\theta}+e^{-h\theta})=2$ or $r\cosh h\theta=1$, where $h=\cot\beta$, *Poinsot's Spiral* (*see* no. 31). The stereographic projection of a loxodrome from one of its poles on the plane of the equator is a *logarithmic spiral.* Nunes had the idea (not yet dead) that a loxodrome joining two points on a sphere was the shortest distance on the sphere between those points. Support of this view may have been found by some in the fact that on Mercator charts (1569) the spherical loxodrome becomes a straight line. In the 19th century intelligent mariners realized that great-circle sailing should replace loxodromic paths for shortest distances. The most notable history of the loxodromic line is that of S. Günther, *Studien z. Gesch. d. Math. u. Phy. Geographie,* pt. 6 (Halle, 1879).

The general question of loxodromes on any surface of revolution was studied for the first time by J. G. Walz in 1741. But Scheffers introduced the idea (1902) of a loxodrome as a space curve and not a surface curve, a curve which cuts all planes of a pencil under a constant angle. Loxodromes are space W-curves of Klein and Lie (1870); see *Enzykl. d. Math. Wiss.*, v. 3, p. 247.

60. *Spherical Catenary* (F. *Chaînette Sphérique* or *Caténaire Sphérique;* G. *Sphärische Kettenlinie*). (*a*) This is the form of a curve assumed under gravity by a heavy, homogeneous, flexible, inextensible cord placed with its two ends fixed on the perfectly smooth surface of a sphere. Taking the centre of the sphere as origin and the axis of z vertical we find (as in Appell, *Traité de Méc. Rat.*, v. 1, 3rd ed., 1909, p. 207) for the equations of curve

$$r^2=a^2-z^2 \text{ and } d\theta=Aadz/(a^2-z^2)Z,$$

where $Z=(h-z)^2(a^2-z^2)-A^2$, A and h being constants. Hence θ is, in general, an elliptic transcendent. Discussion of various possibilities in connection with the constants, and the roots of the equation $Z=0$, has been the subject for numerous monographs and dissertations. Greenhill found (1895), for example, that under certain circumstances the spherical catenary becomes a closed algebraic curve. The problem of a surface catenary was first discussed by Bobillier (1829) for any surface.

(*b*) Gudermann defined a spherical catenary by the equation $\tan\theta=\cosh m\phi$, without any reference to mechanics but simply from analogy with the equation of the plane catenary curve (*Grundriss d. analyt. Sphärik,* 1830 and Crelle's *Journal,* v. 11, 1834). He showed that this catenary is an *evolute* of the *spherical loxodrome* (1834).

61. *Spherical Epicycloid* (F. *Épicycloïde Sphérique;* G. *Sphärische Epizykloide*). This curve is the locus of a point on the circumference of a circle which rolls on the circumference of a fixed circle, the plane of the rolling circle always making with that of the fixed circle a constant angle, ω. These curves were first studied by Hermann (1728) as a result of a problem proposed in 1718 by Offenbourg: To construct on the surface of the sphere a window with contour algebraically rectifiable. (It would seem as if the problem had been suggested by that of *Viviani's windows,* no. 62.) Hermann's mistake in imagining all such curves rectifiable was pointed out by Jean Bernoulli (1742) and the only possible case for this was indicated. Clairaut, Gudermann and Lexell were other workers in this field. (*See* H. M. Jeffrey, *Quart. Journ. Math.*, v. 19, 1883, p. 44 *seq.*) The equations of such curves may be written

$$x=a\cos\theta-b[1-\cos(a\theta/b)]\cos\omega\cos\theta+a\sin(a\theta/b)\sin\theta,$$
$$y=a\sin\theta-b[1-\cos(a\theta/b)]\cos\omega\sin\theta-a\sin(a\theta/b)\cos\theta,$$
$$z=a[1-\cos(a\theta/b)]\sin\omega,$$

and define spherical curves, algebraic and unicursal if a/b is rational, and transcendental if a/b is irrational. If $a=b$ and $\omega=\pi/2$, we have a *Spherical Cardioid* whose orthogonal projections are (J. Schreiner, *Gymn. Progr.*, Kempten, 1896): (i.) on the XY-plane a *cardioid;* (ii.) on the YZ-plane a *pear-shaped quartic;* (iii.) on the XZ-plane part of a parabola.

62. *Viviani's Curve* or *Viviani's Windows* (F. *Vivianienne* or *Courbe de Viviani* or *Fenêtre de Viviani;* G. *Viviani'sche Kurve*) results from the solution of the following problem proposed for solution in 1692 by Viviani, a pupil of Galilei: On a hemispherical dome construct four equal similarly shaped windows such that the rest of the surface of the dome is exactly rectifiable. Among others, Leibniz, Jacques Bernoulli and Wallis solved the problem. The equations of the curve are, in part:

$$x^2+y^2+z^2=a^2, \text{ and } x^2+y^2-ay=0,\ x>0,$$

where a is the radius of the sphere; or $x=a\sin\phi\cos\phi$, $y=a\cos^2\phi$, and $z=a\sin\phi$; or, if $t=\tan(\phi/2)$,

$$x=2at\frac{1-t^2}{(1+t^2)^2},\quad y=a\frac{(1-t^2)^2}{(1+t^2)^2},\quad\text{and } z=a\frac{2t}{1+t^2}.$$

This curve corresponds to the curved boundary of two windows [the YZ-plane is here the base of the dome considered by Viviani]; here would be two corresponding windows on the other side of the hemispheres. The area of the hemisphere left is $8a^2$. The orthogonal projection of Viviani's curve on the XZ-plane is half of the *eight curve*, $z^4=a^2(z^2-x^2)$, and on the YZ-plane is a portion of the parabola $z^2=a(a-y)$. The stereographic projection of Viviani's curve on: (1) the XZ-plane and with the point (0, a, 0) as pole is half of the equilateral hyperbola $z^2-x^2=a^2$; (2) on the XZ-plane with the point (0, $-a$, 0) as pole is half of the *lemniscate* of *Bernoulli* $(x^2+z^2)^2=a^2(z^2-x^2)$; (3) on the XY-plane with the point (0, 0, a) as pole is part of the *strophoid*

$$y(x^2+y^2)-2a(x^2+y^2)+a^2y=0$$

with double point at (0, a, 0). The projection of Viviani's curve from (0, 0, 0) on the plane $z=a$ is part of the *kappa curve* $y^2(x^2+y^2)=a^2x^2$. (*See* T. Huber, *Diss.* Bern, 1916.)

63. *Helix* (F. *Hélice;* G. *Helix*, or *Schraublinie*). This is the curve cutting the generators of a right circular cylinder under a constant angle, β. Then the equations of the curve are $x=a\cos\theta$, $y=a\sin\theta$, and $z=a\theta\cot\beta$; $s=a\theta\operatorname{cosec}\beta$. The helix is mentioned by Geminus (*c.* 70 B.C.) and a passage in Proclus (*c.* 460) suggests that it was known to Apollonius (*c.* 225 B.C.). It was used by Pappus (*c.* 300) for producing the *quadratrix of Hippias* and we have seen that by projecting it in various ways we get a *cycloid* a *trochoid*, a *cochleoid* and a *hyperbolic spiral*. Its orthogonal projection on a plane parallel to the axis of the cylinder is a *sine curve* (Pitot, 1724). The ratio of the radii of curvature and torsion of the helix is constant (Lancret, 1802). Puiseux found (1842) that the only curve for which the radii of curvature and torsion are constant is the right circular helix. The helix is a special case of *Bertrand Curves* for which a linear relation between curvature and torsion exists. A moving straight line always meeting a helix and intersecting its axis orthogonally traces out a right circular helicoid which is the only real minimal ruled surface (Catalan, 1842).

The curve which cuts the generators of a cone of revolution under a constant angle is a *Cylindro-Conical Helix* or *Conica Loxodrome* (F. *Hélice cylindro-conique* or *Spirale logarithmique conique;* G. *Zylinderkegelschraubenlinie*) and was first discussed by Guido Grandi (1701). Its equation may be written

$$x=he^{a\theta}\cos\theta,\quad y=he^{a\theta}\sin\theta,\quad z=he^{a\theta}\cot\beta.$$

Grandi noted that this helix cuts also under a constant angle the generators of a cylinder of which one generator coincides with the axis of the cone and whose base is a *logarithmic spiral* having its pole on this axis. A certain logarithmic spiral on the XY-plane, and with pole at the origin, is an *involute* of Grandi's helix (1826).

64. *Cubical Conic Sections* (F. *Coniques Cubiques;* G. *Kubische Kegelschnitte*), which may be obtained as the line of intersection of two cones of the second order, or of two hyperboloids of one sheet, with a common generator, was first discussed by Möbius in his *Der barycentrische Calcul* (Leipzig, 1827), and later studied by Chasles (1837), Cayley (1845), Cremona (1862) and others. Möbius showed that a moving tangent to such a cubic traces out a conic on a fixed osculating plane. Seydewitz classified the cubics (1847) according to the nature of their infinitely distant points: (a) The *Cubical Ellipse* which has one real, and two conjugate points at infinity; this curve has one real asymptote. (b) The *Cubical Hyperbola* which has three real distinct points at infinity; three real distinct asymptotes. (c) The *Cubical Parabolic Hyperbola* with three real points at infinity but two of them coincident; three real asymptotes, two coincident. (d) The *Cubical Parabola* with three coincident points at infinity; the plane at infinity is an osculating plane and the curve has no asymptote. Through six given points in space a gauche cubic curve can be passed. The locus of the vertices of the cones of the second degree which all pass through the six given points in space is the cubic of the third degree determined by these six points (Chasles, 1837). If a gauche cubic with six points in common with a quadric has also a seventh point in common it lies wholly on the surface (Chasles, 1857). The quadrics through the cubic form a pencil. An elliptic cylinder passes through a gauche ellipse; three hyperbolic cylinders through a gauche hyperbola; a hyperbolic and a parabolic cylinder through the gauche parabolic hyperbola; and a parabolic cylinder through the gauche parabola. The numerous results found for such cubics are summarized in *Ency. d. Sc. Mathém.*, t. 4 v. 4, pt. 1, Paris, 1914, p. 119 *seq. See* also O. Staude, *Kubische Kegelschnitte* (Leipzig, 1913), and P. W. Wood, *The Twisted Cubic with some account of the Metrical Properties of the Cubical Hyperbola* (1913). Interpretations of the invariants and covariants of a binary cubic in terms of the geometry of a twisted cubic are given in Grace and Young, *Algebra of Invariants* (1903).

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CURVILINEAR, in architecture, any form with curved or flowing lines. The term is used especially to designate the flowing tracery (*q.v.*) employed in the later decorated style (*see* DECORATED PERIOD) of English Gothic and of the French Flamboyant (*see* FLAMBOYANT STYLE), and similar styles (*see* GOTHIC ARCHITECTURE).

CURWEN, JOHN (1816–1880), English Nonconformist minister and founder of the tonic sol-fa system of musical teaching, was born at Heckmondwike, Yorkshire, of an old Cumberland family, and died at Manchester on May 26, 1880. His father was a Nonconformist minister, and he himself adopted this calling, which he practised until 1864, when he gave it up in order to devote himself to his new method of musical nomenclature, designed to avoid the use of the stave with its lines and spaces. He adapted it from that of Miss Sarah Ann Glover (1785–1867) of Norwich, whose sol-fa system was based on the ancient gamut. Curwen was led to feel the importance of a simple way of teaching how to sing by note by his experiences among Sunday-school teachers. Apart from Miss Glover, the same idea had been elaborated in France since J. J. Rousseau's time, by Pierre Galin (1786–1821), Aimé Paris (1798–1866) and Emile Chevé (1804–1864), whose method of teaching how to read at sight also depended on the principle of "tonic relationship" being inculcated by the reference of every sound to its tonic, by the use of a *numeral* notation. Curwen brought out his *Grammar of Vocal Music* in 1843, and in 1853 started the Tonic Sol-Fa Association; in 1879, the Tonic Sol-Fa college was opened. Curwen also took to publishing, and brought out a periodical called the *Tonic Sol-Fa Reporter*, and in his later life was occupied in directing the spreading organization of his system. His son, JOHN SPENCER CURWEN (1847–1916), who became principal of the Tonic Sol-Fa college, continued the promulgation and popularization of the Sol-Fa gospel, with the able co-operation of his wife, whose numerous teaching works are deservedly held in high repute.

CURZOLA (Serbo-Croatian, *Korčula* or *Karkar*), an island in the Adriatic, forming part of Dalmatia, Yugoslavia. Pop. (1931) of island 28,492; of capital (same name) 6,563. Length about 38m., breadth (average) 5 miles. The island lies 2m. W. of Sabioncello promontory. The hilly interior has prehistoric grave mounds, and Phoenicians may have colonized here. Greeks did so in the 4th century B.C., and the name may be corrupted from Κέρκυρα Μέλαινα, perhaps referring to the dark pines that still partly cover the island. It first became Venetian in A.D. 998, was ruled by Hungary and Genoa in turn in the 12th century, became independent for a while, and then its counts submitted to Venice (1255). Marco Polo was taken prisoner by the Genoese in a sea-fight near by. Curzola became Hungarian in 1358, was bought by Ragusa (1413–17), and again submitted to Venice in 1420. The capital is on a rocky foreland and contains the *loggia* (council chambers) and palace of the Venetian governors, a fine Gothic cloister in a 15th century Franciscan friary, walls and towers of the citadel (1420) on the hill crown, and a church (12th–13th century), formerly a cathedral. It was a see from 1301 to 1806.

The resistance of Curzola to the Turks in 1571 earned for it the title *fidelissima.* In 1776–97 it was a Venetian arsenal, succeeding Lesina. In the Napoleonic wars it passed through Russian, French and British to Austrian hands (1815), and it became Yugoslav in 1918. The people are sailors and fishermen, build boats, grow vines, olives and corn, breed mules, and quarry slate, stone and marble. They cling to old ways and dance the "Moreska." Italy occupied Curzola in World War II.

CURZON OF KEDLESTON, GEORGE NATHANIEL, 1st Marquess (1859–1925), English statesman, eldest son of the 4th baron Scarsdale, rector of Kedleston, Derbyshire, was born on Jan. 11, 1859, and was educated at Eton and Balliol college, Oxford. At Oxford he was president of the Union (1880), and was elected a fellow of All Souls college in 1883. He became assistant private secretary to Lord Salisbury in 1885, and in 1886 entered parliament as member for the Southport division. He was appointed under-secretary for India in 1891–1892 and for foreign affairs in 1895–1898. As under-secretary he created the impression that his career might rise to any height. Meantime he had travelled in Central Asia, Persia, Afghanistan, the Pamirs, Siam, Indo-China and Korea, and published three important books: *Russia in Central Asia* (1889), *Persia and the Persian Question* (1892) and *Problems of the Far East* (1894). In 1895 he married Mary Victoria Leiter (d. 1906), daughter of a Chicago millionaire.

In Jan. 1899 he was appointed governor-general of India. On his appointment he chose an Irish peerage, which would leave him free to re-enter the House of Commons on his return. Reaching India shortly after the suppression of the frontier risings of 1897–98, he paid special attention to the independent tribes of the north-west frontier, inaugurated a new province called the North West Frontier province, and carried out a policy of conciliation mingled with firmness of control. The only trouble on this frontier during the period of his administration was the Mahsud Waziri campaign of 1901. He exerted himself to encourage British trade in Persia, paying a visit to the Persian gulf in 1903; while on the north-east frontier he anticipated a possible Russian advance by the Tibet mission of 1903, which rendered necessary the employment of military force for the protection of the British envoys. The mission, which had the ostensible support of China as suzerain of Tibet, penetrated to Lhasa, where a treaty was signed in Sept. 1904. Curzon appointed a number of commissions to inquire into Indian education, irrigation, police and other branches of administration, and he placed on a stable basis the financial relations between the provinces and the Government of India. He established the Imperial Cadet corps, settled the question of Berar with the nizam of Hyderabad, reduced the salt tax, and gave relief to the smaller income-tax payers. He created the new department of commerce and industry. In Jan. 1903 he presided at the durbar which was held at Delhi in honour of the coronation of King Edward VII. On the expiration of the customary five years of office, Lord Curzon was reappointed governor-general and was thus able to supervise the execution of the reforms based on the exhaustive inquiries made during his first term. Of these the partition of Bengal, not actually carried out until after he had left India, roused bitter opposition, and was practically reversed in 1911. A difference of opinion with the commander-in-chief, Lord Kitchener, regarding the position of the military member of council in India, led to a controversy in which Lord Curzon was not supported by the home government. He resigned (1905) and returned to England. After his return he became warden of the Cinque Ports. In 1906 Lady Curzon died of heart failure. Curzon succeeded Goschen in 1907 as chancellor of the University of Oxford. He took his duties very seriously, and inaugurated several important changes in the constitution of the university. He now gave up the idea of returning to the House of Commons, and took his seat in the House of Lords as an Irish representative peer.

Lord Curzon received an earldom, along with the viscountcy of Scarsdale and the barony of Ravensdale, as a coronation honour in 1911. He was a strong opponent of the Parliament bill. Nevertheless, when the crisis came, he stood by Lord Lansdowne in persuading the bulk of the Conservative peers to abstain from voting, and so to permit the bill to pass and avoid a constitutional crisis.

During the vehement party conflicts of the years before the World War he was the chief lieutenant of Lord Lansdowne in the Lords. But much of his time and attention was given to the affairs of Oxford university. He had, moreover, a scholarly love for antiquities, and bought and preserved from further ruin the ancient castles of Tattershall in Lincolnshire and Bodiam in Sussex, and eventually presented them to the nation.

He joined Asquith's Coalition Cabinet in the summer of 1915, as lord privy seal; he introduced the bill constituting the new Ministry of Munitions, and took charge in the Lords of the Munitions of War bill. He became president of the Air Board in May 1916 and in July became a permanent member of the War Committee of the cabinet. When Lloyd George formed his ministry in December, Lansdowne and Crewe—the two leaders of parties in the Lords—both retired from office, and Curzon became the leader of the House with the office of lord president. He was also one of the four ministers who constituted the war cabinet, and were charged with the permanent daily conduct of the war. After the Paris conference he took over the Foreign Office from A. J. Balfour, retaining his leadership of the party in the House of Lords.

His lifelong study of foreign politics, and his first hand knowledge of Asiatic problems fitted him admirably for the foreign office. But foreign affairs in the years immediately following the war were still dominated by the prime minister and the Supreme Council; and it was at meetings of the latter, which Lloyd George attended—at Paris, San Remo, Spa, Lympne and London—that a settlement, or at least a temporary salve, was found for recurrent difficulties. Lord Curzon's reputation was a rather formidable one He had the grand manner, and none but his few intimates knew the witty, friendly and even modest personality behind the façade. His autocratic method in India and the conflict with Lord Kitchener there led people to expect that he would be a masterful foreign secretary. But to the general surprise he accepted the position imposed by Lloyd George's assumption of the main work of diplomacy, and never showed any resentment. It was not until after the fall of the coalition (Oct. 1922) that Curzon had the full powers associated with the position of foreign secretary. He retained office under Bonar Law and Baldwin until 1924.

During this period he had first to straighten out British relations with the Nationalist Turks, who, disregarding the Treaty of Sèvres, had driven the Greeks out of Thrace and Asia Minor by force of arms. In the winter of 1922–3 he presided over a European conference at Lausanne, where he employed all his resources of knowledge, skill, patience and courtesy in the vain endeavour to win Turkish consent to a satisfactory settlement. Ultimately Turkey was allowed to retain all she had regained. Relations with Russia also presented great difficulties. By remonstrances in the spring and summer of 1923, he obtained from the Russian Government the suspension of anti-British action and propaganda, and the removal of their incriminated officials at Kabul and Teheran.

But his principal preoccupation was the relations of England, France and Germany. Poincaré, the French prime minister, in spite of serious British protests, embarked in the winter of 1922–23 on the Ruhr expedition to exact reparations from Germany; and he continued and intensified the pressure throughout the year, accompanying it with the policy of encouraging Separatist movements in the Rhineland. Curzon, who had begun by merely dissociating Britain from French action, gradually took up a position of decided antagonism; and finally in August issued a note of severe condemnation, asserting the total illegality of the French movement. It is fair to say that this note was drafted in the prime minister's department, and that the most that can be alleged against the foreign office is that they did not modify its terms so as to make it more acceptable. In any case the remonstrance merely exacerbated the situation. Meanwhile Curzon had encouraged Germany to make, in regard to reparation, offers of her own, which eventually became sufficient to afford a basis for negotiation. Before he left office he had secured the consent of

France and Belgium to an advisory committee of experts (in which the United States had decided to co-operate) to be appointed by the Reparations Commission. This developed under Ramsay MacDonald into the Dawes committee, from whose report dated the improvement of European relations.

Curzon had two serious disappointments in his last years, both of which he bore with dignity. The first of these was when, on Bonar Law's resignation in May 1923, Baldwin was chosen prime minister, mainly because it was only in the House of Commons that the real opposition, the Labour party, could be encountered. The other was when Baldwin formed his second cabinet in the autumn of 1924, and passed over Curzon's claims to return to the Foreign Office in favour of Austen Chamberlain. On the first occasion, Lord Curzon consented to take the chair at the conservative party meeting which elected Baldwin to the leadership; on the second, he accepted the presidency of the council, retaining, of course, the leadership in the Lords.

The first Lady Curzon, by whom he had three daughters, died in 1906, and in 1917 he married, as his second wife, Grace Elvina, widow of Alfred Duggan, of Buenos Aires, and daughter of J. Munroe Hinds, United States consul, Rio, Brazil. He succeeded to the barony of Scarsdale on his father's death in 1916 and became a K.G. in the same year. He was created a marquess on the king's birthday in 1921. In 1925 he received the gold medal of the Royal Geographical Society.

Curzon's life was one of unremitting industry. He followed a strict *régime,* was always working and always writing. In spite of a serious weakness, curvature of the spine, which he developed in his early days at Oxford, he took violent physical exercise, and during his eastern travels, rode many hundreds of of miles. He had forced himself by sheer will-power, to do day by day more than a strong man's work; and in the early spring of 1925, his health suddenly broke down, and after a fortnight's illness he died in London on March 20. As he left no son, the marquessate and earldom became extinct; the viscountcy and barony of Scarsdale passed, with Kedleston, to his nephew; and his eldest daughter, Lady Irene Curzon, inherited the barony of Ravensdale.

His *British Government in India* (2 vols.), on the proofs of which he was engaged during his last illness, appeared in 1925. To his later years also belongs the *Tales of Travel* (1923).

The official *Life of Lord Curzon,* in three volumes, by Lord Ronaldshay, appeared in 1928.

CUSANUS, NICOLAUS (Nicholas of Cusa) (1401–1464), cardinal, theologian and scholar, the son of a boatman named Krypffs or Krebs, derived his name from his birthplace, Kues or Cusa, on the Moselle. He took his doctor's degree in law at Padua in 1423, and after studying theology at Cologne became archdeacon of Liége. He was a member of the council of Basel (1437), and dedicated to the assembly his *De concordantia Catholica,* in which he maintained the superiority of councils over popes, and assailed the genuineness of the False Decretals and the Donation of Constantine. Later, he zealously defended the supremacy of the pope. He was entrusted with various missions by the pope, being sent to Constantinople to bring about a union of the Eastern and Western churches. From 1440 he was in Germany, as papal legate at the diets of 1441, 1442, 1445 and 1446. In 1448, in recognition of his services, Nicholas V. raised him to the cardinalate, and in 1450 he was appointed bishop of Brixen. In 1451 he was sent to Germany and the Netherlands to check ecclesiastical abuses, to purify monastic life and to promote the crusade. He died Aug. 11, 1464.

Apart from his religious reforms, Cusanus is notable for his emphasis on the less predominant tendencies of mediaeval thought. Thus, like the early Oxford Franciscans, he exalts mathematics and experiment and objects to an excessive devotion to Aristotle. In his *Reparatio Calendarii,* presented to the council of Basel, he proposed the reform of the calendar after a method resembling that adopted by Gregory. In his *De Quadratura Circuli* he professed to have solved the problem; and in his *Coniectura de novissimis diebus* he prophesied the end of the world in 1734. He anticipated Copernicus by maintaining a universal movement in which the earth, which is not the centre of the universe, is involved. Celestial bodies are neither strictly circular in form nor in movement. In his principal work, *De docta ignorantia* (1440), supplemented by *De Coniecturis libri duo* (1440) he maintains that, because no two things are alike, all human knowledge is mere conjecture, and man's wisdom is to recognize his ignorance. From scepticism he escapes by holding that God (the reality in which things participate and in which contradictions vanish) can be apprehended by intuition; hence the universe and man, who return to God by their love of unity, are called the contracted maximum. He thus laid himself open to the charge of pantheism brought against him in his day. His chief philosophical doctrine was taken up by Giordano Bruno, who calls him the divine Cusanus.

The works of Cusanus were published at Basel, 1565. There are Eng. translations of *The Idiot* (1650), *Coniectura de Ultimis diebus* (1696), *De Visione Dei* (1646) and ch. 2. of Bk. 3. of *De cord. Cath.* dealing with the Donation of Constantine. *See* F. A. Scharpff's *Der Kardinal und Bischof Nikolaus von Cusa als Reformator in Kirche, Reich und Philos. des 15 Jahrhund.* (Tübingen, 1871); J. M. Düx, *Der deutsche Kard. Nicolaus von Cusa und die Kirche seiner Zeit.* (Regensburg, 1848); F. J. Clemens, *Giordano Bruno und Nikolaus Cusanus* (Bonn, 1847); E. van Steenberghe, *Le Cardinal N. de Cusa* (1920).

CUSCO, Peru: *see* CUZCO.

CUSH, the eldest son of Ham, in the Bible, from whom seems to have been derived the name of the "Land of Cush," commonly rendered "Ethiopia" by the Septuagint and the Vulgate. The exact territory thus designated is uncertain, some maintaining that it lies in Africa, in which case it will be the country to the south of Assouan, others that it is in Arabia, whilst a third view again associates the name with the "Kassites," who for some centuries dominated Babylonia. The various references suggest that the term may have been applied to districts in all three regions.

CUSHENDUN, 1st Baron (the Rt. Hon. Ronald John M'Neill, P.C.) (1861–1934), British politician, was born April 3, 1861, the son of an Ulster landowner, Edmund M'Neill, and educated at Harrow and Christ Church, Oxford. He became a barrister, but found a career in journalism. In 1899 he became assistant editor of *The St. James's Gazette,* and was editor of the same journal 1900–04. From 1906–10 he assisted Mr. Hugh Chisholm in the preparation of the 11th edition of *The Encyclopædia Britannica.* Having made several unsuccessful attempts to enter parliament, he was, in 1911, returned as Conservative M.P. for the St. Augustine (in 1918 for the Canterbury) division of Kent. As a politician he was for some years associated with Sir Edward Carson and the more strenuous opponents of Home Rule. When Baldwin formed his first ministry in 1922, M'Neill was appointed Under-secretary for Foreign Affairs; he held that office until early in 1924 and returned to it in Nov. of the same year again under Baldwin. From 1925–27 he was financial secretary to the Treasury. In 1927 he was appointed Chancellor of the Duchy of Lancaster, and raised to the peerage in the same year, taking the title Baron Cushendun from one of his family estates. When Sir Austen Chamberlain was obliged by ill-health to relinquish the conduct of the Foreign Office in the summer of 1928, Lord Cushendun took his place. He was signatory for Great Britain of the Kellogg Peace Pact, Aug. 27, 1928.

CUSHING, CALEB (1800–1879), American statesman and lawyer, was born in Salisbury, Mass., on Jan. 17, 1800. He graduated at Harvard in 1817, was tutor in mathematics there in 1820–21, was admitted to the Massachusetts bar in Dec. 1821, and began the practice of law in Newburyport, Mass., in 1824. After serving, as a Democratic-Republican, in the State house of representatives in 1825, in the State senate in 1826, and in the house again in 1828, he spent two years in Europe. He again served in the State house of representatives in 1833–34, and in the latter year was elected by the Whigs as a representative in Congress. He served in this body from 1835 until 1843, but during this period he was forced out of the Whig Party by his support of Tyler's vetoes of certain Whig measures. In 1843 President Tyler nominated him for secretary of the treasury, but the Senate refused to confirm him for this office. He was appointed later in the same year U.S. commissioner to China, where he negotiated the first treaty between China and the United States (1844);

in it was outlined the principle of exterritoriality. During the Mexican War he raised the funds necessary to equip a regiment and served with it first as colonel and afterwards as brigadier-general of volunteers. In 1847 and again in 1848 the Democrats nominated him for governor of Massachusetts, but each time he failed to be elected. After serving in the State legislature in 1851, he became an associate justice of the Massachusetts supreme court in 1852, and during the administration (1853–57) of President Pierce, was U.S. attorney general. In 1860 he presided over the Democratic national convention which met first at Charleston and later at Baltimore; when the split in the party came, he presided over the seceders, who nominated Breckinridge. During the Civil War he supported loyally the Union and served the Administration in various minor positions. At the Geneva conference for the settlement of the "Alabama" claims in 1871–72 he was one of the counsel for the United States. In 1873 President Grant nominated him for chief justice of the United States, but vigorous opposition in the Senate caused his name to be withdrawn. From 1874 to 1877 Cushing was U.S. minister to Spain. He died at Newburyport, Mass., on Jan. 2, 1879. He published *History and Present State of the Town of Newburyport, Mass.* (1826); *Review of the Late Revolution in France* (1833); *Reminiscences of Spain* (1833); *Orations on the Growth and Territorial Progress of the United States* (1839); *Life and Public Services of William H. Harrison* (1840); and *The Treaty of Washington* (1873).

See C. M. Fuess, *The Life of Caleb Cushing* (1923).

CUSHING, HARVEY (1869–1939), American surgeon, fourth in direct line of a family of physicians, was born at Cleveland (O.), on April 8, 1869. He graduated from Yale university in 1891 and from the Harvard medical school in 1895. After four years at Johns Hopkins hospital he studied abroad under Kocher at Berne, and Sherrington at Liverpool. On his return to Baltimore he held various positions in the department of surgery at Johns Hopkins university, becoming associate professor in charge of cases of surgery of the central nervous system. He wrote numerous monographs on the surgery of the brain and developed the method of operating with local anaesthesia. His work on the pituitary body (1912) gave him an international reputation. He also made important contributions to the study of blood pressure in surgery, and to the classification of brain tumours. From 1912 to 1932 he was professor of surgery in the Harvard medical school and surgeon-in-chief at the Peter Bent Brigham hospital in Boston. From 1917–19 he was director of U.S. base hospital No. 5 attached to the B.E.F. in France. In 1918 he was made senior consultant in neurological surgery for the A.E.F. He wrote a *Life of Sir William Osler* (1925) which received the Pulitzer Prize for Biography. In 1933 he became Sterling professor of neurology at Yale university.

CUSHING, WILLIAM BARKER (1842–1874), American naval officer, was born in Delafield, Wis., on Nov. 4, 1842. His father's early death forced him and his two brothers, who later displayed great gallantry in the army, to assist their mother. He was for a time a congressional page, but in 1857 received an appointment to the naval academy, from which he was obliged to resign in 1861 as the result of a prank played on one of his professors. The outbreak of the Civil War gave him, however, an opportunity to redeem himself, of which the self-styled "ex-midshipman, ex-master's mate, hare-brained scapegrace" took the fullest advantage. Coolness, daring, exceptional resourcefulness and a good fortune which caused the more superstitious of the sailors to believe him invulnerable made him the hero of a series of most spectacular feats. Foremost among them was the destruction of the Confederate ironclad "Albemarle" in the Roanoke river on Oct. 27, 1864. This vessel, which had done much damage to the Federal naval forces, was at anchor when Lieutenant Cushing in a steam launch succeeded in eluding the Confederate look-out and in exploding against her a spar-torpedo with such success that she sank. Cushing's own launch was destroyed and the crew compelled to take to the water, only he and one other man escaping capture or death. For this achievement he was thanked by Congress and made lieutenant-commander. He was promoted commander at the exceptionally early age of 30. He died at Washington, D.C., of brain fever on Dec. 17, 1874.

See a sketch by C. F. Stewart, which contains autobiographical material, in U.S. Naval Instit., *Proceedings*, vol. xxxviii., pp. 425–491, 913–991 (1912); T. W. Haight, *Three Wisconsin Cushings* (1910).

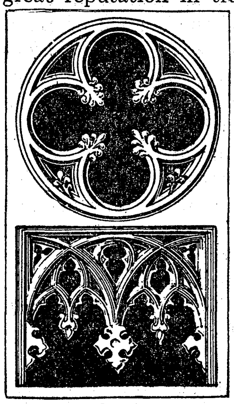
CUSHING, a city of Payne county, Oklahoma, U.S.A., 70m. N.E. of Oklahoma City, near the Cimarron river. It is served by the Missouri-Kansas-Texas and the Santa Fe railways. In 1900 the population was 826; in 1930, 9,301; and it was 7,703 in 1940 by the federal census. Cushing is in the oil, gas and cotton belt of Oklahoma. It has cotton gins, compresses, lumber yards, two refineries and three pump stations. It was settled about 1892, and incorporated in 1894.

CUSHION, a soft bag of some ornamental material, stuffed with wool, hair, feathers or even paper torn into fragments. It may be used for sitting or kneeling upon, or to soften the hardness of a chair or couch. It is a very ancient article of furniture, the inventories of the contents of palaces and great houses in the early middle ages constantly making mention of it. It was then often of great size, covered with leather, and firm enough to serve as a seat, but the tendency of all furniture has been to grow smaller. It was, indeed, used as a seat, at all events in France and Spain, at a very much later period, and in Saint-Simon's time we find that at the Spanish court it was still regarded as a peculiarly honourable substitute for a chair. In France the right to kneel upon a cushion in church behind the king was jealously guarded and strictly regulated, as we may learn again from Saint-Simon. This type of cushion was called a *carreau* or square.

The term "cushion" is given in architecture to the sides of the Ionic capital. It is also applied to an early and simple form of the Romanesque capitals of Germany and England, which consist of cubical masses, square at the top and rounded off at the four corners, so as to reduce the lower diameter to a circle of the same size as the shaft.

CUSHITE LANGUAGES, the name given to a group of Hamitic languages spoken from the Red Sea littoral to the area south of the Horn of Africa. (*See* HAMITIC LANGUAGES.)

CUSHMAN, CHARLOTTE SAUNDERS (1816–1876), American actress, was born in Boston, Mass., on July 23, 1816. Her father, a West India merchant, left his family in straitened circumstances, and Charlotte, who had a fine contralto voice, went on the operatic stage. In 1835 she successfully appeared at the Tremont theatre as the Countess Almaviva in *The Marriage of Figaro*. But her singing voice failing her she entered the drama, and played Lady Macbeth in the same year. In 1842 she managed and played in the Walnut street theatre in Philadelphia. She accompanied Macready on an extensive American tour, winning a great reputation in tragedy. In 1845 and again in 1854–55 she fulfilled successful engagements in London.



CUSP

Top: Early English, Lichfield Cathedral. Bottom: Gothic

She was a keen student, and acquired a large range of classic rôles. Her best parts were Lady Macbeth and Queen Katherine, her most popular, Meg Merrilies, in a dramatization of Scott's *Guy Mannering*. Her commanding figure and her animated vigorous temperament enabled her to play with success such male parts as Romeo and Cardinal Wolsey. Her last stage appearance was at the Globe theatre, Boston (May 15, 1875). She died in Boston Feb. 18, 1876.

See Emma Stebbins' *Charlotte Cushman, her Letters and Memories of her Life* (1878); H. A. Clapp, *Reminiscences of a Dramatic Critic* (1902); and W. T. Price, *A Life of Charlotte Cushman* (1894).

CUSP, technically, the intersection of two curves; hence, in architecture, the intersections of lobed or scalloped forms, particularly in arches (cusped arches) and tracery. Thus the three lobes of a trefoil (clover leaf form) are separated by three cusps. Cusped forms appear commonly in early Mohammedan work (*see* Mohammedan Architecture), as in the mosque of Ibn Touloun at Cairo (*c.* 875), and were especially frequent in the Moorish work of Algiers and Spain. The cusp is found occasionally in the Romanesque work (*see* Byzantine and Romanesque Architecture) of France, as in the chapel of St. Michel de l'Aiguille at Le Puy en Velay (probably late 11th century), due perhaps to influence from Spain, but it did not become popular until the Gothic period (*see* Gothic Architecture), during which it was used universally and frequently enriched with leaves, flowers or even human heads at the tip.

CUST, HENRY JOHN COCKAYNE (1861–1917), English journalist, was born in London on Oct. 10, 1861, and educated at Eton and Trinity college, Cambridge. He was Unionist member for Stamford from 1890 to 1895, and for Bermondsey from 1900 to 1906. From 1892 to 1896 he was editor of the *Pall Mall Gazette.* In Aug. 1914, he founded the Central Committee for National Patriotic Organizations, and a Cust annual lecture "on some important current topic relating to the British empire" was endowed in Nottingham university to commemorate his work. His *Occasional Poems* appeared in 1918, printed in Jerusalem. He died in London on March 2, 1917.

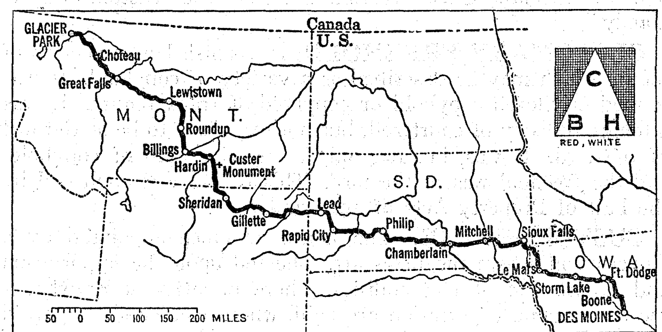
CUSTARD APPLE, a name applied to the fruit of various species of the genus *Annona* (family Annonaceae). The members of this genus are shrubs or small trees having alternate, exstipulate leaves, and flowers with three small sepals, six petals arranged in a double row and numerous stamens. The fruit of *A. reticulata,* the common custard apple, or "bullock's heart" of the West Indies, is dark brown in colour, and marked with depressions, which give it a quilted appearance; its pulp is reddish-yellow, sweetish and very soft (whence the name); the kernels of the seeds are said to be poisonous. The sour-sop (*q.v.*) is the fruit of *A. muricata,* native of the West Indies. The sweet-sop (*q.v.*) is produced by *A. squamosa,* a native of tropical America and widely cultivated in the tropics. *A. cherimola* yields the Peruvian cherimoya, which is a much esteemed fruit of superior flavour. *A. palustris,* alligator-apple or cork-wood, a native of South America and the West Indies, is valued for its wood, which serves the same purposes as cork; the fruit, commonly known as the alligator-apple, is not eaten, being reputed poisonous. (*See* Annonaceae; Cherimoya.)

CUSTER, GEORGE ARMSTRONG (1839–1876), American cavalry soldier, was born in New Rumley, Ohio. He graduated from West Point in 1861, and was sent at once to the theatre of war in Virginia, joining his regiment as it was going into the first battle of Bull Run. He served afterwards on the staff of Gen. Kearny, and later a daring reconnaissance on the Chickahominy river brought him to the notice of Gen. McClellan, the commander-in-chief, to whose staff he was promptly attached. When McClellan was relieved of his command, Custer returned to his regiment, but early in 1863 was selected as an aide-de-camp by Gen. Pleasonton who promoted him to the rank of brigadier general of volunteers. Custer distinguished himself at the head of the Michigan cavalry brigade in the battle of Gettysburg and served brilliantly through the remaining operations of the campaign of 1863. When the cavalry corps of the Army of the Potomac was reorganized under Sheridan in 1864, Custer retained his command and took part in the various actions of the cavalry in the Wilderness and Shenandoah campaigns. He led a division in the brilliant cavalry action called the battle of Woodstock, and took a most conspicuous part in the decisive battle of Cedar creek. In 1865 he accompanied Sheridan on his last great cavalry raid, won the action of Waynesboro, fought bravely at Five Forks, and led the final cavalry charge at Appomattox court house. He emerged as one of the most brilliant cavalry leaders of the Civil War.

In 1866 Custer was made lieutenant colonel of the 7th U.S. cavalry and ordered to Kansas to take part under Gen. Hancock in an expedition against the Cheyenne Indians. A crushing defeat was inflicted upon them at Washita river in November, 1868. After five more leisurely years during which time he wrote *My Life on the Plains* (1874) Custer and the 7th regiment were ordered against the Sioux in Dakota and Montana. As the advance guard of the troops under Gen. Terry, Custer's force arrived at the junction of Big Horn and Little Big Horn rivers, Montana territory, June 24, 1876; the main body was due to join him on the 26th. Unfortunately, the presence of what was judged to be a small force of Indians was reported to the general, and dividing his regiment into three parties he moved forward on the 25th to surround this force. But instead of meeting only a small force of Indians, the regiment was promptly attacked by the full force of the enemy. The flanking columns maintained themselves with difficulty until Terry came up. Custer and 264 men of the centre column rode into the midst of the enemy, and were slaughtered.

Bibliography.—Besides Custer's own book, consult those of his wife, Elizabeth Bacon Custer, *Boots and Saddles* (1885), *Tenting on the Plains* (1887), and *Following the Guidon* (1891). *See* F. W. Whittaker, *Life of General George A. Custer* (1876); F. S. Dellenbaugh, *George Armstrong Custer* (1917); P. E. Byrne, *Soldiers of the Plains* (1926); and W. A. Graham, *The Story of the Little Big Horn* (1926).

CUSTER BATTLEFIELD HIGHWAY extends from Des Moines, Iowa, to Glacier National park, Montana, a distance of about 1,500 miles. It includes along its course six national



CUSTER BATTLEFIELD HIGHWAY

forests, three national monuments, two national parks, two Indian reservations and a region adapted to camping, hunting and fishing. The Custer Battlefield national cemetery, which is replete with historic memories of the early West; the Bad Lands of South Dakota; the Black Hills; the Roosevelt monument at Deadwood; the "Devil's Tower"—are the outstanding landmarks of this interesting route. Ft. Dodge, Sioux Falls, Deadwood, Billings, Roundup, Lewiston and Great Falls are among the cities along the way.

CUSTINE, ADAM PHILIPPE, Comte de (1740–1793), French general, was born in Metz on Feb. 4, 1740, and began his military career in the Seven Years' War. He next served against the English in the War of American Independence. In 1789 he was elected to the States General by the *bailliage* of Metz. In Oct. 1791 he again joined the army, with the rank of lieutenant-general and became popular with the soldiers, amongst whom he was known as *Général Moustache.* General-in-chief of the army of the Vosges, he took Speyer, Worms, Mainz and Frankfurt in September and October 1792. During the winter a Prussian army forced him to evacuate Frankfurt, re-cross the Rhine and fall back upon Landau. He was accused of treason, defended by Robespierre, and sent back to the army of the north. But he dared not take the offensive, and did nothing to save Condé, which the Austrians were besieging. Sent to Paris to justify himself, he was found guilty by the revolutionary tribunal of having intrigued with the enemies of the republic, and guillotined on Aug. 28, 1793. (*See* French Revolutionary Wars.)

See A. Rambaud, *Les Français sur le Rhin* (1880); A. Chuquet, *Les Guerres de la Révolution,* "L'Expédition de Custine" (1886–95).

CUSTOM, in general, a habit or practice. Thus a tradesman calls those who deal with him his "customers," and the trade resulting as their "custom." The word is also used for a toll or tax levied upon goods (*see* Customs).

In law, such long-continued usage as has by common consent become a rule of conduct is termed custom. The adoption of local customs by the judiciary has undoubtedly been the origin of a great portion of the English common law. Blackstone divides custom into (1) general, which is the common law properly so called, and (2) particular, which affects only the inhabitants of particular districts. The requisites necessary to make a particular custom good are: (1) It must have been used so long that the memory of man runneth not to the contrary; (2) it must have been continued, and (3) enjoyed peaceably; (4) it must be reasonable, and (5) certain; (6) it must be compulsory, and not left to the option of every man whether he will use it or not; (7) it must be consistent with other customs, for one custom cannot be set up in opposition to another. Customs may be of various kinds, for example, customs of merchants, customs of a certain district (such as gavelkind and borough English), customs of a particular manor, etc. The word custom is also generally employed for the *usage* of a particular trade or market; for a trade custom to be established to the satisfaction of the law it must be a uniform and universal practice so well defined and recognized that contracting parties must be assumed to have had it in their minds when they contracted.

In the history of France the term "custom" was given to those special usages of different districts which had grown up into a body of local law, as the "custom of Paris," the "custom of Normandy."

CUSTOMARY FREEHOLD, in English law, a species of tenure which may be described as a variety of copyhold. It was termed privileged copyhold or copyhold of frank tenure. It was a tenure by copy of court roll, but not expressed to be at the will of the lord. It was, in fact, only a superior kind of copyhold, and the freehold was in the lord. This tenure was abolished by the Law of Property Acts of 1922 and 1925.

CUSTOM HOUSE. The house or office appointed by a Government where the taxes are collected upon the importation and exportation of commodities, where bounties or drawbacks receivable upon exportation are paid, where free goods imported or exported are declared, and where vessels are entered and cleared. The term "Custom House" has passed into all English-speaking countries.

Collection of Customs.—In early days it was the regular practice to farm the customs revenue for lengthy periods, generally of three years. In the middle of the 17th century this system was found to be very cumbersome and the revenue was therefore supplemented by the establishment of the excise, which included duties on many imported articles, differing from the customs duties only in that they were collected by commissioners of excise under the direct control of the crown. The farming system finally collapsed after the Restoration owing, chiefly, to its inconvenience, but also to the fact that the farmers were bankrupt through the country having been in quarantine for nearly a year during the Great Plague. Thereafter the collection of the customs revenue remained in the hands of the government. The collection and management of duties of customs and excise were after 1909 the responsibility of the customs and excise department, under the direction of the commissioners of customs and excise who are subject to the control of the treasury.

From the earliest times the British custom house was used for purposes other than the collection of the customs revenue. Formerly the customs officials were responsible for the collection of the light dues on behalf of the various lighthouse proprietors, and transacted all business concerning the measurement, registration and transfer of shipping, while until 1896 the customs department was also responsible for the enforcement of the quarantine regulations.

The customs and excise department assists in controlling for other departments the traffic in many nondutiable goods which, on various grounds of public policy (*e.g.*, for the protection of health), are subject to prohibition or special regulation. (*See* Customs Collector.) **(W. D. C.)**

CUSTOMS (*see* also Tariffs). The use of the British term "Customs" is of early origin, and arose as an abbreviated form of "customary" dues. It was anciently used to describe any customary payment, whether to king or church, but in process of time it came to be restricted to taxes on the import or export of commodities. As early as the reign of Richard I a tax called prise was levied on wine imports. In the Exchequer Statute of 1266 we find reference made to the yield of the customs duty on wool. The ancient customs were three. There was the grant by Parliament to the Throne of export duties on wool and leather. Then there were the import duties on wine at so much a ton—"tonnage," and at so much a pound on the value of all other goods—"poundage." Poundage at 1/- the pound, or 5%, became customary for a long period. In 1303 a charter of Edward I to alien merchants granted them liberty of trading on payment of certain duties on wine, wool, hides, cloth, etc., known variously as "new customs," "butlerage," "alien duty," or "petty custom."

The first complete legal grant of tonnage and poundage imposed by Parliament, extending to English citizens, was in 1373, in the reign of Edward III. This was called, as indeed it was, a "subsidy" to the sovereign, and after 1373 Parliament renewed the subsidy to each sovereign at the beginning of his reign. Much later we find the Act of Tonnage and Poundage of 1660 (Charles II) setting out certain scheduled rates of duty—the book of rates—as the figures at which the *ad valorem* poundage duties were to be assessed.

Growth of Customs Complexity.—In the reign of William III. the system began of mortgaging the customs yield in return for war loans, and many complicated additional dues were exacted; thus in 1698 there was an additional levy on Scottish and coastwise coals. So, in 1702, the yield of the customs rose to £1,285,605. Further heavy additions were made under Queen Anne, and in 1714 the yield was £1,779,696. In 1751, in the reign of George II., a competent authority, quoted by Pittar in his history of the Customs Tariffs, wrote: "What a maze our merchants must be in . . . Can we wonder at the decay of our commerce . . . should we not wonder that we have any left?" In 1784 the complexities had become so great that a consignment of 2,000 ells of Russian linen paid duty under ten different heads to the tune of £69 17s. od., and this sum was earmarked in detail and painfully divided up amongst many different public funds. In 1785 a committee of public accounts investigated 68 cumbrous heads of customs, in addition to five plantation duties, and directed attention to "the intricacy and perplexity that involve the collection of accounts." As a result Pitt, in 1787, consolidated the customs into single rates for each article, and enacted that all their produce should be paid into a single account to be called the "Consolidated Fund." Nevertheless, the Customs Rate Book of 1787 was a formidable compilation, and the regulations remained numerous and complicated; a shipmaster could not tackle them without expert aid. In 1793 came the war with France and heavy customs increases, and in 1798 convoy duties were enacted to pay for naval protection. Until the unions with Scotland and Ireland, there were vexatious customs duties against Scottish and Irish imports which greatly impaired trade with those countries; William III., for example, was moved to use the customs to discourage the Irish in the woollen manufacture while permitting them to trade with England in linens. Ireland, although a pastoral country, might not export her cattle or produce to England.

The Coming of Free Trade.—In 1801, the United Kingdom had no less than 1,500 specific rates of customs duty, and each article imported bore four different rates; a hundredweight of copper had to pay £2 5s. 8d. on importation. In 1826, and again in 1833, there were codifications, but excessive restrictions and prohibitions remained until 1842, when Sir Robert Peel began his great reforms, sweeping away many imposts and simplifying others. The customs tariff of 1842 reduced the import taxes on raw materials to rates not exceeding 5%, and those on manufactures to rates not exceeding 20%. Then followed the Free Trade Acts of 1845 and 1846, which cancelled hundreds of duties, virtually repealed the Corn Laws, and gave free entry to animals, meat and vegetables. By his budget of 1860, Mr. Gladstone reduced the customs tariff, for practical purposes, to a revenue tariff on a few articles not produced in the United Kingdom, and the customs duties thus ceased to have any protective effect. The duties were reduced to 26 denominations, of which ten, viz., those on beer, cards, chicory, dice, spruce, hops, malt, paper, vinegar and plate were solely imposed as countervailing duties to balance excise revenue taxes on the like articles produced at home.

Tariff Revival After War.—Thus the British customs system became a very simple one, used for revenue purposes, and so it remained until the World War, when (1915–16) import duties were imposed on a few imported luxuries, which, not being countervailed by excise duties, had a certain protective effect. Mr. McKenna, the chancellor of the exchequer who imposed these duties, chose cinematograph films, clocks and watches, pleasure motor-vehicles, and musical instruments for his purpose as proper articles upon which to levy sumptuary taxes, and these war time customs duties came to be called the "McKenna duties." In 1924, the Labour Government, in its brief tenure of office, repealed these duties, notwithstanding their incidence upon wealth, in the cause of Free Trade, but Mr. Churchill reimposed them in 1925, and in addition imposed a sumptuary customs duty on silk and artificial silk largely countervailed by an excise duty. The policy of safeguarding "key" and other industries also led, after the war, to the enactment of the safeguarding of industries act, 1921, which scheduled certain groups of articles as "key" or indispensable industries to be chargeable to customs duty at $33\frac{1}{3}\%$ *ad valorem;* these were optical glass, optical instruments, scientific glassware, laboratory porcelain, scientific instruments, measuring instruments of precision, certain compounds (not ores or minerals) of the rare metals, and certain chemicals. Few as these classifications seem, they cover in practice thousands of articles, and fill an official book of 68 pages. The safeguarding of industries act also made dutiable competing imports in cases in which it could be demonstrated by official enquiry that home industries were unfairly competed with through foreign currency depreciation, subsidies, or inferior labour conditions. Under this provision, lace, embroidery, gas mantles, leather and fabric gloves, cutlery, packing and wrapping paper, tableware and translucent pottery were made dutiable. So the British import duties grew again, but by far the greater part of the British customs tariff in 1928 was levied for revenue purposes only. (*See* FREE TRADE, PROTECTION, and SAFEGUARDING OF INDUSTRY.)

BIBLIOGRAPHY:—Pittar's *Customs Tariffs of the United Kingdom* (Blue Book G 8706 of 1897), is the best detailed account of customs history to that date; for the years after 1897 it is necessary to consult the *Statistical Abstract* of the United Kingdom, and the lists published by the British Stationery Office under the safeguarding of industries act.

BRITISH STATISTICS

The chief heads under which these duties are imposed in Great Britain are: oil, spirits, beer, tobacco, tea, sugar, wine, silk and artificial silk, cocoa, matches, beef and veal, motor vehicles, entertainments and liquor and other licences. Spirits, beer, artificial silk, sugar, matches and mechanical lighters are subject to both customs and excise duties. Tobacco, tea, silk, cocoa, oil, beef and veal, and clocks are subject to customs duties only. Entertainments are subject only to excise duties.

Items	1937–38		1926–27	
	Customs	Excise	Customs	Excise
	£	£	£	£
Cocoa, etc.	871,765		753,905	
Beer	4,498,816	61,241,404	5,432,875	78,763,480
Dried fruit	649,944		588,109	
Spirits	4,813,872	31,092,200	6,494,279	37,058,506
Sugar, etc.	9,807,635	2,065,781	17,429,320	1,354,188
Tobacco	82,951,392		53,857,530	1,831
Wine	4,996,611	498,521	4,328,908	
Tea	7,352,116		5,952,668	
Beef and veal	3,563,398			
Clocks, watches	733,342			
Motor vehicles	1,693,375			
Oil	50,258,914			
Matches	2,128,495	2,120,587	2,122,947	1,455,895
Silk and artificial silk	4,169,995	2,136,615	4,960,133	706,583
Imports Duty Act, 1932	29,712,341			
Key industry goods	1,012,386			
Eire imports	4,182,011			
Ottawa duties	8,096,993			
Liquor licenses		4,305,194		4,246,743
Entertainments		7,985,071		5,729,054
Patent medicine labels		732,699		1,295,139
McKenna duties			2,711,767	

The yield from the combined customs and excise duties was as follows: 1913–14, £75,226,538; 1917–18, £109,467,421; 1918–19, £163,129,231; 1919–20, £283,335,635; 1920–21, £333,813,420; 1921–22, £323,354,993; 1922–23 (in and after which year the figures apply to Great Britain and Northern Ireland, the Irish Free State having come into existence), £279,733,257; 1923–24, £267,730,836; 1924–25, £235,006,811; 1925–26, £237,758,442; 1933–34, £286,884,014; 1937–38, £336,116,854.

UNITED STATES

Customs or import duties in the United States are collected at certain specified ports of entry according to the schedules of the tariff act then in effect (*see* TARIFFS). However, according to the Tariff Act of 1922, the president may alter rates of duty by proclamation whenever, upon investigation, it is found that the duties fixed in the act do not equalize the differences in the costs of production of articles that are the growth or product of the United States, and of like or similar articles the growth or product of competing foreign countries. The right to change any rate or duty is restricted to a total increase or decrease of 50% of the rate specified in the act. Customs in the United States are confined to imports only, as the Constitution prohibits both export and inter-State duties. Some rates are specific, *i.e.,* based upon count, volume or weight irrespective of value; while others are *ad valorem, i.e.,* based upon value alone. The imports of the United States for the calendar year 1926 were valued at $4,408,076,000, of which $1,499,969,000 worth were dutiable, assessed $590,045,000 or an *ad valorem* of 39·34%. The world wide depression cut these figures by 1933 to: imports $1,433,013,000, dutiable $529,466,000, duty $283,681,000, equalling an *ad valorem* of 53·58%.

In 1937 imports were $3,084,061,000. The actual customs collections reported for years ending June 30 fell from the all time peak of $605,500,000 in 1926–27 to $250,750,000 in 1932–33. In 1937–38 the amount was $359,187,249.

Customs claims for the return of money illegally exacted by the administrative customs official are brought before the U.S. customs court. If the valuation by the local appraiser of imported merchandise upon which an *ad valorem* duty is assessed is disputed by the importer he may appeal for revaluation within ten days after the personal delivery or mailing of the written notice of appraisement by the local appraiser. If the importer is dissatisfied with the classification by the collector of customs at the port of entry, he may file a protest in writing within 60 days with such collector, who thereupon must forward the papers to the court, and the case is regularly docketed. There are within the United States and its Territories 47 customs districts, and, at 11 of these, regular dockets for the trial of such cases are held.

CUSTOMS COLLECTOR, the official of the U.S. Treasury Department who is the head of the customs office in a port of entry. The collectors at the principal ports are named by the president with the advice and consent of the Senate, and the major appointments are awarded to active party workers. Collectors at minor ports are named under the civil service regulations. At the principal ports the collector is assisted by an appraiser, a comptroller, a surveyor and a corps of inspectors and clerks.

CUSTOMS UNION. The idea denoted by the term is almost more familiar in its German form of "Zollverein." Strictly speaking, it means any agreement or union of a number of separate states affecting their arrangements with regard to tariffs, either among themselves or against the outside world. The classic instance was the treaty of March 1833, under which the Prussians agreed with various independent German states (at first Hesse Cassel, Hesse Darmstadt, Bavaria and Württemberg) to impose no tariffs whatever against each other and to adopt a uniform tariff against the rest of the world. This became later the germ of the idea of the Federation of the German States.

In other cases the customs union has been the means by which a small state has brought itself within the tariff system of a larger adjoining state while theoretically retaining its political independence in other ways, *e.g.* San Marino with Italy by the treaty of 1862, Monaco with France, 1865, Liechtenstein with Austria, 1875, and Portuguese India with British India, 1878. The union in this case may be very unequal, and is practically a recognition of the dominance of the adjoining greater power in commercial affairs, making the preservation of fiscal independence really not feasible.

In 1889 Cape Colony entered into a customs union with the Orange Free State, and this was afterwards extended by the adhesion of British Bechuanaland, Basutoland, the British Bechuanaland Protectorate, Natal and, after the Boer War, the Transvaal. Southern Rhodesia also joined in 1903, Swaziland in 1904 and Northern Rhodesia in 1905. The formation of the Union of South Africa in 1910 of course superseded this arrangement for the most part, but the Union does not include Rhodesia.

In the British fiscal controversy begun by Joseph Chamberlain in 1903 the idea of the Zollverein was frequently put forward as the ideal for the British empire, but any real customs union throughout the empire as a whole was never seriously discussed, because most of the constituent colonies were already committed to a system of protective tariffs, and while they were prepared to discuss preferential treatment with Great Britain, few went so far as to suggest that they should adopt free trade within the empire. (*See* IMPERIAL PREFERENCE.)

See T. E. Gregory, *Tariffs; a study in method,* 1921. (J. A. T.)

CUSTOS ROTULORUM, one of the justices selected to keep the rolls of the peace on the county. He is appointed by the Crown and is usually a person of rank, most frequently the lord-lieutenant of the county. In practice the records are in the custody of the clerk of the peace. This latter was appointed by the *custos rotulorum,* but since the passing of the Local Government Act, 1888, the appointment is made by the standing joint-committee of the county council.

CUSTOZZA, a village of Italy, 11 m. S.W. of Verona, famous as the scene of two battles between the Austrians and the Italians in the struggle for Italian unity. The first battle of Custozza was fought in 1848, the Austrians being victorious. The second battle was fought in 1866, and resulted in the victory of the Austrians. (*See* ITALIAN WARS.) Pop. (1936) 320 (town); 869 (commune).

CÜSTRIN (Küstrin), a fortified town of Germany, in the Prussian province of Brandenburg, at the confluence of the Oder and Warthe, 18 mi. N.E. from Frankfort-on-Oder and 51 mi. N.E. of Berlin by rail. Pop. (1939) 23,788.

About 1250 a town was erected on the site of Cüstrin, where a fishing village originally stood. From 1535 till 1571 it was the residence of John, margrave of Brandenburg-Cüstrin, who died without male heirs in 1571. It consists of the town proper within the fortifications, a suburb on the left bank of the Oder, and one on the right bank of the Warthe. It has manufactories of machinery, furniture, cigars, etc., and there is a considerable river trade.

CUTANEOUS SENSATION: *see* SKIN, SENSORY FUNCTIONS OF.

CUTCH, a native state of India, in the Western Indian States agency, with an area of 8,461 sq.mi. It is a peninsular tract of land, enclosed towards the west by the eastern branch of the Indus, on the south by the Indian ocean and the gulf of Cutch, and on the north and east towards the interior, by the great northern Rann, a salt morass or lake. The interior of Cutch is studded with hills and a range of mountains runs through it from east to west, many of them of fantastic shapes scattered with large isolated masses of rock. The greater part of Cutch is rocky and wild; the ground is cold, poor and sterile; and the whole face of the country bears marks of volcanic action. With the exception of a few fields near the villages, the country is a rocky and sandy waste. Wheat, barley, millet, pulse and cotton are grown. Water is scarce and brackish, and is chiefly found at the bottom of the low ranges of hills; and the inhabitants of the extensive sandy tracts suffer greatly from the want of it. Owing to the uncertainty of the periodical rains in Cutch, the country is liable to famines, and it has suffered greatly from plague.

The temperature of Cutch during the hot season is high, the thermometer frequently rising to 100° or 105° F; and in the months of April and May there are frequent storms, with clouds of dust and sand. The influence of the monsoon is greatly moderated before it reaches this region, and the rains sometimes fail. Bhuj, the capital of the state, is situated inland, and is surrounded by hills. The detached hill of Bhuja, on which the fort is situated, rises to the height of 500 ft. in the middle of the plain. There are many mountain-streams, almost dry except in the rainy season, when they are very full and rapid, and discharge themselves into the Rann, all along the coast of which the wells and springs are saline.

Famine, pestilence and tyranny have contributed in the past to thin the population of Cutch. The inhabitants numbered 500,800 in 1941. One quarter are Mohammedans and the remainder Hindus of various castes. The Jadeja Rajputs form a particular class, being the aristocracy of the country; they are all more or less connected with the family of the rao or prince, and claim their descent from a prince who reigned in Sind about 1,000 years ago. From him also the reigning sovereign is lineally descended, and he is the liege-lord of whom all the chiefs or nobles hold their lands in feu. They are all termed the brotherhood of the rao or Bhayad, and supposed to be his hereditary advisers, and their possessions are divided among their male children. To prevent the breaking down of their properties the necessary consequence of this law of inheritance, infanticide was common, but it has been put down. The Jadejas have a tradition that when they entered Cutch they were Mohammedans, but that they afterwards adopted the customs and religion of the Hindus. It is certain, indeed, that they still retain many Mohammedan customs. The natives are in general intelligent and more strongly built and handsome than those of western India. The artisans are celebrated for their ingenuity. The palace at Mandvi and a tomb of one of their princes at Bhuj, are fair specimens of their architectural skill. There are special manufactures of silver-work, silk and cotton and embroidery. The maritime population supplies good sailors. Since the withdrawal of British military forces, £5,484 is paid in tribute. There is a railway from Bhuj to Tuna, a distance of 37 miles.

History.—Cutch was invaded about the 13th century by Mohammedans of the Summa tribe, under whose sway it continued tranquil for many years. The succession continued in the same line from Prince Khengayi until 1697, when Pragji murdered his elder brother and usurped the sovereignty. This line of princes continued till 1760 without any remarkable event, when, in the reign of Rao Ghodji, the country was invaded four times by the Sinds. Fateh Mohammed, a native of Sind, continued to rule the country until his death in 1813. It was in the reign of Fateh Mohammed that communication was first made with the British Government. During the contests for the sovereignty between the usurper and the legal heir, the leader of the royal party, Hansraj, the governor of Mandvi, sought the aid of the British.

Fateh Mohammed left several sons by different wives, who were competitors for the vacant throne. Husain Miyan succeeded to a considerable portion of his father's property and power. Jugjevan, a Brahman, the late minister of Fateh Mohammed, also received a considerable share of influence; and the hatred of these two factions was embittered by religious animosities, the one being Hindu and the other Mohammedan.

The administration of affairs was nominally in the hands of Husain Miyan and his brother Ibrahim Miyan; Jugjevan was murdered and the executive authority was much weakened by the usurpations of the Arabs and other chiefs. In the meantime Ibrahim Miyan was assassinated; and after various other scenes of anarchy, the rao Bharmulji assumed the chief power. His hostility to the British became evident, and accordingly a force of 10,500 men crossed the Runn in November, 1815, and were within five miles of Bhuj, the capital of the country, when a treaty was concluded, by which the rao Bharmulji was confirmed in his title to the throne, on agreeing among other stipulations to cede Anjar and its dependencies in perpetuity to the British. Failing to fulfill the terms of the treaty, he was deposed on his surrender to the British forces and his infant son, Desalji II. was enthroned (1819.)

In 1822 the relations subsisting between the ruler of Cutch and the British were modified by a new treaty, under which the territorial cessions made by the rao in 1816 were restored in consideration of an annual payment.

Rao Desalji II. did much to suppress infanticide, suttee and the slave trade in his state. His successor Maharao Pragmalji, an excellent administrator, built harbour works at Mandvi and a reservoir. In 1876 he was succeeded by Maharaja Rao Khengarji III. the present ruler, who is also a keen advocate for education. In 1924, Cutch with Kathiawar and Palanpur (formerly under the Government of Bombay) were put in direct relation with the Government of India, through an agent to the Governor-General in the States of Western India. *See* INDIA.

CUTCH, GULF OF, an inlet on the west coast of India heading in the Runn of Cutch. The recent completion of a safe ocean port at Okha at its entry, and half way between Karachi and Bombay, is noteworthy.

CUTCH, RUNN OF or **RANN OF KACHH** (*see* INDIAN DESERT). A salt-impregnated tract in the State of Cutch. It represents the seaward margin of the Indian desert.

CUTHA, an ancient city in Mesopotamia, mentioned in the Bible but not certainly identified with any site. Sir Henry Rawlinson identified it with the mound Tell Ibrahim, 20 m. N. of Kish and 35 m. S.E. of Sippar. The mound is 60 ft. high and two miles in circumference. Cutha was devoted to the cult of Nergal, the god of the lower world. This deity was worshipped in every Sumerian city, and Cutha, because of its sanctity, seems to have been kept in repair by all Sumerian and Semitic rulers down to the last few centuries before the Christian era.

See S. Langdon, *Cambridge Ancient History* vol. i. (1923).

CUTHBERT, SAINT (d. 687), bishop of Lindisfarne, was probably a Northumbrian by birth. He entered the monastery of Melrose in 651, where, after having spent a short time in the monastery of Ripon, he succeeded Boisel as prior in 661. Three years later he became prior at Lindisfarne, retiring in 676 to the island of Farne. In 684 at the council of Twyford in Northumberland, Egfrith, king of Northumbria, induced him to become bishop of Hexham, a see which he afterwards exchanged with Eata, abbot of Melrose, for that of Lindisfarne. In 687 Cuthbert again retired to Farne, where he died on March 20, 687. His remains were removed to Durham. Another Cuthbert (or Cuthbeorht) was bishop of Hereford (736–40) and archbishop of Canterbury from 740 until his death in Oct. 760.

The best life of Cuthbert is by Bede, published in Bede's *Opera*, ed. J. Stevenson (1841). *See* also C. Eyre, *The History of St. Cuthbert* (1887); and J. Raine, *St. Cuthbert* (1828).

CUTLASS, a curved, basket-hilted sword, used at sea.

CUTLER, MANASSEH (1742–1823), American clergyman, was born in Killingly, Conn., on May 13, 1742. He graduated at Yale college in 1765, and after being a school teacher and a merchant, and occasionally appearing in the courts as a lawyer, he decided to enter the ministry. From 1771 he was pastor of the Congregational church at what is now Hamilton, Massachusetts. In the American Revolution he served as chaplain, thereafter supplementing his ministry by the practice of medicine and the conduct of a private boarding-school. In 1786 he became interested in the settlement of Western lands, and in the following year, as agent of the Ohio Company (*q.v.*), which he had taken a prominent part in organizing, he made a contract with Congress whereby his associates, former soldiers in the Revolutionary War and business men, might purchase 1,500,000ac. of land in the region north of the Ohio at the mouth of the Muskingum river. He also took a leading part in drafting the famous Ordinance of 1787 for the government of the North-west Territory. From 1801 to 1805 he was a Federalist representative in Congress. A versatile man, Cutler conducted painstaking astronomical and meteorological investigations, and made researches of scientific value in botany. He died in Hamilton, Mass., July 28, 1823.

See W. P. and Julia P. Cutler, *The Life, Journals, and Correspondence of Manasseh Cutler* (1888); and *Records of the Original Proceedings of the Ohio Company,* ed. A. B. Hulbert ("Marietta College Hist. Coll." vol. i.–ii., 1917).

CUTLERY, the name given to the various types of knives and cutting instruments used for domestic purposes. It also includes razors, scissors, carving forks and steels used for sharpening knives. Table forks which were formerly made from steel have been generally superseded by the nickel-silver article, which along with spoons form another trade.

Among primitive tribes in pre-historic times, cutting tools and weapons used in hunting and defence were made from stones and flint. Later, with the coming of a knowledge of the use of metals, cutting tools were made of bronze and iron. The Romans taught the early Britons much concerning the working of iron, and the Norman invaders are said to have brought over many smiths and skilled workers in metal. Some of the early knives and weapons acquired a high reputation for perfection and skill of production, and examples of Toledo and Damascus blades remind us of the high quality of these productions.

The production of cutlery is centred and localised in definite towns in England, the United States, France and Germany where the bulk of the world's cutlery is produced. In Europe, this localisation has been largely due to the natural resources of Sheffield, Thiers and Solingen respectively. Each of these towns is situated in a district plentifully supplied with mountain streams, the energy of which has been utilized from early times to drive water-wheels and thereby to provide the power required for manufacturing purposes. In Chaucer's time (1328-1400) the name of Sheffield was especially associated with cutlery, as when in writing of the miller, he says: "A Sheffield thwitel baar he in his hose."

In the United States now there are important centres of cutlery manufacture, especially in the New England states. The workmen employed there are largely immigrants from Sheffield and Solingen. According to the latest United States Census of Manufactures, there were then 211 American establishments under the classification "Cutlery and Edge Tools," employing 16,400 persons, with a product valued at $80,260,000. The interesting feature of American cutlery production is the growing adoption of machine processes and the passing of certain branches of the industry into the hands of some of the leading American engineering firms. A similar movement in the direction of the extended employment of machine methods is also at work in Sheffield, Solingen and Thiers.

Types of Cutlery.—There are many types of cutlery, each having distinctive uses. They vary from a small wafer blade used in the safety razor to such larger cutting instruments as the carving knife or tailor's shears, and they may be divided into the following classes: table knives, butcher and kitchen knives, pocket knives, scissors, razors, safety razors, and miscellaneous cutting tools. In all these types the blade is the fundamental part which determines the value and quality of the tool or instrument. Blades are made from steel and the quality of the article is largely a question of the quality of the steel employed in its production, and of the skill with which it is manipulated during manufacture.

In the early days of the manufacture of high-grade cutlery both cast steel and shear steel were used, and the cutlery made from these steels is specially noted for the quality of its cutting edge, and for its ability to maintain it. Later, open-hearth steel has been used for table-knives and scissors. But the introduction of steel known as "stainless" steel for cutlery has been revolutionary in its effects, and much of the steel hitherto used has been superseded by the new material, particularly in Sheffield.

The use of the word "stainless" is not a strictly accurate description of the steel, though it does resist corrosion from domestic acids to a remarkable extent. The stainless quality of the blade depends upon its having been produced in a properly hardened condition.

TABLE CUTLERY

The production of blades for table cutlery is accomplished in three successive stages: the first consisting of forging the steel into the desired shape, the second in grinding the steel to a cutting edge and imparting a polish to the steel, and the third in finishing the blade and fitting the handle.

Forging.—The better quality of knives are hammered by machinery from short, square bars of good steel. The blade receives many hundreds of blows in being forged down to the desired pattern. This hammering, like the old hand-forging, it is claimed, imparts to the blade the valuable quality of resisting wear and retaining a sharp cutting edge.

A shoulder or "bolster" is usually forged, or rolled, at the handle end of the blade, and the forging is continued below the bolster to form the "tang" or prolongation of the blade for insertion into the handle.

The introduction of machinery into the forging processes involved in table-knife forging has had the effect of creating in Sheffield a new subsidiary trade called "the goffing trade."

Hardening and Tempering.—After the blades are forged or cut out they are hardened by heating in a suitable furnace to the correct temperature and then quenched, that is, immersed in a cooling liquid. The temperature of heating required for the "stainless" steel is higher than that required in the case of other steels, the temperature of heating being in the one case 1740° F and in the other 1400° F before quenching. Various mediums are used for quenching purposes, water being the one most commonly adopted. After hardening, the blades are very brittle and are much too hard for regular use. They are then tempered by reheating to a low temperature (390° F) and again quenched. This latter treatment gives the blades the right amount of toughness combined with hardness.

A number of interesting instruments for obtaining the exact measure of hardness of the material have been introduced.

Grinding.—The blade is now subjected to the next stage, that of grinding. Machinery has largely superseded craftsmen in the grinding of table-knives; there are, however, many hand-grinders employed in Sheffield, Solingen and Thiers. In a few cases they use the same equipment driven by a water-wheel, which was in use more than a century ago. Prior to 1914 the grinders used exclusively a sandstone grinding-wheel for grinding down the forged blade to a knife blade having an even, fine cutting edge, and having a back of increasing thickness from the point of the blade to the handle. This caused a fine dust from the grindstone, and although in most cases it was saturated with water it was extremely injurious to the lungs of the grinder and resulted in a disease known as "silicosis." This injurious effect upon the health of the workman is recognized by the British Government, which requires the payment by the employer of compensation under certain conditions.

The grindstones from 5ft. to 6ft. in diameter, when new, are made to revolve in a trough containing sufficient water to wet the surface of the grindstone. In some cases the sandstone has been replaced by an artificial abrasive wheel which has the advantage of being a "healthy" wheel, but the cost unfortunately is many times the cost of the sandstone.

The grinders use the wheels differently in various centres. In Sheffield they sit on a "horsing" which is mounted over the wheel, and the men exert a pressure of the work on the wheel by standing up slightly and putting the weight of the body on the work. In Solingen the wheel is made to revolve in front of the grinder, whilst in Thiers the men lie flat on boards placed over and behind the grinding wheels. In all cases the wheels revolve so that the periphery moves away from the worker and not towards him.

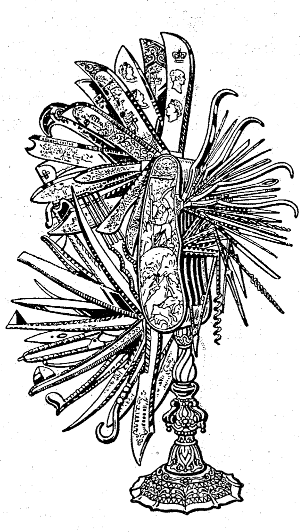
After the grinding operation has been completed the blades are fitted with handles. A wide range of material is used for the handles, varying from ivory or silver in the most expensive knives to wood in the very cheap knives. The material which is most popular in Europe is celluloid, whereas in the United States preference is given to the solid steel handle.

Carvers are made up in sets consisting of knife, fork and steel for sharpening the knife. The carving fork is the sole remaining example of the old steel forks used formerly with the table knives. The fork is provided with a guard made in various designs to prevent the blade from cutting the hand during use.

Another form of kitchen knife is the "bread knife." Some of these knives are made with a wavy edge, others are made with saw teeth cut into the finished knife, the object being to be able to cut newly-baked bread.

Table cutlery has been recently extended to include a small knife, generally made in fancy patterns with coloured handles, called a "tea knife." It is popular in cafés, where it is frequently used when eating pastries.

Pocket Knives.—The production of pocket knives commenced with the "Jack" knife, and at first was confined to heavy knives containing one blade which would open and close into a groove in the handle. Later a spring was used to secure the blade in both positions. Pocket knife manufacture is therefore known as "spring knife" cutlery. Then other blades were introduced, and the knife containing a small blade at one end and a larger blade at the other end became known as the "pen knife," due to the use of the smaller blade for sharpening quill pens.



BY COURTESY OF JOSEPH RODGERS AND SONS LTD.

THE NORFOLK SPORTSMAN'S KNIFE
Made by Joseph Rodgers & Sons Ltd., of Sheffield, for the Exhibition of 1851; this knife has 75 blades, most of which are etched or chased, and took two years to manufacture

Pocket knives are made in a great variety of patterns, some firms alone offering them in a thousand different forms. The more expensive are finished by jewellers, the cutlers supplying the skeleton knife without the covering. The jeweller then completes the knife by fitting gold scales, and some of these are even inlaid with precious stones.

The fitting of the spring knife calls for highly skilled work, as the slightest variation in the length of the spring, or the joints, will affect the correct position of the blade when open or shut.

The blades of pocket knives are made from high-grade steel, and they are tempered slightly harder than table knives, this operation calling for much skill.

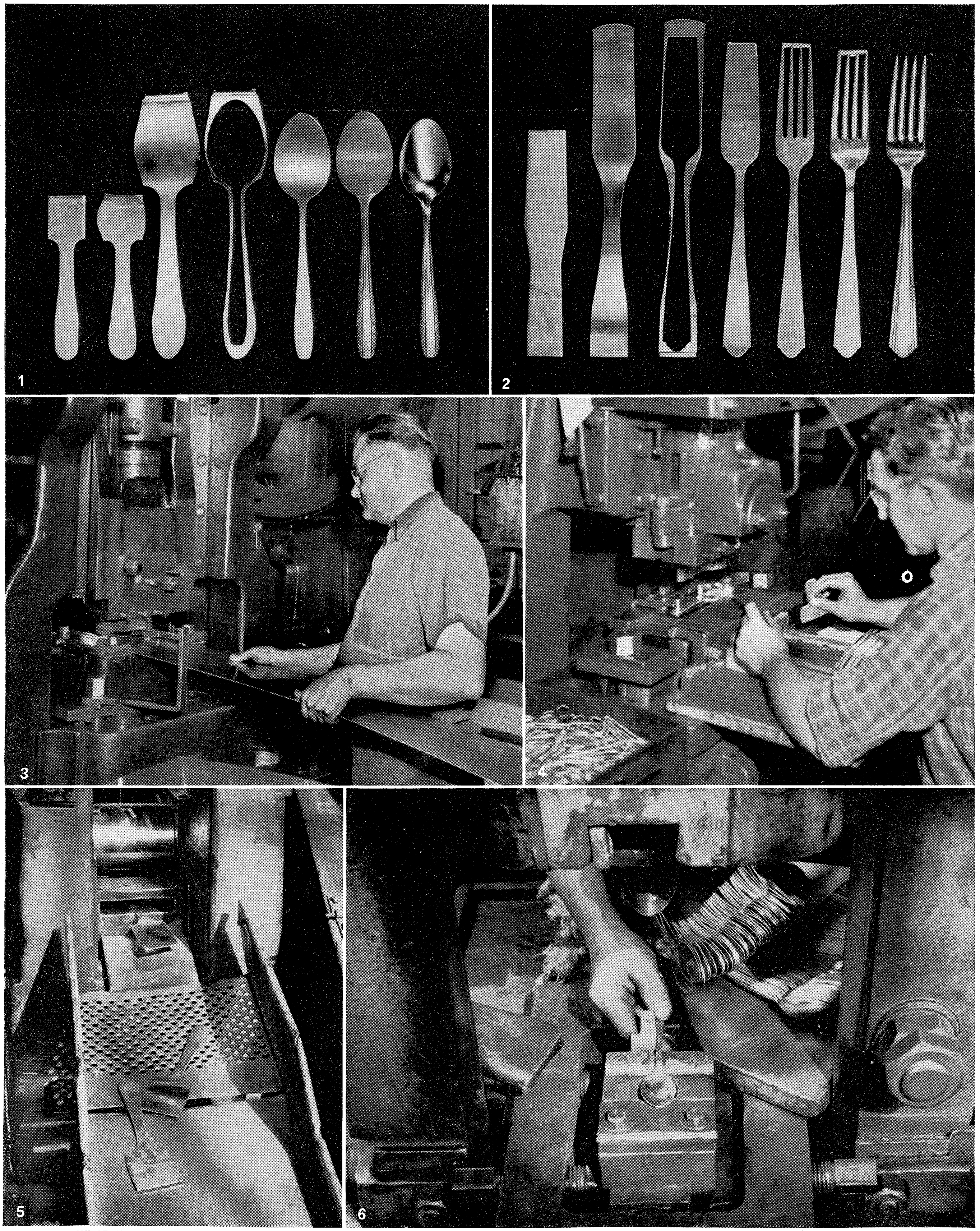
The pocket knife which is fitted with a variety of articles, such as corkscrew, pricker, scissors, etc., is known as a "sporting knife." This type of knife lends itself to many extreme uses, for example a pocket knife made for an engineer includes a foot folding rule, calipers and screw-driver, in addition to the blades.

Razors.—Razors are of very remote origin, and their manufacture is carried on in most cutlery centres. The finest steel is used for the blades, which are most accurately ground and carefully whetted to produce the fine shaving edge. The hollow-ground razor is made in various patterns known as "full hollow," "three-quarter hollow," and "half hollow." The full-hollow razor is ground to an extremely thin part about the middle of the blade and is increased in thickness towards the edge, finally tapering off to the cutting edge. The essential qualities of the blade are its proper hardness and its extremely fine cutting edge.

Many attempts have been made in the past to introduce safety devices for razors, but it was not until the advent of the "Gillette" razor that this problem was satisfactorily solved, and later other types have been successfully introduced.

The safety razor consists of a small blade secured by a holder and to which is fitted a guard. The guard keeps the edge of the blade from coming into actual contact with the skin. It is, however, possible for a careless individual to cut himself even with this precaution, especially if he tries to use it at a wrong angle or uses the corner of the blade. The safety blade is of simple form; straight of edge, and lends itself to production by machine methods, eliminating most of the grinding required for ordinary hollow-ground razors. On the other hand, the safety blade in use must be kept clean. The blades, unless exceptional care is taken, require renewing frequently. To avoid this expense a stropping device is included in some patterns.

The principle of fitting a guard has been extended and applied



BY COURTESY OF (1-4) R. WALLACE & SONS MANUFACTURING CO., WALLINGFORD, CONN., U.S.A., (5, 6) INTERNATIONAL SILVER CO., MERIDEN, CONN., U.S.A.; PHOTOGRAPHS, (5, 6) EWING GALLOWAY

PRELIMINARY STEPS IN THE MANUFACTURE OF SPOONS AND FORKS

1, 2. Stages in the manufacture of spoons and forks from the blank to completion

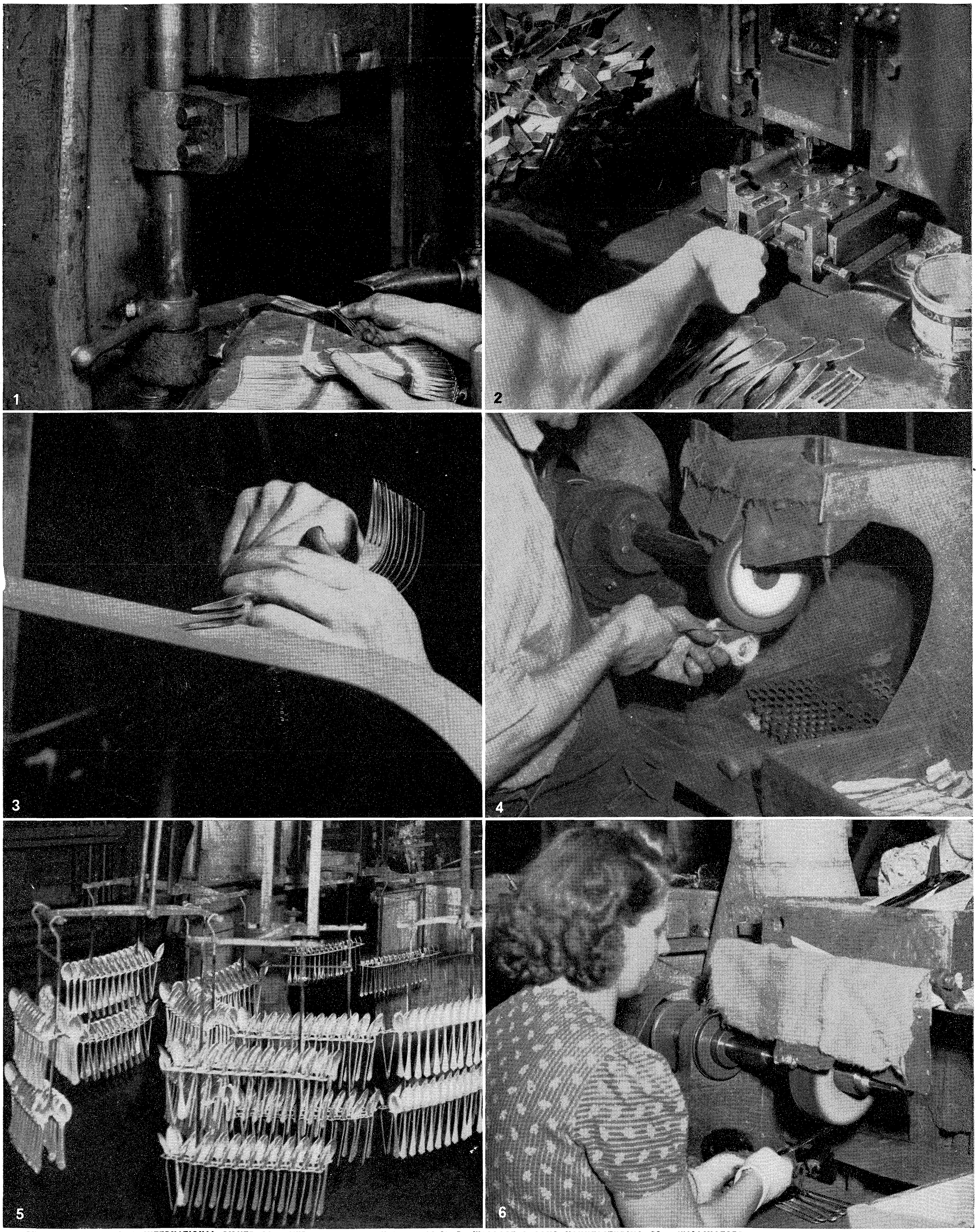
3. Blanking or cutting lengths of metal—the first step in manufacture

4. Cutting out spoon blanks from the metal strips

5. Rolling the blanks to get a proper distribution of the metal

6. Shaping the spoon bowl. The metal blank is placed over a steel die into which the shape of the bowl has been cut

CUTLERY



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FINAL STEPS IN THE MANUFACTURE OF FORKS AND SPOONS

1. Striking the design of the handle, on a drop press
2. Cutting out the narrow strips of metal left on the end of the fork blank, thus forming the tines of the fork
3. Belting the tines of the fork to give a smooth finish to the surfaces between
4. Sand-buffing spoons before silver-plating
5. Silver-plated spoons after removal from the plating machine
6. Buffing to provide the final finish

to the ordinary hollow-ground razor, thus converting the plain razor into a safety razor. Another pattern of safety razor adopts the hollow-ground blade of the ordinary razor using a small section of this blade.

Scissors.—Scissors are largely produced by forging the two parts in drop stamps from a milder quality of steel than is used for razors or pocket knives. The parts are "dressed up" and "put together," and, in order to prevent the scissors from working loose, the screw which holds them together is tightly fitted and made from hard steel. There are two interesting features of fitting scissors, the first is that the blades are slightly bent towards each other, so that they make a close contact on the cutting edge, and in addition there is provision made in the joints for ensuring this contact.

Scissors are sometimes made with shaped bows so that the thumb and fingers can operate with more ease. These shaped scissors are sometimes produced from malleable castings and the blades made from steel are later fitted to the castings. Another process is to die-cast the parts in aluminium and fit steel blades to them, the latter possessing the advantage of being very light and of having an attractive appearance. There are many types of household scissors in addition to dressmaking, embroidery and manicure patterns, whilst for trade purposes there are scissors made for tailors, weavers, gardeners, cattle marking and many others. Many forms of cutting instruments cannot be strictly defined as domestic articles, such as knives for kitchen purposes, paper knives, and knives for shoe-makers, painters, and many other trades.

The Craftsman.—One of the most interesting features of the cutlery trade is the survival of some of the old guild conditions, particularly in Sheffield. The practice of dividing the trade into three sections of forging, grinding and finishing still continues.

It is in the grinding section particularly that many old customs are maintained. The workmen in some cases work at communal factories, called tenement factories, or "wheels," which are put up for the purpose of obtaining rents from any grinder who desires accommodation. The grinder pays rent and he obtains a trough in which he fits his grinding wheel, and in addition he is supplied with power to drive it and light. In some factories a small weekly charge is made for light.

BY COURTESY OF JOSEPH RODGERS AND SONS LTD.

GRINDING KNIFE BLADES
The blade is hand-held in a frame against power-driven grinding wheels, the workman gauging, by experience, the degree of grinding necessary

The craftsmen are in many cases free to go and return from work at any time to suit their own convenience. They work for any employer who will provide them with work, but as there is no contract of service they are prevented from coming within the provisions of certain factory legislation, such as the Workmen's Compensation Act.

In the early days of cutlery manufacture, both in England and on the Continent, guilds or companies of cutlers were established, the object being to protect the trade, maintain the quality of production and regulate the conditions under which the trade was carried on, including the number and training of apprentices. Some of these companies became very powerful and exerted considerable influence over the welfare of the trades.

THE CARE OF CUTLERY

The universal use of cutlery makes it desirable that some information should be given on its care and maintenance. An important precaution to take with table cutlery is to avoid washing the blades in water which is too hot. The white handles become plastic when hot and begin to leave the blades at the shoulder or bolster, displaying an ugly, narrow gap.

It is often complained that the "stainless" table knife is not stainless, and that it fails to maintain its edge. In order to test a "stainless" knife, two or three drops of malt vinegar should be allowed to dry on the blade. The blade should then be washed in hot water, and if stained there would be just cause for complaint. The failure to keep a sharp edge is a further frequent criticism, but it should be remembered that there has been a great change in practice on the part of the householder. As the "stainless" knives require no cleaning like the ordinary knives they do not receive that rubbing which helps to maintain the sharp edge in the ordinary blade. The user of stainless cutlery should keep a sharpening appliance made for stainless blades, or a small stick of fine carborundum to be used like a steel, but very sparingly.

Pocket knives require attention, particularly in the joints, which should be kept well oiled. The pocket knife blade can also be sharpened on the carborundum stick (purchased from any ironmonger) by drawing the blade slightly inclined across the stick.

Another necessary precaution both for table knives and pocket knives is not to use them for screwdrivers or for levers. The blades are made from special steels, hardened and tempered to maintain a cutting edge and not for withstanding bending strains.

Razors will maintain their cutting quality if care is taken to prevent corrosion of the extremely fine edge. After use they should be stropped and if the strop is kept in good condition, by applying a little castor oil occasionally, it will put a thin film of oil over the cutting edge, thus preventing the action of moisture upon it. This procedure is equally successful in maintaining a sharp edge on safety-razor blades.

Scissors require attention at the joints; they should be quite free but not allowed to become slack. There is a tendency in most screw joints for the blades to unscrew the rivet and so bring about slackness in the blades. The edges of the blades do not require sharpening except at long intervals, and the carborundum stick will be found a very suitable tool for this operation.

See G. I. H. Lloyd, *The Cutlery Trades;* E. Page, *La Coutellerie.* (W. R.)

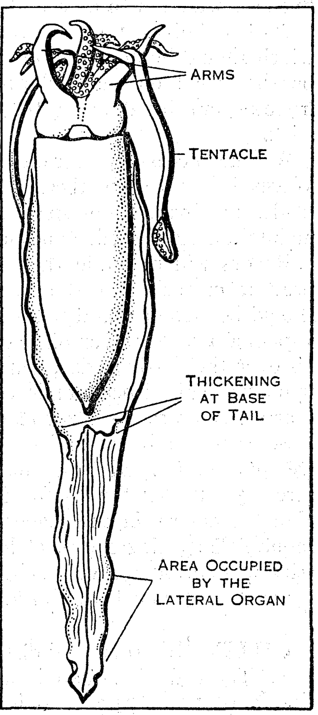
CUTTACK, town and district of British India in Orissa province. The town is situated on the river Mahanadi. The population in 1941 was 74,291. It is the centre of the Orissa canal system, and a station on the Bengal Nagpur railway from Madras to Calcutta.

It contains a government college and girls' high school, named after Ravenshaw, a former commissioner, a training college, a school of engineering and a medical school. The principal industries are silver filigree work of fine quality and tanning.

Formerly the capital of the Hindu kings of Orissa, Cuttack was the capital of the Mogul and, after them, of the Maratha governors of Orissa till its capture by the British in 1803. Some remains are still left of the Barahbati fort, which dates back to the 16th century.

The district of Cuttack forms the delta of the Mahanadi and Brahmani, together with a hilly tract inland. It has an area of 4,571 sq.mi. and a population of (1941) 2,431,427. It consists of three physical divisions: first, a marshy salt-impregnated strip along the coast, from 3 to 30 mi. in breadth; second, an intermediate stretch of alluvial plain; third, a broken hilly region, which forms the western boundary of the district. Cultivation does not begin till the limits of the salt tract are passed. The rice plain stretches inland for about 40 mi., and is a fertile region with an extensive system of irrigation. The hilly frontier separates the delta from the feudatory states. It consists of a series of ranges, 10–15 mi. in length, running nearly due east and west, with wooded slopes and valleys between. The highest hill is Assiagiri, 2,500 ft. The district is intersected by three large rivers, the Baitarani, Brahmani and Mahanadi, which after numerous bifurcations find their way into the sea by three principal mouths. Silt-banks and surf-washed bars render the entrance to these rivers perilous. The rivers having, by the silt of ages, gradually raised their beds, now run along high levels, and during floods pour over their banks and sometimes destroy the crops. Numerous interlacing channels establish communication between the main streams. Rice forms the staple product of the district; its three chief varieties are *biali* or early rice, *sarad* or winter rice, and *dalua* or spring rice. Cuttack is one of the few districts in the province in which jute is largely grown. The Orissa canal system, which lies within Cuttack district, is used both for irrigation and transport purposes. Interesting archaeological remains are found at the subdivisional town of Jajpur (*q.v.*) and at Dhauli is an inscription of the edicts which express Asoka's remorse for the suffering he inflicted in his conquest of Kalinga.

CUTTLEFISH, a marine invertebrate animal related to the octopus and placed in the molluscan class Cephalopoda (*q.v.*). The name has been regularly given to members of the family Sepiidae; but it has also been applied to other cephalopods, *e.g.*, to various kinds of squid. It is considered to be more desirable, however, to maintain the more precise usage, when possible, and to avoid confusing the cuttlefish (Sepiidae) with squids. The most characteristic feature of the cuttlefish is the internal calcified shell or "cuttle-bone," and it is this structure which affords the best means of distinguishing the cuttlefish from other forms, which on account of certain structural resemblances, are associated with it in the suborder Sepioidea of ten-armed Cephalopoda. These forms (e.g., *Sepiola, Rossia,* etc.) have a horny "shell." The interesting genus *Spirula* is regarded by some zoologists as allied to the cuttlefish; but the shell of *Spirula* is not wholly internal and its structure is not comparable with that of the Sepiidae. The sepiids include the widely distributed genus *Sepia,* in which the common European cuttlefish (*Sepia officinalis*) *Sepiella, Hemisepius,* and a few other genera are placed. These animals have a somewhat flattened body (visceral mass) edged by a pair of rather narrow fins. In the common cuttlefish the body is ornamented with a number of zebra-like stripes. The remarkable *Sepiella ornata* has a series of longitudinal patches (ocelli) down each side. Five pairs of arms encircle the mouth in all cuttlefish. One pair of these is specialized for capturing prey. These are longer than the rest and can be withdrawn into two pouches. The suckers of the shorter arms are arranged in transverse rows of four suckers each down the entire length of the arms, except on one of the ventral arms of the male (hectocotylized arm), from which they are absent towards the base. On the tentacles the suckers are restricted to an expanded pad (the "hand") at the tip of the arm. (For the general anatomy of these animals *see* CEPHALOPODA.)



FROM "ANNALS AND MAGAZINE OF NATURAL HISTORY" (TAYLOR & FRANCIS)

SQUID-LIKE CUTTLEFISH (DORATOSEPION CONFUSUM)

The male of this species has its fins prolonged backwards and provided with two lateral organs of unknown function

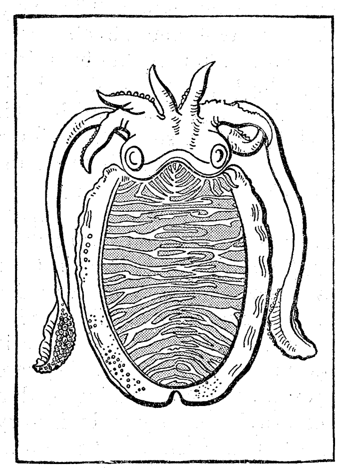
The cuttlefish are active muscular animals. They swim usually by means of the fins, which perform undulating movements; but on being alarmed or attacked the animal can dart violently backwards by expelling a jet of water from the mantle-cavity through its funnel (*q.v.* in article CEPHALOPODA). In common with the majority of the Cephalopoda the cuttlefish secretes a dark substance ("ink"), the value of which as a means of protection is discussed in the general article on the Cephalopoda.

About 100 species of cuttlefish are known. They are found in most tropical and temperate seas, but only rarely in high latitudes. According to G. Grimpe the European species are not found farther north than the Skager Rak. Among the more noteworthy species are *Sepia rouxii* and *Sepia hierreda,* which are found in the Indian ocean and the Atlantic respectively and attain a length of over 2 ft.; *Sepiella ornata* from West Africa, the colouring of which has been already alluded to, and the squid-like members of the subgenus *Doratosepion.* One of these, *Doratosepion confusum,* has its fins prolonged backwards in two long "streamers" in the male and furnished with two organs of unique structure and unknown function. The cuttlefish are mainly inhabitants of shallow coastal waters. Certain species (*e.g.,* the common European *Sepia officinalis*) seem, however, to perform regular migrations into deeper water during part of the year, and there is not much doubt that these movements, as in the case of some other marine animals, are related to various phases in the reproductive cycle. From Cuénot's account of the migrations of *S. officinalis* it seems certain that this cuttlefish enters the Bassin d'Arcachon (Bay of Biscay) during the spring, summer, and autumn for the purpose of breeding and egg-laying, and that all the individuals, young and old, depart for deeper off-shore water in the winter. Grimpe, however, has observed an additional periodicity in the occurrence of *S. officinalis* in the North sea, for there are apparently years in which this cuttlefish is far more frequent in that area than at other times. Grimpe and L. Cuénot have likewise recorded the occurrence of seasonal dimorphism in *S. officinalis.* The former states that a plump summer form ("*S. fillouxii*") replaces the slender ("*S. officinalis*") winter form in the North Sea.

The pear-shaped eggs of *Sepia* are enclosed in tough capsules and are dark in colour. They are deposited in clusters on fragments of coral, the tubes of marine worms and the stems of plants. Lo Bianco observed that in the Gulf of Naples *Sepia officinalis* prefers submerged land plants, such as *Pistacia,* for this purpose.

The breeding habits of the common cuttlefish have been recently studied by Grimpe, who records that, at least in captivity, the animal is monogamous.

The food of *Sepia* mainly consists of crustacea, though fishes are also eaten by it. J. T. Cunningham has described the capture of prawns by *S. officinalis* in the aquarium of the Marine Biological station at Plymouth. The cuttlefish marks down a prawn that is poised on a projecting ledge of rock and stalks it with great caution. When it is within striking distance the cuttlefish shoots out its tentacles and drags the prawn into the circlet of shorter arms, by which it is held as it is dismembered by the "beaks" or horny jaws of its captor. In all probability the enemies of the cuttlefish are large fishes; but exact observations on the special enemies of these animals are wanting.



COMMON EUROPEAN CUTTLEFISH

This species, distinguished by zebra-like stripes on the flattened body, is found in coastal waters. The long arms are used for catching prey. About one-quarter natural size

Cuttlefish are eaten by men in various parts of the world, *e.g.,* in Italy, Greece, India and Japan. In the Gulf of Naples *Sepia officinalis* is caught with various kinds of tackle, and the Neapolitan fishermen in the breeding season of this animal sometimes tow a female *Sepia* behind their boats and catch the males which invariably follow her. It has been found that some species of *Sepia* which are partly nocturnal in their habits are attracted by light, and in various countries fishermen lure them into their nets by torches or lanterns. In Naples the flesh of *Sepia* is not so much esteemed as that of *Octopus* and *Loligo;* but it is obtained and sold in great quantities in the Gulf of Naples and additional supplies are obtained from the Adriatic and Gulf of Manfredonia.

The "ink" secreted by these animals is used as the well-known brown pigment "sepia." It is made by cutting out the ink sac (*q.v.* in article CEPHALOPODA), dissolving its dried contents in a dilute alkaline solution, precipitating with a weak mineral acid, such as hydrochloric acid, and then adding gum arabic. The "cuttlebone" or internal shell has been used, either powdered or whole, as a dentifrice, for fine polishing, for taking casts in metalwork, as an agricultural fertilizer, for "pouncing" (dusting unsized paper to prevent ink spreading on it) and for feeding cage-birds. It was also used as a cosmetic by Roman women of fashion.

The modern cuttlefish make their appearance in the Miocene period. They are undoubtedly derived from a Belemnite-like ancestor, *Belosepia,* which lived in the Eocene seas and is found in a fossil state in the London clay.

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CUTTS OF GOWRAN, JOHN CUTTS, Baron (1661–1707), British soldier, was educated at Catherine Hall, Cambridge. In 1686 he served under Charles of Lorraine in Hungary, and in 1688 as lieutenant-colonel in Holland. He fought for William in the English revolution of 1688, and in 1690, as commander of a regiment of foot, distinguished himself at the battle of the Boyne and at the siege of Limerick, for which William created him Baron Cutts of Gowran in the kingdom of Ireland. Later he served under Marlborough in the opening campaign of the War of the Spanish Succession, later being third in command at Blenheim. Cutts sat in five parliaments for the county of Cambridge, and under Anne was returned for Newport in the Isle of Wight.

CUVIER, GEORGES LÉOPOLD CHRÉTIEN FRÉDÉRIC DAGOBERT, Baron (1769–1832), French naturalist, was born on Aug. 23, 1769, at Montbéliard. After spending four years at the Academy of Stuttgart, he became tutor in the family of the Comte d'Héricy, who was in the habit of spending the summer near Fécamp. There he made the acquaintance of the agriculturist, A. H. Tessier, who secured for him in 1795 the post of assistant to the professor of comparative anatomy at the Muséum d'Histoire Naturelle. In 1796 he began to lecture at the École Centrale du Panthéon, and at the opening of the National Institute in April, he read his first palaeontological paper, which was subsequently published in 1800 under the title *Mémoires sur les espèces d'éléphants vivants et fossiles.* In 1798 appeared his first separate work, the *Tableau élémentaire de l'histoire naturelle des animaux,* which was an abridgment of his course of lectures at the École du Panthéon, and may be regarded as the foundation and first and general statement of his natural classification of the animal kingdom.

In 1799 he succeeded L. J. M. Daubenton as professor of natural history in the Collège de France, and in the following year he published the *Leçons d'anatomie comparée,* a classical work, in the production of which he was assisted by A. M. C. Dumeril in the first two volumes, and by G. L. Duvernoy in three later ones. In 1802 Cuvier became titular professor at the Jardin des Plantes; and in the same year he was appointed commissary of the Institute to accompany the inspectors-general of public instruction. In this latter capacity he visited the south of France; but he was in the early part of 1803 chosen perpetual secretary of the National Institute in the department of the physical and natural sciences.

He now devoted himself more especially to three lines of inquiry—one dealing with the structure and classification of the mollusca, the second with the comparative anatomy and systematic arrangement of the fishes, and the third with fossil mammals and reptiles primarily, and secondarily with the osteology of living forms of those groups. The results of Cuvier's principal palaeontological and geographical investigations were ultimately given to the world in his *Recherches sur les ossements fossiles de quadrupèdes* (1812, later editions 1821 and 1825) and in *Discours sur les révolutions de la surface du globe* (1825). In his *Règne animal distribué d'après son organisation* (4 vols. 1817; 2nd ed. 5 vols. 1829–30) Cuvier embodied the results of the whole of his previous researches on the structure of living and fossil animals. In 1808 Napoleon named him to the council of the Imperial University, and in this capacity he presided (in the years 1809, 1811 and 1813) over commissions charged to examine the state of the higher educational establishments in the districts beyond the Alps and the Rhine which had been annexed to France, and to report upon their affiliation with the central university. Before the fall of Napoleon (1814) he had been admitted to the council of state, and retained his position under the Bourbons. He was also elected chancellor of the university. In 1819 he was appointed president of the committee of the interior. In 1826 he was made grand officer of the Legion of Honour; and in 1831 he was raised by Louis Philippe to the rank of peer of France, and was subsequently appointed president of the council of state. In the beginning of 1832 he was nominated to the ministry of the interior, but on May 13 he died in Paris after a brief illness.

M. J. P. Flourens, *Éloge historique de G. Cuvier* and *Histoire des travaux de G. Cuvier* (3rd ed., 1858); H. D. de Blainville, *Cuvier et Geoffroy Saint-Hilaire* (1890); W. Lubosch, "Der Akademiestreit zwischen Geoffroy St.-Hilaire und Cuvier," *Biologisches Zentralblatt,* vol. xxxviii. (1918).

CUVILLES, FRANÇOIS DE (1698–1767), French architect and engraver. He helped to carry the French rococo taste to Germany—he was summoned about 1720 to Cologne by the elector James Clement; in 1738 he became architect to the elector of Bavaria, and afterwards occupied the same position towards the emperor Charles VII. His style, while essentially thin, is elaborate and bizarre. His son, François de Cuvilles the younger, succeeded his father at the court of Munich.

CUXHAVEN or **KUXHAVEN,** a seaport of Germany, in the Prussian province of Hanover, on the west side of the Elbe, 71 mi. by rail N.W. of Hamburg. Pop. (1939) 33,365. The town dates only from 1873, having been formed by uniting the villages of Ritzebüttel and Cuxhaven, which had belonged to Hamburg since 1394. The harbour is good and secure. A new harbour was made in 1891–1896 and became the seat of the German-American traffic. There is a fishing fleet, for which a new harbour was opened in 1892, and some ship-building is carried on. It was frequently bombed by the British in World War II.

CUYAHOGA FALLS, a city of Summit county, Ohio, U.S.A. on the Cuyahoga river, 5 mi. N.E. of Akron. It is served by the Baltimore and Ohio and the Pennsylvania railways. The population was 10,200 in 1920 (91.8% native white), and was 19,797 in 1930 and 20,546 in 1940 by the federal census. It has important manufactures (chiefly of iron and rubber goods), with an output in 1937 valued at $3,665,020; there were 22 industrial establishments in that year with 555 workers who received $807,513 in wages. It is a growing residential suburb of Akron. The city has a planning commission. Cuyahoga Falls was founded in 1812, incorporated as a village in 1868, and chartered as a city in 1921.

CUYAPO, a municipality (with administrative centre and 39 *barrios* or districts) of the province of Nueva Ecija, Luzon, Philippine Islands, 28 mi. N.N.W. of San Isidro, the provincial capital. Rice is the principal product. Pop. (1939) 24,570, of whom 12,288 were males. Of those aged 6 to 19, inclusive, 37.6% in 1939 attended school and of those 10 years old and over 51.2% were literate. Pampango is the vernacular.

CUYP, the name of a Dutch family which produced two generations of painters. The Cuyps were long settled at Dordrecht, in the neighbourhood of which they had a country house, where Albert Cuyp (the most famous) was born.

The eldest member of the family who acquired fame was Jacob Gerritsz Cuyp, born at Dordrecht Dec. 1594, and taught by Abraham Bloemaert of Utrecht. He is known to have been alive in 1649, and the date of his death was probably 1651 or 1652. J. G. Cuyp's pictures are little known. But he produced portraits in various forms, as busts and half-lengths thrown upon plain backgrounds, or groups in rooms, landscapes and gardens. Of portrait busts there are signed examples dated 1624, 1644, 1646 and 1649, in the museums of Berlin, Rotterdam, Marseilles, Vienna and Metz. In a family scene at the Amsterdam museum there are likenesses of men, women, boys and girls with a cottage and park.

Benjamin Cuyp (1612–1652) another painter of this family, was born Dec. 1612 and is supposed to have been a nephew of Jacob Gerritsz and to have resided principally at Dordrecht. He painted in the style of Rembrandt. He died in Aug. 1652.

Albert Cuyp (1620–1691), the son of Jacob Gerritsz by Grietche Dierichsdochter (Dierich's daughter), was born at Dordrecht in Oct. 1620, and married in 1658 Cornelia Bosman. By right of his possessions at Dordwyck, Cuyp was privileged to sit in the high court of the province. As a citizen he was sufficiently well known to be placed on the list of those from whom William III, stadtholder of the Netherlands, chose the regency of Dordrecht in 1672. His death, and his burial on Nov. 7, 1691 in the church of the Augustines of Dordrecht, are historically proved. He seldom dates his pictures, but it appears probable that he ceased to paint about 1675. That he was a pupil of van Goyen has been surmised on the strength of his early style. His works are supposed to be divisible into such as bear the distinctive marks C. or A. C. in cursive characters, the letters A. C. in Roman capitals, and the name "A. Cuyp" in full, but spurious examples exist. Generally speaking, the finished examples of Cuyp's middle and final period all bear his full signature.

Familiar subjects of the master's earlier period are stables with cattle and horses (Rotterdam, Amsterdam, Leningrad and Brussels museums). Occasionally he painted portraits in the bust form familiar to his father, one of which, dated 1649, is in the National gallery, London. More frequently he produced portraits of ladies and gentlemen on horseback, in which the life and dress of the period and the forms of horses are most vividly represented (Buckingham palace, Bridgewater gallery, Louvre and Dresden museums). Later on we find him fondest of expansive scenery with meadows and cattle and flocks, or rivers and barges in the foreground, and distances showing the towers and steeples of Dordrecht. Cuyp is to the river and its banks what Willem Vandevelde is to calm seas and Hobbema to woods. In his best period from about 1655–70, his landscapes are saturated with golden light and masterpieces of an acknowledged beauty, the "Riders with the Boy and Herdsman" in the National gallery, London, the Meuse, with Dordrecht in the distance, in three or four varieties, in the Bridgewater, Grosvenor, and Brownlow collections, the "Piper with Cows," in the Louvre attest his power.

John Smith's *Catalogue raisonné* of the Dutch and Flemish painters, in 9 vols. (1840), enumerated 335 of Albert Cuyp's works, of which in 1877 Sir J. A. Crowe wrote in this encyclopaedia that "it would be difficult now to find more than a third of them." In C. Hofstede de Groot's *Catalogue raisonné,* vol. ii (1909), revising Smith's, the number is extended to nearly 850, but he accepts too readily the attributions of sale catalogues; the work is, however, the best modern authority on the painter.

CUYPERS, PETRUS JOSEPHUS HUBERTUS (1827–1921), Dutch architect, was born on May 16, 1827, at Roermond, Holland. He studied under Viollet-le-Duc, and was inspired both by the Gothic and the Netherland style of the 16th century in building the Rijks museum at Amsterdam (1877–85) and in restoring and rebuilding many Roman Catholic churches, town halls and other buildings. His chief merit, however, was that he awakened the interest of his countrymen in architecture and the decorative arts, and so prepared the way for Berlage, de Bazel and others, who created the modern Dutch style of architecture. Cuypers received honorary degrees from the universities of Utrecht and Delft. He died on March 3, 1921.

CUYUNA RANGE, an area in Minnesota, U.S.A., containing extensive iron ore deposits. It was the last of the three large iron ranges in Minnesota to be opened, the first ore being shipped in 1911. The other two iron ranges in the state are the Vermilion range and the Mesabi range, both located farther to the north. There is no surface ridge or outcropping distinguishing the Cuyuna range, and the existence of the ore deposits was discovered with a drift needle. The ore lies in vertical lenses, and is covered with glacial drift which varies from 80 to 350 ft. thick, making underground mining necessary. The ore of the Cuyuna range is distinguished from that of the other two ranges in that it contains a notable amount of manganese, which is important in steelmaking.

CUZA or **COUZA, ALEXANDER JOHN** (Alexandru Joan) (1820–1873), first prince of Rumania, was born on March 20, 1820, at Galatz in Moldavia, of an ancient *boiar* or noble family. He was educated at Jassy, Pavia, Bologna, Athens and Paris. In 1845 he married Elena Rosetti. Cuza was expelled from Moldavia by Prince Sturdza for taking part in the Rumanian revolution of 1848 and took refuge in Vienna. On his return, in 1850, he was appointed president of tribunal and, later, prefect of Galatz. In 1857 he rejoined the army and within a few months rose to the rank of colonel. He became minister of war in 1858 and represented Galatz in the assembly which was elected in the same year to nominate a prince for Moldavia. In default of a foreign prince, he was himself elected prince of Moldavia by the assembly at Jassy (Jan. 5–17, 1859), and prince of Walachia by the assembly at Bucharest (Jan. 24–Feb. 5). He thus became ruler of the united principalities, with the title Prince Alexander John I; but as the Convention of Paris (Aug. 19, 1858) had intended and provided for the continued separation of the two principalities his authority was not recognized by his suzerain, the sultan of Turkey, until Dec. 11–23, 1861, when the union of the principalities under the name of Rumania was formally proclaimed. For a full account of Cuza's reign, *see* Rumania. The drastic and unconstitutional reforms which he imposed on all classes alienated his subjects, and the popular discontent culminated in revolution. At four o'clock on the morning of Feb. 23, 1866, a band of military conspirators broke into the palace and compelled the prince to sign his abdication and to leave the country. He died in Heidelberg on May 15, 1873.

CUZCO (preferably Cusco), an inland department and city of southern Peru; bounded by those of Apurimac, Ayacucho, Junín, Loreto, Madre de Dios, Puno and Arequipa and touching Brazil (area 55,717 sq.mi.). It consists of mountains, a network of high valleys tributary to great rivers, Apurimac and Urubamba, and low, jungle-covered plains. Within the summer-rain zone, the climate changes with altitude, ranging from tropical to frigid. Sugar, cacao, coca, coffee and tobacco are raised in the lower valleys, maize, cereals, alfalfa, potatoes and barley above. The amount of cultivation depends upon markets, *i.e.*, transportation. Cattle are raised in northern valleys, sheep and alpacas in the southern provinces. Though the department is rich in minerals (gold, silver, copper, iron, lead, coal, salt and others), few mines are in operation, also for lack of transportation. There are many miles of finished roads in the highland portions of the department, but none in the lowlands. One can travel by car from Cusco to Puno on the shores of Lake Titicaca, and to Lima (600 mi.). The Mollendo-Cusco railway extends beyond Cusco to Macchu and Urubamba, both in the upper Urubamba valley. Manufacturing is still in embryo. The population (565,458 in 1940) is largely composed of Indians who speak their native tongue (Quechua). The department abounds in ruins, of which the most famous are in the Urubamba valley at Pisac (Intihuatana), Ollantaitambo and Macchu Picchu (*see* Inca).

Cusco, capital of the department (13° 31′ S., 72° W.), lies in a small valley (Huatanay) tributary to the Urubamba, at a height of 11,380 ft. It is protected by lofty mountains and surrounded by orchards, gardens and cultivated fields. The population (1940, 45,158) is mostly Indian and mestizo. Founded in the 11th century by Manco Capac, first of the Incas, it has legendary prestige as capital of that vast empire. It is a strange mixture of massive Inca stone walls, early Spanish colonial architecture—of which the Renaissance cathedral (1560–1654) is a superb example—and crude adobe buildings of the present day. The houses are often built upon a foundation of Inca stonework, the modern superstructure roofed with red tile. The narrow, irregular streets are roughly paved, the wide plazas, surrounded by arcades, the site of busy markets and weekly fairs. Cusco is still in many respects a primitive Indian city, the pure, transparent air compensating for lack of sanitation. The climate is chilly (mean annual temperature 53°–59° F.), the nights cold, with rains from November to March. The cyclopean fortress of Sachsaihuaman dominates the city on the north. Among the principal buildings are the cathedral, the convent of Santo Domingo, incorporating in its walls part of the Inca temple of the sun (Coricancha), the prefecture (palace of Francisco Pizarro, who took the city in 1533), the university (founded in 1598, secularized in 1828), hospitals, library and museum of pre-Columbian Peruvian antiquities. It is the seat of a bishopric and superior court, has many monasteries and convents and more than 20 churches. The university, with four faculties (jurisprudence, political science, letters and physical science), has about 150 students. There are two *colegios nacionales* and many elementary schools. Though ancient industries such as gold and silver work are fast disappearing, there are several small manufactories such as breweries, tanneries, sugar and chocolate mills. One cotton mill produces 1,000,000 yd. annually. Cusco is the trade hub of a vast region but commerce is limited on account of transportation costs. The railway to Mollendo, more than 500 mi. distant, is the only rail outlet to the coast. There are a few modern conveniences in this venerable city, including electric lights (power furnished by a hydro-electric station 10 mi. distant), a mule-drawn tram, a telephone system and, since 1925, a new water-supply. This involved bringing in additional sources of supply, building storage reservoirs, and laying pipe-lines in the narrow, cobblestone streets, 104,800 ft. in all. It was necessary to build a motor-road 9 mi. long to permit delivery of cement pipe along the route, manufacturing it in a plant set up on the spot. (M. T. Bi; X.)

CYANAMIDE forms white crystals, melting at 40° C. and readily soluble in water, alcohol and ether. It is the amide of normal cyanic acid, NC·OH, having the formula $NC{\cdot}NH_2$. It is obtained by acting on cyanogen chloride, bromide or iodide with ammonia, or generally by desulphurizing thio-urea with mercuric oxide. Heated above its melting point cyanamide polymerizes to di-cyandiamide $(CN_2H_2)_2$, which at 150°C. is transformed into the polymer *n*-tri-cyantriamide or melamine $(CN_2H_2)_3$, the mass solidifying. Nascent hydrogen reduces cyanamide to ammonia and methylamine. It gives mono-metallic salts of the type NC·NHM when treated with aqueous or alcoholic solutions of alkalis. Di-metallic salts are obtained by heating cyanates alone, *e.g.,* calcium, or cyanides in a current of nitrogen, *e.g.,* barium.

Calcium cyanamide has assumed importance in agriculture since the discovery of its economic production in the electric furnace (*see* below). It may also be produced by heating lime or chalk with charcoal to 2,000° in a current of air. It appears that with soils which are not rich in humus or not deficient in lime, calcium cyanamide is almost as good, nitrogen for nitrogen, as ammonium sulphate or sodium nitrate; but it is of doubtful value with peaty soils or soils containing little lime, nor is it usefully available as a top-dressing or for storing.

The metallic cyanamides, of which calcium cyanamide, $CaCN_2$, is the only one of technical importance, are derivatives of cyanamide, H_2CN_2. In practice, calcium cyanamide is always formed by the action of nitrogen on calcium carbide. In 1892 Moissan showed that calcium carbide could be prepared easily and in quantity in the electric furnace, and in 1895 A. Frank and N. Caro began investigations on the absorption of nitrogen by metallic carbides which have led to the establishment of the modern cyanamide industry. Although pure calcium carbide does not absorb nitrogen even at 1,200° C. (Moissan), Frank and Caro found that technical carbides did so readily at much lower temperatures, probably owing to their impurities.

Formation of Cyanamides by Nitrogen.—By the action of nitrogen on metallic carbides, mixtures of cyanamides and cyanides are obtained, the proportions depending on the metal and on the temperature. The general type of the reaction may be illustrated by the case of calcium carbide.

$$\begin{aligned} CaC_2+N_2&=CaCN_2+C \\ CaCN_2+C&=Ca(CN)_2 \end{aligned} \quad \cdots \quad (1)$$

With alkali carbides, cyanide preponderates largely. With barium carbide about 30% cyanide and 70% cyanamide are obtained at 700°–800°C., whilst with calcium carbide cyanamide is practically the only product up to 1,100°C. In all cases the proportion of cyanide increases with the temperature. These facts explain the formation of cyanide by fusing calcium cyanamide and carbon with sodium chloride. The mechanism of the production of calcium cyanamide is by no means clear, in spite of numerous investigations. The chief difficulty in interpreting the results is the effect of impurities, always present in commercial carbide.

Absorption of Nitrogen.—The rate of absorption of nitrogen by carbide has been much studied. Pure calcium carbide does not absorb nitrogen at 1,200°C. With commercial carbide (containing about 10% lime) absorption is rapid and complete at 1,050°–1,100°C. Below 1,000°C. the absorption is less rapid and is incomplete, the nitrogen absorbed tending to a limiting value, which is lower the lower the temperature. These limiting values do not represent true equilibria (Foerster and Jacoby). Pollacci found that the velocity of absorption is proportional to the nitrogen pressure up to two atmospheres, but that further increase of pressure makes little difference.

Many substances when added to calcium carbide lower the temperature at which nitrogen absorption begins and increase the velocity of absorption for a given temperature. The most important of these substances are calcium chloride (Polzenius) and calcium fluoride (Carlson). Many other substances, including lime, act similarly, and this explains the action of commercial carbide. The rôle of these additions has been investigated by G. Bredig, W. Fraenkel and E. Wilke, F. Foerster and H. Jacoby, Rudolphi, G. Pollacci and others, and has been connected with the lowering of the melting-point of the mass which they cause; but how this increases the velocity of absorption, whether by removing protecting layers of reaction products from the carbide, by allowing the nitrogen to dissolve in the liquid mass, or by other means, has not been settled. Reaction (1) is strongly exothermic. The heat of reaction is about 77,800 calories at 25°C.

Technical Production.—On the commercial scale a mixture of calcium cyanamide and carbon ($CaCN_2+C$) is produced by heating ground calcium carbide in an atmosphere of nitrogen to about 1,000°–1,100°C. The nitrogen is generally prepared by the fractional distillation of liquid air by the Linde or Claude process, and should be as free as possible from moisture, oxides of carbon and especially oxygen, as these act on either the carbide or cyanamide and diminish the nitrogen content of the final product.

Discontinuous Process.—In the discontinuous process a vertical steel drum lined with firebrick is fitted loosely with a thick paper or thin, perforated, sheet-iron cylinder. Down the centre of the retort passes a carbon rod contained in a cardboard tube to separate it from the carbide. This rod is connected to an alternating current supply and is used as a heating resistance to start the reaction. The ground carbide is packed between the inner tube and the outer cylinder. The lid is luted on airtight. Nitrogen is admitted by a pipe through the outer casing. The charge consists of 300–800 kilos of carbide. A battery of such units is connected to the current supply. The heated carbon resistor starts the reaction at the centre. After a time the current is cut off as the reaction produces sufficient heat to maintain the charge at about 1,000°C. and so complete the reaction. The drums are allowed to cool, the contents ground and treated with sufficient water to slake the lime and decompose any uncombined carbide. The ground product is sometimes mixed with a little oil to render it dustless before packing in bags. The crude cyanamide, known as "nitrolim," "lime nitrogen," "kalkstickstoff" or "stickstoffkalk," contains 20–22% of nitrogen, corresponding to 57–63% of $CaCN_2$ and about 20% lime, 7–8% silica, iron oxide and alumina and 14% of graphitic carbon.

Continuous Process.—In one type of continuous furnace the carbide is packed in perforated metal boxes which are sent through a tunnel filled with nitrogen and heated, electrically or by external gas firing, to the necessary reaction temperature. Another common type is a vertical iron shaft lined with firebrick and divided internally into sections by shelves. The carbide is fed in at the top and heated by arcs between carbon electrodes. It meets an ascending stream of nitrogen and is made to fall slowly from shelf to shelf by scrapers until it is discharged at the bottom. In the Carlson process calcium fluoride is added to the carbide to increase the velocity of absorption and to lower the reaction temperature.

Uses of Nitrolim.—Nitrolim may be used directly on most soils as a nitrogenous fertilizer. When treated with water or steam under pressure it gives up practically the whole of its nitrogen as ammonia (*q.v.*):—

$$CaCN_2+3H_2O=CaCO_3+2NH_3.$$

The addition of alkali increases the yield of ammonia by lessening the formation of polymerides of cyanamide. By fusing a mixture of nitrolim, common salt and calcium carbide in an arc furnace, sodium cyanide is a product of the reaction. By rapidly cooling the melt the reverse reaction is prevented and the cyanide preserved. By suitable treatment numerous organic compounds (urea, dicyandiamide, guanidine, etc.) may be prepared from cyanamide. It also forms the basis of "ferrodur," used for case-hardening iron.

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(J. KN.)

CYANIC ACID AND CYANATES. Cyanic acid, HO.CN, was discovered by F. Wöhler in 1824. The acid is best prepared by distilling its polymeride, cyanuric acid, in a current of carbon dioxide (F. Wöhler and J. v. Liebig, 1827), the vapours distilling over being condensed in a freezing mixture. It is a very volatile liquid of strong acid reaction, and is stable only below 0°C. It has a smell resembling that of acetic acid. At 0°C. it is rapidly converted into a mixture of cyanuric acid, $C_3N_3O_3H_3$, and another polymeride cyamelide $(CNOH)_x$, a white amorphous powder, insoluble in water. Cyanogen chloride, CNCl, which may be regarded as the chloride of cyanic acid, is prepared by the action of chlorine on hydrocyanic acid or on mercuric cyanide. It is a very poisonous volatile liquid, which boils at 15.5°C. (*See* CHEMICAL WARFARE.)

The salts of cyanic acid are known as the cyanates, the two most important being potassium cyanate (KOCN) and ammonium cyanate (NH_4OCN). Potassium cyanate may be prepared by heating potassium cyanide with an oxidizing agent, or by heating potassium ferrocyanide with manganese dioxide, potassium dichromate or a mixture of potassium carbonate and minium. It crystallizes in flat plates and is readily soluble in alcohol or cold water. It is a somewhat important reagent, and has been used by Emil Fischer in various syntheses in the uric acid group. (*See* PURINES.) J. Walker and J. K. Wood (1900) prepared pure ammonium cyanate by the union of gaseous ammonia and cyanic acid, special precautions being taken to keep the temperature below the point at which the salt is transformed into urea. It crystallizes in fine needles, which melt suddenly at about 80°C., then resolidify, and melt again at about 128° to 130°C. (this temperature being the melting point of urea).

Esters of normal cyanic acid are not known, but those of isocyanic acid (HN:CO) may be prepared by the action of alkyl halides on silver cyanate, by oxidizing the isonitriles with mercuric oxide, or, more conveniently, by rearrangement of the amide or azide of a carboxylic acid, by rearrangement of a hydroxamic acid, or by the action of phosgene upon the hydrochloride of an aromatic primary amine. They are volatile liquids which boil without decomposition, and possess a disagreeable odour. When hydrolyzed with caustic alkalis, they yield primary amines (this reaction determines their constitution): $C_2H_5NCO+2NaOH=C_2H_5NH_2+Na_2CO_3$. With alcohols they give urethanes, and with amines they give substituted ureas. The sulphur analogues of these esters, the isothiocyanates, are known as mustard oils (*q.v.*).

Ethyl isocyanate, C_2H_5NCO, a colourless liquid (b.p. 60°C.) was first prepared by A. Wurtz (1854) by distilling a mixture of potassium ethyl sulphate and potassium cyanate.

Cyanuric acid, $H_3C_3N_3O_3$, was obtained by Wöhler and Liebig by heating urea, and by A. Wurtz by passing chlorine into melting urea. It forms white efflorescent crystals. Treatment with phosphorus pentachloride gives cyanuric chloride, $C_3N_3Cl_3$, which is also formed by the combination of anhydrous chlorine and hydrocyanic acid in the presence of sunlight. These substances contain a ring of three carbon and three nitrogen atoms.

CYANIDE, in chemistry, a salt of prussic or hydrocyanic acid, the name being more usually restricted to inorganic salts, *i.e.,* the salts of the metals; the organic salts (or esters) being termed nitriles. The properties of cyanides are treated in the article PRUSSIC ACID; reference should also be made to the articles on the particular metals. The most important cyanide commercially is sodium cyanide, which receives application in the "cyanide process" of gold extraction (*see* GOLD), as an insecticide, in case-hardening, electroplating, in the separation of minerals by flotation, and in organic syntheses.

Sodium Cyanide, NaCN, is manufactured by six methods.

(1) *Sodium Process.*—Metallic sodium is melted with charcoal in a steel vessel, and dry ammonia gas blown into the liquid at a dull red heat (600°C.); the sodium and carbon combine with the nitrogen of the ammonia, yielding sodium cyanide which is liquid at this temperature. The combination really takes place in three stages; sodamide is first formed, $Na+NH_3=NaNH_2+H$, but it has only a momentary existence, reacting at once either with charcoal or with sodium cyanide, to form sodium cyanamide ($2NaNH_2+C=Na_2CN_2+2H_2$, or $NaNH_2+NaCN=Na_2CN_2+H_2$), which then takes up carbon more slowly, yielding sodium cyanide, $NaCN_2+C=2NaCN$. To complete this last reaction the temperature is raised finally to about 850°C. After cooling, but while still molten, the finished cyanide is filtered through iron turnings into moulds of convenient size. The product is a pure white crystalline material containing 97.5% of sodium cyanide.

(2) *Formamide Process.*—When the vapour of formamide is passed over a catalyst at a moderately high temperature, *e.g.,* 600°C., it decomposes almost completely into hydrocyanic acid and water, $H{\cdot}CO{\cdot}NH_2=HCN+H_2O$. The former is absorbed in caustic soda and the resulting solution of sodium cyanide is evaporated to dryness in a vacuum. The briquetted product contains about 90% of sodium cyanide. This process has been made economically possible by the development of the high-pressure technique of chemical industry; the necessary formamide is obtained by the direct combination of carbon monoxide and ammonia at 80° to 90° under a pressure of 200 atmospheres. The reaction takes place most readily in presence of sodium methoxide, obtained by dissolving sodium in methanol (methyl alcohol).

(3) *"Schlempe" Process.*—The juice of the sugar beet contains, in addition to sugar, certain nitrogenous compounds. After the sugar has been removed as completely as possible, there remains a dark brown syrup, known in Germany as "Schlempe," which contains a large part of these constituents. This is dried and then distilled in retorts resembling those used in coal-gas manufacture. The gas evolved contains, among other things, ammonia and the three methylamines; when heated to 1,000°C. the latter decompose, yielding hydrocyanic acid. On leaving the heating stoves the gases contain ammonia, hydrocyanic acid and carbon dioxide; the ammonia is recovered by treatment with sulphuric acid after which the hydrocyanic acid is washed out with water, the dilute solution produced (about 2% HCN) is distilled and the hydrocyanic acid absorbed in caustic soda. This product resembles that of the formamide process.

(4) *The Cyanamide Process* begins with calcium cyanamide (*q.v.*), which is manufactured in large quantities by the direct union of atmospheric nitrogen with calcium carbide. A mixture of calcium cyanamide, common salt, and a little calcium carbide is fed into an electric furnace, consisting of a vertical shaft with carbon bottom and a single, suspended carbon electrode. Alternating current passes between the electrode and the charge, heating it to 1,200°–1,400°C. The fused furnace charge is run off almost continuously on to a rotating, water-cooled, steel drum which cools it rapidly. The product is obtained in the form of thin, grey flakes and contains cyanide equivalent to 48 to 50% of sodium cyanide. The formation of cyanide in this process is due to the combination of calcium cyanamide with carbon, $CaCN_2+C=Ca(CN)_2$. A part of the necessary carbon is already present in the calcium cyanamide owing to its method of formation, $CaC_2+N_2=CaCN_2+C$; the addition of calcium carbide to the charge furnishes a further quantity in a more chemically active form. Rapid cooling of the melt is necessary to prevent the decomposition of calcium cyanide which takes place between 700° and 400°C.

(5) *The Carbonate Process,* historically the oldest of those in use, was first described by L. Thompson in 1838. An intimate

mixture of sodium carbonate, carbon and iron is heated at 950°C. in a nichrome retort lined with steel with a current of nitrogen employed in excess: $Na_2CO_3+4C+N_2=2NaCN+3CO$, the iron acting as a catalyst. This process presents many difficulties, but has nevertheless obtained a measure of success as a producer of hydrocyanic acid.

(6) *Arc Process.*—When a mixture of methane and nitrogen, diluted with hydrogen, is passed through a high-tension electric arc, hydrocyanic acid is formed, $2CH_4+N_2=2HCN+3H_2$.

Control of Insect and Other Pests.—The value of hydrocyanic acid as an insecticide was first recognized in 1886 by D. W. Coquillett, who used it in the control of scale insects on citrus trees in California. The methods of work were standardized by the investigations of R. S. Woglum in 1907–10, and the method spread to most of the fruit-growing countries of the world. Hydrocyanic acid was first used for the destruction of vermin in the sleeping carriages of the Cape Government Railway in 1898, and its use for similar purposes spread so rapidly that the town council of Johannesburg found it necessary, in 1916, to draw up by-laws for the licensing of fumigators and for regulating the practice. Hydrocyanic acid was authorized as a fumigant in the United States Quarantine Regulations of 1910, but was first used on a large scale for killing rats in ships at New Orleans in 1914.

In the fumigation of plants it is important to secure a concentration of hydrocyanic acid which will kill the insect pest without injury to the plant; since these are more susceptible to injury in sunlight than in the dark, fumigation is done at night and at 38°–65°F. Some plants are more easily damaged than others.

In order to confine the gas, plants growing in the open are covered with a tent of closely-woven cotton cloth, measuring usually from 36 to 45ft. across, which hangs down, touching the ground all round. The distance round the bottom of this tent is then measured and the distance over the top of the tree read off from a scale which is painted on the cloth itself; the quantity of cyanide required for the enclosure is then read off from tables constructed by Woglum and based on the use of 1 oz. of potassium cyanide (or $\frac{3}{4}$ oz. of sodium cyanide) for 100 cu.ft. of enclosed space; allowances are made for the size of tree and the nature of the insect to be dealt with. The exposure to the gas is usually one hour. The hydrocyanic acid is generated by mixing together sodium cyanide (1 oz.), concentrated sulphuric acid ($1\frac{1}{2}$ fluid oz.) and water (2 oz.). The water is placed in a 2 to 3gal. stoneware jug, the sulphuric acid added, the charge of cyanide is thrown in, and the tent closed at once. In more gas-tight enclosures, such as greenhouses, a smaller dosage is sufficient; in some cases a repetition of the treatment after a suitable interval may be needful, eggs and pupae being more resistant than the larvae and mature insects; most scale insects require about $2\frac{1}{2}$ oz. per 1,000 cubic feet.

In the fumigation of ships and mills, modifications of the procedure are necessary owing to the larger quantity of gas required and the difficulty of protecting the operator from danger, several hours being allowed for the gas to escape.

The necessity of handling strong sulphuric acid and difficulties in disposal of the poisonous acid residues have led to the introduction of pure liquid hydrocyanic acid. This was first manufactured commercially in California in 1917 and in South Africa in 1920. In California, the liquid, which contains 2 to 4% water, is supplied in iron drums holding 100 lb. each. It is applied by means of a portable vessel containing 17 to 21 lb. with attached hand pump; each stroke of the pump delivers a measured quantity of the liquid to a spraying nozzle which is pushed into the tent; 22c.c. of the liquid acid are equivalent to 1 oz. of sodium cyanide.

Liquid hydrocyanic acid is unstable and may even explode. For this reason its use was restricted to districts in which distribution by motor transport from a local factory was possible. The instability is principally due to the presence of traces of ammonia gradually formed by the action of water on the acid itself. Small quantities of a strong acid neutralize the ammonia and therefore confer temporary stability; larger quantities are useless because they accelerate the formation of ammonia. Recently many other substances which neutralize ammonia have been proposed; among these, substances which also act as detectors are especially interesting. Owing to its faint smell the presence of a dangerous quantity of hydrocyanic acid may easily escape notice (the smell is much more perceptible when one is smoking). The addition of 2 or 3% of such violently lachrymatory substances as cyanogen chloride, ethyl chlorocarbonate or ethyl bromoacetate is said to stabilize the acid and also give unmistakable warning of its presence in the air. Stabilized, liquid hydrocyanic acid, absorbed in granular diatomite, is marketed under the name of *Cyclon.*

The impure calcium cyanide produced by the cyanamide process gives off hydrocyanic acid by mere contact with moist air. Where the residue of lime is harmless the powdered material may therefore be used instead of hydrocyanic acid; for example, it has been used for killing rabbits by blowing the dust into their burrows.

Case Hardening.—Since 1910 case hardening by immersion in fused sodium cyanide has come into use more especially in the United States and Canada. Mild steel absorbs carbon from fused sodium cyanide and is so converted, superficially, into steel which can be hardened by rapid cooling. The articles to be treated are suspended in a bath of fused sodium cyanide at 850°C. preferably diluted with sodium chloride or carbonate to contain about 50% of NaCN. The rate of penetration of carbon into mild steel is $\frac{1}{100}$th in. (0·25mm.) per hour, or about 50% more when 3% nickel steel is used. The rate of penetration is independent of the percentage of cyanide in the bath, but the carbon content, and therefore the hardness after quenching, increases with it; an immersion of 10 to 15 min. is sufficient in some instances.

Electroplating.—The use of cyanide solutions for plating with silver was discovered in 1840. A plating solution is prepared by dissolving a silver salt (*e.g.,* the cyanide or carbonate) in a solution of potassium cyanide. The article to be plated, of which the surface has been carefully cleaned, and a sheet of silver of about the same size are suspended a few inches apart in the solution and a current of electricity is passed through the bath from the silver to the article. The silver dissolves and an equal quantity is deposited, so that the composition of the bath remains unchanged except for a slight decomposition of the cyanide by the action of atmospheric carbon dioxide. The quality of the deposit improves with the age of the bath: solutions are to be found which have been in use for more than 50 years. The composition of the bath varies, but from 2 to 4 oz. of silver per imperial gallon, with about double the minimum quantity of cyanide required to dissolve it, is usually satisfactory. The improvement with age is probably due to the higher electrical conductivity of the solutions containing accumulated impurities, principally potassium carbonate. The current generally used is 3 amp. per sq.ft. of surface. Plating with gold, gold–silver or gold–copper alloys is done in a similar way. Cyanide solutions are also used in the deposition of copper, zinc, brass and cadmium, more especially on iron.

Flotation.—Intimate mixtures of the sulphides of lead, zinc, copper and iron with gangue often occur in nature. The separation of the minerals is effected by agitating a mixture of the powdered ore, water and a little oil with air. A froth is formed in which the minerals predominate. G. E. Sheridan and G. G. Griswold (U.S. Patents 1,421,583 and 1,427,235 of 1922) have found that the addition of a small quantity of sodium cyanide and, preferably, zinc sulphate to the liquid, previously made faintly alkaline with soda ash, prevents the flotation of zinc sulphide and of iron pyrites without affecting that of the sulphides of lead or copper. The iron and zinc may be separated by a second treatment in more strongly alkaline solution, the zinc alone floating. The process is in use at several mines in North America.

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CYANIDE PROCESS. When the cyanide process was invented in 1887 there was pressing need for improvement in the treatment of gold ores. The industry, after languishing for many years, had received a fillip from the discovery of the Rand goldfield and was attracting great attention. The mining of ores was by no means inefficient, but extraction of the gold from them was poor and behind the times. The old amalgamation (*q.v.*) process was cheap but in general could only extract some 60% of the values, and most of the finely divided gold, as well as the gold contained in minerals such as pyrites and other sulphides, escaped in the tailings. Many ores had been discovered which could not be treated by amalgamation or were too poor to pay for working. Smelting, although effective, was costly and required the supply of large quantities of rich ore, together with lead ore and cheap fuel at no great distance from the gold mines. Metallurgists were busily engaged in the search for new methods and almost any proposal was eagerly seized upon and tested. It was the paradise of the bogus process-monger. Many new processes, including novelties in amalgamation, were found to be worthless or of limited scope.

The proposal to use cyanide of potassium as a solvent for gold in ores is almost the only instance on record of an invention of vital importance to an industry being made to order. It was put forward by J. S. MacArthur and R. W. and W. Forrest and was received at first with derision, partly because the chemical was rare and had been little studied. Cyanide was best known at the time as a deadly poison, although small quantities were used in electro-plating and in photography.

However, it was soon found that the proposal was a sound one. It was tried in New Zealand in 1889 and in South Africa in 1890 and before long was recognized as the new process for which everyone had been seeking. At first it was used mainly on the tailings from amalgamation in the Transvaal, but it was applied later to both gold and silver ores without previous amalgamation, and this practice had become the general rule by 1925.

In the process, pulverized gold ores or the tailings from amalgamation are mixed with a dilute solution of potassium cyanide (KCy) or sodium cyanide (NaCy) in water. The gold and silver are dissolved and the solution is separated from the ore by filtration. The clear solution then flows through a mass of zinc shavings, when the gold and silver are precipitated and appear on the surface of the zinc as a black slime, while some zinc is dissolved. The black slime is purified, melted down and cast into bars of gold and silver. In modern practice the zinc shavings are replaced by zinc dust.

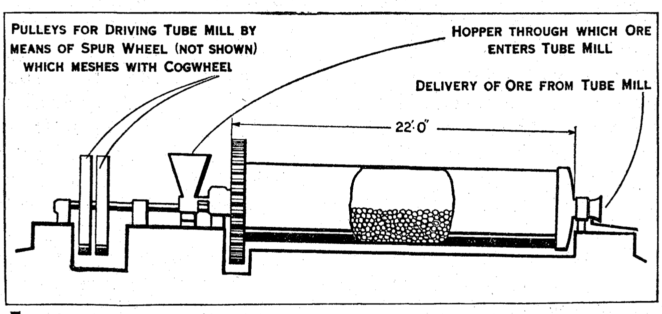


FIG. 1.—SECTION OF TUBE MILL SHOWING HOW THE BROKEN GOLD ORE, SCREENED TO A MAXIMUM SIZE OF ½ IN., IS GROUND WITH PEBBLES OR UNBROKEN ORE TO A MIXTURE OF SAND AND SLIME

The chemical action is complicated but need not be discussed here at length. The gold is not dissolved without chemical change, as sugar is dissolved in water. It is converted into cyanide of gold and is dissolved as a double cyanide of gold and potassium. When chemical symbols are used, the dissolving of the gold is represented by the following equation:—

$$4\,Au+8\,KCy+O_2+2\,H_2O=4\,KAu\,Cy_2+4\,KHO$$

Among the involved chemical actions which take place there is one which should be borne in mind, and that is the part played by air in dissolving the gold. It is necessary to ensure the continuous presence of oxygen at the surface of the particles of gold or the action stops altogether.

Crushing and Cyaniding the Ore.—Gold ores are generally crushed in cyanide solution instead of water. The result is that the gold begins to be dissolved at once, and the dissolving continues throughout the succeeding stages until filtering is completed. A variety of machines are used for crushing, among which may be mentioned the stamp battery (*see* AMALGAMATION). When the ore has been reduced to a maximum size of about ½in. in diameter it is delivered into tube mills (fig. 1), for further grinding. A tube mill is a long iron cylinder placed in a horizontal position and made to revolve on its own axis. It is half filled with flint pebbles or pieces of unbroken ore, which roll over each other as the mill revolves and grind the ore to a mixture of sand and slime. It is continuous in action. The ore enters ceaselessly at one end and passes out at the other.

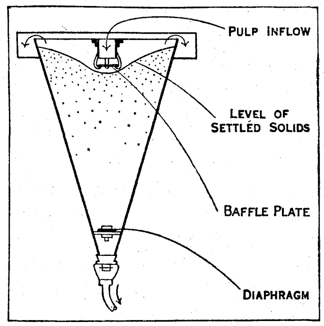


FIG. 2.—CONE CLASSIFIER
The product of the tube mill passes into this apparatus which separates the coarse sand from the slime

The product of the tube mill is next "classified" or separated nto sand and slime. One type of classifying machine much used in South Africa is the Cone Classifier (fig. 2). This is kept full of water and the pulp is run in at the top. The coarse sand settles and passes through a nozzle at the bottom; the fine slime overflows at the top with most of the water. The coarse sand is returned to the tube mill to be ground again and the product is fed once more into the classifier. The ore is thus all ground to slime in the end, as the only part which goes forward to other machines is the overflow from the classifier (fig. 3). This method of work is called "all-sliming."

At this stage of the operations the dissolving of the gold is assisted by the use of agitating vats. One of the most ingenious of these is the Pachuca tank (fig. 4), so called because of its use on silver ores at Pachuca in Mexico. Air is forced into the central tube A at the bottom and bubbles up the tube, carrying the slimed ore with it. The slime overflows at the top of the tube and, passing down in the tank outside, enters the tube at the bottom and is carried up again. Aeration and mixing continue until the gold is dissolved.

Filtration and Gold Recovery.—After the gold has been dissolved in the agitators the mixture is pumped into a filtering tank and the solution is separated from the residue by means of leaf filters. A single filter leaf (fig. 5) is a canvas bag, wide and deep but nearly flat. It may be pictured as an empty sack. In the Butters leaf a vacuum is created inside the bag so that the clear liquid is sucked through the canvas into it. The solids form layers or cakes of slime on the outside surfaces. When the cakes have grown to about 1in. thick, they are detached and the filtering is renewed. A large number of filter leaves are clamped near together in a parallel position and the whole frame of filter leaves, or "basket" as it is called, is immersed in the pulp to be filtered. In some other leaf filters the pulp is forced under pressure into the interior of the leaf or bag and the clear liquid passes through the canvas to the outside, leaving the solids inside. This variety of filtering is called "filter-pressing."

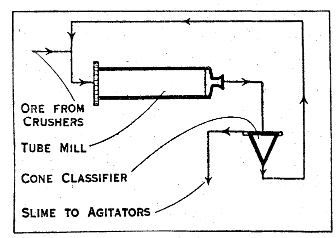


FIG. 3.—"ALL-SLIMING" PROCESS
The ore, ground to slime, passes on to the agitators, while the sand is returned to the tube mill

An alternative and older method of separating the gold-cyanide solution from the ore-slime is by decantation. The mixture is allowed to settle in large vats and the clear liquid is drawn off from the top. Lime is added to the charge to hasten the settling. An improvement consists in continuously introducing a slow current of clear water at the bottom and allowing it to overflow at the top (counter-current decantation). In this way the ore-slime never settles but remains in suspension in the water in the vat and is gradually washed clean.

For the recovery of the gold from the cyanide the dissolved air is first removed from the clear solution by applying a vacuum to thin streams of the liquid (Crowe process). The solution is then mixed with zinc dust and the gold precipitated as black slime (not to be confused with the ore-slime mentioned previously), while most of the zinc is dissolved. The gold-slime is then filter-pressed in leaf filters and the clear cyanide solution separated in them is conveyed to a storage tank for use again after it has been re-aerated. The gold-slime is purified by furnace methods and is finally melted and cast into bars.

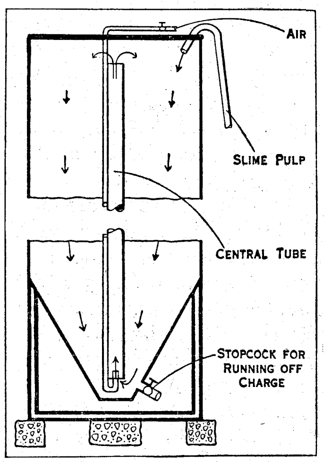
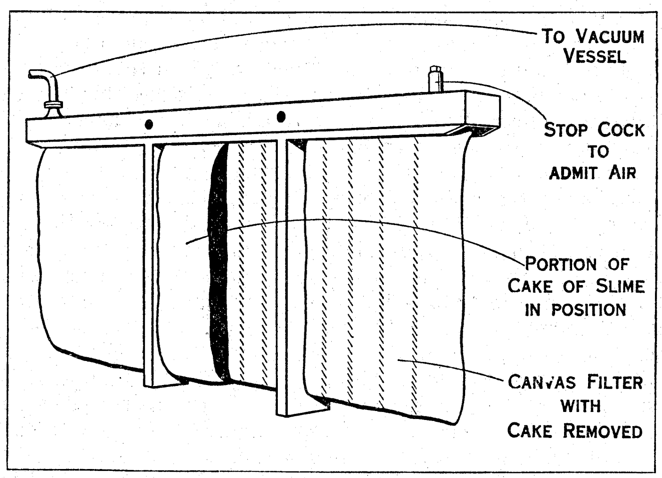


FIG. 4.—SECTION (INCOMPLETE) OF A PACHUCA AGITATING TANK
Here, the slimed ore is charged with air while the gold is being dissolved. Aeration is an important factor in the solution of gold by the cyanide process

One of the most striking features in the cyanide process is the extreme dilution of the solutions. In South Africa the cyanide solutions are kept as far as possible at a strength of only 0·027% (0·54 lb. per ton), and in 1922 the consumption of cyanide was only about 0·27 lb. per ton of ore. The total cost of treatment by a modern plant is 3s. 6d. per ton. This is remarkably low considering the complexity of the process, which can hardly be realized from the incomplete outline presented here. About 98% of the gold is extracted.

Silver ores are treated similarly to gold ores, but the solutions are stronger, generally containing from 0·1% to 0·5% of cyanide.

In places where the amalgamation process still lingers, as in India, gold ores are crushed in water, not cyanide solution. The all-sliming method is not used, but instead the sands and slimes are cyanided separately. The sands are charged into large circular vats. Cyanide solution is pumped on to the top and sinks downwards through the sand, dissolving the gold as it passes. It runs out at the bottom through a filter bed of coarse sand covered with canvas. The oxygen is supplied from that dissolved in the solution and from the air held in the porous ore. The air supply may be renewed by draining the charge dry. Similar methods were in use in South Africa before 1925.



FROM GOWLAND "METALLURGY OF THE NON-FERROUS METALS" (FRASER & CHALMERS)

FIG. 5.—BUTTERS' LEAF FILTER, BY WHICH THE PULP FROM THE AGITATORS IS SEPARATED INTO RESIDUE AND LIQUID. THE CLEAR SOLUTION IS SUCKED INTO THE LEAF FILTERS, WHILE THE RESIDUE CAKES ON THE OUTSIDE SURFACES

In conclusion it may be observed that the cyanide process was responsible for a very large proportion of the world's production of gold and silver in recent years, and that the mining industry is well satisfied with its results.

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CYANIN is the pigment of cornflowers and occurs also in deep red dahlias.

(*See* ANTHOCYANINS AND ANTHOXANTHINS.)

CYANITE: *see* KYANITE.

CYANOGEN, a gas composed of carbon and nitrogen. The name was suggested by Prussian blue (Gr. κύανος, blue), its earliest known compound. Cyanogen (C_2N_2) was first isolated in 1815 by J. Gay-Lussac, who obtained it by heating mercury or silver cyanide; this discovery is of considerable historical importance, since it recorded the isolation of a "compound radical." It may also be prepared by heating ammonium oxalate or by the addition of a concentrated solution of potassium cyanide to one of copper sulphate, the mixed solutions being then heated. It also occurs in blast-furnace gases. When cyanogen is prepared by heating mercuric cyanide, a brown residue known as paracyanogen $(CN)_x$ is left; this is to be regarded as a polymeride of cyanogen.

Cyanogen is a colourless gas, possessing a peculiar characteristic smell, and is very poisonous. It burns with a purple flame, forming carbon dioxide and nitrogen; and may be condensed (by cooling to −20° C.) to a colourless liquid, and further to a solid, which melts at −34.4° C. (M. Faraday, 1845). It dissolves readily in water and the aqueous solution decomposes on standing; a dark-brown flocculent precipitate of azulmic acid, $C_4H_5N_5O$, separating, while ammonium oxalate, urea and hydrocyanic acid are found in the solution.

In many respects it resembles chlorine in its chemical behaviour, a circumstance noted by Gay-Lussac; it combines directly with hydrogen (at 500° to 550° C.) to form hydrocyanic acid, and with chlorine, bromine, iodine and sulphur, to form cyanogen chloride, etc.; it also combines directly with zinc, cadmium and iron to form cyanides of these metals. Concentrated hydrochloric acid converts it into oxamide.

A dilute solution of potassium hydroxide converts it into a mixture of potassium cyanide and cyanate. With tin and hydrochloric acid it yields ethylene-diamine.

CYAXARES (Sī-ăks′-ah-rēz), king of Media, reigned, according to Herodotus (i. 107), 40 years, about 624–584 B.C. That he was the real founder of the Median empire is proved by the fact that in Darius's time a Median usurper, Fravartish, pretended to be his offspring (Behistun inscr. 2. 43). Herodotus narrates (i. 103 *et seq.*) that he renewed the war against the Assyrians and, while he besieged Nineveh, was attacked by a great Scythian army under Madyas. The Scythians defeated Cyaxares and ruled 28 years, till at last they were made drunk and slain by him at a banquet (*cf.* also Herod. i. 73).

We know from Jeremiah and Zephaniah that Syria and Palestine were really invaded by northern barbarians in 626 B.C., and it is probable that this invasion was the principal cause of the downfall of the Assyrian empire. (*See* MEDIA and PERSIA: *Ancient History.*)

Cyaxares now renewed his attack on Assyria, and in 606 B.C. destroyed Nineveh and the other capitals of the empire (Herod. i. 106). The countries north and east of the Tigris, the northern part of Mesopotamia, Armenia and Cappadocia were likewise subdued. The attempt to advance farther into Asia Minor led to a war with Alyattes of Lydia, in which Syennesis of Cilicia and Nebuchadrezzar (in Herodotus "Labynetus") of Babylon interceded and effected a peace, whereby the Halys was fixed as frontier between the two empires. Cyaxares died shortly afterwards.

CYBELE, a goddess native to Asia Minor, known to the Romans most commonly as the GREAT MOTHER OF THE GODS. (*q.v.*).

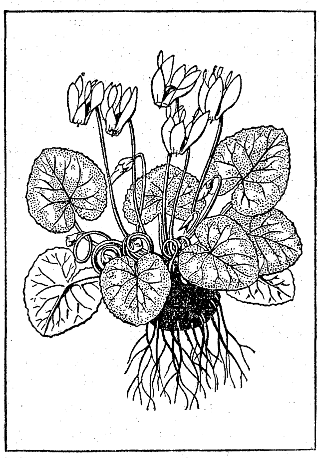
CYCADALES: *see* GYMNOSPERMS.

CYCADS: *see* Gymnosperms.

CYCLADES, islands in the Greek Archipelago, around the island of Syra (Syros), the principal town of which, Hermoupolis, is the capital of a department. The islands are interesting and picturesque; their inhabitants present the best type of Greek, and many islands bear traces of the feudal rule of Venetian families. Delos (*q.v.*), was a great centre of ancient religious, political and commercial life, and has been thoroughly excavated by French archaeologists; Melos (*q.v.*), has Hellenic and Roman remains, and the prehistoric town of Phylakopi has been excavated by the British school at Athens. In the volcanic Thera (*see* Santorin), the ancient capital has been explored by Baron Hiller von Gärtringen. Naxos, largest and most fertile, contains the highest mountain (Zia, 3,290 ft.), and exports emery, a state monopoly hypothecated to the foreign debt. Ceos (*q.v.*) or Zeá and Ios furnish valonia. Kimolos produces fuller's-earth. The marble of Paros has been practically abandoned; that of Tenos is worked by a British syndicate; iron ore is exported from Seriphos, manganese and sulphur from Melos, and pumice for cement (*pozzolana*) from Santorin. But the mineral wealth of the Cyclades is ill-exploited as yet. Though of rugged and barren aspect, they export wines, brandy, tobacco and hides. Cythnos, Melos and other islands possess hot medicinal springs. Tenos has a pilgrim-church, modern but famous throughout Greece.

Population of the Cyclades (1928, last census before World War II) 129,702. The islands were occupied by Germany in 1941.

CYCLAMEN, in botany, a genus belonging to the family Primulaceae, containing 20 species native in the mountains of central Europe and the Mediterranean region. *C. europaeum* (sow-bread) is found as an introduced plant in copses in Kent and Sussex. The plants are low-growing herbs with large tuberous rootstocks, from the surface of which spring a number of broad, generally heart-shaped or kidney-shaped, long-stalked leaves, which in cultivated forms are often beautifully marbled, ribbed or splashed. The flowers are nodding, and white, pink, lilac or crimson in colour. The corolla has a short tube and five large reflexed lobes. After flowering the stalk becomes spirally coiled, drawing the fruit down to the soil. Cyclamen is a favourite flower, and *C. persicum* is the sort most grown by florists as a pot plant. It is a small-growing kind bearing medium-sized leaves and numerous flowers. *C. persicum giganteum* is a large, strong-growing variety, not quite so free flowering as *C. persicum* but in all other respects superior to it when well grown. *C. persicum papilio* differs in the fringed character of the petals. There is also a beautiful crested race. (N. Tr.)



FROM A. JORDAN "ICONES AD FLORAM EUROPAE"

WILD CYCLAMEN (CYCLAMEN EUROPAEUM), A STEMLESS PLANT, SOMETIMES CALLED "SOW BREAD" BECAUSE ITS TUBERS ARE RELISHED BY SWINE

CYCLE, in astronomy, a period of time at the end of which some aspect or relation of the heavenly bodies recurs. (Gr. κύκλος, a circle.) (*See* Calendar and Eclipse.) In physics, the term is applied to a series of operations which, performed upon a system, brings it back to its original state; "Carnot's Cycle" is an example (*see* Thermodynamics). The word is used loosely of any long period of time. From the phrase ὁ ἐπικὸς κύκλος, the epic cycle (*see* below), comes the application of the term "cycle" to a series of prose or poetical romances which have for a centre one subject, whether a person, as in the Alexander, Arthurian or Charlemagne cycles, or an object, such as the ring of the Nibelungenlied. In music "Song-cycle" (Ger. *Liederkreis*) is similarly used of a series of songs written round one subject or set to poems by the same author. Beethoven's *An die ferne Geliebte* (Op. 98), published in 1816, is the earliest instance. For the epic cycle, or cyclic poems, of Greece *see* Homeric Poems.

CYCLE OF TRADE: *see* Trade Cycle.

CYCLING, the clipped term now given comprehensively to the sport or exercise of riding a bicycle (*q.v.*) or tricycle (*q.v.*).

History.—Suggestions of vehicles having two or more wheels and propelled by the muscular effort of the rider or riders are to be found in very early times, even on the bas-reliefs of Egypt and Babylon and the frescoes of Pompeii; but though sporadic examples of such contrivances are recorded in the 17th and 18th centuries, it was apparently not till the beginning of the 19th century that they were used to any considerable extent. A "velocipede" invented by Blanchard and Magurier, and described in the *Journal de Paris* on July 27, 1779, differed little from the *célérifère* proposed by another Frenchman, de Sivrac, in 1690; it consisted of a wooden bar rigidly connecting two wheels placed one in front of the other, and was propelled by the rider, seated astride the bar, pushing against the ground with his feet. The next advance was made in the *draisine* of Freiherr Karl Drais von Sauerbronn (1785–1851), described in his *Abbildung und Beschreibung seiner neu erfundenen Laufmaschine* (Nuremberg, 1817). In this the front wheel was pivoted on the frame so that it could be turned sideways by a handle, thus serving to steer the machine. A similar machine, known by the name "celeripede," also with a movable front wheel, is said to have been ridden by J. N. Niepce in Paris some years before. In England the draisine achieved a great, though temporary, vogue under various names such as velocipede, patent accelerator, bivector, bicipedes, pedestrian curricle (patented by Dennis Johnson in 1818), dandy horse, hobby horse, etc., and for a time it was popular in America also. The propulsion of the draisine by pushing with the feet being alleged to give rise to diseases of the legs, arrangements were soon suggested, as by Louis Gompertz in England in 1821, by which the front wheel could be rotated by the hands with the aid of a system of gearing, but the idea of providing mechanical connections between the feet and the wheels was apparently not thought of till later. Pedals with connecting rods working on the rear axle are said to have been applied to a tricycle in 1834 by Kirkpatrick McMillan, a Scottish blacksmith of Keir, Dumfriesshire, and to a draisine by him in 1840, and by a Scottish cooper, Gavin Dalzell, of Lesmahagow, Lanarkshire, about 1845. The draisine thus fitted had wooden wheels, with iron tires, the leading one about 30 in. in diameter and the driving one about 40 in., and thus it formed the prototype, though not the ancestor, of the modern rear-driven safety bicycle.

For the next 20 years little was done, and then began the evolution of the high "ordinary" bicycle, with a large driving wheel in front and a small trailing one behind. Rubber tires, in place of iron ones, appeared in 1868, and in two or three years were made an inch or an inch and a half in width. Suspension wheels, with wire spokes in tension, were seen at the Crystal Palace, London, on the "Phantom" of W. F. Reynolds and J. A. Mays in 1869, and early in the same year the manufacture of bicycles, at first for export to France, was begun in England by the Coventry Sewing Machine company, till then makers of sewing machines. There was a rapid growth in the size of the front wheel with a corresponding shrinkage in the rear wheel until by 1874, the date of the invention of the tangent wheel by James Starley, 54 in. wheels were being made. It is important (historically) to remember that James Starley died before John Kemp Starley (his nephew) began work. The high bicycle was now fairly established in form and very fast times were made with it both on the road and on the racing path. In 1882 H. L. Cortis rode 20 mi. 300 yd. in one hour, and in April 1884 Thomas Stevens started from San Francisco to ride round the world, a feat which he accomplished in Dec. 1886.

The improvement of the high bicycle was attempted in two directions. On the one hand it was modified by placing the rider farther back, his position "over his work" being ensured by arranging the pedals immediately below him and connecting them to the front wheel, which was usually reduced in size, by levers and cranks or by chain-gearing, often with a multiplying action.

On the other, the rear wheel was enlarged and made the driving wheel. This latter developed into the modern rear-driven safety. There are numerous claimants for the invention—or rather the reinvention—of this type, but it appears that the credit for its practical and commercial introduction in substantially its present form is due to J. K. Starley in England. His "Rover," brought out early in 1885, had two nearly equal wheels, the driving wheel 30 in. in diameter and the steering 32 in., and the rider sat so far back that he could not be thrown forward over the handles. The motion imparted by the pedals to a sprocket wheel mounted between the wheels was transmitted by an endless chain to the rear wheel, and by sufficiently increasing the size of this sprocket wheel the machine could be made to travel as far or farther than the "ordinary" for each complete revolution of the pedals. From about 1890 the "safety" monopolized the field. At first it was fitted with the narrow rubber tires customary at the time, but these gave way to pneumatic tires, invented in 1888 by J. B. Dunlop, a Scotsman practising as a veterinary surgeon in Belfast, whose idea, however, had been anticipated in the English patent No. 10,990 taken out by R. W. Thomson in 1845. The result was a great gain in comfort, due to reduction of vibration, and a remarkable increase of speed or, alternatively, decrease of exertion. The beginning of the 20th century saw the introduction of two innovations: one was the "free-wheel," a device which allows the driving wheel to rotate independently of the chain and pedals, so that the rider, controlling his speed with powerful brakes, can "coast" down a hill using the stationary pedals as footrests; and the other was the motorcycle, in which a gasoline-engine relieves him, except at starting, from all personal exertion, though at the cost of considerable vibration.

The safety bicycle, with pneumatic tires, rendered cycling universally popular, not merely as a pastime but as a convenient means of locomotion for everyday use. Made with a drop-frame, it also enabled women to cycle without being confined to a heavy tricycle or compelled to assume "rational dress." In consequence there was an enormous expansion in the cycle industry. In Britain the demand for machines had become so great by 1895 that the makers were unable to cope with it. Numbers of new factories were started, small shops grew into large companies, and the capital invested advanced by millions of pounds. The makers who had devoted their mechanical skill to perfecting the methods of cycle-construction were swallowed up by company promoters and adventurers, bent simply upon filling their own pockets. In America the manufacture of bicycles was not begun until about 1878, when it was introduced by A. A. Pope (1843–1909), and even by 1890 the value of the products barely exceeded $2,500,000, while for several years later much of the steel tubing required for bicycle manufacture continued to be imported from Great Britain. The industry, however, thanks to automatic machinery and perfect organization grew rapidly, and in 1900 the value of its products was nearly $32,000,000. In the two years 1897 and 1898 the exports of cycles and cycle parts alone were worth nearly $14,000,000, though they fell off in subsequent years, and British makers had to contend with an American invasion in addition to their domestic troubles. But the competition was short-lived. The American makers sent over machines with single tube tires and wooden rims, which did not secure the approval of the British purchaser, and so they too lost their hold. In the opening years of the 20th century the industry in Great Britain gradually recovered itself. More attention was paid to the production of cheap machines which were sound and trustworthy, and sales were further stimulated by the introduction of systems of deferred payments. In 1905 about 600,000 machines were made in Great Britain, and 47,604 were exported, the total value of the home market for cycles and their parts being about £3,500,000 sterling, and of the export trade about £1,000,000. In the same year the number of machine imported was only 2,345.

Touring Clubs.—Cycle tours were taken and cycling clubs established almost as soon as the cycle appeared, the Pickwick Bicycle club in London, founded in 1870, being the oldest in the world. The organization of these clubs was chiefly of a social character, and few possessed well-appointed clubhouses. To a great extent they have been superseded by the large touring organizations. The Cyclists' Touring club, organized in 1878 as the Bicycle Touring club, has members scattered through Europe, America and even the east. Many other countries possessed national clubs, as for instance the now extinct original League of American Wheelmen organized in 1880; Touring Club de France, founded in 1895, of whose objects cycling is only one, though the chief. The aim of these national associations, which have formed an international touring league, is the promotion of cycle touring. To this end they publish roadbooks, maps and journals; they recommend hotels, with fixed tariffs, in their own and other countries; they appoint representatives to aid their members when touring; and they have succeeded in inducing most governments to allow their members to travel freely across frontiers without paying duty on their machines. In all countries they have erected warning-boards at dangerous places; in France the best route is suggested by a signpost, and cyclists who meet with accidents in lonely places find repair outfits provided for their free use. Another important part of the work of these clubs, either directly or indirectly, is the improvement of the roads. France has done more for the cyclist than any other country, owing to the fact that she possesses the best roads, kept up to a certain extent by the cycle tax, whereby the cyclist acquires a certain official position and right; moreover cycles accompanied by their owners are conveyed without extra charge on the railways, and aid is given to the sport and pastime from public funds. In Belgium the cycle has worked a veritable revolution in the national life. The surface of the greater part of the country being loose and sandy, the roads have been paved, and this paving is so bad as to be impossible for light traffic. The cycle tax has consequently been devoted, first, to the construction of paths on which cyclists have equal rights with pedestrians, and secondly to the replacing of the paving by macadam. In this way alone cycling has proved of inestimable benefit to Belgium and Luxembourg. In the United States measures for securing good roads and side paths have been introduced in various states, mainly at the instigation first of cyclists and then of motorists, and in Great Britain the Roads Improvement association has worked for the same end.

Racing.—Each country also possesses an organization for the government of cycle racing; and although these unions, one object of which—usually the main one—is the encouragement of cycle racing and cycle legislation, boast an enormous membership, their membership is often composed of clubs and not individuals. Among the most important are the National Cycling association, which controls professional track racing, and the Amateur Bicycle League of America, in the U.S.A.; the Canadian Wheelmen's Association in Canada, the National Cyclists' Union of England and the Union Vélocipédique of France. These bodies, with the exception of the A.B.L. of A. are also bound together by the Union Cycliste Internationale which is devoted mainly to the promotion of racing and legislation connected with it all over the world. The National Cyclists' Union, originally the Bicycle Union, which was the parent body of all, formed in Feb. 1878, was the first to put up danger-boards, and also was early instrumental, alone and with the C.T.C., in framing or suggesting laws for the proper government and regulation of cycle traffic, notably in establishing its position as a vehicle in securing universal rights, in endeavouring, again in conjunction with the C.T.C., to increase facilities for the carriage of cycles on the railways, in securing the opening of parks, and in promoting many other equally praiseworthy objects. For a number of years, however, it has been more prominent as the ruling race-governing body. But cycle racing in England fell upon evil days. At one time cycle racing attracted a large number of spectators, but gradually it lost the public favour, or rather was ignored by the public because it became mainly an advertisement for cycle makers. The presence of the man, directly or indirectly, in the employ of, or aided by a maker, and the consequent mixing up of trade and sport, lowered racing not only in the public estimation, but in that of all genuine amateurs. There have always been a few amateurs who have raced for the love of the sport, but the greater number of prominent racing men have raced for the benefit of a firm, so much so that, at one time, an entire section of racing men were classed as "makers' amateurs." They did not confine themselves to the race track, but appropriated the public roads until they became a danger and a nuisance, and road-racing, on the old lines, finally was abolished, though record rides, as they are called, are still indulged in, claims being checked and adjudicated upon by a strong organization, known as the Road Records association, founded in 1888. The makers' amateurs at least rode to win and to make the best time possible. But the scandal was so great that a system of licensing riders was adopted by the N.C.U., and if this did not effectively kill the sport, the introduction of waiting races did.

In the United States the National Cycling association controls professional cycle racing. This body succeeded the League of American Wheelmen. All six-day races are held under N.C.A. sanction. The Amateur Bicycle League of America controls all amateur racing, on the road, dirt or board tracks, also encourages touring and record making attempts. In 1940 Raymond Bryan rode from New York city to San Francisco, a distance of 3,149 miles, in 27 days 11 hours.

The A.B.L. of A. is composed of 80 clubs from 36 states and Hawaii. National championships are held yearly. They have taken place in Washington; Atlantic City; Chicago; Buffalo; Philadelphia; Kenosha, Wis.; Columbus, O.; Detroit; Pasadena, Calif.; Louisville, Ky.; St. Louis and Newark. The A.B.L. of A. is affiliated with the Amateur Athletic union and the United States of America Sports federation. The U.S.A.S.F. is the body into which the American Olympic Games and the Pan-American Games committees were combined. In America (*see* below) the system of proving the capacity of racing machines was carried so far that in 1899 a board track was laid down on the Long Island railway for about 2 mi. between the rails and a cyclist named Charles M. Murphy, followed a train, and protected by enormous wind-shields, succeeded in covering a mile in $57\frac{4}{5}$ seconds. This gave birth to the expression "a mile a minute." Other cyclists have devoted themselves, at the instigation of makers, to the riding of 100 mi. a day every day for a year. It would be difficult to say what advantage there is in these trials and contests. They are not convincing records, and only prove that some people are willing to take great personal risks for the benefit of their employers. E. Hale, during 1899–1900, covered 32,496 mi. in 313 days. For many years also long-distance races, mostly of six days' duration, have been promoted on covered tracks, and though condemned by all cycling organizations, they find a great deal of pecuniary support. In 1941 Alf Letourner, professional rider, travelled at the rate of 108.92 miles per hour behind a midget auto racing car on a California state highway. Letourner was officially timed by an American Automobile association representative.

Military.—The cycle has also been taken up for military purposes. For this idea the British army is indebted to Colonel A. R. Savile, who in 1887 organized the first series of cycle manoeuvres in Britain. Thereafter military cycling underwent a great development, not only in the country of its origin but in most others.

Recent Developments.—During the period following 1910 the evolution of the bicycle was not maintained, mechanical changes being less frequent and not so drastic as had been the case during the early pneumatic era. After 1918 interest in every branch of cycling increased to a marked extent, and this had its origin in the attitude taken up by the big cycle makers, who, desiring the freedom from trouble which mass production provides, discouraged development and allowed design to stagnate.

Thus an opportunity arose for the assembler or small maker, generally an active cyclist himself, and invariably a working mechanic. Numbers of such men started in business, making a specialty of bicycles built to order and complying with the customer's own specification. These assemblers purchased parts from the various houses specializing in the production of fittings for the trade and built them up into complete machines. Under their aegis, supported by a growing demand from the large number of club riders of both sexes, the light roadster bicycle was evolved, a type which the large manufacturer had persistently ignored for more than a generation.

In addition to reducing the weight of his product, the small maker incorporated certain improvements which hard riders were quick to appreciate; among these were the drop-out rear wheel and the caliper brake, both of which, it is worth noting, were old ideas, the advantages of which had not been realized when they originally appeared on the market. The light-weight bicycle with small (26 in.) wheels gave cycling a new lease of life; contemporaneously with its advent came a movement to popularize rational dress among lady cyclists. The fashion of wearing short skirts, aided by the adoption of breeches, by the many women who took up agricultural work during World War I enabled the bifurcated garment to overcome prejudice and to score an almost complete triumph over the skirt. In 1944 nearly 90% of club women and keen riders in England wore rationals for their more serious cycling, though skirts were retained for shopping expeditions and short journeys. Many wearers of rational dress used diamond-framed machines. But in the United States most women wore shorts, slacks or culottes.

Officials of the big factories were somewhat slow to note the tendency of demand, and allowed the small makers to obtain a long lead in the production of light bicycles. Ultimately they began to realize the position, and many of them designed light and speedy models to compete with the locally built machines. These may be procured from most of the large manufacturers, but the small assembler enjoys the great advantage of being able to comply with the whims of his client, and the ability to build "to order" without undue interruption of his works routine. Another feature of the period after World War I was the revival of interest in tandem riding. This, again, was fostered by the little maker with the encouragement of club riders.

Road racing flourished exceedingly. In Europe, America and Australia competitions are run on ordinary racing lines, the riders starting together, or, in the case of handicaps, in the order of their time allowance, the first man to finish being the winner. In Great Britain and Ireland the time trial system is in vogue, and has proved an extraordinary success. So great has the number of events become that, in 1922, the most prominent cycling clubs came together and formed the Road Racing council, to which 80 clubs are affiliated, and which has compiled regulations for the conduct of road trials. Two years before, the Amateur Bicycle League of America was formed for the same purpose. The most popular distances are 25, 50 and 100 mi., while several races at 12 and 24 hours are organized each year. One of the best things the R.R.C. has done for the sport has been to limit the number of entrants for any race run under its jurisdiction, and in the more important events not more than 100 riders may take part.

The Road Racing council has managed to cope successfully with that age-old problem, the "trade-assisted amateur" by decreeing that a rider whose performances have been advertised shall not compete in a speed trial promoted by any of its adherent clubs. The National Cyclists' union does not go as far as this in its efforts to discourage the association of the trade with the sport, but it requests cycle and accessory manufacturers to refrain from quoting the names of riders in their announcements. The legislative bodies of Great Britain are unique in their desire to prevent the exploitation of wins by amateurs for trade purposes. In every other country where cycle racing flourishes makers are allowed to advertise the exploits of racing amateurs. This is not the only detail in which Britain is peculiar. Whereas professional cycling thrives in every other civilized country, Britain has few professional racing men, but Australia produced some of the world's outstanding racing cyclists.

Track racing continues to enjoy great popularity in France, Germany, Belgium, Switzerland, Holland, Denmark, America, Italy and Australia, but in Great Britain, Spain, Norway, South Africa and certain other countries, the scarcity of up-to-date tracks prevents the development of this branch of the sport. One of the finest tracks in the world is the one in Casablanca. The annual races for the championships of the world have been continued, the Union Cycliste Internationale having taken over the series which were inaugurated by its predecessor, the International Cyclists' association. They were, of course, interrupted by World War II. In 1921 the motor-paced race for the amateur title was dropped, and its place as a distance test was taken by a road race the distance of which is usually 100–120 mi.

Important influences in the development of cycling can be traced to the periodical exhibitions which have been a regular feature since they were first inaugurated by the Stanley Bicycle club in London in 1878. Since that year London has seen at least one cycle show each season, and the idea has been copied and expanded in every country throughout the world. The annual "show" which cyclists and cycle makers originated has been imitated by the newer industry which caters for motoring, and nowadays motor exhibitions are held in every important capital. The yearly show serves a dual purpose; it encourages manufacturers to improve their products, each striving to evolve something better than his rivals; thus is mechanical advancement fostered. Secondly, the exhibitors provide the public with frequent opportunities for inspecting the latest models, with the obvious incentive to purchase the newest types. (H. W. B.; W. Ra.)

Bicycle racing, after many vicissitudes, became in the United States one of the nation's major sports. A troupe of English professionals inaugurated it in the U.S. about 1870 when they introduced the high wheel. The dirt tracks used for trotting races served for the first set of cycling events, staged near Springfield, Massachusetts. With the invention of the safety-wheel about 1889, there came also the board tracks. Americans then took the lead in the sport that they have since maintained. Formerly cycling was extremely popular all over the country. There were tracks from Manhattan Beach to California. Manufacturers of bicycles and accessories kept the sport alive by organizing competing racing teams. With the coming of the automobile about 1895, cycling, as a utility, died out, only to return later as a sport. It prospered in Salt Lake City, then spread back to the east, with Newark, N.J., as the centre. While there were not in 1928 as many bicycle tracks in America as there were in the old days, the sport was increasing in popularity where tracks were located. Outdoor tracks for summer racing were in New York; Philadelphia; Newark;

Chicago; San Jose, Calif.; Detroit; Boston; Providence, R.I.; Hartford, Conn. and other cities. The track in Chicago, a cement bowl in Humboldt park, is owned by the city. The six-day racing branch of cycling for many years attracted people by the thousands to Madison Square Garden in New York and to the Coliseum in Chicago, the largest amphitheatres in those cities. In 1927 Detroit, with the completion of its new Olympia holding 17,000 people, saw its first six-day race, and that city became permanently in the six-day circuit. In New York six-day bicycle racing was witnessed by sport enthusiasts twice a year, in December and March, while Chicago had its two races in October and February.

Six-day racing in the U.S. spread from New York to San Francisco and Los Angeles, from New Orleans to Montreal and Toronto. But almost as rapidly as the sport grew, the interest waned, and by 1938 the average weekly attendance at New York races had dropped from over 100,000 to about half. As a result Madison Square Garden dropped six-day bicycle racing from its sports calendar after the Nov. 1939 race, and Chicago and other cities followed.

Government war regulations in the U.S. restricted bicycle production to 750,000 in 1942, whereas in 1941 the eight leading factories in the country turned out 1,800,000. In 1940 the output was 1,500,000. From 1935 to 1941 the average output was 1,000,000 yearly. As a result, bicycles soon were difficult to get. About 12,000,000 were in use in the U.S. in 1944. (W. Ra).

CYCLOID: *see* Curves, Special.

CYCLONE. A name variously applied to rotating wind systems of a stormy character. In meteorology the term is applied to an area of relatively low pressure usually 50 to 1,000 mi. in diam. together with its revolving wind circulation. Popularly, this name is sometimes given to the small, extremely violent, twisting cloud appendage which is more properly called a *tornado* (*q.v.*). Meteorologists classify cyclones as (1) tropical cyclones and (2) extratropical cyclones. The first are called typhoons in the far east and hurricanes or cyclones elsewhere. For a complete discussion of them, see Tropical Revolving Storms. The second type, the extratropical cyclone, is the common rain and snow-producing disturbance of middle and high latitudes. In England this type is commonly called a depression. Both types have a counterclockwise wind circulation in the northern hemisphere and a clockwise rotation in the southern hemisphere. The areas of low pressure appear on weather charts as oblong or nearly circular systems of isobars which stand out in sharp contrast with the areas of high pressure or anticyclones (*q.v.*).

The extratropical cyclones generally move from west to east with the prevailing winds of their latitude, producing large areas of precipitation and relatively strong winds. The approach of an extratropical cyclone is recognized by an increase in the wind from a direction between southwest and northeast through southeast, accompanied by falling pressure, increasing cloudiness and precipitation. As the centre moves eastward away from the observer, the pressure rises and the wind comes in from a direction between southwest and north. In most cases, the weather then improves, although rain and snow of the shower type and general cloudiness may prevail. Warm air usually precedes the cyclone and cold air moves in somewhat suddenly behind. There is a typical pattern of these warm and cold air currents having distinct boundaries between them, known as fronts. It is in these contrasting temperatures that an extratropical cyclone is most clearly differentiated from a tropical cyclone, which contains horizontally homogeneous air.

On climatic charts as well as on most weather maps cyclonic centres are found in the northern Atlantic and Pacific oceans, known respectively as the Icelandic and Aleutian "lows." In summer, semipermanent low-pressure centres exist over warm continental regions. They are in some places belts of low pressure, such as that which extends from the Sahara desert through the Red sea and Asia Minor to the Persian gulf, northern India and Burma. A belt of low pressure also is found near the equator between the circulations of the oceanic anticyclones of the northern and southern hemispheres. (*See* Meteorology; Wind.) (H. R. B.)

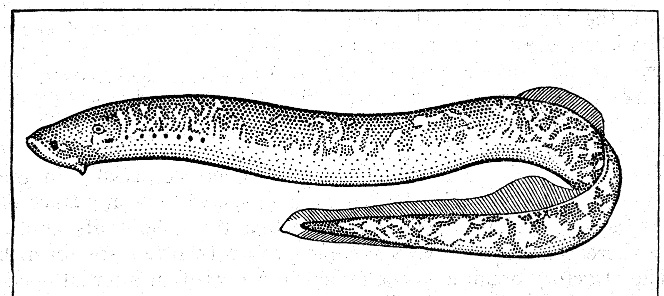
CYCLOPEAN MASONRY, a term in architecture, used in conjunction with Pelasgic, to define the rude polygonal masonry employed by the Greeks, the Etruscans and other primitive peoples (from the Cyclopes, the supposed builders of the walls of Mycenae). In the earliest examples it consists only of huge masses of rock, of irregular shape, piled one on the other and depending on their great size and weight for cohesion; sometimes smaller pieces of rock filled up the interstices. The walls and gates of Tiryns and Mycenae were thus constructed. Later, these blocks were shaped to fit one another. The date cannot always be determined by the type of construction; where stratified rocks were obtainable horizontal coursing may in some cases have been early adopted; in fact, there are instances in Greece of a later wall of cyclopean construction being built over one with horizontal courses.

CYCLOPES. (1) In Homer the Cyclopes are one-eyed cannibal giants (Κύκλωψ, Round-eye), living a rude pastoral life in a distant land (traditionally identified with Sicily), having no social unit larger than the family (*see* Acis; Polyphemus). (2) In Hesiod they are sons of Heaven and Earth, three in number—Arges, Brontes and Steropes (Bright, Thunderous, Lightener)—who forge the thunderbolts of Zeus; later authors say Apollo killed them for making the thunderbolt which slew Asclepius, and make them the workmen of Hephaestus (*q.v.*). (3) The walls of several ancient cities, *e.g.*, Tiryns, of Mycenaean architecture, are sometimes said to have been built by Cyclopes, perhaps the same as (2). Hence in modern archaeology the term *Cyclopean* applied to walling of which the stones are not squared.

See Roscher's *Lexikon, art.* "Kyklopen" (bibl.)

CYCLOSTOMATA or **MARSIPOBRANCHII,** a group of vertebrate animals, generally regarded as a class, comprising the lampreys (fig. 1) and the borers (*q.v.*). There are two types of borers, the hagfishes (fig. 2) and the slime-eels or *Myxine* (*q.v.*).

These are all aquatic creatures, smooth, slimy, scaleless and shaped like eels. The known species—about 50—inhabit the waters of the temperate zones. Most are marine, but a few lampreys are confined to lakes and streams and the sea lampreys spawn in fresh waters. The maximum size ranges from less than 6 in. to about 3 ft.



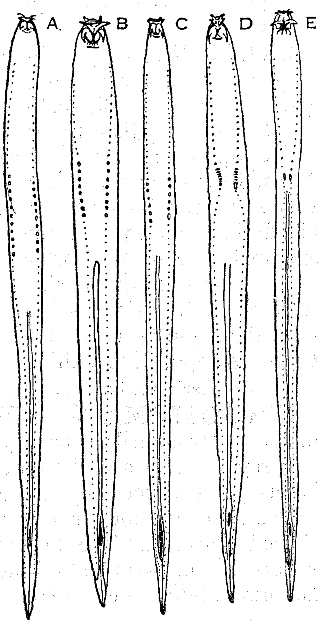
FROM JORDAN, "FISHES" (D. APPLETON-CENTURY CO.)

FIG. 1.—SEA LAMPREY, AN INHABITANT OF ATLANTIC COAST WATERS OF EUROPE AND NORTH AMERICA. IT ENTERS RIVERS TO BREED

Importance.—Most of the cyclostomes are regarded as harmful to man because they destroy food and game fishes. The larger lampreys attach themselves to fishes and drain their blood. In the Great Lakes considerable damage is thus done by the sea lamprey (fig. 1), which entered these waters by way of a canal and soon became very abundant, feeding extensively on lake trout and spawning in the lake tributaries. Efforts are made to control the increase of these lampreys by destroying the mature adults which are caught in a weir placed in the spawning stream. Marine food fishes are bled by seagoing lampreys, but suffer greater damage from the attacks of the borers. Both the hagfishes and the slime-eels eat their way into and through the flesh of food fishes. Large numbers of valuable fish are thus destroyed. Fish that are caught in nets or on set-lines are particularly subject to such loss. On the other hand lampreys are esteemed as food in many places and their larvae are extensively used as bait by fresh-water anglers. Adult brook lampreys, which are harmless because they do not feed, furnish, along with the larvae of all lampreys, considerable natural food for trout and other game fishes.

Scientifically the cyclostomes are of great significance, because they are the most primitive of the living vertebrates. The lamprey larva or ammocoete (fig. 4) in particular is regarded as providing the closest facsimile of the ancestor of the backboned animals. For this reason the ammocoete is recommended as one of the types to be studied in comparative anatomy courses. Adult lampreys and the borers depart from the ancestral form because they are specialized for parasitic existence.

Distinctive Characters.—The cyclostomes (or marsipobranchs) differ from all other living vertebrates in many important respects. None of their gill-arches have been converted into jaws, for which reason they are classified among the jawless vertebrates or Agnatha (a group which contrasts with the jaw-bearing vertebrates or Gnathostomata). The cyclostomes are also devoid of any trace of the paired fins (pectorals and pelvics), which, except for occasional loss through degeneration, are present in all other fishes and, in the form of limbs, are represented in all higher vertebrates. The muscular, protrusible tongue in all cyclostome fishes, and in the adult lampreys the buccal disc or funnel (figs. 3 and 5) as well, bear teeth which are composed of thin horny tissue rather than dentine or enamel. Instead of forming partitions between slits, the gills lie in spherical pouches which connect with the pharynx and with the exterior through tubes. The internal ear has only one or two semicircular canals, not three as in typical vertebrates (the horizontal canal is missing). The brain is small, primitive and distinctive, and the brain case is incomplete, especially in the borers. The skeleton is wholly cartilaginous, without any trace of calcification. The notochord is persistent throughout life and is nowhere constricted. No vertebrae proper (centra) are formed. The olfactory organ is a single median sac with an internal opening into the cavity of the pituitary and an external opening that lies on the midline either on the top or at the front of the head. On the basis of the narial structure some authorities classify the cyclostomes, along with certain extinct groups discussed below as the Monorhini. All other vertebrates are said to be diplorhine, for they have paired nostrils, with one sac on each side of the head.



FROM DEAN, JOUR. COLL. SCI. UNIV. TOKYO

FIG. 2.—FOUR HAGFISHES AND A SLIME-EEL

A. *Polistotrema stouti,* California; B-C. Japanese species of *Eptatretus;* D. *Paramyxine,* from Japan; E. *Myxine garmani,* Japan

Classification.—The Cyclostomata are divided into two subgroups, which are very different in anatomy, appearance and habits:

	Hyperoartii (lampreys)[1]	*Hyperotreti* (borers)
Nasal opening	On top of head	At front of head
Pituitary canal	Closed internally	Opening into pharynx
Cartilaginous rings around this canal	Lacking	Developed
Pineal eyes	Easily visible	Degenerate
Eyes	Well developed	Vestigial
Oral funnel	Developed	Not present
Teeth	On disc also	Only on tongue
Tentacles about mouth and nostril	Lacking	Six, supported by cartilage
Number of gills	Always seven	5 to 14
Gill-openings	Close to head	Remote from head
Internal gill tubes	United	Separate
Duct on left side, pharynx to exterior	Lacking	Developed
Branchial skeleton	A conspicuous basket-work	Greatly reduced
Dorsal fin	One or two well developed	None or only a trace
Neural arches	Present	Lacking
Dorsal and ventral roots of spinal nerves	Distinct	United
Kidneys	Compact organ	Separate
Eggs	Minute, without horny shell	Very large, with horny shell
Development	With larva and metamorphosis	Direct (young much like adult)
Spawning place	Gravel in streams	Ocean floor
Feeding on	Fish blood	Fish flesh
Type of parasitism	External	Internal

[1]The characters are those of adult lampreys. In several respects the lamprey larvae agree with the Hyperotreti.

The differences between the lampreys and the borers are so extensive and so fundamental as to lead some authorities to think that the two groups are unrelated. They appear, however, to have had a common ancestor.

The Hyperoartii or lampreys may be classified into three families. The chief family, Petromyzonidae, comprises all the northern hemisphere species. The well-known sea lamprey, *Petromyzon marinus* (fig. 1), occurs on both sides of the Atlantic. Three related genera, *Eudontomyzon, Entosphenus* (figs. 3-5) and *Lampetra,* occur in Eurasia as well as in North America. The primitive genus *Ichthyomyzon,* with more species than any other, inhabits only the fresh-waters of eastern North America. *Caspiomyzon* is confined to the Caspian sea basin. About half the species of Petromyzonidae are of the dwarfed nonparasitic brook type, with weak teeth (fig. 5). Nearly all of these have arisen through degeneration from different parasitic kinds, and hence they are named as distinct species (in the genera *Ichthyomyzon, Eudontomyzon, Entosphenus* and *Lampetra*). The distinctive lampreys of the southern hemisphere are placed in two families, Geotriidae and Mordaciidae, each with a single genus (*Geotria* and *Mordacia*). These southern genera live along the coasts of Chile, New Zealand and Australia. Like all lampreys they spawn in fresh water.

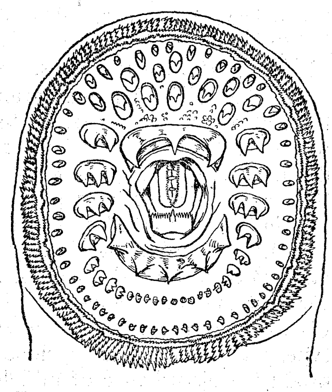
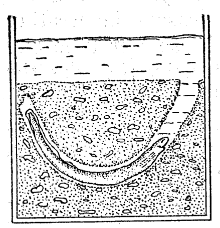
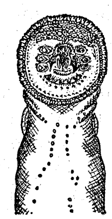


FIG. 3.—BUCCAL DISC AND TEETH OF A PARASITIC LAMPREY, ENTOSPHENUS TRIDENTATUS (PACIFIC SEA LAMPREY)





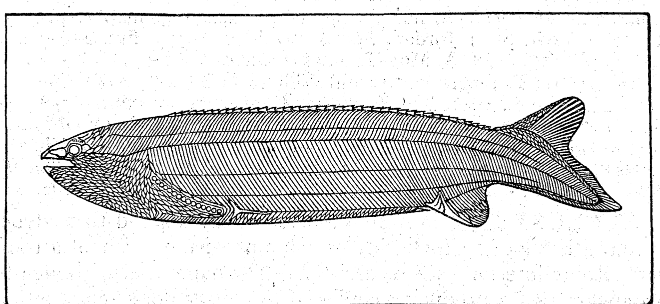
FROM JORDAN, "FISHES" (D. APPLETON-CENTURY CO.)

FIG. 4.—LARVAL LAMPREY (AMMOECOETE OF AMERICAN BROOK LAMPREY) IN ITS BURROW IN AQUARIUM FILLED WITH SAND

FIG. 5.—BUCCAL DISC AND TEETH OF THE NONPARASITIC AMERICAN BROOK LAMPREY (ENTOSPHENUS LAMOTTENII)

The Hyperotreti or borers comprise the Eptatretidae, or hagfishes, with the genera *Eptatretus, Polistotrema* and *Paramyxine,* and the Myxinidae or slime-eels, with the one genus *Myxine* (fig. 2). That genus is characterized by the single external gill-opening on each side. It is approached by *Paramyxine,* which has the gill-openings closely approximated (fig. 2). For this reason some authors prefer to unite the Eptatretidae with the Myxinidae. All members of both groups are marine. One species of *Myxine* occurs in deep water off Panamá but all other known Hyperotreti are inhabitants of temperate waters—in western North America, Japan, New Zealand, Chile, Patagonia and South Africa. Fewer than 24 species are recognized.

Life History.—All lampreys spawn in the spring on gravel beds in streams. The marine species migrate into the streams to breed, passing over dams and other obstructions by inching their way up the vertical walls, to which they adhere by their sucking mouth disc. The males arrive first on the spawning grounds and start to prepare the nest. By adhering to and tugging out pebbles a depression is formed. The female then maintains a hold on a stone while the male clamps onto the female and twists around her as the eggs are extruded and fertilized. Then by further tugging the pebbles above the depression are loosened, so that they are carried down to surround and cover the eggs. By the time the spawning act is completed the adults are emaciated. They never recover, but invariably die.



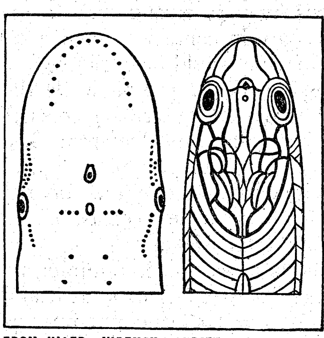
KIAER, "THE DOWNTONIAN FAUNA OF NORWAY"

FIG. 6.—PHARYNGOLEPIS OBLONGUS, AN ANASPID FROM THE UPPER-SILURIAN OF NORWAY. THERE WAS A SERIES OF SMALL GILL-OPENINGS BEHIND THE HEAD, AS IN THE LAMPREYS

After about two weeks the eggs hatch and the larval or ammocoete life, that lasts several years, begins. The several size groups, each resulting from one year's spawning, prove this point. The wormlike, toothless, nearly blind larvae (fig. 4) live in burrows in the bottom of mixed sand and mud, coming out at night to feed on the organic ooze which is strained through the thick cirri in the hoodlike mouth.

After at least three years of such life the ammocoete rapidly transforms in late summer and fall into the adult form. The eye becomes much larger and better developed, the hood is replaced by the disc and the cirri by teeth, the nostril opening moves from the front to the top of the head, and many other changes take place simultaneously. The body becomes rounder in cross-section, the flesh firmer and the colour brighter. During this transformation or metamorphosis the lamprey shrinks considerably in length.

Soon after metamorphosis the sea lampreys become silvery and large-eyed in preparation for life in the ocean, to which they promptly migrate. Some of the nonparasitic brook lampreys pass through this same stage, known as the macrophthalmia, as though in racial remembrance of the former seaward journey, though this trip has been abandoned for millenia.



FROM KIAER, VIDENSK. SKRIFT, OSLO

FIG. 7.—A COMPARISON OF THE HEADS, SEEN ABOVE, OF THE LIVING LAMPREY (PETROMYZON) AND THE SILURIAN FOSSIL ANASPIDA (RHYNCHOLEPIS), SHOWING ESSENTIAL SIMILARITY

All parasitic lampreys feed and grow rapidly on their nutritious diet of fish blood. Those that remain in fresh water live thus for a year. A larger size is reached in the sea but it is not known how long the marine forms live as adults, for they are seldom encountered. After their growth has been attained and the sex products ripened the parasitic species spawn once and then die, to complete the life cycle.

The nonparasitic species metamorphose at a size at least as large as do their parasitic relatives, but the teeth are poorly developed and the gut shrinks to a solid strand. Without taking any food they complete, over-winter, the ripening of the sex products that had begun before the metamorphosis. Like the parasitic species they then spawn and die.

The hagfishes and slime-eels (fig. 2) deposit a large, yolk-filled egg. This is enclosed in a protective horny shell and is attached to the bottom of the sea by threadlike tendrils. The development is slower than in lampreys and the young are much larger when hatched. They look much like the adults, into which they gradually develop without a metamorphosis. Thus in life history as well as in structure the Hyperotreti are very unlike the Hyperoartii.

Evolutionary History.—The fossil record as well as the evidence from comparative anatomy indicates that the Cyclostomata are cousins of the earliest and lowest vertebrates. The oldest fossilized remains of vertebrate animals, found in the Silurian deposits with traces in the yet more ancient Ordovician rocks, prove on close study to be similar in many respects to lampreys and borers. Superficially the fossils (figs. 6-12) bear little resemblance to their modern relatives, which, in correlation with their parasitic habits, are highly specialized in some respects and in other ways much degenerated. In fundamental anatomy, however, they were much alike. Thus the extinct forms resembled the cyclostomes in lacking jaws, for the anterior gill arches remain unaltered. They appear also to have lacked true paired fins, though in some species flipperlike flaps were developed in place of pectoral fins. The extinct forms agreed further with the cyclostomes in gill structure and in having had only two semicircular canals in the internal ear. Some of the extinct groups had, like the cyclostomes, a single median nostril.

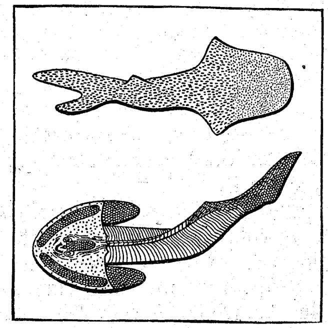
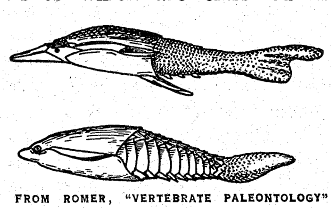


FIG. 8. AFTER TRAQUAIR, LANKESTER "TREATISE ON ZOOLOGY" (A. & C. BLACK, LTD.) FIG. 9. AFTER WOODWARD "PROCEEDINGS," BY COURTESY OF GEOLOGISTS' ASSOCIATION

FIGS. 8 AND 9.—FOSSIL AGNATHA

Above: *Thelodus scoticus*, one of the Coelolepida from the Silurian of Lanarkshire. Below: *Cephalaspis murchisoni*, from the Devonian of Herefordshire. It was covered with bony plates

Most of these early fishes, and naturally those that are best known because most thoroughly preserved, were heavily armoured with dermal bone—hence the group name Ostracodermi that has often been applied to them as a whole. On these grounds many paleontologists have regarded the bizarre armoured fishes as the direct ancestors of the more ordinary modern types. It is more logical to assume, however, that both the armoured and the progressive types were derived from unarmoured fishes with the usual fish form. The highly specialized mailed kinds were probably evolved to provide protection from such enemies as the gigantic "water scorpions" of early times. Furthermore such types had a much greater chance than their slender, soft-bodied and probably free-swimming ancestors to be fossilized and well preserved in the rocks. The more highly evolved, heavily armoured types persisted throughout late Silurian time and all of the Devonian, along with the earlier jawed or gnathostome fishes which are classified as the Placodermi. None of the Ostracodermi are known to have survived beyond the end of the Devonian, but some primitive member of the Agnatha must have persisted, to give rise to the living group with which we are dealing. In conformity with an evolutionary rule the highly specialized group died out, while some generalized relative lived on.



FROM ROMER, "VERTEBRATE PALEONTOLOGY" (UNIV. CHICAGO PRESS)

FIGS. 10-11.—FOSSIL PTERASPIDA OR HETEROSTRACI

Above: Poraspis, from Silurian of Spitzbergen
Below: Anglaspis, from Devonian of England

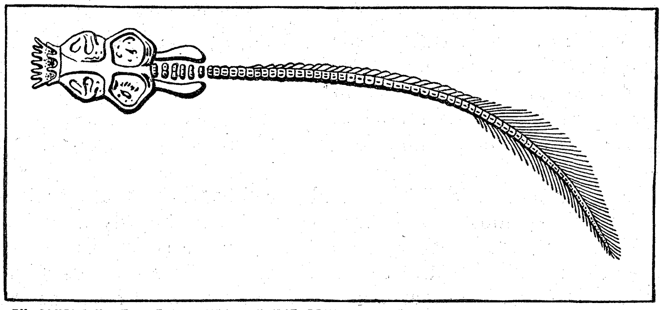
Fossil Relatives.—Since the cyclostomes are the only living Agnatha or jawless vertebrates their relatives are to be sought exclusively among the extinct fishes. Five groups, commonly treated as orders, all Paleozoic and none persisting beyond the Devonian, show evidence of relationship with the lampreys and borers.

(1) In some ways the most lampreylike of the fossils were the Anaspida (fig. 6). These Silurian and Devonian creatures seem primitive because of their small size (none exceeding 10 in.), their almost ordinary fish form and their small scales, which apparently

overlaid the muscle segments. These characters and more particularly the rather straight contour of the back, the terminal rather than inferior mouth and the hypocercal or reversed heterocercal tail (with the body axis extended into the long lower caudal lobe), indicate that they escaped their enemies by swimming at the surface of the water. As in the cyclostomes, they had the eyes lateral and a single nostril in front of the third or pineal eye (fig. 7); and the gill-openings formed a row of pores on each side.

(2) The Cephalaspida (or Osteostraci) also had a median, superior nostril and a row of porelike gill-openings, but differed from the Anaspida (and from the cyclostomes) in having the head enclosed in a flat bony shield (fig. 9). The tail was heterocercal (with the body axis extending into the long upper lobe of the caudal fin) and the eyes were set close together on the top of the head. All these characters indicate that these armoured fishes lived on the bottom. They varied in length from a few inches to about 2 ft.

(3) The Coelolepida (fig. 8) were small to medium-sized and were completely covered with minute scales (denticles) that did not overlap. Structurally these fishes are poorly known, but from superficial resemblances they are thought to have been related to the Pteraspida. Indeed they may have belonged to that group and by some authorities they have been so classified. Or they may have been ancestral to the Pteraspida. Denticles thought to have belonged to one of the Coelolepida are known from the Ordovician.



BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM

FIG. 12.—PALAEOSPONDYLUS GUNNI, TWICE NATURAL SIZE, FROM THE SILURIAN OF SCOTLAND

(4) The Pteraspida (or Heterostraci) were armoured fishes (figs. 10-11) that closely resembled the Cephalaspida. Both groups were abundant in late Silurian and early Devonian times and disappeared completely by the end of the Devonian. Some of the very earliest known vertebrates, fragments of dermal plates from the Ordovician rocks, are thought to have been pteraspidans, because of the microscopic structure. In this group the armour lacks the bone cells that were characteristic of the Cephalaspida. The paired eyes were far apart and there was no dorsal nostril. The olfactory organs, which were close together but paired, are supposed to have opened into the mouth cavity. Like the anaspids the typical pteraspidans had a straightish dorsal contour, a reversed heterocereal tail and little depressed bodies—all indicative of surface-swimming habits. None exceeded 1 ft. in length.

(5) The Devonian group known as Cycliae or Palaeospondyloidea is recognized for one of the most problematical of the fossil vertebrates, Palaeospondylus (fig. 12), which by some has been thought to be an ancient lamprey or lampreylike animal. If so, the living lampreys must be very degenerate, for they lack the vertebral centa that are well developed in the fossil. Other zoologists regarded it as a larval arthrodire. The remains of this 1 to 2 in. fishlet abound in one quarry in Scotland and have been very thoroughly studied. Nevertheless, its relationships remain uncertain. Opinions differ as to whether or not it had gills or paired fins.

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CYCLOSTYLE, in architecture, a term applied to a structure consisting of a simple ring of columns with or without a roof, but with no interior walls or divisions. The name is also applied to an apparatus for producing copies of letters or documents, either written or typewritten. This is effected on the principle of a stencil (*q.v.*) by means of a prepared paper. The pen or type perforates the paper and when an inked roller is passed over it the written matter is transferred to a sheet of paper placed beneath it.

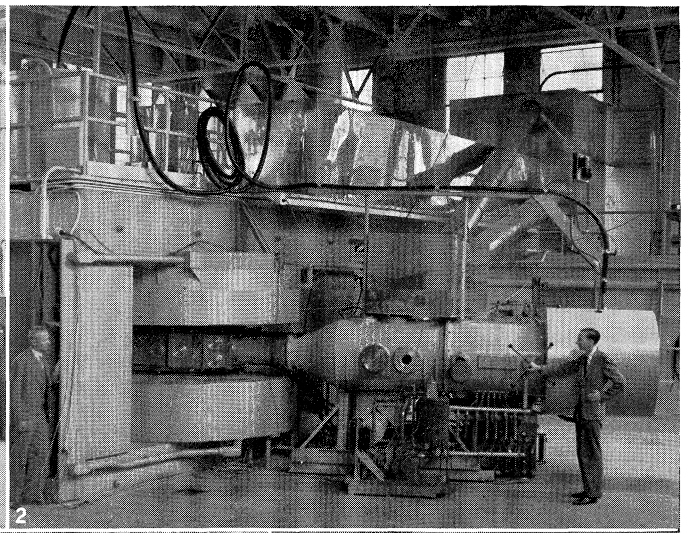
CYCLOTRON. The cyclotron is a device for accelerating nuclear particles to very high speeds. These high-speed particles are used by physicists to investigate the properties of atomic nucleii and to produce nuclear transmutation and artificial radioactive substances. The cyclotron was invented in 1930 by a U.S. physicist, Ernest O. Lawrence.

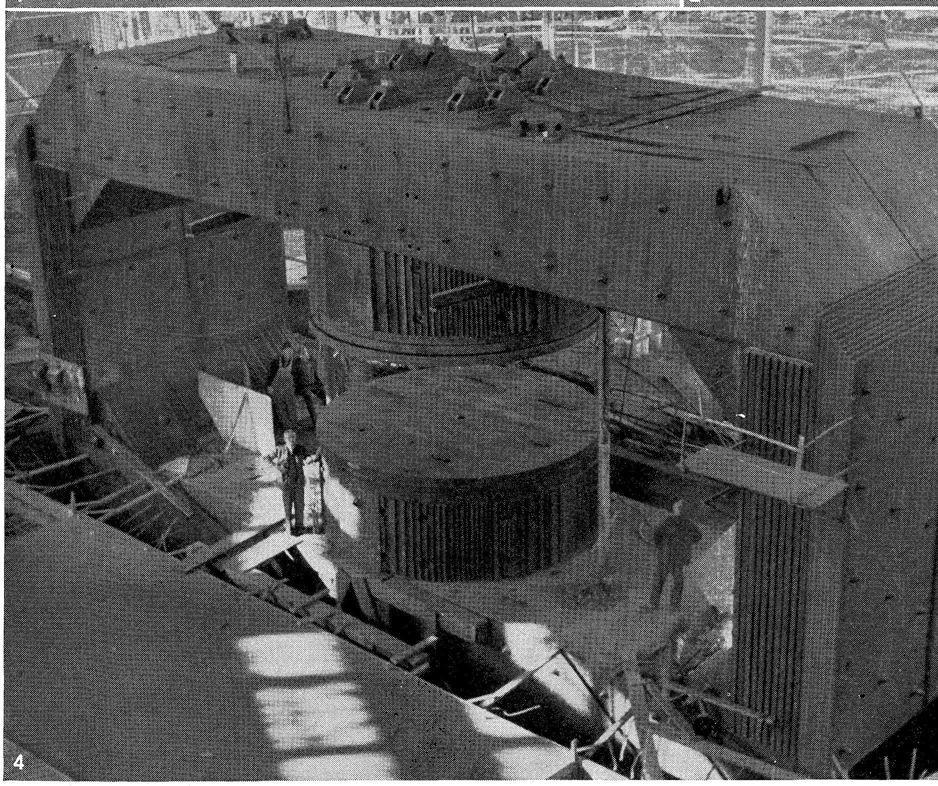
Why Build a Cyclotron?—To appreciate the problem involved, it must be remembered that man is midway in the scale of size between the solar system and the atom. Thus an atom is 10 to 100,000,000,000 times smaller than a man. And yet like the solar system the atom is mostly empty space with practically all of its mass concentrated in the positively charged nucleus, which is in turn 10,000 times smaller than the atom itself. It may at first seem strange that man should consider it necessary to construct an instrument weighing thousands of tons in order to investigate such a particle!

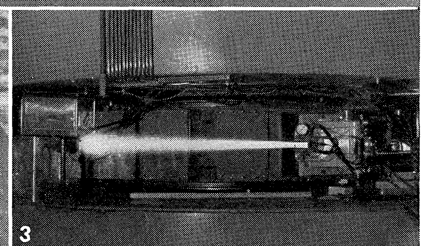
The atom's nucleus is built up of protons and neutrons. These fundamental building blocks are almost equal in mass but the proton is positively charged while the neutron is neutral. The particles are held together in the nucleus by very strong short-range forces acting only when the particles are in contact. (Small particles covered with a thick coating of glue would be an analogy.) The ordinary hydrogen nucleus consists of one proton while the nucleus of the heavier isotope of hydrogen (deuterium) consists of one proton and one neutron and is called the deuteron. The helium nucleus (alpha particle) is built up of two protons and two neutrons, and the complexity increases as one goes up the periodic table to uranium, most of whose nucleii consist of 92 protons and 146 neutrons giving a total mass of 238.

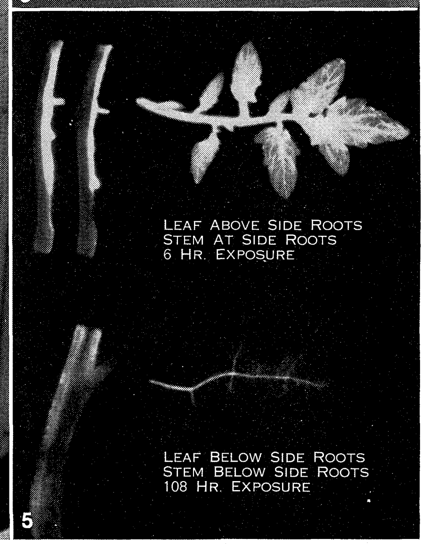
Since the nucleus was so small, the best way of determining its properties was to shoot particles of similar size and mass at it and then investigate the results of the collision. However, the nucleus is positively charged and the available shooting particles were also positively charged so that (by the inverse square law of repulsion between those like electric charges) it was necessary to give the shooting particles very high speed (or energy) in order that they could get close enough to the nucleus to be captured by it. Once this was done the short-range forces mentioned above became operative on the intruding particle and the various sequels became the field for many exciting discoveries in nuclear physics.

The first artificially produced nuclear transmutation was made by Ernest Rutherford in 1919. He used the energetic alpha particles emitted by a natural radioactive element to bombard nitrogen and produce a few atoms of oxygen. Similar experiments were done on other light nucleii during the following decade, but in general the alpha particles were not sufficiently energetic to overcome the repulsive force on their two units of positive









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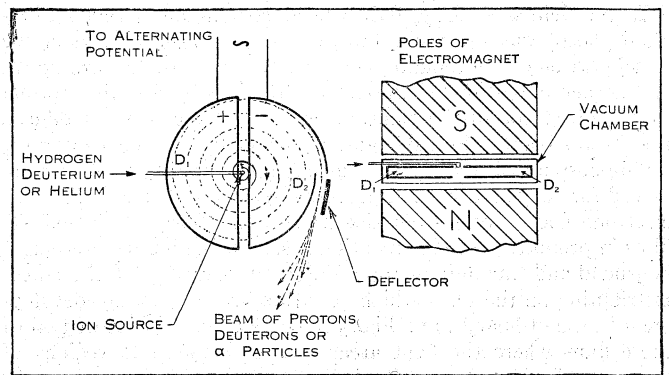
THE CYCLOTRON AND ITS APPLICATION

1. A 60-in. cyclotron showing the vacuum chamber between the poles of the electromagnet. The target chamber where the nuclear transmutations take place is shown as an extension of this side of the vacuum chamber between the coils of the magnet. The cylindrical tank on top of the magnet is the voltage supply for the deflector
2. View of the opposite side of the 60-in. cyclotron, showing the Dee-support housings. The Dee supports form a quarter wave resonant line with the Dees at the high voltage end
3. View between the magnet coil tanks of the 60-in. cyclotron showing the beam of 15 Mev deuterons when it is allowed to emerge from the target chamber on the right. The beam is about 5 ft. long and becomes more diffuse at the end because the deuterons as they slow down are more easily scattered by air molecules
4. View of the giant 184-in. cyclotron magnet in process of construction (Berkeley, Calif.). 300 tons of copper were used in the coils later placed around the pole cores.
5. The importance of the cyclotron to the biological sciences rests largely upon its production of radioactive isotopes of the biologically important elements. The radiation from these radioactive tracers (as they are called) can be detected in very minute quantities; thus the tracer can be administered to the biological specimen so as not to affect the physiological equilibrium of the specimen. In the field of botany, for instance, it has been demonstrated that assimilated phosphorus can move downward as well as upward in the aerial portion of the tomato plant. Tracer phosphorus introduced at side roots grown on a tomato plant was found to be present in the upper leaves in sufficient quantity to give a bright picture after 6 hours' exposure of film, while in the lower leaves it required 108 hours' exposure to show on the radio-autograph. This proved that although minerals travel upward with the greatest facility they do also move downward in plants



On the right is a vertical section through the magnet poles of the cyclotron showing the vacuum chamber and the two hollow semicircular insulated electrodes D_1 and D_2. The horizontal section on the left shows the spiral path taken by the positive ions as they receive repeated accelerations across the gap between D_1 and D_2 until they finally are attracted by the deflector and emerge as a beam of high-speed particles. The ions are produced from the gas admitted to the ion source; protons from hydrogen, deuterons from deuterium, or alpha particles from helium

charge.

Description of the Cyclotron.—About 1930, physicists began to develop devices for accelerating singly charged protons (hydrogen nucleii) and other particles to high speeds. The most successful of these was the cyclotron invented by Ernest O. Lawrence of the University of California. The success of this scheme lay in its subtlety. Instead of trying to attain a direct potential difference between two parts of the apparatus sufficiently great to give a particle all of its energy in one push, a much lower potential difference was used to give the particle a series of pushes. In addition, the charged particles (positive ions) were bent around in a magnetic field so that the same electrodes could be used over and over again to give the series of pushes.

At first glance, the most prominent feature of the cyclotron is the large electromagnet which produces the magnetic field. A vacuum chamber is placed between the poles of the electromagnet (*see* diagram) and in it are suspended two hollow semicircular electrodes or Dees (so named because of their shape). This hollow circular electrode system is shaped like a shallow drum which has been cut along a diameter and the two parts separated slightly. The positive ions to be accelerated are introduced at the centre of the Dee system where they are repelled by the positive D_1 and attracted by the negative D_2. Thus the ions are accelerated across the gap between the Dees and pass into the electric field-free region within the interior of D_2 where they are unaffected by subsequent changes in the voltage between the Dees. However, the magnetic field forces the ions to trace out a semicircular path within D_2 so that they eventually emerge again into the gap between the Dees. If the electric field between the Dees had still the same direction as before, the ions would be slowed down to rest. However, by reversing the electric potential while the ions are in D_2 so that now D_1 is negative and D_2 is positive, the ions are given another acceleration and pass into D_1. Then the electric potential is reversed again to its original direction and the ions receive a further acceleration in passing from D_1 into D_2. This process was usually repeated about 100 times so that if, for example, the potential difference between the Dees is 200,000 volts the ions will eventually gain an energy equivalent to that which they would have after falling through a drop in potential of 20,000,000 volts. Since the difficulties attendant upon the maintenance of steady direct potentials above 3,000,000 or 4,000,000 volts were found to be very great, the advantages of Lawrence's method are clearly indicated.

There is a physical law which makes the cyclotron relatively simple. Thus a uniform magnetic field constrains a moving ion to follow a circular path, and the law states that the time required for the ion to traverse the circle is a constant for a given ion and magnetic field and does not depend upon the speed of the ion. This is true also for half a circle, so that in the cyclotron as the ion gains speed it goes around in larger and larger semicircles such that the length of path increases in correct proportion to keep the time of travel constant between accelerations. This means that a potential source of constant frequency can be used to make the Dees alternately plus and minus. The frequency turns out to be in a convenient range (10–20 mc. per sec. for accelerating protons, for example).

When the ions have spiraled out to the outer diameter of the Dee system, they have received as much energy as they can get from the system and they are then attracted out of their circular path by a negatively charged plate. This deflector, as it is called, deflects the now high-speed ions away to bombard an external target, where the various nuclear transmutations, etc., are carried out. The maximum ion energy available clearly depends upon the diameter of the Dee system for a given maximum magnetic field. In order to prevent the ions from being lost by collision with gas molecules, the pressure in the vacuum chamber must be kept down to about one ten millionth of an atmosphere.

Development.—The energy of nuclear particles is usually expressed in terms of a unit called the electron-volt. This is the kinetic energy gained by an electron in falling through a potential difference of one volt. Thus if an alpha particle has an energy of 30,000,000 electron volts (Mev) it means that it has the same energy that an electron would gain in falling through a potential difference of 30,000,000 volts. However, since the alpha particle has an electric charge equal in magnitude to two electrons (although plus instead of minus) it would only have to fall through a potential difference of 15,000,000 volts in order to gain 30 Mev of energy.

The first ions accelerated by a preliminary 4-inch model of the cyclotron in 1930 had an energy of only 80,000 electron volts. This was soon followed, however, by the first real cyclotron using a magnet with 11-inch pole faces to accelerate protons to an energy somewhat in excess of 1,000,000 electron-volts. These particles were used to produce nuclear transmutation in 1932. During that same year an 80-ton magnet was converted to cyclotron use with 27-inch pole faces and immediately 1.8 Mev protons were obtained, then shortly afterward the energy was raised to 2.4 Mev. In 1934, heavy water was available in sufficient quantities so that deuterium ions (deuterons) could be accelerated, and in 1935 the 27-inch cyclotron was accelerating deuterons to energies of 4 Mev. It was soon found that the deuteron was a particularly effective particle at producing nuclear transmutation, partly because of the loosely bound neutron it contains. In 1937 the pole-face diameter was increased to 37 in. and shortly thereafter deuterons of 8 Mev energy were obtained and used regularly for physical and biological experimentation.

The success of the cyclotron was so spectacular by that time that many laboratories throughout the world had built or were building cyclotrons. In the decade following its invention, more than 40 cyclotrons were built or being built, about 30 in the United States, three in Great Britain, one in Canada and one or more in five other countries. The design and construction of almost every new cyclotron has added some improvement or alternative, large or small, to the general cyclotron technique. It is beyond the scope of this article to list the source of even the major improvements made by the various laboratories and later adopted as standard cyclotron design.

By 1937 the biological experiments looked so promising that construction was started in Lawrence's laboratory at Berkeley, Calif., on a new 60-inch cyclotron to be used especially for biological and medical work. The completion of this instrument in 1939 made available deuterons of energy 14.5 Mev and alpha particles of energy 29 Mev, which were immediately applied to biological, medical and physical problems. Photograph 1 in the Plate shows this instrument and its 220-ton magnet with the evacuated accelerating chamber between the pole faces. Fig. 2 in the Plate shows the opposite side of the magnet with the large cylindrical tubes which act as leads for the alternating potential to be applied to the Dee electrodes. The useful length of these horizontal tubes is adjusted so that they act as a coaxial quarter wave line resonant at the desired frequency. The Dees form the high voltage end of this line, and with 75 KW of radio frequency power the potential between them rises somewhat in excess of

200,000 volts. The deflector potential is about −100,000 volts. Fig. 3 in the Plate shows the beam of 15 Mev deuterons when it is allowed to emerge into the atmosphere instead of (as is usual) producing nuclear transmutations by striking a target inside the evacuated chamber. Such beams average about one ten thousandth of an ampere, which means that there are 600,000,000,000,000,000 deuterons per second accelerated to a speed of 25,000 mi. per sec. In order to produce an equivalent number of particles from naturally radioactive substances over 30 lb. of pure radium would be required, at $11,000,000 per lb. In 1945 this cyclotron was rebuilt to produce deuterons of over 22 Mev energy. No attempt will be made to summarize the many fundamental discoveries made and research problems attacked with the cyclotron. Hundreds of papers on nuclear physics alone have been published using it as a tool.

The winter of 1939–40 brought two great honours to the cyclotron and its inventor. Lawrence was awarded the Nobel prize in physics for the invention and development of the cyclotron, and the Rockefeller foundation made a large grant for the construction of a giant cyclotron at Berkeley, Calif. The plans for this cyclotron called for a magnet weighing over 4,000 tons and with a pole face diameter of 184 in. The yoke of the magnet was made 59 ft. long, 30 ft. high and 184 in. wide.

By the end of 1941, scientists were working on the use of uranium 235 in the atomic bomb. First, however, this material had to be separated from its 140 times more abundant isotope, uranium 238. To attack this problem Lawrence rushed the giant magnet to completion in May, 1942, and used it in the development of the electromagnetic or "Calutron" (California University Cyclotron) method of isotope separation which was later embodied in the huge electromagnetic separation plant at Oak Ridge, Tenn. After the end of World War II the giant magnet was used for its original purpose—as a cyclotron to accelerate deuterons to the terrific energy of 200 Mev.

Applications of the Cyclotron.—A discussion of the cyclotron would be incomplete without mentioning some of its many important biological and medical applications. The importance of the cyclotron to the biological sciences rests largely upon its production of radioactive isotopes of the biologically important elements. These artificially produced isotopes differ from the stable form of the same element only in their nuclear properties such as radioactivity. The extra-nuclear components of the two atomic forms are practically identical, which means that the chemical and physiological properties of the two forms are identical. The radiations from the radioactive isotopes as used in this application are kept far below the intensity at which they would cause physiological changes.

The radiations from these radioactive tracers (as they are called) can be detected in very minute quantities by such instruments as the Geiger counter (which can detect under favourable conditions the radioactivity of a single atom). Thus the tracer can be administered to the biological specimen in a quantity sufficiently small so as not to affect the physiological equilibrium of the specimen, and yet its subsequent presence in different parts of the specimen can be readily detected. Important work of this kind has been done using radioactive phosphorus in studying the uptake and distribution of phosphorus in plants, animals and man. In the case of mice, for example, the distribution and speed of assimilation of phosphorus in the muscle, bone, liver, lymph node and spleen has been investigated, both for normal animals and those with leukaemia. This was done by administering a single dose of tracer phosphorus to each of a large group of normal and leukaemic mice, then sacrificing them at varying intervals and determining the content of both total and radioactive phosphorus in the tissues. Considerably larger uptake of the tracer was found in the lymph node and spleen of leukaemic than in normal mice. In addition it was demonstrated that in human leukaemia radiophosphorus was selectively accumulated in the leukocytes (malignant white blood cells) rather than in the red blood cells or plasma. These demonstrations, together with many other careful experiments, led to extensive trials of the therapeutic application of radio-phosphorus in the treatment of human leukaemia.

In the field of botany, it has been demonstrated that assimilated phosphorus can move downward as well as upward in the aerial portion of the tomato plant. To show this roots were grown on the aerial portion of the stem midway between the normal roots and the top of the plant. These roots were then introduced for several hours into a di-sodium phosphate solution containing radio-phosphorus. Finally the various portions of the plant were placed for varying times flat against photographic films. The fast electrons (beta rays) from the tracer phosphorus darkened the films in proportion to the tracer's density in the immediate neighbourhood and thus left pictures (radio-autographs) of the tracer distribution on the films which could be brought out by development in the ordinary way. Fig. 5 in the Plate is a print of two of these films where the light areas now correspond to regions of greater radio-phosphorus (tracer) density. It is seen that the phosphorus carrying with it the chemically identical tracer has passed up the stem and thence through the conduction system of the leaves with great facility. However, the lower film shows that a much smaller fraction of the phosphorus has also moved *down* the stem and so to leaves below the side roots. It was even found that some radio-phosphorus (and therefore also normal phosphorus) had penetrated to the normal root structure. A conclusive demonstration of this downward movement of minerals in plants would be quite difficult by any other method.

Another method of using radioactive tracers as produced by the cyclotron is illustrated by the applications of radio-iodine. The isotope of iodine which is usually used emits gamma rays sufficiently penetrating to be detected through many layers of tissue. Thus the uptake of iodine, particularly by the thyroid gland, can be investigated by first orally administering a sample of radioiodine to the human subject and then placing a Geiger counter at the neck to detect the gamma rays from the tracer as it is taken up by the thyroid. A comparison of this uptake for normal controls and patients suffering from different types of hyperthyroidism has lead to many informative conclusions. An interesting sidelight on this problem was an experiment in administering element 85. This element is not found in nature but was first produced by the cyclotron from bismuth and was found to be radioactive. Since this element according to the periodic table should be very similar to iodine in its chemical properties it was injected into guinea pigs. It was found to be concentrated by the thyroid gland in a manner very similar to iodine.

Radioactive tracers have also been used extensively in medical diagnosis. An example of this is the use of radioactive sodium in the diagnosis of cases of peripheral vascular diseases (which involve poor circulation of the blood). The blood circulation time can be determined by using a Geiger counter to indicate when the tracer arrives in the member concerned after intravenous injection elsewhere in the body. The competency of the circulation at different points will then indicate the type and best site for surgery. Also the efficiency of therapeutic measures can be tested by this means.

Mention should be made of the results obtained using radioactive carbon. This element is extremely important because it is so basic to all life. Using tracer carbon, results were early obtained showing that in photosynthesis carbon dioxide is attached to a complicated molecule prior to its photochemical reduction.

The investigations mentioned here are only a small sample of the work which was done during the first decade while the biologists were learning to apply to the solution of their problems the new tools furnished by the cyclotron. The research which remained to be done was almost unlimited in scope. The perfection of the uranium pile by 1945 made it possible to produce much larger quantities of some of the biologically important radioactive isotopes although for others the cyclotron remained the only source.

The radioactive isotopes of the known elements are useful in chemistry because of the same properties that have made them such an important tool in biology. Of the some 90 elements which occur in nature there are about 390 naturally occurring isotopes. Less than 10% of these are radioactive and they are generally at the heavy end of the periodic table. In the decade before 1942 some 350 radioactive isotopes were artificially produced, and over two-thirds of them were discovered by means of cyclotrons throughout the world. These isotopes are generally distributed throughout the periodic table so that they will undoubtedly be of great value in future chemical investigations.

Of particular interest to chemists is the production of new elements which do not occur in nature and the subsequent investigation of their chemical properties. One of these first produced by the cyclotron has already been mentioned (element 85). In addition, element 43 was produced and in 1940 the cyclotron first produced minute amounts of elements 93 (neptunium) and 94 (plutonium). These new elements were of great importance in the atomic bomb program and were produced by the cyclotron in sufficient quantities to determine all their chemical properties using microchemical methods. Neptunium and plutonium were later produced in larger quantities, by means of uranium "piles," in the plant at Hanford, Wash. In 1945, minute quantities of elements 95 and 96 were produced by the cyclotron and their chemical properties were determined, indicating the possible existence of a new "rare earth" series starting with uranium.

Ion Paths in the Cyclotron.—In explaining qualitatively the action of the cyclotron the fact was brought forward that the time required for an ion to traverse a complete circle (or semicircle) in the magnetic field was independent of its velocity. This can easily be demonstrated by an ion of charge e moving in a plane perpendicular to the magnetic field H with a velocity v in a space which is free from electric field (inside one of the Dees, for example). The magnetic field will exert a force equal to Hev on the moving ion perpendicular both to its direction of motion and to the magnetic field. Thus the ion is forced to move in a circle like a ball on the end of a string. Applying Newton's Second Law we have:

$$Hev = \frac{mv^2}{r} \tag{1}$$

where m is the mass of the ion and r is the radius of the circular path.

Solving $v = \frac{eHr}{m}$, and so the time required to traverse a full circle would be

$$T = \frac{2\pi r}{v} = \frac{2\pi m}{eH} \tag{2}$$

which is independent of the velocity of the ion. Also the frequency (f) of the alternating potential required for the Dees would be

$$f = \frac{1}{T} = \frac{e}{m} \cdot \frac{H}{2\pi} \tag{3}$$

The kinetic energy gained by the ions when they have reached the exit slit at radius R can be expressed in terms of the equivalent voltage V which would give them the same energy.

$$Ve = \tfrac{1}{2}mv^2 = \frac{e^2 H^2 R^2}{2m}$$

or

$$V = \frac{e}{m} \frac{H^2 R^2}{2} \tag{4}$$

So the kinetic energy of the ions measured in electron-volts would be

$$W = \frac{Z^2}{A} H^2 R^2 (4.8 \times 10^{-5}) \text{ electron-volts} \tag{5}$$

where Z is the number of electronic charges on the ion ($Z = 1$ for protons, deuterons and 2 for alpha particles) and A is its atomic number ($A = 1$ for protons, 2 for deuterons, 4 for alpha particles) H is in oersteds, R in cm. Similarly, for the frequency:

$$f = \frac{Z}{A} H (1.53 \times 10^3) \text{ cycles per second} \tag{6}$$

Equations (5) and (6) are the fundamental design formulae of the cyclotron. The magnetic field H is limited by saturation in the iron of the magnet to about 20,000 oersteds so that in order to increase the energy W one must increase the exit radius R. However, the relationship is quite favourable—doubling the pole face diameter, for example, will give four times the energy W. For the 60-inch cyclotron prior to 1945, the exit radius R was 63 cm. and $H = 13{,}000$ oersteds. Substituting in equation (5) we obtain for deuterons $W = 16$ Mev and for alpha particles $W = 32$ Mev. Similarly from (6) we obtain $f = 10$ mc. which is equivalent to a wave length of 30 m. for the radio-frequency power supplied to the Dees.

The ions in the cyclotron are kept near the horizontal median plane of the Dees by several focusing actions. In the initial stages of acceleration when the ions are moving comparatively slowly there is some focusing action produced by the electric lens effect of the gap between the Dees, although under some circumstances this action is defocusing. When the ions are moving faster the focusing due to the magnetic field becomes predominant, since as in equation (1) the force exerted by the magnetic field is proportional to the velocity of the ions. This focusing force is due to the radial decrease of the magnetic field as one approaches the edge of the pole face. This corresponds to the bending of the magnetic lines of force in such a way as to exert a restoring force on any ions which stray from the horizontal median plane. A magnetic field which increases with the radius, on the other hand, causes defocusing so that the ions are lost before they are accelerated to full energy.

In the discussion so far we have neglected the increase of mass with velocity which was predicted by the theory of relativity:

$$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{7}$$

where m_0 is the mass of the particle when at rest and c is the velocity of light. Combining this expression with equation (3) we see that in order to keep the frequency constant as the velocity increases (in other words, to maintain the resonance condition) the magnetic field H should increase proportionately with the mass m. But we have just seen that it would cause defocusing and loss of the ions for the magnetic field to increase when the radius increased.

There have been several promising suggestions for avoiding this dilemma, which sets a limit to the highest available energy. The most straightforward solution was to raise the voltage on the Dees so that the ions had to make fewer revolutions to attain their final energy and thus making the resonance condition less stringent. Calculations indicated that a Dee voltage of 1,200,000 volts would give a beam of 100 Mev deuterons from the giant 184-inch magnet. Other suggestions were the placing of grids or foils along the interface of the Dees to give larger electrical focusing, or the periodic modulation of the frequency proportional to the mass increase in (7), which would bring the ions out in bursts. In any case, it seemed clear as of 1945 that experimental ingenuity could deal with the relativistic mass increase and that cyclotrons could go on to the acceleration of particles to higher and higher energy. (*See* also on RADIOACTIVITY; ELECTROMAGNET; NUCLEUS; ELECTRICAL MACHINE.)

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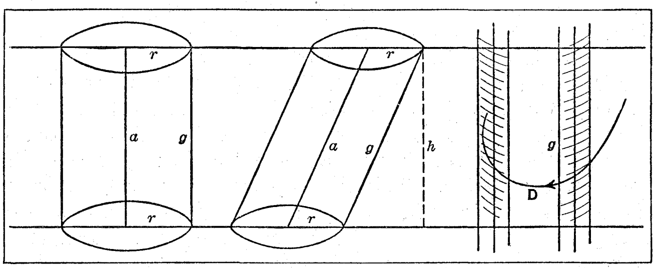
CYDER: *see* CIDER.

CYGNUS ("the swan"), in astronomy, a constellation of the northern hemisphere fabled by the Greeks to be the swan in the form of which Zeus seduced Leda. In this constellation β Cygni is a fine coloured double star, consisting of a yellow star, 3 mag., and a blue star, $5\frac{1}{2}$ mag. A wide double star 61 Cygni was, on account of its large proper motion of 5″ per annum, singled out by Bessel for the first successful attempt to measure stellar parallax. The parallax is about 0.31″. The constellation includes one of the most interesting regions of the Milky Way for astronomical research.

CYLINDER. In its oldest mathematical sense, the space swept out by a rectangle (fig. 1) rotating round one side as axis. It is from the Greek *kylindros*, roller, from *kylindein*, to roll. The side (called *generatrix*, g) parallel to the axis (a) traces the curved *cylindric surface;* the other two (each equal to r) trace the circular *bases* of such a right *circular cylinder*. The nearest-lying generalization supposes g not perpendicular to the parallel base-planes, but oblique, inclined at a fixed angle (like a pencil in writing), and tracing in the planes equal circles about the ends of the oblique axis as centres (fig. 2).

Measurement.—The perpendicular distance between the planes is called the cylinder's *altitude* (h). The area of each base



FIGS. 1, 2 AND 3

is clearly πr^2; the product of base and altitude (h) is the cylinder's volume $\pi r^2 h$; its curved surface (which suppose rolled out on a tangent plane) is the parallelogram of its edge (g) and the circumference of its base, *i.e.,* $2\pi rh$. A sector of the cylinder has a volume and curved surface proportional to the sector's angle. Subtracting from this volume that of the triangular prism of the axial sector-planes and the plane through parallel chords of the sector in the two bases, we obtain the volume of the cylinder segment cut off by a plane parallel to the axis, the formula being easily found by trigonometry.

Archimedes.—The metrical relations of cone, hemisphere and cylinder of the same base and height were especially studied by Archimedes of Syracuse (*c.* 225 B.C.), who showed (in Book I of his *Sphere and Cylinder*) their volumes to be as 1: 2: 3; and the surface of the sphere to equal the curved surface of the (right) circumscribing cylinder; *i.e.,* two-thirds of its whole surface. These relations were deemed by Archimedes so important and beautiful that he expressed the wish that the sphere-cylinder figure be engraved on his tomb, a wish fulfilled at command of Marcellus and furnishing a mark by which the quaestor Cicero identified it in 75 B.C., after nearly a century and a half.

Later View.—The more modern mind regards rather the cylindric surface as the cylinder itself (compare the cone, *q.v.*), and defines it in full generality as the path of a right line (g) moving without turning, *i.e.,* always parallel to itself or some fixed line or direction. To make such a surface definite, we must prescribe some *directrix* (d), generally a curve which the generatrix (g) shall describe passing through its points (fig. 3). Obviously such a surface is *developable*; that is, it may be imagined as flattened or rolled out smooth, without stretching, tearing or crinkling, on a tangent plane which evidently touches the surface full length along an element in any one of its positions. In case the directrix be an ellipse, the surface has been called "cylindroid," and may be defined as the path of an ellipse moving always parallel to itself, its centre always on a fixed line or axis. The same name is also applied to Cayley's conoidal cubic surface traced by the intersection of two moving planes $y=x \tan\theta$, $z=m \sin 2\theta$, whence, on eliminating the parameter θ, there results the equation of the surface, $z(x^2+y^2)=2mxy$. Plainly any cylindric surface may be vividly conceived as a straight tube traced by a directrix moving always straight and keeping always parallel to itself.

Sections.—If any directrix has a centre, the line through it, along which the centre moves parallel to g, is called the *axis*. Any plane through the axis makes a "principal section," namely, two opposite parallels, elements of the surface, which, with two parallel sections of this plane by two parallel planes through the cylinder, form a parallelogram. This parallelogram becomes a rectangle if the two planes be perpendicular to the generatrix g. In a right circular cylinder such a perpendicular plane cuts it in a circle, but any plane oblique to the axis, in an ellipse, which is thus seen to be the parallel projection of a circle on an inclined plane, a fact leading directly to many properties of that curve (*see* ELLIPSE). If the circular cylinder be not right but oblique, then the plane sections across it are in general elliptic, but become circular for planes parallel to the directrix circle, and also in sections "subcontrary," *i.e.,* of planes perpendicular to the principal section and inclined to the axis equally, but oppositely, to the directrix plane. The same condition occurs in oblique cones (*see* CONE).

A Limiting Case of the Cone.—The cylinder may be regarded as a cone whose vertex has withdrawn to infinity (Desargues, 1639). Accordingly all oblique sections of the right circular cylinder yield ellipses, but those parallel to an element (g) or the axis yield a pair of parallels, a limiting case of the parabola. Still further turned, the plane again cuts through, giving ellipses. But the same two parallels may be held for a limiting case of the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$, which for $b=\infty$ becomes $x=\pm a$, an hyperbola straightened out into a pair of right lines tangent at the vertices. The conjugate, hyperbola, $\frac{x^2}{a^2}-\frac{y^2}{b^2}=-1$, on the same supposition ($b=\infty$) becomes a pair of imaginary lines, $x=\pm a\sqrt{1}$. (*See* CONIC SECTIONS and CO-ORDINATES.) (W. B. SM.)

CYLINDER IN ENGINEERING

The cylinder is one of the primary mechanical elements used in numerous kinds of prime movers, compressors, pumps, and pneumatic and hydraulic appliances. The earliest cylinders were employed in what were termed fire-engines, which operated by the production of a partial vacuum beneath a piston. Huygens in 1678 exploded gunpowder below the piston; with the expulsion of the gaseous products and the cooling of the remainder a vacuum was produced for the piston to descend by atmospheric pressure. Papin in 1690 applied steam in a crude fashion, and Savery and Newcomen carried developments further (*see* CONDENSER), but

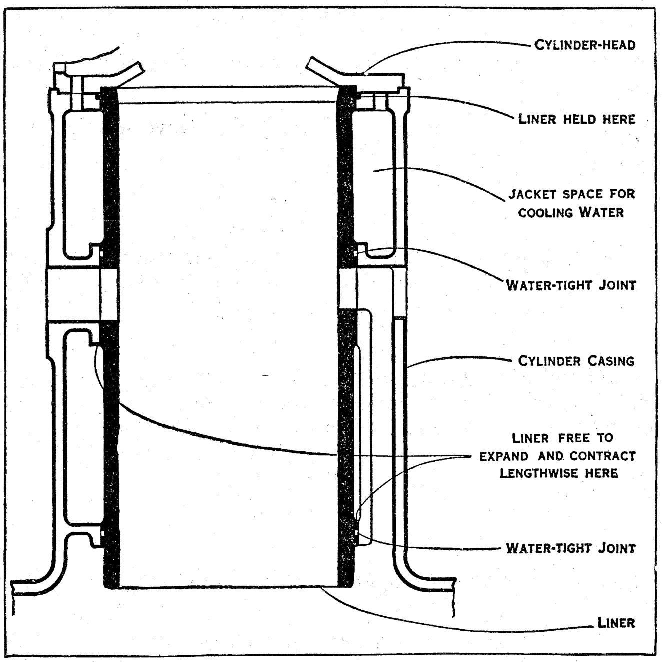


FIG. 4.—SECTION OF AN OIL-ENGINE CYLINDER FITTED WITH LINER
A renewable liner of hard-wearing metal is fitted into the cylinders of many kinds of engines. After a period of service it can be replaced by a new liner; which is a more satisfactory procedure than that of re-boring a cylinder

Watt initiated the era of practical steam-engine construction, making double-acting cylinders in which steam drove the piston to and fro, the principle remaining unchanged to-day. Later improvements involved better methods of manufacture, the use of higher steam pressures and superheated steam, as well as of the expansive energy in successive cylinders, in compound, triple-expansion, and quadruple-expansion engines. Now these multi-cylinder types are challenged by a single-cylinder engine, the "Uniflow," with its method of exhausting through central ports instead of at the ends of the cylinder as usual. Great efficiency results from the fact that condensation losses are reduced by the absence of alternate rushes of hot live steam and cooled exhaust steam over the cylinder surfaces.

Steam cylinders must be kept warm by lagging with non-conducting substances packed around the exterior, or by passing live steam around in a jacket. In internal-combustion engines and compressors the opposite need must be satisfied. The temperature must be kept down in order that the lubricating oil may keep in a working condition, and the parts maintain their shape. Air or water cooling systems deal with this problem (*see* COOLING SYSTEMS). But in any class of cylinder the risk of distortion must be guarded against by careful design; no very thick parts must be adjacent to thin ones, or expansions and contractions will be unequal, and leakages of steam or gas or vapour will occur. The strongest construction is in the Diesel engines, which have to act as powerful air-compressors, and then withstand the ensuing strong power stroke. The *liner* is an important constructional feature in great numbers of cylinders; it is a very plain tube of close-grained, hard-wearing, iron or steel, fitted into the cylinder, and often held at one end only, leaving the remainder of the length to expand longitudinally (fig. 4). When much worn the liner can be taken out and a new one inserted. It is also convenient when employing aluminium cylinders for lightness, steel liners taking the wear of the piston. Liners of gun-metal or phosphor-bronze are fitted in some kinds of hydraulic machinery (*e.g.* pumps) to prevent rusting, and the rams may be of stainless steel for the same reason. When cast-iron does not afford sufficient strength, cast-steel is chosen, particularly in hydraulic work, while if pressures are very high, as in some pumps, the cylinder bodies are bored out of solid blocks of forged steel.

Thicknesses range between remarkable extremes; on the one hand are the $\frac{3}{16}$ in. walls of aero-engines, and on the other the 9in. cast-steel walls of a Davy 12,000 ton armour-plate press. Sound metal is particularly important in cylinders, and careful selection and casting of the metal are imperative. Many steam cylinders and others including those for hydraulic presses, are cast with a large extra lump of metal at the top, termed head-metal, the dross and scoriae rising into this. When the casting is taken from the mould, this lump is cut off, leaving pure sound metal throughout the cylinder.

Multi-cylinders are used to a great degree in steam-engines, compressors, pumps, and motor and aero work. They are either

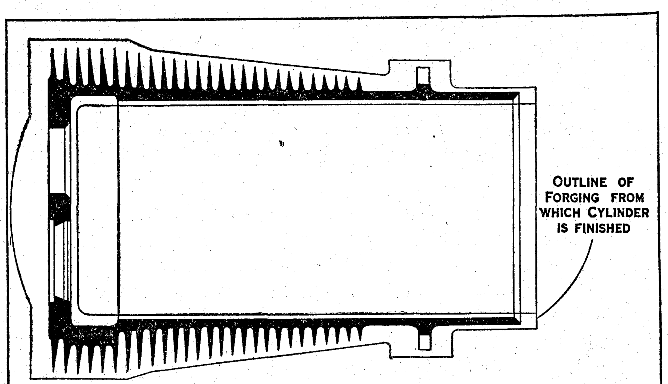


FIG. 5.—SECTIONAL DRAWING OF BRISTOL "JUPITER" RADIAL AERO-ENGINE CYLINDER
The method of producing these cylinders affords an example of the best practice to secure absolutely flawless metal. A steel forging weighing 86 lb. is bored, and turned to make the finished outline shown in black, weighing then only 18 pounds

built up by bolting together, or cast *en bloc,* the latter method being preferable from the point of view of rigidity and compactness. Aero-cylinders are sometimes cast, sometimes bored and turned from solid blocks of forged steel, so as to ensure sound metal throughout. Or a heavy forging is prepared, as in the Bristol "Jupiter" radial engines, and the cylinder machined out of this, removing a large amount of metal. This appears in fig. 5, the outline of the forging being shown by thin lines. The forging weighs 86 lb., the finished piece only 18 lb.

The importance of making a truly circular and parallel bore need scarcely be emphasized; without this, wasteful leakages occur in any sort of cylinder, and the compression cannot be properly obtained in an internal-combustion engine. The methods of finishing a bore from the casting or forging include boring, reaming, and grinding. The first-named process is often followed by the second to obtain superior finish and accuracy. Grinding gives a high

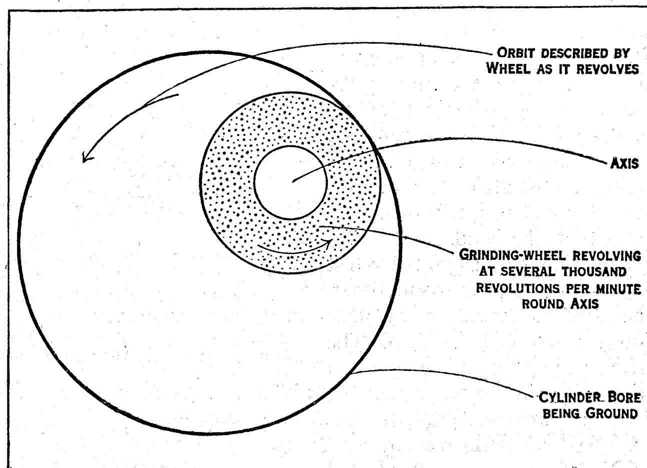
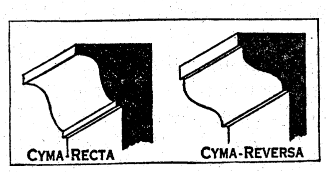


FIG. 6.—A DIAGRAM SHOWING ACTION OF PLANETARY GRINDING OF CYLINDER BORES
The peculiar planetary motion of the grinding-wheel spindle is necessary in order to grind the bores of cylinders while held in a fixed position on the table of the grinding-machine. Cylinder blocks, being bulky and unbalanced, cannot be conveniently revolved by a chuck, as is usual with other classes of work requiring to be ground internally

mirror-finish, and by reason of the nature of the operation, which removes a mere film of metal, it tends to avoid distortion of the cylinder by pressure and heat. A number of machines have been developed for these operations, including single-spindle and multi-spindle boring and reaming machines, for units and block castings. The grinding machines are specially designed for the purpose, having a planetary action to the wheel-spindle which can be moved round in a circle of lesser or greater diameter as required, while the spindle is turning on its own axis at 5,000 or 6,000 revolutions per minute (fig. 6). This peculiar action is necessary because the cylinders cannot be conveniently revolved, but must be clamped to a fixed table. Honing is a newer finishing process, a revolving and reciprocating spindle moving a circle of carborundum cylinders round the bore and up and down. (*See* STEAM ENGINE; INTERNAL COMBUSTION ENGINE; DIESEL ENGINE.) (F. H.).

CYLLENE (1) a mountain in Greece, in the north-east of Arcadia, mod. *Ziria,* 7,789 ft. It was sacred to Hermes, who was born in a cave on the mountain, and had a temple and an ancient statue on its summit.

(2) An ancient port in Elis doubtfully identified with (3) the modern port at Glarentza, with mineral baths a little to the south.

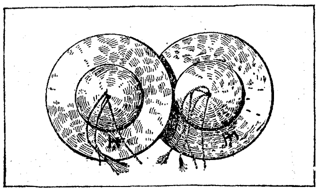


CYMA, in architecture, a moulding of double curvature, whose profile is concave at one end, convex at the other. When the more projecting portion is concave, it is known as a *cyma recta,* when convex as a *cyma reversa.* (Gr. *kuma,* wave.) (*See* MOULDING.)

CYMATIUM, the uppermost member of a classic cornice (*q.v.*), usually consisting of a projecting moulding. In the Greek Doric the cymatium occurs only upon the pediment cornices, returning along the sides only the depth of the pediment coping which it decorates. It is in the form of an ovolo or projecting convex moulding. The cymatium also takes an ovolo form in the Tuscan order, a cavetto, or concave, form in the Roman Doric and a cyma recta form, or moulding of double curvature, elsewhere. (*See* MOULDING; ORDER.)

CYMBALS, a modern instrument of percussion of indefinite musical pitch, whereas the small ancient cup-shaped cymbals sounded a definite note. Cymbals consist of two thin round plates of an alloy containing eight parts of copper to two of tin, and the sound is obtained by clashing and rubbing them against each other. Although cymbals are not often required they form part of every orchestra. They are specially suited for suggesting frenzy, fury or bacchanalian revels, as in the Venusberg music in Wagner's *Tannhäuser* and Grieg's *Peer Gynt* suite.

The *timbre* of the ancient cymbals is entirely different, more like that of small hand-bells or of the notes of the keyed harmonica. They are not struck full against each other, but by one of their edges, and the note given out by them is higher in proportion as they are thicker and smaller. Berlioz in *Romeo and Juliet* scored for two pairs of cymbals, modelled on some ancient Pompeian instruments no larger than the hand.



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

CHINESE BRONZE CYMBALS MARKED WITH THE CHARACTER "JEWEL"

The cords of the Chinese instrument are usually red, symbolizing happiness

The origin of the cymbals must be referred to prehistoric times. The ancient Egyptian cymbals closely resembled our own. The British Museum possesses two pairs, $5\frac{1}{3}$in. in diameter, one of which was found in the coffin of the mummy of Ankhhapē, a sacred musician.

CYMBALUM: *see* CHIME-BELLS.

CYME, the name given in botany to an arrangement of flowers (inflorescence) in which each successive branch of the flowering axis ends in a flower after bearing one or more bracteoles in whose axils the branching is continuous. Cymes are subdivided according to the number of these branches. (*See* FLOWER.)

CYNEGILS (d. 643), king of the West Saxons, succeeded his uncle King Ceolwulf in 611. With his son Cwichelm (d. 636), he defeated the advancing Britons at Bampton, Oxfordshire, in 614, and Cwichelm sought to arrest the growing power of the Northumbrian king Eadwine by procuring his assassination; the attempt failed, and in 626 the West Saxons were forced to own Eadwine's supremacy. Cynegils' next struggle was with Penda of Mercia, who defeated him in 628 at Cirencester. Cynegils was converted to Christianity by Birinus, and was baptized in 635 at Dorchester, Oxfordshire, where he founded a bishopric. His son Cenwalh succeeded him.

CYNEWULF (d. 785), king of Wessex, succeeded to the throne in 757 on the deposition of Sigebert. He was constantly at war with the Welsh. In 779 Offa of Mercia defeated him and took Bensington. In 785 he was surprised and killed at Marten, Wilts (Merantune), by Cyneheard, brother of Sigebert.

See J. Earle and C. Plummer's edition of the *Anglo-Saxon Chronicle,* 755, 779 (Oxford, 1892).

CYNEWULF, the only Old English vernacular poet, known by name, of whom any undisputed writings are extant. He is the author of four poems preserved in two mss., the *Exeter Book* and the *Vercelli Book,* both of the early 11th century. An epilogue to each poem contains the runic characters answering to the letters *c, y, n* (*e*), *w, u, l, f*. The runes are to be read as the words that served as their names; these words enter into the metre of the verse, and (except in one poem) are significant in their context.

In *Juliana* and *Elene* the name is spelt Cynewulf; in *The Ascension* the form is Cynwulf. In *The Fates of the Apostles* the page is defaced, but the spelling Cynwulf is almost certain. The absence of the E in *The Ascension* can hardly be due to a scribal omission, for the name of this letter (meaning "horse") would not suit the context; this was perhaps the motive for the choice of the shorter form. The orthography (authenticated as the poet's own by the nature of his device) has chronological significance. If the poems had been written before 740, the spelling would almost certainly have been Cyniwulf. From the scanty extant evidence we should conclude that the form Cynwulf came in about 800, and the four works may therefore be referred provisionally to the beginning of the 9th century, any lower date being for linguistic and metrical reasons improbable. The mss. of the poems are in the West-Saxon dialect, but Prof. E. Sievers's arguments for a Northumbrian original have considerable weight.

Cynewulf's unquestioned poems show that he was a scholar, familiar with Latin and with religious literature, and they display much metrical skill and felicity in the use of traditional poetic language; but of the higher qualities of poetry they give little evidence. There are pleasing passages in *Elene,* but the clumsy and tasteless narration of the Latin original is faithfully reproduced, and the added descriptions of battles and voyages are strings of conventional phrases, with no real imagination. In *The Ascension* the genuine religious fervour imparts a higher tone to the poetry; the piece has real but not extraordinary merit. Of the other two poems no critic has much to say in praise.

Until recently it was commonly thought that Cynewulf's authorship of the Riddles in the *Exeter Book* (*q.v.*) was beyond dispute. Some of the Riddles have been shown by Prof. E. Sievers to be older than Cynewulf's time; that he may have written some of the rest remains a bare possibility. The similarity of tone in the three poems known as the *Christ* affords some presumption of common authorship. Both *The Incarnation* and *The Last Judgment* contain many passages of remarkable power and beauty. The *Christ* is followed in the ms. by two poems on *Saint Guthlac,* the second of which is generally, and with much probability, assigned to Cynewulf. The first Guthlac poem is almost universally believed to be by another hand. Cynewulf's reputation can gain little by the attribution to him of *Guthlac.* Very different would be the effect of the establishment of his much disputed claim to *Andreas,* a picturesque version of the legend of the Apostle Andrew. The poem abounds to an astonishing extent in "Cynewulfian" phrases, but it is contended that these are due to imitation. If the author of *Andreas* imitated *Elene* and *Juliana,* he bettered his model. Cynewulf's authorship has been asserted by some scholars for *The Dream of the Rood,* the noblest example of Old English religious poetry. But an extract from this poem is carved on the Ruthwell Cross; and, notwithstanding the arguments of Prof. A. S. Cook, the language of the inscription seems too early for Cynewulf's date. The similarities between the *Dream* and *Elene* are therefore probably due to Cynewulf's acquaintance with the older poem. The only remaining attribution that deserves notice is that of the *Phoenix.* The author of this fine poem was, like Cynewulf, a scholar, and uses many of his turns of expression, but he was a man of greater genius than is shown in Cynewulf's signed compositions.

For the older literature relating to Cynewulf, *see* R. Wülker, *Grundriss der angelsächsischen Litteratur* (1885). References to the most important later discussions will be found in M. Trautmann, *Kynewulf, der Bischof und Dichter* (1898), and the introductions and notes to the editions of *Cynewulf's Christ,* by I. Gollancz (1892) and A. S. Cook (1900). For the arguments for Cynewulf's authorship of *Andreas, see* F. Ramhorst, *Andreas und Cynewulf* (1885). *See* also C. W. Kennedy, the *Poems of Cynewulf Translated into English Prose* (1910); A. S. Cook, "Cynewulf's Part in our Beouwulf," *Conn. Ac. Arts and Sci.* xxvii. (1925).

CYNICS, a small but influential school of ancient philosophers. Their name is variously derived from the building in Athens called Cynosarges, the earliest home of the school, and from the Greek word for a dog (κύων), in contemptuous allusion to the uncouth and aggressive manners adopted by the members of the school. Whichever of these explanations is correct, it is noticeable that the Cynics agreed in taking a dog as their common badge or symbol (*see* DIOGENES). From a popular conception of the intellectual characteristics of the school comes the modern sense of "cynic," implying a sneering disposition to disbelieve in the goodness of human motives and a contemptuous feeling of superiority.

As regards the members of the school, the separate articles on ANTISTHENES, CRATES, DIOGENES and DEMETRIUS contain all biographical information. We are here concerned only to examine the general principles of the school in its internal and external relations as forming a definite philosophic unit. The importance of these principles lies not only in their intrinsic value as an ethical system, but also in the fact that they form the link between Socrates and the Stoics, between the essentially Greek philosophy of the 4th century B.C. and a system of thought which has exercised a profound and far-reaching influence on mediaeval and modern ethics. From the time of Socrates in unbroken succession up to the reign of Hadrian, the school was represented by men of strong individuality. The leading earlier Cynics were Antisthenes, Diogenes of Sinope, Crates of Thebes, and Zeno; in the later Roman period, the chief names are Demetrius (the friend of Seneca), Oenomaus and Demonax. All these men adhered steadfastly to the principles laid down by Antisthenes.

Antisthenes was a pupil of Socrates, from whom he imbibed the fundamental ethical precept that virtue, not pleasure, is the end of existence. He was, therefore, in the forefront of that intellectual revolution in the course of which speculation ceased to move in the realms of the physical (*see* IONIAN SCHOOL OF PHILOSOPHY) and focused itself upon human reason in its application to the practical conduct of life. "Virtue," says Socrates, "is knowledge": in the ultimate harmony of morality with reason is to be found the only true existence of man. Antisthenes adopted this principle in its most literal sense, and proceeded to explain "knowledge" in the narrowest terms of practical action and decision, excluding from the conception everything except the problem of individual will realizing itself in the sphere of ordinary existence. Just as in logic the inevitable result was the purest nominalism, so in ethics he was driven to individualism, to the denial of social and national relations, to the exclusion of scientific study and of almost all that the Greeks understood by education. This individualism he and his followers carried to its logical conclusion. The ordinary pleasures of life were for them not merely negligible but positively harmful inasmuch as they interrupted the operation of the will. Wealth, popularity and power tend to dethrone the authority of reason and to pervert the soul from the natural to the artificial. Man exists for and in himself alone; his highest end is self-knowledge and self-realization in conformity with the dictates of his reason, apart altogether from the State and society. For this end, disrepute and poverty are advantageous, in so far as they drive back the man upon himself, increasing his self-control and purifying his intellect from the dross of the external. The good man (*i.e.* the wise man) wants nothing: like the gods, he is αὐταρκής (self-sufficing); "let men gain wisdom—or buy a rope"; he is a citizen of the world, not of a particular country (*cf.* Diogenes Laërtius vi. 2).

It is not surprising that the pioneers of such a system were criticized and ridiculed by their fellows, and this by no means unjustly. We learn that Diogenes and Crates sought to force their principles upon their fellows in an obtrusive, tactless manner. The very essence of their philosophy was the negation of the graces of social courtesy; it was impossible to "return to nature" in the midst of a society clothed in the accumulated artificiality of evolved convention without shocking the ingrained sensibilities of its members. Nor is it unjust to infer that the sense of opposition provoked some of the Cynics to an overweening display of superiority. At the same time, it is absurd to regard the eccentricities of a few as the characteristics of the school, still more as a condemnation of the views which they held.

In logic Antisthenes was troubled by the problem of the One and the Many. A nominalist to the core, he held that definition and predication are either false or tautological. Ideas do not exist save for the consciousness which thinks them. "A horse," said Antisthenes, "I can see, but horsehood I cannot see." Definition is merely a circuitous method of stating an identity: "a tree is a vegetable growth" is logically no more than "a tree is a tree."

Cynicism appears to have had a considerable vogue in Rome in the 1st and 2nd centuries A.D. Demetrius (*q.v.*) and Demonax are highly eulogized by Seneca and Lucian respectively. It is probable that these later Cynics adapted themselves somewhat to the times in which they lived and avoided the crude extravagance of Diogenes and others. But they undoubtedly maintained the spirit of Antisthenes unimpaired and held an honourable place in Roman thought. This very popularity had the effect of attracting into their ranks charlatans of the worst type. So that in Rome also Cynicism was partly the butt of the satirist and partly the ideal of the thinker.

Disregarding all the accidental excrescences of the doctrine Cynicism must be regarded as a most valuable development and as a real asset in the sum of ethical speculation. With all its defective psychology, its barren logic, its immature technique it emphasized two great and necessary truths; firstly, the absolute responsibility of the individual as the moral unit, and, secondly, the autocracy of the will. These two principles are sufficient ground for our gratitude to these "athletes of righteousness" (as Epictetus calls them). Furthermore they are profoundly important as the precursors of Stoicism. The closeness of the connection is illustrated by Juvenal's epigram that a Cynic differed from a Stoic only by his cloak. Zeno was a pupil of Crates, from whom he learned the moral worth of self-control and indifference to sensual indulgence (*see* STOICS).

Finally it is necessary to point out two flaws in the Cynic philosophy. In the first place, the content of the word "knowledge" is never properly developed. "Virtue is knowledge"; knowledge of what? and how is that knowledge related to the will? These questions were never properly answered by them. Secondly they fell into the natural error of emphasizing the purely animal side of the "nature" which was their ethical criterion. Avoiding the artificial restraints of civilization, they were prone to fall back into animalism pure and simple. Many of them upheld the principle of community of wives (*see* Diogenes Laërtius vi. 2); some of them are said to have outraged the dictates of public decency. It was left to the Stoics to separate the wheat from the chaff, and to assign to the words "knowledge" and "nature" a saner and more comprehensive meaning. For relation of Cynicism to contemporary thought, *cf.* CYRENAICS, MEGARIAN SCHOOL OF PHILOSOPHY. (*See* also ASCETICISM.)

See F. W. Mullach *Fragmenta philosophorum Graecorum* (Paris, 1867), ii., 261–438; H. Ritter and L. Preller *Hist. phil. Graec. et Rom.* ch. v.; hist. of ancient philosophy, and specially Ed. Zeller *Socrates and the Socratic Schools,* E. trans., O. J. Reichel (1868, 2nd ed. 1877); Th. Gomperz *Greek Thinkers,* E. trans., vol. ii., G. G. Berry (1905); E. Caird *Evolution of Theology in the Greek Philosophers* (1904), ii. 44 *seq.,* 55 *seq.* 62 *seq.;* arts. STOICS and SOCRATES.

CYNOCEPHALUS (or GALEOPITHECUS), the scientific names of the species of Colugo or Cobego, commonly known as flying lemurs (*q.v.*) and alone representing the family Cynocephalidae of the order Dermoptera. The family characters are as follows: Herbivorous, climbing, clawed mammals, provided with a very extensive gliding membrane, and having the dental formula $i. \frac{2}{2}$, $c. \frac{0}{1}$, $p. \frac{3}{3}$, $m. \frac{3}{3}$, total 34. The lower incisors are directed forwards and have a comb-like structure of their crowns, while the outermost of these teeth and the canines are double-rooted, being in these respects, taken together, quite unlike those of all other mammals; the cheek-teeth have numerous sharp cusps; and there is the normal replacement of milk-molars by premolars. In the skull the orbit is surrounded by bone, and the tympanic has a bulla and an ossified external meatus. The ulna and fibula are to some extent inclined backwards; the carpus has a scapho-lunar; and the feet are five-toed. The hemispheres of the brain are short and but slightly convoluted; the stomach is simple; there is a large caecum; the testes are received into inguinal pouches; the uterus is two-horned; the placenta is discoidal; and there are two pairs of pectoral teats. A single offspring is produced at a birth. (*See* INSECTIVORA.)

There are two well-marked species, *Cynocephalus temminckii,* ranging from Burma, Thailand and the Malay Peninsula to Borneo, Sumatra and Java, and *Cynocephalus volans,* of the Philippine group. The former, which is nearly 2 ft. in total length, is distinguished by its larger upper incisors, shorter ears and smaller skull. In both species not only are the long and slender limbs connected by a broad integumentary expansion extending outwards from the sides of the neck and body, but there is also a web between the fingers and toes reaching as far as the base of the claws; and the hind-limbs are further connected by a similar expansion passing outwards along the back of the feet to the base of the claws, and, inwardly, involving the long tail to the tip, forming a true interfemoral membrane, as in bats.

CYNOSCEPHALAE, BATTLE OF (197 B.C.). Once the Hannibalic War (*see* PUNIC WARS) was concluded Roman expansion began. Expansion eastwards soon brought the Republic into contact with the fragments of the Alexandrian Empire, and between the years 200 and 197 B.C. the Second Macedonian War took place culminating in the decisive victory of Quinctius Flamininus, the Roman Consul, over Philip, King of Macedon, at Cynoscephalae in Thessaly. Both armies numbered about 26,000 men, the Macedonian being organized in a phalanx of two divisions of 8,000 men each, about 7,000 light troops and 2,000 horse. Flamininus had the same number of heavy foot, but was considerably the stronger in cavalry as the Aetolian horsemen had joined him; he also possessed a force of war elephants.

When the king arrived at Larissa he learnt that Flamininus was approaching Pherae, and immediately pushed forward to that place. Finding the ground there "thickly wooded and full of walls and gardens and consequently unsuited to the movements of his phalanx" he fell back to Scotussa, a corn-growing district which offered him not only moderately level ground but ample supplies and forage.

Learning of his withdrawal, Flamininus followed him, and quite unknown to each other both armies encamped on the opposite sides of a low range of hills called from their appearance Cynoscephalae, or "the Dogs'-heads."

The next day both generals sent out reconnoitring parties to occupy the ridge; a dense fog covered the ground; in it the two forces of light infantry met unexpectedly, and the Romans being the weaker were driven back, then being reinforced they advanced, were once again heavily attacked by the Macedonians who would have cut them up had not they been held back by the Aetolian cavalry.

Flamininus now, the fog having cleared, drew out his legions. Ordering his right wing to remain where it was with the elephants in front of it, he advanced at the head of the left wing covered on its left by light troops, to support his advanced guard. Philip was a sound but weak general. At first he had no intention of entangling his columns in the hilly ground, but finally was persuaded by his subordinates to advance. Placing himself at the head of the right division of the phalanx he was soon compelled to form it into a heavy column in order to cross the broken ground.

Meanwhile Nicanor who was in command of the left division of the phalanx was instructed to follow the right division as soon as possible. This over-haste to support the Macedonian advanced guard resulted in Philip's army being beaten in detail.

On approaching Flamininus, Philip threw out his light infantry on his right flank and sounded the charge. The sarissas (pikes) were lowered, and the Roman left wing driven down the hill. Flamininus, seeing that it was not possible to prevent his men falling back, and perceiving that the Macedonian wings were separated, Nicanor being still a considerable distance in rear, galloped over to his right wing and ordered it to advance against the Macedonian left, which caught in column of march was thrown into confusion by the elephants, and at once broke and fled, being pursued by the Roman right wing. One of the tribunes, a man of quick tactical insight, seeing that the Roman left was hard pressed, broke away from the pursuit and wheeling round some 20 maniples moved rapidly towards the Macedonian right wing, and charged it in rear. The nature of the phalanx being such that it was most difficult for the men to face round singly and defend themselves, confusion at once resulted. Under cover of this confusion the Roman left wing reformed its ranks and attacked the Macedonians in front. This dual attack in rear and front proved decisive.

Philip left the field with a small party of men, his right wing was cut to pieces, his losses being 8,000 killed and 5,000 prisoners; the Romans lost 700.

Tactically the battle of Cynoscephalae is an interesting one. Both armies attacked and were attacked in detail. In the actual charge the sarissa proved once again all-powerful, but the legionary organization being the more flexible enabled a clear-sighted subordinate quickly to break off a small party of men and manoeuvre towards the decisive point—the rear of the victorious Macedonian right. *See* also ROME: *Ancient History.*

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CYNOSURE, the name given by the Greeks and Romans to the constellation of the Little Bear, Ursa Minor. (Lat. *cynosura,* Gr. *κυνόσουρα,* from *κυνός,* genitive of *κύων,* a dog, and *οὐρά* tail.) The word is applied in English to the pole-star which appears in that constellation, and hence to something bright which, like a "guiding-star," draws all attention to it, as in Milton's "cynosure of neighbouring eyes."

CYNOTHERAPY, the practice of healing by means of dogs, is of great antiquity and almost world-wide distribution. In it the use of the dog may be merely magical or ceremonial, or the parts of the dog itself may be used as medicine or as ingredients therein. Primitive thought does not clearly distinguish between what is magical and what is medicinal. The domestication of the dog dates from the Mesolithic age, and its use as food is widespread and has generally some ceremonial significance, a significance perhaps due to the great value of the dog to the ancient hunter or shepherd. Thus in the Nicobar islands, where the dog is apparently a tribal token, it is sacrificed, then cooked and eaten. The Lhota Nagas of Assam sacrifice (and eat) dogs at a propitiatory ceremony because the dog, being the cleverest of all animals, is therefore the most gratifying to the spirits. Among the Igorot of Luzon the dog is used as a ceremonial food, and in mediaeval Europe it was a favourite animal in offerings to the devil. In Argos the dog was sacrificed to a fertility god, and in Sparta and Caria to the god of war; the Macedonians and Boeotians sacrificed dogs in purification rites and so apparently did the Romans, for Pliny mentions that live dogs were fastened in a wooden fork (*Nat. Hist.* xxix., iv.), much as a Kuki or Naga of Assam impales them on a bamboo spike at this day. The dog also appears to have been eaten as food in Rome. In 813 the Bulgar leader, Krum, sacrificed dogs before Constantinople. The Sema Nagas mark a boundary by burning a live puppy, and a similar use of dogs as sacrifices on important occasions such as in peace-makings, in cementing friendships, in taking oaths and even in rain-making is common.

But though these uses of the dog may be merely the outcome of a vague feeling of reverence, caused by its sagacity and valuable qualities, of such a feeling as that recorded of the Kenyahs of Borneo, there seems to be more than this at the bottom of its use as medicine, and it may be that there is, or has been, an idea that the soul matter of human beings and of dogs is of similar quality (*see* METEMPSYCHOSIS; LYCANTHROPY; HEAD-HUNTING), and that the latter can usefully be substituted for the former for that reason. It has been suggested—Carveth Read, *Origin of Man* (1925)—that the sympathy between man and dogs is due to the fact that both are descended from ancestors that hunted in packs. In any case hunting dogs are often treated as human beings; if an Angami Naga kills one, he must leave the village for five days, that of his departure and return being kept as communal tabu days, as if he had committed homicide on a small scale. Hunting dogs were crowned in ancient Italy, are buried with particular respect by the Naga tribes of Assam, and are allotted a definite share of the game killed by the Oraons of Chhota Nagpur in India, by the Khasis and the Naga tribes in Assam, and by the Tinguians of the Philippine Islands. So, too, canine have been substituted for human victims in sacrifice on the Nile, in Hawaii, in the Naga hills, and perhaps in Ireland; and the same idea is no doubt present in the use of dogs for sacrifice in illness by the Koryaks of Siberia, in New Guinea, in Hawaii, and by the Kuki tribes of Assam and Burma, the dog being the sacrifice *par excellence* in illness among the Thado, Lushei, and Chins. The Buru and Aru islanders of Indonesia eat dogs to acquire bravery, as do the Kansas Indians of the U.S.A. The Romans sacrificed dogs to the Bona Dea and at the Lupercalia. The Huancas of Peru had the same idea and ate dogs at their greatest festival, while the Angami Nagas also make a practice of eating dog at their important annual festival, the Sekrengi, which is intended to secure the health of the community during the ensuing year. The Naga tribes all regard dog's flesh as a valuable tonic and as generally health-giving, while the flesh, blood, or fat of dogs has long been regarded as medicinal in Europe. Hippocrates advocated a diet of dog flesh in certain illnesses, as consumption, and Pliny remarks "that sucking puppies were held fit for food." Culpeper, in his *Pharmacopoeia Londiniensis* (1659), recommends newly-whelped puppy as an ingredient in liniment for bruised or wounded limbs, and the *Pharmacopée Universelle* (1763) gives directions for the preparations of ointment, oil, and liniment from dogs for use in rheumatism, while a remedy called "dog oil" is still used in the north of

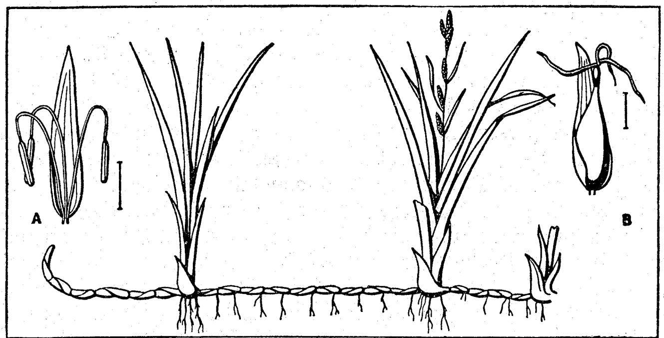


FIG. 1.—CAREX RIPARIA, THE LARGEST BRITISH SEDGE, FROM 3 TO 5 FT. HIGH
A. Male flower (Enlarged) B. Female flower (Enlarged)

England for arthritis. Dog, too, is a common nostrum against poison; "nothing is more potent against poison than dog's blood," says Pliny again (*Loc. cit.*), and in Ireland "the blood of many dogs" forms part of a charm against poisoning, while the Angami Naga antidote is the eyes of a living dog, plucked out and swallowed. The hair of the dog that bit you is a remedy for dog-bite in Assam as well as in Great Britain, while in China there is medicinal virtue in the hair of any dog.

Of course the belief in the virtue of dog flesh may be due, or partly due, to the observations of the healing effects of a dog's licking its own wounds. *Langue de chien sert de médécine* says the French proverb, while the scriptural case of Lazarus seems to contain that idea. Cures were effected at Epidaurus in the 4th century B.C. by the licking of the patient by dogs sacred to Aesculapius (*q.v.*), to which dogs the Athenians actually offered sacrifices. The idea is still current, for a whole family in Co. Durham in 1921 attributed their recovery from scabies to the licking of a pet dog (*The Lancet*, Nov. 1921). (J. H. H.)

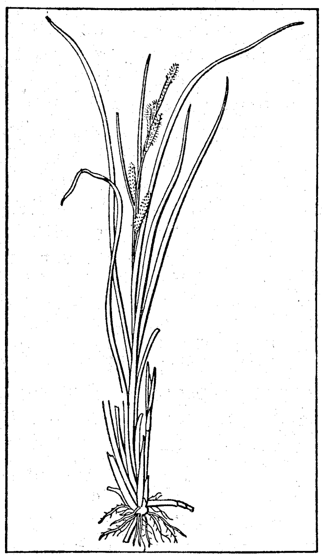


FIG. 1A.—CAREX AMPULLACEA, WHICH GROWS FROM 1 TO 3 FT. HIGH, IN BOGS AND MARSHES IN PARTS OF EUROPE, ASIA AND NORTH AMERICA

CYPERACEAE, in botany, a family of monocotyledons. They are grass-like herbs, sometimes annual, but more often persisting by means of an underground stem, from which spring erect solitary or clustered, generally three-sided aerial stems, with leaves in three rows. The minute flowers are arranged in spikelets somewhat as in grasses, and these again in larger spike-like or panicled inflorescences. The flower has in rare cases a perianth of six scale-like leaves arranged in two whorls, and thus conforming to the common monocotyledonous type of flower. Generally the perianth is represented by hairs, bristles or similar developments, often indefinite in number; in the two largest genera, *Cyperus,* and *Carex* the flowers are naked. In a few cases there are two whorls of stamens, with three members in each; but generally only three are present; the pistil consists of two or three carpels, united to form an ovary bearing a corresponding number of styles and containing one ovule. The flowers, often unisexual, are wind-pollinated. The fruit is one-seeded, with a tough, leathery or hard wall. There are 85 genera containing about 3,200 species and widely distributed throughout the earth, chiefly as marsh-plants. In the arctic zone they form 10% of the flora. They will flourish in soils rich in humus which are too acid to support grasses. The large genus *Cyperus* contains about 600 species, chiefly in the warmer parts of the earth; *C. papyrus*

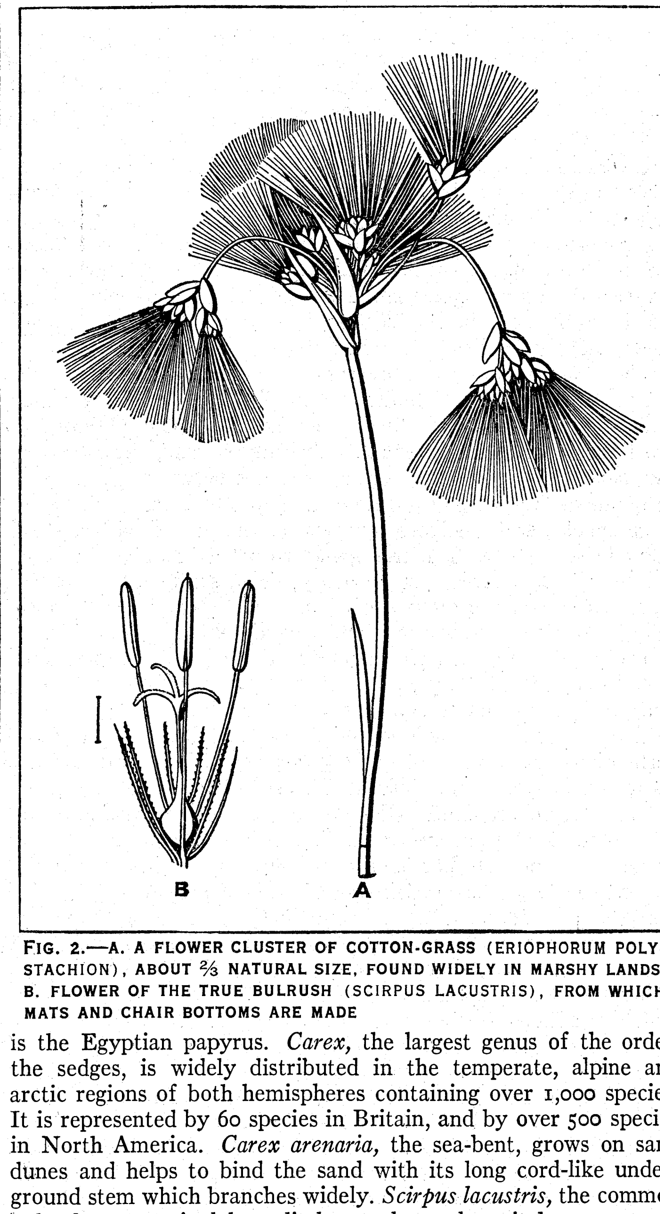


FIG. 2.—A. A FLOWER CLUSTER OF COTTON-GRASS (ERIOPHORUM POLYSTACHION), ABOUT ⅔ NATURAL SIZE, FOUND WIDELY IN MARSHY LANDS. B. FLOWER OF THE TRUE BULRUSH (SCIRPUS LACUSTRIS), FROM WHICH MATS AND CHAIR BOTTOMS ARE MADE

is the Egyptian papyrus. *Carex,* the largest genus of the order, the sedges, is widely distributed in the temperate, alpine and arctic regions of both hemispheres containing over 1,000 species. It is represented by 60 species in Britain, and by over 500 species in North America. *Carex arenaria,* the sea-bent, grows on sand dunes and helps to bind the sand with its long cord-like underground stem which branches widely. *Scirpus lacustris,* the common bulrush, occurs in lakes, ditches and marshes; it has a spongy, green, cylindrical stem, reaching nearly an inch in thickness and 1 to 8ft. high, which is usually leafless with a terminal branched inflorescence. *Eriophorum,* cotton grass, is represented in Britain by several species in boggy land. They are small tufted herbs with cottony heads due to the numerous hair-like bristles which take the place of the perianth and become much elongated in the fruiting stage.

In North America, some species of *Carex* grow on dry land, but the largest ones occur in low grounds. They cover great areas of marsh land in the Upper Mississippi region, and are employed in the manufacture of "grass carpets."

CY-PRÈS, in English law, a principle adopted by the court of chancery in dealing with trusts for charitable purposes. When the charitable purpose intended by a testator cannot be carried into effect, but the general charitable intent is clear, the court will apply the funds to some other purpose, as near the original as possible (whence the name).

In the United States, charitable trusts have become more frequent as the wealth of the country has progressed, and are regarded with increasing favour by the courts. The *cy-près* doctrine has been either expressly or virtually applied to uphold them in several of the States, and in some there has been legislation in the same direction. In others the doctrine has been repudiated; *e.g.*, in Michigan, Tennessee, Indiana and Virginia. For many years the New York courts held that this doctrine was not in force there, but in 1893 the legislature repealed the provisions of the revised statutes on which these decisions rested and restored the ancient law. Statutes passed in Pennsylvania have established the doctrine there, and dissolved any doubt as to its being in force in that state.

CYPRESS, the name given to several evergreen, aromatic trees and shrubs belonging to the genera *Cupressus* and *Chamaecyparis* of the coniferous family Cupressaceae. The cypresses, which are indigenous to southern Europe, Asia and North America, feature scale-like overlapping leaves, usually in four ranks; few-scaled catkins; cones consisting of from six to ten peltate, woody, terminally bossed scales; and numerous small, winged seeds. All species exude a resin but no turpentine.

The Italian cypress (*Cupressus sempervirens*) has been well-known throughout the Mediterranean region since classic times. It is a tapering tree resembling the Lombardy poplar; its branches are thickly covered with small, imbricate, shining, green leaves; the male catkins are minute; the cones are between 1 and 1½ in. in diameter, sessile, and generally in pairs, and are made up of large angular scales, slightly convex exteriorly, and with a sharp point in the centre. The tree grows to a height of 90 ft. in its native soil. It thrives best on a dry, deep, sandy loam, on airy sheltered sites at no great elevation. The timber is hard, close-grained, of a fine reddish hue, and very durable.

The cypress, which is incapable of developing stump sprouts once the tree is cut down, was regarded as a symbol of the dead, and perhaps for that reason was sacred to Pluto.

The tree grows straight, or nearly so, and has a gloomy and forbidding, but wonderfully stately aspect. With advancing age its foliage becomes almost black. Its origin is doubtful.

The Port Orford white-cedar (*Chamaecyparis lawsoniana*), native to south Oregon and north California, is commonly known as Lawson cypress to horticulturists. The finest representative of the genus *Cupressus* in California is the Monterey cypress (*C. macrocarpa*). It is a tree of beautiful symmetry, becoming 150 ft. in height, with a trunk 8 ft. to 10 ft. in circumference. It grows rapidly, even on poor soils, and thrives best near the sea. Other Californian species are *C. goveniana* and *C. macnabiana,* which are much smaller trees than the Monterey cypress. *C. funebris* is a native of the north of China, where it is planted near pagodas. *Chamaecyparis nootkatensis,* the Nootka sound cypress or Alaska-cedar, is a hardy species, reaching a height of from 80 ft. to 100 ft. *C. obtusa* of Japan is a tall tree reaching 100 ft. in height, and widely planted by the Japanese for its timber—one of the best for interior construction. It is also cultivated by them in a dwarf form not exceeding a foot in height.

The baldcypress, *Taxodium distichum,* a deciduous conifer, is a member of the family (Taxodiaceae), a native of the southern United States and Mexico. It is a lofty tree reaching a height of about 170 ft., with a massive trunk 15 ft. or more in diameter, growing in or near water. The lower part of the trunk bears huge buttresses, each of which ends in a long branching far-spreading root, from the branches of which arise the peculiar knees above the level of the water. The knees are of a soft spongy texture and have been thought to act as breathing organs, supplying the roots with air. Some authorities assert that their function is largely mechanical and they give greater stability to the standing tree. The stout, horizontally spreading branches give a cedar-like appearance; the foliage is light and feathery; the leaves and the slender shoots which bear them fall in the autumn.

The cones, about the size of a small walnut, bear spirally-arranged imbricated peltate scales which subtend the three-angled, winged seeds. The wood is light, soft, straight-grained and easily worked; it is very durable in contact with the soil, and is used for railway-ties, posts, fencing and for construction.

The baldcypress is very extensively developed in Mexico, as one of the important assets of that country, furnishing valuable timber for many purposes. Its durability and resistance to water are remarkable. The geological history of cypress dates back to the Upper Cretaceous, the evidence being that the group was derived from the pine group during the Mesozoic. (E. S. Hr.)

CYPRIAN, SAINT (*Caecilius Cyprianus,* called Thascius) (*c.* 200–258), the illustrious bishop of Carthage, was born of a wealthy patrician family at Carthage, where he became a teacher of rhetoric. About 246 he was converted by the priest Caecilianus. His enthusiasm and ability, together with his devotion of his wealth to the relief of the poor and other pious uses, led to his being made head of the church in Carthage *c.* 248. During the persecution of Decius (250), Cyprian had to seek safety in retreat, but he returned when it relaxed under Gallus, the successor of Decius. Several councils were held to discuss such questions as heretical dissensions from the belief in the divine authorship of the episcopal order and the unity of Christendom, baptism by heretics and the readmission into the church of those who had lapsed during persecution. Though tolerant towards the lapsed, Cyprian was strict in the matter of baptism, and only escaped conflict with the Roman bishop Stephen through the new persecution under the Emperor Valerian. Stephen was martyred in Aug. 257, and Cyprian was banished to Curubis. He was recalled and beheaded on Sept. 14, 258, the first African bishop to obtain the martyr's crown.

Cyprian's works, written in a smooth, persuasive style reflecting his practical mind, are concerned, like Tertullian's, and often in imitation of them, with apologetic, dogmatic and pastoral themes. The best known is the *De Unitate Catholicae Ecclesiae* called forth in A.D. 251 by the schism at Carthage and the Novatian schism at Rome. It proclaims the doctrine of one church founded upon Peter, whose "tangible bond is her one united episcopate, an apostleship universal yet only one—the authority of every bishop perfect in itself and independent, yet not forming with all the others a mere agglomeration of powers, but being a tenure upon a totality like that of a shareholder in some joint property." The *Ad Donatum* (*De Gratia Dei*) contrasts the regenerated life with the moral degradation of the heathen; the *De Opere et eleemosynis* presents the Tertullian conception of merit and satisfaction; and the *Letters,* only 66 of the present collection being genuine, are important for church history and ecclesiastical law. Cyprian, who "set his seal on Episcopalianism" and stressed infant baptism and penance as means of grace, was of unparalleled authority in the West, especially for Augustine.

See his works by W. von Hartel in *Corpus Scriptorum Ecclesiasticorum* (Eng. trans. in the *Oxford Library of the Fathers*). *See* also E. W. Benson, *Cyprian, his life, his times, his works* (1897); A. Harnack, *Hist. of Dogma* ii and v; O. Bardenhewer, *Gesch. der Altkirchl. Lit.* II; Joseph H. Fichter, *Saint Cecil Cyprian* (1942).

CYPRINODONTS, a family of fishes, soft-rayed and with abdominal pelvic fins, but without a duct to the air-bladder. The head is flat-topped, the mouth generally small and protractile, with bands of small teeth in the jaws, the scales usually large. About 400 species are known, none of which exceeds a foot in length; they are found in all warm countries, but are especially abundant in America; many species are marine, but these especially frequent lagoons and estuaries; others are confined to fresh water. The Cyprinodonts are much appreciated as aquarium fishes, on account of their small size, pretty colours, and lively habits. Courtship and pairing are general throughout the group, and in many species the sexes are very dissimilar, the males being brilliantly coloured and having large and beautifully ornamented fins. *Cynolebias* of South America is unique among fishes, the dorsal fin of the male being not only much larger than that of the female, but having many more rays. There are seven subfamilies, of which the *Fundulinae* and *Cyprinodontinae* are oviparous and occur in Africa, southern Europe, and Asia, as well as in America. In the extraordinary *Phallostethinae,* from Johore and the Philippines, pelvic fins are absent and the male has a large muscular appendage under the head. The other viviparous groups, four in number, are American, and in them the anal fin of the male is modified into an intromittent organ. *Lebistes reticulatus,* the "Millions" fish of the West Indies, devours mosquito larvae and so helps to prevent malaria. *Xiphophorus helleri* of Mexico, named "sword-tail" because the lower half of the caudal fin of the male is produced into a long pointed process, is remarkable for "sex inversion," about half the females becoming converted into males before they reach an inch in length. One of the most curious types is the "four-eyed fish" (*Anableps*) of Central and South America, in which the eyes project above the top of the head, and are divided by a black horizontal band into an upper part for vision in the air and a lower for vision in the water. Spermatophores have been described in the *Phallostethinae* and *Poeciliinae,* and may be characteristic of the group. The *Amblyopsidae,* which include the blind cave fishes of North America, are a related family. (C. T. R.)

CYPRUS, one of the largest islands in the Mediterranean, after 1914 a British Crown colony, at roughly equal distance from the coasts of Asia Minor to the north and of Syria to the east. The headland of Cape Kormakiti in Cyprus is distant 44 m. from Cape Anamur in Asia Minor, and its north-east point, Cape St. Andrea, is 69 m. from Latakieh in Syria. It lies between 34° 33′ and 35° 41′ N., and between 32° 20′ and 34° 35′ E. Its greatest length is about 141 m., from Cape Drepano in the west to Cape St. Andrea in the north-east, and its greatest breadth, from Cape Gata in the south to Cape Kormakiti in the north, reaches 60 m.; while it retains an average width of from 35 to 50 m. through the greater part of its extent, but narrows suddenly to less than 10 m. about 34° E., and from thence sends out a long narrow tongue of land towards the E.N.E. for a distance of 46 m., terminating in Cape St. Andrea. The coast-line measures 486 m., the area is 3,572 sq.mi., or a little more than the area of Norfolk and Suffolk. Cyprus is the largest island in the Mediterranean after Sicily and Sardinia.

Mountains.—A great part of the island is occupied by two mountain ranges, both having a general direction from west to east. Of these, the most extensive and lofty fills almost the whole southern portion of the island, and is generally designated as Mt. Olympus. The highest summit, Mt. Troödos, attains 6,406 feet. Subordinate spurs diverge on all sides; one extends to Cape Arnauti (the ancient Acamas), which forms the north-west extremity of the island; others descend to the northern and southern coasts. South-east of the summit are governmental and military summer quarters. The main range is continued eastward by Mt. Adelphi (5,305 ft.), Papoutsa (5,124) and Machaira or Chionia (4,674), and ends in the isolated Hill of the Holy Cross (2,260 ft.), Santa Croce, Stavrovouni or Oros Stavro, a conspicuous object from Larnaca, only 12 m. distant, and a place of pilgrimage. The northern range, a narrow but rugged and rocky ridge, begins at Cape Kormakiti (the ancient Crommyon) and is continued unbroken to the eastern Cape St. Andrea, a distance of more than 100 miles. It has no collective name; its western part is the Kyrenia mountains, the remainder Carpas. Its highest summit (Buffavento) attains only 3,135 feet. It descends abruptly to the south into the great plain of Lefkosia, and to the north to a narrow plain bordering the coast.

The Mesaoria.—Between the two mountain ranges lies a broad plain, extending across the island from the bay of Famagusta to that of Morphou on the west, a distance of nearly 60 m., with a breadth varying from 10 to 20 miles. It is known by the name of the Mesaoria or Messaria. The chief streams are the Pedias and the Yalias, which follow roughly parallel courses eastward. The greater part consists of open, uncultivated downs; but corn is grown in the northern portions. Though Cyprus was celebrated in antiquity for its forests, the whole Mesaoria is now treeless. The disappearance of the forests (which is being artificially remedied) has reduced the rivers to mere torrents, dry in summer. Even the Pedias (ancient *Pediaeus*) does not reach the sea in summer, and forms unhealthy marshes. The mean annual temperature in Cyprus is about 69° F (mean maximum 78° and minimum 57°). The mean annual rainfall is about 19 inches. October to March is the cool, wet season. Earthquakes are not uncommon.

Geology.—Cyprus lies in the continuation of the folded belt of the Anti-taurus. The northern coast range is formed by the oldest rocks in the island, consisting chiefly of limestones and marbles with occasional masses of igneous rock. These are supposed to be of Cretaceous age, but no fossils have been found in them. On both sides the range is flanked by sandstones and shales (the Kythraean series), supposed to be of Upper Eocene age; and similar rocks occur around the southern mountain mass. The Oligocene consists of grey and white marls (known as the Idalian series), which are distributed all over the island and attain their greatest development on the south side of the Troödos. All these rocks have been folded, and take part in the formation of the mountains. The great igneous masses of Troödos, etc., consisting of diabase, basalt and serpentine, are of later date. Pliocene and later beds cover the central plain and occur at intervals along the coast. The Pliocene is of marine origin, and rests unconformably upon all the older beds, including the Post-oligocene igneous rocks, thus proving that the final folding and the last volcanic outbursts were approximately of Miocene age. The caves of the Kyrenian range contain a Pleistocene mammalian fauna.

Population.—The estimated population of Cyprus in 1944 was 424,656, of whom somewhat less than one-fifth were Mohammedans; it was 347,959 by the census of 1931. The people are mainly Greeks and Turks, though there is also an Armenian colony and a distinct, though not numerous, Latin colony. The bulk of the inhabitants are Christians of the Independent Cypriote Church, a branch of, and in communion with, the Orthodox Eastern Church, though "autocephalous" (*i.e.,* independent, with the right of electing its own archbishop). The chief towns, with 1944 populations, are Nicosia (pop. 28,126), the capital, in the north central part of the island, Limasol (17,825) and Larnaca (13,043) on the southeastern coast. The other capitals of districts are Famagusta, on the east coast, Kyrenia, on the north, and Ktima, capital of Paphos, on the southwest.

Agriculture and Minerals.—The most important species of trees are the Aleppo pine, the *Pinus laricio,* cypress, cedar, carob, olive and *Quercus alnifolia.* Forest land occupies about 19% of the total area of the island. Under the terms of the Colonial Development and Welfare act, 1940, the British government provided over £200,000 for reclamation and reafforestation of forest areas. The principal crops are grain, fruit (including carob), olive, mulberry, cotton, vegetables and oilseeds. The government regulates the grading and packing of agricultural produce for export, prohibits the export of inferior wines and ensures the high standard of tobacco and cotton production. Considerable works of irrigation were undertaken at the expense of the British treasury.

The rearing of livestock, especially mules, is important. Arab stallions and good breeds of cattle and pigs have been imported by the government, which maintains a stock farm at Athalassa. Sponge fishery is important.

Arazi land is held by title deed issued by the Land Registry office; there are special categories of wasteland and trust-lands for public, religious or charitable purposes. *Mulk* includes all buildings, gardens, planted land and grafted trees and is inscribed at the land registry. All minerals belong to the state; permission is necessary for erection of buildings; and any kind may be expropriated for public purposes.

Cyprus was celebrated among the ancients for its mineral wealth, especially for its mines of copper. In modern times cupreous pyrites is by far the most important mineral produced in the island, principally from the Skouriotissa, Mavrovouni, Kalavasos and Lymni mines. The asbestos-bearing rock on Mount Troödos is quarried at Amiandos, and the chrome iron ore obtained in the Troödos area is concentrated near Kakopetria. Auriferous deposits are worked in the Nicosia and Larnaca districts, and terra umbra in the latter district, while gypsum is produced by quarrying at many localities.

Communications.—Cyprus lacks natural harbours. That at Famagusta, enlarged in 1932–33, is the only one suitable for large vessels. The ports of Larnaca and Limasol have only open roadsteads, and there are small harbours at Kyrenia and Paphos. A government-owned railway, of 2 ft. 6 in. gauge, runs from Famagusta through Nicosia and Morphou to Kalokhorio, 71 mi. distant; the only section open to regular passenger traffic in 1943 was that between Famagusta and Nicosia, 37 mi. Cable and Wireless, Limited, operates land telegraphs between the six principal towns, cables to Egypt and Palestine and also a wireless station. In 1943 there were 886 mi. of main and 1,716 mi. of secondary roads. There are mail-steamer and air services.

Administration.—The governor has the assistance of an executive council consisting of four official and three non-official nominated members. For many years Greek-speaking Cypriotes clamoured for the island to be united to Greece, and in 1931 the agitation resulted in rioting and the destruction of the governor's residence. In consequence the legislative council, which had existed since 1882, was deprived of its functions and power to legislate was vested in the governor. An advisory council was established in 1933 to represent the views of the Cypriotes; this body comprised 4 official members and 10 others annually selected from the unofficial community. District commissioners represent the government in each of the six districts of the island, namely —Nicosia, Larnaca, Limasol, Famagusta, Kyrenia and Paphos. Courts of Justice laws, 1935 and 1938, provided for a supreme court, and in each district an assize court and a district court. The courts apply local legislation and certain Ottoman legislation specified in the 1935 Courts of Justice law. The family law of the various religious communities which had received recognition under Turkish rule was preserved; and three *Sheri* courts administer the Moslem religious law.

Finance and Trade.—The principal sources of revenue are from immovable property and animal taxes; an excise on tobacco; stamps, court fees, royalties and licences; the salt monopoly; import duties and shipping and wharfage dues. The Cyprus pound, divided into 180 piastres, is equal to the pound sterling; there are also government currency notes. The Bank of Cyprus has its head office in Nicosia, and banking institutions with branches in the island include the Ottoman bank, the Bank of Athens and Barclays bank (Dominion, Colonial and Overseas). The chief exports are cupreous concentrates, cupreous pyrites, carobs, citrus fruit, asbestos, wines and potatoes. Chief imports are wheaten flour, cotton manufactures, machinery, iron and steel, timber and woollens. Turkish weights and measures are used.

Education.—The government assumed direct control of elementary education in 1933. Education is voluntary (though the government obtained compulsory powers in 1931) and free for all children from the age of six up to the end of the teaching year preceding their 14th birthday. Each religious community has an entirely separate system of schools. Orthodox-Christian and Maronite schools are taught in Greek, Moslem schools in Turkish, though English is included in the curriculum of all the larger schools. The Secondary Education law, 1935, provided for the registration and inspection of all secondary schools by the government, which made grants-in-aid. Most secondary schools are under the management of the various religious communities, though three are undenominational—the English school, Nicosia (which came under government control in 1936) and two American academies (co-educational at Larnaca and for girls at Nicosia). (J. L. My.; W. B. Pn.)

ANCIENT HISTORY AND ARCHAEOLOGY

The Stone age has left but few traces in Cyprus. The "megalithic" monument of Halá Sultán Teké near Larnaca may perhaps be early, but the vaulted chamber of Agia Katrína near Enkomi is Roman, and the chapel of Agia Phareromeni at Larnaca is a tomb of similar late date. The perforated monoliths at Ktima seem to belong to oil presses of uncertain date. A neolithic settlement is reported at Frenaros.

The Bronze age, on the other hand, is of peculiar importance since Cyprus was one of the chief early sources of copper. Throughout this period, which began probably before 3000 B.C. and ended about 1200 B.C., Cyprus evidently maintained a large population, and distinct art and culture. This culture falls into three main stages. In the first, the implements are of copper, the pottery is hand-made, with a red burnished surface, gourd-like forms and incised patterns; zoomorphic art is rare, and imported objects are unknown. In the second stage, implements of bronze (9 to 10% tin) became common; pottery of buff clay with painted geometrical patterns appears alongside the red-ware; and foreign imports occur, such as Egyptian blue-glazed beads.

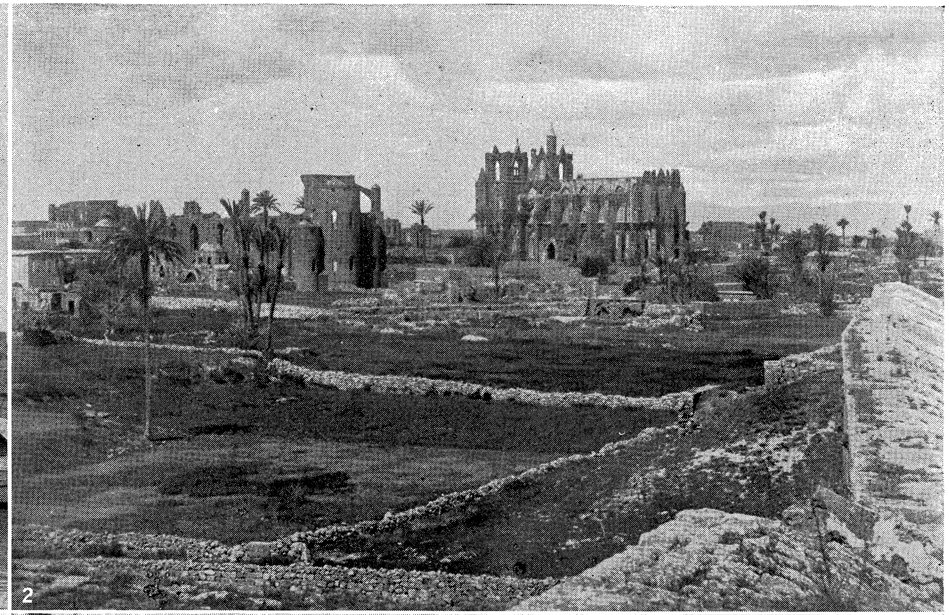
In the third stage, Aegean colonists introduced the Mycenaean culture and industries; with new types of weapons, wheel-made pottery, a naturalistic art which rapidly becomes conventional; gold, ivory, glass and enamels. Intercourse with Syria, Palestine and Egypt brought other types of pottery, jewellery, etc. There is, however, nothing in this period which can be ascribed to specifically "Phoenician" influence; the only traces of writing are in a variety of the Aegean script (British Museum, *Excavations in Cyprus*, 1900). It is in this third stage that Cyprus first appears in history, under the name *Asi*, as a conquest of Tethmosis (Thothmes) III. of Egypt (18th dynasty, *c.* 1500 B.C.) (E. Oberhummer, *Die Insel Cypern,* Munich, 1903, i., pp. 1–3). It was still in Egyptian hands under Seti I., and Rameses III. *Alasya,* sometimes identified with Cyprus, is probably in north Syria.

The Early Iron age which succeeds is a period of obscurity and relapse. The introduction of iron was accompanied, as in the Aegean, by economic and political changes, which broke up the Mycenaean colonies. Foreign imports almost cease; cylinders and scarabs are replaced by conical seals like those of Asia Minor, and dress-pins by brooches (*fibulae*). Representative art languishes; decorative art becomes purely geometrical. Lingering thus, Mycenaean traditions met new oriental influences from the Syrian coast. But there is no clear proof of Phoenician or other Semitic activity in Cyprus till the end of the 8th century.

No reference to Cyprus has been found in Babylonian or Assyrian records before the reign of Sargon II. (end of 8th century B.C.). The Hebrew geographers of this and the next century reckoned it as predominantly Greek. Sargon's campaigns in north Syria, Cilicia and south-east Asia Minor (721–711) provoked first attacks, then an embassy and submission in 709, from seven kings of *Yatnana* (the Assyrian name for Cyprus); and an inscription of Sargon himself, found at Citium, proves an Assyrian protectorate. Under Sennacherib's rule, *Yatnana* figures (as in Isaiah) as the refuge of a disloyal Sidonian in 702; but in 668 ten kings of Cypriote cities joined Assur-bani-pal's expedition to Egypt. Citium does not appear by name; but is recognized in the list under its Phoenician title *Karti-ḥadasti,* "new town."

Thus before the middle of the 7th century Cyprus reappears in history divided among at least ten cities, of which some are certainly Greek, and one at least certainly Phoenician. With this, Greek tradition agrees[1]. The settlements at Paphos and Salamis, and probably at Curium, were believed to date from the period of the Trojan War. Late Mycenaean settlements were discovered on these sites. The Greek dialect of Cyprus shows marked resemblances to that of Arcadia from which it must have been separated not later than the 12th century. Further evidence of continuity is the peculiar Cypriote script, a syllabary related to the linear scripts of Crete and the south Aegean, and traceable in Cyprus to the Mycenaean age[2]. It remained in regular use for Greek records until the 4th century at least; before that time the Greek alphabet occurs in Cyprus only in a few inscriptions erected for visitors[3]. A few inscriptions in the syllabary preserve another language which has not yet been identified. In Citium and Idalium, a Phoenician dialect and alphabet were in use from the time of Sargon onward[4]. Sargon's inscription at Citium is cuneiform[5].

[1]W. H. Engel, *Kypros* (Berlin, 1841).
[2]G. Smith, *Tr. Soc. Bibl. Arch.* i. 129 *sqq.;* Moritz Schmidt, *Monatsb. k. Ak. Wiss.* (1874), pp. 614–615; *Sammlung kypr. Inschriften* (Jena, 1876). On its Aegean origin, A. J. Evans, "Cretan Pictographs" (1895), *Journ. Hell. Studies,* xiv., *cf.* xvii.
[3]British Museum, *Exc. in Cypr.* (1900), p. 95.
[4]M. de Vogüé, *Mélanges d'archéologie orientale* (1869); J. Euting, *Sitzb. k. preuss. Ak. Wiss.* (1887), pp. 115 *sqq.;* Ph. Berger, *C. R. Acad. Inscr.* (1887), pp. 155 *sqq.*, 187 *sqq.*, 203 *sqq.*
[5]E. Schrader, *Abh. d. k. preuss. Ak. Wiss.* (1881).



PHOTOGRAPHS, (1, 4) EWING GALLOWAY, (2, 3) E.N.A.

VIEWS OF MODERN CYPRUS

1. The waterfront at Larnaca, a seaport on the southeast coast of Cyprus
2. Famagusta, view showing (on the left) the ruined church of St. George of the Greeks, and (right) the mosque of St. Sophia, once the cathedral of St. Nicholas
3. Kyrenia, showing Virgin castle, built *c.* 1200, which has remained impregnable throughout the history of Cyprus
4. A closer view of the mosque of St. Sophia

The culture and art of Cyprus in this Graeco-Phoenician period are well represented, the earlier phases at Lapathus, Soli, Paphos and Citium; the later Hellenization at Amathus and Marion-Arsinoë. Three distinct foreign influences may be distinguished, originating in Egypt, in Assyria and in the Aegean. Their effects are best seen in sculpture and in metal work, though it remains doubtful whether the best examples of the latter were made in Cyprus or on the mainland[1]. The first two merged in a mixed art which, from its intermediate position between the art of Phoenicia and its western colonies and the earliest Hellenic art in the Aegean, has been called Graeco-Phoenician. Pottery-painting for the most part remains geometrical. Those Aegean influences, however, which had predominated in the later Bronze age, and had never wholly ceased, revived, as Hellenism matured and spread, and slowly repelled the mixed Phoenician orientalism. Early in the 6th century appear the specific influences of Ionia and of Naucratis. The revival of Egypt as a phil-Hellene state under the 26th dynasty, admitted strong Graeco-Egyptian influences in industry and art, and led, about 560 B.C., to the conquest of Cyprus by Amasis (Ahmosi)II.[2]

The annexation of Egypt by Cambyses of Persia in 525 B.C. was preceded by the voluntary surrender of Cyprus, which formed part of Darius's "fifth satrapy."[3] The Greek cities joined the Ionic revolt in 500 B.C.[4]; but the Phoenician States, Citium and Amathus, remained loyal to Persia; the rising was soon put down; in 480 Cyprus furnished 150 ships to the fleet of Xerxes[5]; and remained subject to Persia during the 5th century[6]. But the Greek cities retained monarchical government throughout, and domestic arts and religious cults remained almost unaltered. The principal Greek cities were now Salamis, Curium, Paphos, Marion, Soli, Kyrenia and Chytri. Phoenicians held Citium and Amathus on the south coast, Tamassus and Idalium in the interior. At the end of the 5th century a fresh Salaminian League was formed by Evagoras (*q.v.*), who became king in 410, aided by the Athenian Conon after the fall of Athens in 404, and revolted openly from Persia in 386, after the peace of Antalcidas. Athens again sent help. But the Phoenician states supported Persia as before, the Greeks were divided by feuds, and in 380 the attempt failed; Evagoras was assassinated in 374, and his son Nicocles died soon after. After the victory of Alexander at Issus in 333 all the states of Cyprus welcomed him.

After Alexander's death in 323 Cyprus passed, after several rapid changes, to Ptolemy I., king of Egypt. In 306 B.C. Demetrius Poliorcetes of Macedon overran the whole island, but Ptolemy recovered it in 295 B.C. Under Ptolemaic rule Cyprus was usually governed by a viceroy of the royal line, but it gained a brief independence under Ptolemy Lathyrus (107–89 B.C.), and under a brother of Ptolemy Auletes in 58 B.C. The great sanctuaries of Paphos and Idalium, and the public buildings of Salamis, which were wholly remodelled in this period, have produced but few works of art. It is in this period that we first hear of Jewish settlements[7] which later become populous.

In 58 B.C. Rome, which had made large unsecured loans to Ptolemy Auletes, sent M. Porcius Cato to annex the island. Under Rome, Cyprus was at first appended to the province of Cilicia; after Actium (31 B.C.) it became a separate province, which remained in the hands of Augustus and was governed by a *legatus Caesaris pro praetore* as long as danger was feared from the East. No monuments remain of this period. In 22 B.C., however, it was transferred to the senate[8], so that Sergius Paulus, who was governor in A.D. 46, is rightly called proconsul[9]. Of Paulus no coins are known, but an inscription exists[10]. Other proconsuls are Julius Cordus and L. Annius Bassus who succeeded him in A.D. 52[1]. The persecution of Christians on the mainland after the death of Stephen drove converts as far as Cyprus; and soon after converted Cypriote Jews such as Joses the Levite (better known as Barnabas), were preaching in Antioch. The latter revisited Cyprus twice, first with Paul on his "first journey" in A.D. 46 and later with Mark[2]. In 116–117 the Jews of Cyprus, with those of Egypt and Cyrene, revolted, massacred 240,000 persons, and destroyed a large part of Salamis. Hadrian, afterwards emperor, suppressed them, and expelled all Jews from Cyprus.

For the culture of the Roman period there is abundant evidence from Salamis and Paphos, and from tombs everywhere, for the glass vessels which almost wholly supersede pottery in tombs are much sought for their (quite accidental) iridescence.

The Christian Church of Cyprus was divided into 13 bishoprics. It was made autonomous in the 5th century, in recognition of the supposed discovery of the original of St. Matthew's Gospel in a "tomb of Barnabas," still shown at Salamis; and the patriarch has the right to sign his name in red ink. A council of Cyprus, summoned by Theophilus of Alexandria in A.D. 401, prohibited the reading of the works of Origen (*see* CYPRUS, CHURCH OF).

Of the Byzantine period little remains but the ruins of the castles of St. Hilarion, Buffavento and Kantára; and a series of gold ornaments and silver plate, found at Lapithus in 1883 and 1897 respectively. The Frank conquest is represented by the "Crusaders' Tower" at Kolossi, and the church of St. Nicholas at Nicosia; and, later, by masterpieces of a French Gothic style, such as the church (mosque) of St. Sophia, and other churches at Nicosia; the cathedral (mosque) and others at Famagusta (*q.v.*), and the monastery at Bella Pais; as well as by domestic architecture at Nicosia; and by forts at Kyrenia, Limasol, etc.

(J. L. MY.)

MODERN HISTORY

After the division of the Roman empire (A.D. 395) Cyprus passed into the hands of the eastern emperors, to whom it continued subject, with brief intervals, for more than seven centuries. It was administered as a pro-consulship by an official appointed from Antioch, the capital being transferred from Paphos to Salamis (then known as Constantia). Until 632 the island was exceedingly prosperous, but in that year began the period of Arab invasions, which continued intermittently for three centuries. In 647 the Arabs under the caliph Othman made themselves masters of the island, and destroyed Salamis, but were driven out by the emperor only two years later.

Again conquered by the Arabs in the reign of Harun al-Rashid (802), Cyprus was finally restored to the Byzantine empire under Nicephorus Phocas (963–969). Its princes became practically independent, and tyrannized the island, until, in 1191, Isaac Commenus, who in 1184 had assumed the title of Despot of Cyprus, provoked the wrath of Richard I, king of England, by wantonly ill-treating his crusaders. Richard thereupon wrested the island from Isaac, whom he took captive. He then sold Cyprus to the Knights Templars, who resold it to Guy de Lusignan, titular king of Jerusalem.

Guy ruled from 1192 till his death in 1194; his brother Amaury took the title of king, and from this time Cyprus was governed for nearly three centuries by a succession of kings of the same dynasty, who introduced into the island the feudal system and other institutions of western Europe. Their court was a brilliant one, and the kings of Cyprus in addition often bore the title of kings of Jerusalem, and after 1393, of Armenia also. In 1372, indeed, following a quarrel between the Venetian and Genoese consuls, the Genoese took Famagusta, which had become the chief commercial city in Cyprus, and held it till 1464; but it was recovered by King James II, and the whole island was reunited under his rule.

His marriage with Caterina Cornaro, a Venetian lady of rank, was designed to secure the support of the powerful republic of

[1]G. Perrot and C. Chipiez, *Histoire de l'art dans l'Antiquité*, iii. (1885).
[2]Herod. ii. 182; *see* also EGYPT; *History* (Dyn. 26).
[3]Herod. iii. 19. 91; *see* also PERSIA: *History*.
[4]Herod. v. 108, 113, 115.
[5]Herod vii. 90.
[6]Thuc. i. 94, 112.
[7]I. Macc. xv. 23.
[8]Dio Cass. liv. 4; Strabo 685.
[9]Acts xiii. 7.
[10]D. G. Hogarth, *Devia Cypria*, pp. 114 *sqq.* and app.

[1]*Corp. Inscr. Lat.* 2631–2632.
[2]Acts iv. 36, xi. 19, 20, xiii. 4–13, xv. 39, xxi. 16.

Venice, but had the effect, after his own death and that of his son James III, of transferring the sovereignty of the island to his new allies.

Caterina, feeling herself unable to contend alone with the increasing power of the Turks, abdicated the sovereign power in favour of the Venetian republic, which at once entered into full possession of the island (1489).

The Venetians retained their acquisition for 82 years, notwithstanding the neighbourhood of the Turks. Cyprus was now harshly governed by a lieutenant, and the condition of the natives, who had been much oppressed under the Lusignan dynasty, became worse. In 1570 the Turks, under Selim II, made a serious attempt to conquer the island, in which they landed an army of 60,000 men. The greater part of the island was reduced with little difficulty; Nicosia, the capital, was taken after a siege of 45 days, and 20,000 of its inhabitants put to the sword. Famagusta alone made a gallant and protracted resistance, and only capitulated after a siege of nearly a year (Aug. 6, 1571). The terms of the capitulation were shamefully violated by the Turks, who put to death the governor Marcantonio Bragadino with cruel torments.

On March 7, 1573, Venice recognized the sultan's sovereignty over Cyprus. The period of Turkish administration lasted for 200 years. At first comparatively mild (serfdom was abolished, the Orthodox archbishopric restored, and the Christian population granted a large measure of autonomy), it became increasingly oppressive.

There were serious risings in 1764, 1804 and 1821. In 1838 and 1839 attempts were made to introduce reforms and some self-government, with a local Divan. On June 4, 1878, Great Britain, by treaty with the sultan, took over the occupation and administration of Cyprus, the Porte remained nominal sovereigns, and received an annual "tribute" of £92,800 a year.

Annexation by Great Britain.—On the outbreak of war with Turkey Nov. 5, 1914, Cyprus was annexed to the British crown. The British government offered the island to Greece 12 months later, conditionally upon the latter aiding Serbia, then invaded by Bulgaria. The offer lapsed when Greece declined it. British annexation was formally recognized by Turkey under the Treaty of Lausanne, ratified in 1924.

The annual Turkish "tribute" continued to be borne by the island's revenue, which was supplemented by grants-in-aid from the British government. The amounts varied from year to year until 1911, when the British contribution toward the finances of Cyprus became a fixed sum of £50,000 annually. In 1928 that figure was raised to £92,800 per year, the full amount of the "tribute" payable to Turkey by Cyprus.

Cyprus in World War II.—A pack transport (mule) company from Cyprus arrived in France in 1940, being the first unit of British colonial troops to reach that theatre of war. The Cyprus regiment, formed in 1940, took part in the campaigns in Libya in that and the succeeding year, and other Cypriote units fought in east Africa, Crete, Greece and Syria. During 1943 municipal government was introduced in Cyprus on the basis of adult suffrage, and the British government announced that restoration of self-government in the island was contemplated following conclusion of hostilities.

History of Excavation.—Many archaeological discoveries were made in Cyprus after British occupation of the island in 1878. T. B. Sandwith, British consul, 1865–69, laid the foundations of a sound knowledge of Cypriote pottery (see *Archaeologia*, xlv, 1877); his successor, R. H. Lang, 1870–72, excavated a sanctuary of Aphrodite at Dali (see *Trans. Roy. Soc. Literature*, 2nd ser. xi, 1878); and Luigi P. di Cesnola, U.S. consul, explored sites and tombs in all parts of the island during 1865–77. His collection, in the Metropolitan museum of New York, represented the largest series of Cypriote antiquities in the world.

The Ottoman law of 1874 in regard to antiquities was retained in force after the British occupation. Excavation was permitted under government supervision; and the finds were apportioned in thirds, between the excavator, the landowner (usually bought out by the former) and the government. The most important excavations made late in the 19th century were those conducted by Ohnefalsch Richter at Idalium and Tamassus; by the Cyprus Exploration fund at Paphos, Marion and Salamis; and by the British museum at Amathus, Salamis and Curium. Restrictions imposed in 1905 had the effect of stopping scientific excavation by foreigners, but the law was amended in 1927 to permit the export of antiquities with the permission of the governor in consultation with the authorities concerned.

The Cyprus museum, at Nicosia, organized in 1897 as a memorial to Queen Victoria, contained a representative collection of Cypriote art of all periods. Funds from the Carnegie corporation and other sources made possible a complete reorganization of the museum in 1936–37.

In 1935, by the establishment of an Antiquities department and the enactment of a new Antiquities law, the government inaugurated a policy of closer supervision and protection of the antiquities and historic monuments in the island. Monuments protected under the law numbered 182 in 1943, of which 77 were the property of the government.

Resident custodians were appointed to supervise certain of the declared "ancient monuments," entrance fees being charged to visitors from outside the island.

Excavation at Khirokitia by the Antiquities department in 1936 brought to light a settlement of the Neolithic period, with burials which contained the earliest human remains found in Cyprus down to that time. In 1937–38 the department also excavated early Christian remains surrounding the Church of Ayios Philon, near Rizokarpaso, and a number of Hellenistic tombs in the neighbourhood were investigated with the aid of a grant from the Ashmolean museum at Oxford. Among minor excavations in 1938, a mining settlement of the late bronze age was discovered in Nicosia district by the department.

In the late 1930s an expedition of the museum of the University of Pennsylvania excavated the site of the Sanctuary of Apollo at Curium, as well as a settlement of the late bronze age to the east of the village of Episkopi; a large part of Curium hill was acquired by the government with the aid of a grant from the expedition. On behalf of the British school at Athens, a number of tombs in various parts of the early bronze age cemetery at Vounous, near Bellapais, were excavated during 1937–38 by J. R. Stewart.

The government possessed power to control the height and style of buildings adjoining ancient monuments in certain areas in Kyrenia and Nicosia, and throughout the whole of the old town and fortifications of Famagusta. In 1938, for the first time, funds were made available for the purchase of private properties to secure ancient monuments from the encroachment of undesirable modern buildings and for the demolition of others. This made possible the isolation of the Churches of St. George of the Greeks and Sts. Peter and Paul in Famagusta, and the acquisition of open sites near the Martinengo bastion. Much repair work was also done, notably at Kyrenia castle and, at Famagusta, the Venetian fortifications and the Church of St. George of the Latins.

Over 26,000 visits to museums and monuments were recorded, representing an increase on the figures for 1937 of 64% for residents and 22% for visitors from abroad.

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CYPRUS, CHURCH OF. The Church of Cyprus is in communion and in doctrinal agreement with the other Orthodox Churches of the East (*see* Orthodox Eastern Church), but is independent and subject to no patriarch. This position it has always claimed. At any rate, its independence "by ancient custom" was recognized, as against the claims of the patriarch of Antioch, by the council of Ephesus, A.D. 431, by an edict of the emperor Zeno (to whom the church had sent a cogent argument on its own behalf, the alleged body of its reputed founder St. Barnabas, then just discovered at Salamis), and by the Trullan Council in 692. Attempts have been made subsequently by the patriarchs of Antioch to claim authority over it, the last as recently as 1600; but they came to nothing. And excepting for the period during which Cyprus was in the hands of the Lusignans and the Venetian Republic (1193–1571), the Church has never lost its independence. This period of bondage ceased at the conquest of the island by the Turks: the Latin hierarchy disappeared (the cathedral at Nicosia is now used as a mosque), and the native church emerged into comparative freedom. In 1821, it is true, all the bishops and many of their flock were put to death by way of discouraging sympathies with the Greeks; but successors were soon consecrated, by bishops sent from Antioch at the request of the patriarch of Constantinople, and on the whole the Church has prospered. The bishops-elect required the *berat* of the sultan; but having received this, they enjoyed no little civil importance. Since 1878 the *berat* has not been given, and the bishops are less influential. There are now four bishoprics, Nicosia, Paphos, Kition and Kyrenia, the bishop of the first named being archbishop primate.

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CYPSELUS, tyrant of Corinth from *c.* 657 to 627 B.C. was the son of Aeëtion and Labda, daughter of Amphion, a member of the ruling family, the Bacchiadae. He is said to have derived his name from the fact that when the Bacchiadae, warned that he would prove their ruin, sent emissaries to kill him in his cradle, his mother saved him by concealing him in a chest (Gr. *κυψέλη*). When he was grown up, Cypselus drove out the Bacchiadae, and made himself master of Corinth. In the words of Aristotle he made his way through demagogy to tyranny. Herodotus, with the prejudice of the 5th century Greek against tyrants, says he ruled harshly, but he is generally represented as beneficent and popular. He pursued an energetic commercial and colonial policy (*see* Corinth), and thus laid the foundations of Corinthian prosperity. He laid out the large sums thus derived on the construction of buildings and works of art. At the same time he strove to gain the good will of the powerful priesthoods of Delphi and Olympia. At Delphi he built a treasure-house for Corinthian votive offerings; at Olympia he dedicated a colossal statue of Zeus and the famous "Chest of Cypselus," described by Pausanias (v. 17–19). Cypselus was succeeded by his son Periander (*q.v.*).

See Corinth: *History;* histories of Greece; Herodotus v. 92; Aristotle, *Politics,* 1310b; 1315b; P. Knapp, *Die Kypseliden und die Kypseloslade* (Tübingen, 1888).

CYRANO DE BERGERAC, SAVINIEN (1620–1655), French romance-writer and dramatist, son of Abel de Cyrano, seigneur de Mauvières et de Bergerac, was born in Paris on March 6, 1620. He studied with a country priest, and had for a fellow pupil his friend and future biographer, Henri Lebret. He then studied in Paris at the collège de Beauvais, where he had for master Jean Grangier, whom he afterwards ridiculed in his comedy *Le Pédant joué* (1654). At the age of 19 he entered a corps of the guards, serving in the campaigns of 1639 and 1640, and began the series of exploits that were to make him a hero of romance. The story of his adventure single-handed against 100 enemies is vouched for by Lebret as the simple truth. After two years of this life Cyrano left the service and began to write tragedies cast in the orthodox classical mode. He was, however, as a pupil of Gassendi, suspected of thinking too freely, and in the *Mort d' Agrippine* (1654) his enemies even found blasphemy. But his most famous works are the two romances *L'Histoire comique des états du soleil* (1662) and *L'Histoire comique des états de la lune* (1656?). Cyrano's ingenious mixture of science and romance furnished a model for many writers, such as Swift and Poe. Cyrano spent a stormy existence in Paris and was involved in many duels, and in quarrels with the comedian Montfleury, with Scarron and others. In 1654 he was injured by a falling timber in the house of the duc d' Arpajon, his patron. His reputation as a free-thinker later forced him to seek refuge with friends in Paris, where he died in Sept. 1655.

M. Edmond Rostand's romantic play *Cyrano de Bergerac* (1897) revived interest in the author of the *Histoires comiques.* A modern edition of his *Oeuvres* (2 vols.), by P. L. Jacob (Paul Lacroix), appeared in 1858 (new ed. 1900), with the preface by H. Lebret originally prefixed to the *Histoire comique des états de la lune* (1656?). *See* also P. A. Brun, *Savinien de Cyrano Bergerac* (1894); F. Lachèvre, *Cyrano de Bergerac* (1920). Other studies of Cyrano are those of Charles Nodier (1841), F. Merilhon (Périgueux, 1856), Fourgeaud-Lagrèze (in *Le Périgord littéraire,* 1875) and Théophile Gautier, in his *Grotesques.*

CYRENAICA, in ancient geography, a district of the North African coast, lying between the Syrtis Major and Marmarica. The northern half of the district was known as Pentapolis, from its possession of five considerable cities (1) Hesperides-Berenice (Bengasi), (2) Barca (Merj), (3) Cyrene (Ain Shahat-Grenna), (4) Apollonia (Marsa Susa), (5) Teucheira-Arsinoë (Tocra). In later times two more towns rose to importance, Ptolemais (Tolmeita) and Darnis-Zarine (Derna). These all lay on the coast, with the exception of Barca and Cyrene (*q.v.*), which were situated on the highland now called Jebel Akhdar, a few miles inland. For about 500 years this district enjoyed great prosperity, owing partly to its natural products, more to trade with interior Africa.

Under the Ptolemies, the inland cities declined and the Cyrenaica began to feel the commercial competition of Egypt and Carthage, whence easier roads led into the continent. After all north Africa had passed to Rome, and Cyrenaica itself, bequeathed by Apion, the last Ptolemaic sovereign, had become (in combination with Crete) a Roman province (after 96 B.C.), this competition told more severely, and the Greek colonists, grown weaker, found themselves less able to hold their own against the Libyan population. A great revolt of the Jewish settlers (A.D. 115–116) settled the fate of Cyrene and Barca. Henceforward till the Arab invasion (A.D. 641) Apollonia was the chief city, with Berenice and Ptolemais next in order. After the conquest by Amir ibn el'Asi, inland Cyrenaica regained importance, lying as it did on the direct route between Alexandria and Qairwan, and Barca became its chief place. But with the substitution of Ottoman for Arab empire, resulting in the virtual independence of both Egypt and Tripoli, the district between them relapsed to anarchy, which continued after Mahmud II had resumed direct control over Tripoli (1835), and in the middle of the 19th century Cyrenaica was still so free of the Turks that Sheik Ali bin-Senussi chose it as headquarters of his nascent dervish order.

Modern Cyrenaica became a somewhat larger district than of old, and included ancient Marmarica up to the head of the Gulf of Sollum (Catabathmus Magnus), while the western boundary (toward Tripolitania) was at Gasr El Machtar. The whole area was about 212,000 sq.mi., mostly barren desert, and had in 1931 a population of 165,000 inclusive of 19,000 Europeans, mainly Italians. On Jan. 1, 1934, Cyrenaica, along with Tripolitania (*q.v.*), became part of modern Libya (*q.v.*). The capital and chief seaport is Bengasi. When in 1912 Italy succeeded Turkey in the sovereignty of the vilayet of Bengasi, it was officially styled Cyrenaica. It was made a colony distinct from the adjoining vilayet of Tripoli (Tripolitania), but up to 1914, owing mainly to the opposition of the Senussi, the Italians had occupied little more than the coast region. During World War I Italian occupation was reduced to the ports of Bengasi and Derna and a few other places on the Mediterranean, but from 1919 onward Italian authority was extended. By an agreement, concluded in Dec. 1925, Egypt ceded to Italy the oasis of Jaghbub, which the Italians occupied in Feb. 1926. This enabled them to strengthen their hold on the hinterland, as it is a centre of several important caravan routes, while in 1928 the whole of the coast as far as the Tripoli frontier was subjugated.

The people—Arabs and Berbers—rear large numbers of cattle, sheep and camels, and there is considerable trade in livestock with Egypt. Excellent barley is grown and is usually exported to Great Britain. There are also fisheries. Salt production in 1931 was 25,000 tons. In 1932 imports were valued at $6,550,000 while exports totalled only $538,000. Chief exports were sponges, $80,000; hides and skins, $33,600; wool, $52,800; cattle, $2,100 and carpets, $6,590.

Railway lines extend from Bengasi to Barce (66 mi.) and from Bengasi to Solúch (34 mi.). (*See* SENUSSI.)

Bengasi and Derna are connected by a motor road which leads through Cyrene; and the road to Jaghbub (Giarabub) and Siwa is also possible for vehicles.

The main caravan route to the Wadai runs through the Augila and Kufra oases, but has lost much of its importance since the construction of the railway to Khartoum.

In 1931, 1,170 vessels of 1,075,981 tons entered, and 1,153 vessels of 1,072,900 tons cleared the ports.

Geologically and structurally Cyrenaica is a mass of Miocene limestone. This mass is divided into two blocks, the higher being the western Jebel Akhdar, on which Cyrene was built (about 1,800 ft.): the lower, the eastern Jebel el-Akabah, the ancient Marmaric highlands (700 ft.). There is no continuous littoral plain, the longest strip running from the recess of the Syrtis round past Bengasi to Tolmeita. Thereafter, except for deltaic patches at Marsa Susa and Derna, the shore is precipitous. Jebel Akhdar, being without "faults," has no deep internal valleys, and presents the appearance of downs; but its seaward face is very deeply eroded, and deep circular sinkings (swallow-holes) are common. There is much forest on its northward slopes, and good red earth on the higher parts, which bears abundant crops of barley, much desired by European maltsters. Plenty of springs issue on the highlands. Here the Bedouins (mostly Beni Hassa) pasture flocks and herds, amounting to several million head. The climate is temperate and the rainfall usually adequate, but one year in five is expected to be droughty. The southward slopes fall through ever-thinning pasture lands to sheer desert about 80 m. inland.

Jebel el-Akabah is much more barren than Jebel Akhdar, and the desert comes right down to the sea in Marmarica. In the west of Cyrenaica is the remarkable chain of low-lying oases, which, from the chief member of the group, is commonly called the Augila depression.

Collectively the oases present the aspect of a long winding valley, extending from the Wadi el-Fareg near the Gulf of Sidra, through the Bir Rassam, Augila Jalo, Faredgha, and Siwa oases, to the Natron lakes and the dried-up branch of the Nile delta known as the Bahr bilā-Mā (waterless river). The whole region appears as a silted up marine inlet which, perhaps, in Pliocene times, penetrated some 300 m. S.E. in the direction of the Nile. Nearly all the fossil shells found in its sands belong to the fauna now living in the Mediterranean, and Siwa is 98 ft. below sea-level. This is true also of its eastern extensions, Sittra (80) and the Birket el-Kerun in the Fayum (141). But Augila and Jalo stand 130 and 296 ft. respectively above sea-level. They have considerable variations of temperature (as much as 75° in one day was registered at Augila in Dec. 1921, from 113° to 38° F), strong winds, but very little rain. The population of Augila and Jalo is about 4,500. The production of dates is considerable.

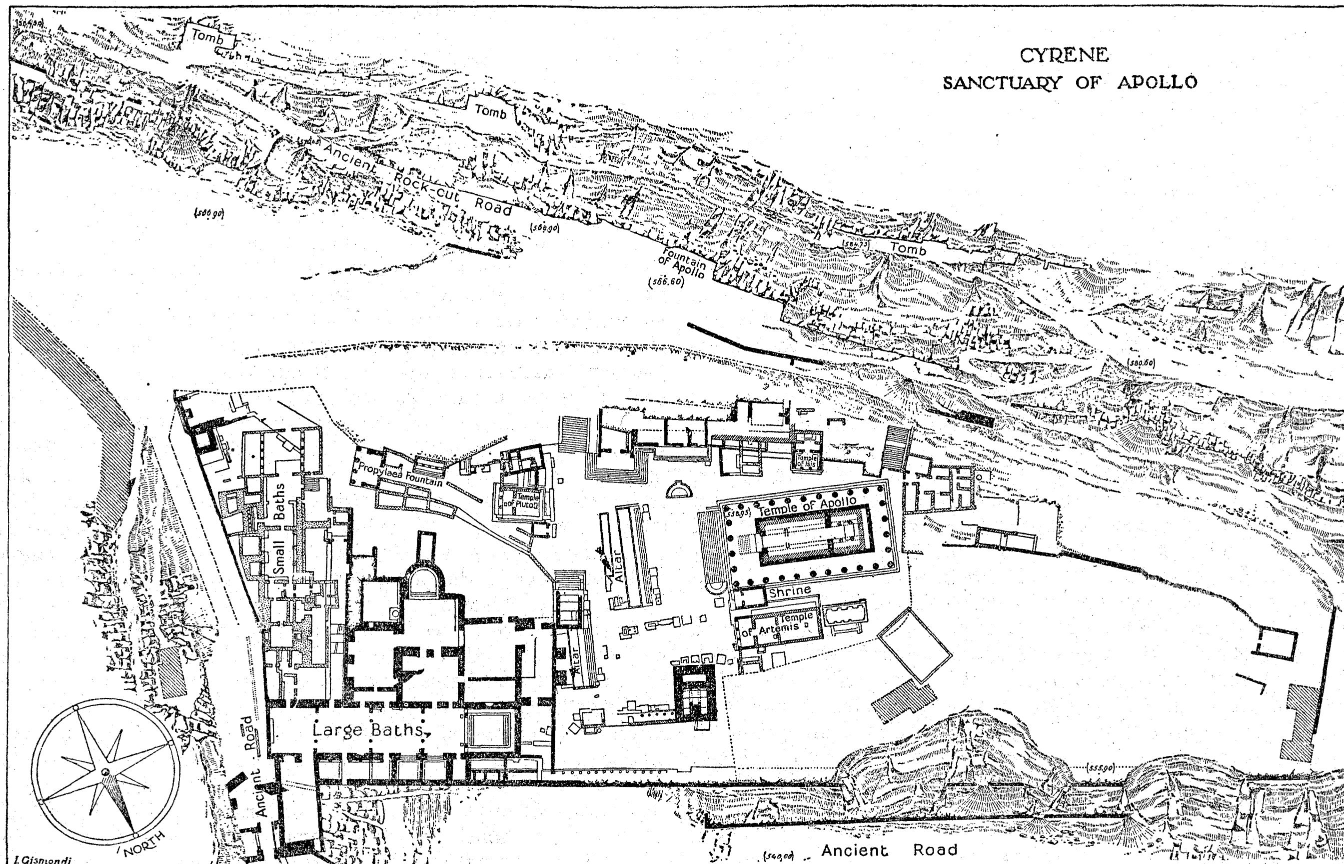
South of the Augila depression the land rises steadily to nearly 1,200 ft. in the *Kufra* oases, which lie between 21° and 24° E., north of the Tropic of Cancer and due east of Fezzan. The group consists of five distinct oases in the heart of the Libyan desert—Taizerbo, Zighen, Bu-Zeima, Erbena and Kebabo—which extend for a distance of 200 m. N.W. and S.E., and have a collective area of 7,000 sq.m., and a population of 6,000 or 7,000 Arabo-Berber nomads. Good water is obtained in abundance from the underground reservoirs, which lie within a few feet of the surface, and support over a million date-palms. Kufra is a centre of the Senūssite brotherhood, with an important *'zawya* (convent) at Jof, in Kebábo. Kufra was visited during 1920–23 by the travellers, Mrs. Forbes, Hassanien Bey and Bruneau de Laborie. Hassanien Bey in his second independent journey (1923), explored the mountain regions of Archenu and el-Avenal (both in Italian territory on the 22nd parallel) pushed on to Erdi, crossed the eastern Ennèdi, and then turned eastwards into the Sudan, finally reaching Darfai. He discovered the presence of a great mass of granitic rock, considerably earlier than the sedimentary calcareous rock of which alone the Libyan desert had been thought to be composed. Bruneau de Laborie, starting from Duàla, on the Gulf of Guinea, came up through the Cameroons, Wadai and Bòrai, and so by the caravan route (which he was the first European to follow) to Tècro, es-Sàrra and Bésciara (all of them waterpoints within Italian territory) and so up to Kufra. (*See* Rosita Forbes, *The Secret of Sahara:* Kufra, 1921; Hassanien Bey, *The Lost Oases,* 1925, and the accounts of both journeys in the *Geographical Journal;* Bruneau de Laborie, *Du Cameronn au Caire par le désert de Libye,* 1924.)

Successful military operations during the spring of 1928 by troops moving simultaneously from Tripolitania and Cyrenaica, led to the decisive victory at the wells of Tegrift and the clearing of the whole district from the 29th parallel northwards, as far south, that is, as Giarabub (which lies immediately west of the oasis of Siwa, which is in Egyptian territory), Augila, Giala, Marada and Zella. Senussi power was thus definitely destroyed. Much may be made of Cyrenaica by judicious colonization. All kinds of trees grow well, from the date palm, numbering 500,000, to the oak; and there are over 200,000 wild olives. There are forests of laitisk and juniper. Conditions in general are like those of Sicily and Apulia, and there is ample room for new settlers in the fertile coast zone, where water is easily found.

BIBLIOGRAPHY.—E. Roberts, *Catalogue of the Greek Coins of Cyrenaica* (1927); and a number of publications by the Ufficio Studi of the Government of Cyrenaica, including an excellent summary of the work of previous explorers by A. Mari (*L'esplorasione geografica della Libia: Rapportie Monografie Coloniali,* Series 2, No. 5, 1926). A map of Cyrenaica, on the scale of 1: 100,000 (some of the coastal districts 1: 50,000) is in active preparation.

The accounts of earlier travellers and especially those of Beechey and of Smith and Porcher, are of great value to the archaeologist owing to the continual destruction that has been going on there until Italy came into possession. For the archaeology of Cyrenaica in general see *Ministero delle Colonie: Notiziario Archeologico* i. 67–239 (1915).

CYRENAICS, a Greek school of philosophy, so called from Cyrene, the birthplace of the founder, Aristippus (*q.v*). It was one of the two earliest Socratic schools, and emphasized one side only of the Socratic teaching (*cf.* CYNICS). Socrates, although he held that virtue was the only human good, admitted to a certain extent the importance of its utilitarian side, making happiness at least a subsidiary end of moral action (*see* ETHICS). Aristippus and his followers seized upon this, and made it the prime factor in existence, denying to virtue any intrinsic value. Logic and physical science they held to be useless, for all knowledge is immediate sensation (*see* PROTAGORAS). These sensations are motions (κινήσεις) which (1) are purely subjective, and (2) are painful, indifferent or pleasant, according as they are violent, tranquil or gentle. Further they are entirely individual, and can in no way be described as constituting absolute objective knowledge. Feeling, therefore, is the only possible criterion alike of knowledge and of conduct. "Our modes of being affected (πάθη) alone are knowable." Thus Cyrenaicism goes beyond the critical scepticism of the Sophists and deduces a single, universal aim for all men, namely pleasure. Furthermore, all feeling is momentary and homogeneous. It follows (1) that past and future pleasure have no real existence for us, and (2) that among present



AFTER THE PLAN BY GISMONDI, REPRODUCED BY COURTESY OF DR. G. OLIVERIO, DIRECTOR OF ANTIQUITIES FOR CYRENAICA

pleasures there is no distinction of kind, but only of intensity. Socrates had spoken of the higher pleasures of the intellect; the Cyrenaics denied the validity of this distinction and said that bodily pleasures as being more simple and more intense are to be preferred. Momentary pleasure (*μονόχρονος ἡδονή*), preferably of a carnal kind, is the only good for man. Yet Aristippus was compelled to admit that some actions which give immediate pleasure entail more than their equivalent of pain. This fact was to him the basis of the conventional distinction of right and wrong, and in this sense he held that regard should be paid to law and custom. It is of the utmost importance that this development of Cyrenaic hedonism should be fully realized. To overlook the Cyrenaic recognition of social obligation and the hedonistic value of altruistic emotion is a very common expedient of those who are opposed to all hedonistic theories of life. Like many of the leading modern utilitarians, they combined with their psychological distrust of popular judgments of right and wrong, and their firm conviction that all such distinctions are based solely on law and convention, the equally unwavering principle, that the wise man who would pursue pleasure logically must abstain from that which is usually denominated "wrong" or "unjust." This idea, which occupies a prominent position in systems like those of Bentham, Volney, and even Paley, was evidently of prime importance, at all events to the later Cyrenaics.

Developing from this is a new point of practical importance to the hedonism of the Cyrenaics. Aristippus, both in theory and in practice, insisted that true pleasure belongs only to him who is self-controlled and master of himself. The truly happy man must have *φρόνησις* (prudence), which alone can save him from falling a prey to mere passion. Thus, in the end, Aristippus, the founder of the purest hedonism in the history of thought, comes very near not only to the Cynics, but to the more cultured hedonism of Epicurus and modern thinkers. Theodorus held even more strongly that passing pleasure may be a delusion, and that permanent tranquillity is a truer end of conduct. Hegesias denied the possibility of real pleasure and advocated suicide as ensuring at least the absence of pain. Anniceris, in whose thought the school reached its highest perfection, declared that true pleasure consists sometimes in self-sacrifice and that sympathy in enjoyment is a real source of happiness.

See HEDONISM, EPICURUS; histories of philosophy by Zeller, Windelband, Ueberweg; A. Wendt, *De philosophia Cyrenaica* (1841); H. von Stein, *De philosophia Cyrenaica* (1855); G. van Lyng, *Om den Kyrenaiske skole* (1868); J. Watson, *Hedonistic Theories* (1895); James Seth, *Ethical Principles*, c. i. (A) (1898); H. Sidgwick, *Methods of Ethics* and *Outlines of the History of Ethics;* Beare, *Greek Theories of Elementary Cognition;* T. Gomperz, *Greek Thinkers* (Eng. trans., vol. ii., bk. iv., *ad fin.*, 1905); and general ethical text-books.

CYRENE, the original capital of ancient Cyrenaica (*q.v.*), and one of the greatest of Greek colonies. The Theraean story of its foundation, as told by Herodotus, runs thus: Battus was bidden by the Delphic oracle to lead a portion of the citizens to Libya and build a city in a "place between waters." By this he understood an island, and therefore established his followers on the barren islet of Platea in the Gulf of Bomba. The colony being unsuccessful made further application to the oracle and was bidden to transfer itself to the mainland. The Libyan barbarians were induced to act as guides, and brought the Greeks to high ground from various points of which issued springs, and Battus, recognizing "a place between waters," began to build. This was in the middle of the 7th century B.C.

History.—The result was Cyrene, so called from a local nymph, the mother of Aristaeus by Apollo, really a nature goddess. The point first occupied was the hill above the fountain of Apollo, on the south-west, afterwards the Acropolis, and there was erected the fortress-palace of the Battiadae, who continued to rule the colony for eight generations. Battus I. reigned *c.* 630 to 590 B.C., and was succeeded by his son Arcesilaus (*c.* 590–574). The kings henceforth bore alternately the names Battus and Arcesilaus. Under Battus II. (570 B.C.?) a fresh band of settlers was invited from Greece, and the colony tended to become henceforth more maritime and democratic. Its port, Apollonia (Marsa Susa), now rose to importance; and a second (winter) port was created at Naustathmos (Marsa Hilal) about 15 m. E., behind a sheltering cape. Fine roads were cut through the rock connecting these harbours with the capital. The Libyans, robbed in favour of the new settlers, called in Egyptian help; but the force sent by Apries was defeated near the spring of Theste, and presently Amasis of Egypt made peace and took a Battiad princess to wife. Under Arcesilaus II. (*c.* 560–550) domestic dissensions and Libyan revolt led to the founding of a rival inland city, Barca, and a severe defeat and massacre. This, with the fact that Battus III. was thought to have disgraced the house by his lameness, prompted the Cyrenaeans to send to Delphi for more advice, and as a result Demonax of Mantinea arrived as arbitrator and framed a Constitution limiting the monarchy and dividing the citizens tribally. Further attempts of the Battiadae (*e.g.*, of Pheretima, wife of Battus III., and Arcesilaus his son), to annul this Constitution, and family dissensions, brought about a Persian invasion, and finally the extinction of the dynasty about 450 B.C.

A republic succeeded, but it was often interrupted by tyrannies; and having made submission by embassy to Alexander in 331, Cyrene passed under Ptolemaic domination ten years later. From this epoch dates a decline which was due to economic causes. Apollonia and Berenice gradually superseded Cyrene and Barca respectively, but Cyrene continued to be a great city after it had passed to Rome (96 B.C.) by the will of Ptolemy Apion, its last king. The Romans took over only his personal property. Three boundary stones of the time of Vespasian have been discovered. In the last years of the reign of Trajan, a Jewish revolt and the repressive measures taken by the Imperial Government (A.D. 115–116), dealt it an irreparable blow, and it is described as deserted in the 4th century, and in the 5th as a vast ruin. Henceforward, to the epoch of Arab conquest (A.D. 641) its Greek life gradually deserted it for Apollonia. At its acme Cyrene is said to have had over 100,000 inhabitants. It was noted among the ancients for its intellectual life. Its medical school was famous, and it numbered among its celebrities Callimachus the poet, Carneades, the founder of the New Academy at Athens, Aristippus, a pupil of Socrates and the founder of the so-called Cyrenaics (*q.v.*), Eratosthenes the polyhistor and Synesius, one of the most elegant of the ancient Christian writers.

Archaeology.—The site lies on the crest of the highland of Jebel Akhdar (about 1,800 ft.) and 17 m. from the sea. The ground slopes very gradually south, and being entirely denuded of trees, makes good corn land. The northward slope falls more steeply in a succession of shelves, covered here and there with forest. Ravines surround the site on three sides, and of the springs in its area, one, having great volume, has been at all times the attraction and focus of the place. This is the so-called "Fount of Apollo," which issues from a tunnel artificially enlarged, and once faced with a portico. The channel is about 300 yd. long, and extremely tortuous. Here are numerous inscriptions of ancient visitors, including a dedication to good fortune *σὺν θεοφανεία, ie.,* with a vision, which it was hoped would be granted. The acropolis was immediately above this on the west, and the main entrance of the city, through which came the sacred processions, passed it. The remains of Cyrene itself are enclosed by a wall having a circuit of about 4 m., of which little remains, but tombs and isolated structures extend far outside this area. The walls date from not before the 5th century B.C., and the large temples lie outside them.

The acropolis, on the south-western of the two hills, into which the site is divided by a valley, had separate fortifications especially conspicuous on the east, where a gate and a long stretch of wall on each side of it are preserved. Excavations made on the summit of the acropolis in 1910–11 (described in *Bulletin of the Archaeological Institute of America,* ii., 1911, R. Norton and others), led to the discovery of a building of the 3rd century B.C. arranged round a colonnade with a series of rooms on the south, and wings on the east and west running north. Another building, with an apse, showed traces of protracted occupation. A number of sculptures, including a fine head of Athena, were found, and, on the north-west slope, a quantity of terracotta objects.

These excavations were suspended when Cyrenaica became Italian, and have not been resumed, attention having been devoted to other parts of the town, where results of the highest importance have been obtained, and work is still (1928) in progress. On the north-east of the slope of the acropolis a small sanctuary of the divinities of Alexandria was found; the numerous works of art include a fine portrait head of Berenice II.

The temple of Apollo occupied the centre of a large level space below the Acropolis on the north. Here Smith and Porcher had already found a number of sculptures, now, with the rest of their discoveries, in the British Museum. Remains of the original temple, erected by Battus, have come to light; it had six columns in front, 11 on the sides, and two internal rows of columns in two stories (*cf.* Paestum). Fragments of its terracotta decoration were found, and also an enormous marble *acroterion* (gable decoration) with a Gorgon's head. In the time of Augustus it was reconstructed on the same plan; but later (perhaps under Hadrian) the interior was divided into three compartments, one behind the other, the older columns being used as material for the foundations. In front of the temple was a huge altar, 25 yards long. To the north of it is the temple of Artemis (beginning of 6th century B.C.) with an altar in front of it, and between the two is a small shrine of the Roman period. The temple was later surrounded by a sacred precinct, entered by propylaea erected in Roman times, in front of which is a temple of Pluto; while in the precinct are some smaller temples, including one of Isis (Iseum) and others dedicated to Apollo.

At the western extremity of the open space is a theatre (not well preserved) and at the eastern the Roman thermae, restored by Hadrian (large baths) and again in the 3rd and 4th centuries A.D. (small baths) cutting off part of the area; they are well preserved and contained numerous works of art, including two marble groups of the Three Graces and (probably) the fine Aphrodite Anadyomene (now in the Museo delle Terme at Rome) which was laid bare by a heavy rainstorm close by. The whole forms a most imposing group of remains; the valley is barred by a large supporting wall on the north, while to the south are the cliffs from which issues the Fountain of Apollo.

To the east of the Acropolis lay the Agora, and away to the north-east, on the eastern hill, the so-called Great Temple, with the stadium to the east of it again. In the centre of the Agora are two archaic round monuments—the heroon and the tomb of Battus. A portico surrounds it, with temples of Zeus Soter (the Saviour) and Rome and Augustus; while a late enlargement produced the temple of Demeter. To the south of the main road is the Capitolium, or temple of Jupiter, Juno and Minerva. The statues of these three deities were presented by Hadrian and Antoninus Pius in A.D. 138. The statue of Jupiter (*Zeus Aigiochos, i.e.,* Zeus holding the aegis) was found in 1915, while the other two, discovered by Smith and Porcher, have recently been identified at the British Museum.

The temples attributed to Bacchus and Venus by Smith and Porcher, which yielded them numerous sculptures, have not yet been re-excavated. The great temple on the eastern hill was, as an inscription of the Roman period shows, dedicated to the Olympian Zeus. Smith and Porcher, in their hasty investigations, had found only fragments of sculpture there; but a fine head of Zeus of Pheidian type, with traces of gilding on the hair and beard, and belonging to an acrolithic statue, has recently been found there, as well as a head of Poseidon, probably belonging to a statue forming a "pendant" to it. To the north was a smaller temple, in which a colossal male head and two statuettes were found by Smith and Porcher; while to the east was the Stadium, and some way to the south of that a basilica of the Byzantine period. Further to the south again, at the south-east angle of the site are some very large reservoirs.

From a study of the numerous sculptures found, especially in the thermae, it is clear that in the archaic period Cyrene was influenced artistically by the Greek islands, and in the 5th century B.C. by Olympia. Some inscriptions of great importance have come to light. The great spectacle, however, which distinguishes the site of Cyrene, is provided by its cemeteries. There is one along each of the approaches to the main gates, but the largest and most splendid lies by the Apollonian road, which winds by easy curves up the northern buttresses of the plateau.

Here the sepulchres rise in tiers one above the other along fully a mile of the way. The most important have pillared façades. Within, they open out either into large halls, leading one out of another with graves in recesses and pits in the floor; or into rock corridors lined with *loculi,* disposed one above another like pigeon holes. Most of the wall paintings have perished; but one tomb still retains its decoration. The scenes are agonistic, *i.e.,* represent funeral games, in which both white and black persons take part, the latter doubtless Libyan *perioeci*: but all wear Greek garments. Several tombs are inscribed and on some external paintings are still faintly visible. The commonest type of grave is a simple pit covered by a gabled lid. These occur by hundreds. But not all the sepulchres are rock-cut: altar tombs and other forms of *heroa* are found built upon plinths of rock.

The harbour of Cyrene was called Apollonia, after the tutelary deity of the city. It is the modern Marsa Susa, 12 m. to the N.E. of it; and scanty remains of the mole are still to be seen. Its fortifications have been largely destroyed by an earthquake, and the same has happened to its other buildings, which suffered further damage from quarrying for material for modern houses within the last hundred years, so that the descriptions given by earlier travellers, such as Beechey and Smith and Porcher are of considerable value here as elsewhere. Remains of a Christian basilica, of tombs, of reservoirs and of an aqueduct may be recognized; but the theatre is better preserved. Remains of the road leading down to it from Cyrene may be traced through the necroplis. Two milestones erected by Trajan in A.D. 100 have been found along its course, and another of Hadrian set up in A.D. 118–119; and remains of several forts may be seen near it.

See authorities for Cyrenaica and F. Studniczka, *Kyrene, eine altgreischische Göttin* (Leipzig, 1890); also *Notiziario Archaeologico del Ministero delle Colonie* (Rome, 1915 *sqq.*) *passim; Africa Italiana* (1927 *sqq.*) *passim.*

CYRIL, SAINT (376–444), made bishop of Alexandria *c.* 412. He had hardly entered upon his office when he closed and plundered the churches of the Novatians, and drove the Jews in thousands from the city. The prefect of Egypt, Orestes, who endeavoured to withstand his furious zeal, was denounced, and the illustrious Hypatia, his friend and the advocate of Neo-Platonism, was murdered in one of the frequent riots. Cyril's antagonism to the Antiochene school is shown in his opposition to Chrysostom, whose name he for some time refused to allow into the lists of martyrs and bishops mentioned in the prayers of his church, and to the apologist, Theodoret. The story of his opposition to Nestorius at the council of Ephesus in 431 is told elsewhere (*see* NESTORIUS). He himself incurred the charge of heresy from the oriental bishops. Satisfied, however, with the deprivation and exile of his opponent, he returned to Alexandria in triumph as the great champion of the faith. Cyril is important for the history of Christology. He taught the personal or hypostatic union of the two natures in Christ, but tended to allow that after the union the Word, which replaces the rational soul, forms but one nature with the body, hence he inclined to Monophysitism. In his Trinitarian expositions, he does expressly affirm the procession of the Holy Ghost *ex Filio.* He introduces an allegorical interpretation of the Bible and appeals often to the Fathers.

In addition to his *Twelve Anathematisms* and the defence of the same, he produced five other books against Nestorius, *Thesaurus*—a treatise in dialogue form on the Trinity, a book *On the Right Way* and another *On the Incarnation.* His letters and sermons are valuable sources of the Nestorian controversy.

BIBLIOGRAPHY.—The collected edition by J. Aubert (Paris, 1638) was reprinted in Migne, *Patr. Graec,* vols. 68–77; Eng. trans. in the *Oxford Library of the Fathers. See* also A. Largent's *Études d'hist. ecclés.; St Cyrille d'Alexandrie et le concile d'Éphèse* (1892); H. Rehrmann, *Die Christologie des hl. C. von Alexandrien* (Hildesheim, 1902); A. Harnack, *Hist. of Dogma,* vol. 4; J. Tixeront, *Hist. of Dogma,* vol. 3; Brightman, *The Age of the Fathers,* vol. 2 (1903); E. Weigl, *Die Heilslehre des hl. C. von Alexandrien* (1905).

CYRIL, SAINT (*c.* 315–386), bishop of Jerusalem, where probably he was born, was ordained a presbyter in 345. In 350 he was elevated to the see of Jerusalem. His metropolitan, Acacius of Caesarea, inclined to Arianism, while Cyril espoused the Nicene creed and was, in consequence, deposed, till the accession of Theodosius permitted him to return in 379. He attended the second council of Constantinople in 381, where he was welcomed for his defence of orthodoxy. Cyril's ability as a pastor is seen in his one important work—his 23 addresses to catechumens delivered in A.D. 348. These lectures, said to be the first example of a popular exposition of Christian doctrine, give us insight into the creed forms and the ceremonies of baptism of the early Church. As regards the Eucharist, Cyril holds the Real Presence and makes the change due to the invocation of the Holy Spirit upon the offerings. He does not explicitly use the Nicene formula of the Trinity.

BIBLIOGRAPHY.—A. A. Touttée (Paris, 1720; reprinted by Migne, *Patrol, Graeca* xxxiii.); W. C. Reischl and J. Rupp (Munich, 1848–60); Translation: *Catecheses* ("Oxford Library of Fathers," vol. ii.). *See* Herzog-Hauck, *Realencyk.* (Förster); G. Delacroix, *St. C. de Jérus., sa vie et ses oeuvres* (Paris, 1865); J. Maden, *Der Hl. Cyrillus, Bischof von Jerusalem* (Ensiedeln, 1901); A. Harnack, *Hist. of Dogma,* v. 3 and 4; Hefele, *Conciliengeschichte* (Freiburg, 1873).

CYRIL (827–869), apostle of the Slavs, amongst whom he worked in conjunction with his elder brother Methodius (*q.v.*). Tradition says that while in the Khazar country (where he combated Jewish and Mohammedan influence) he found at Kherson the remains of Clement of Rome, which he bore with him wherever he went, finally depositing them at Rome in 867. His name is associated with the invention of the modified (Cyrillic) form of the Greek alphabet, which largely superseded the ancient Slavonic characters.

CYRILLIC ALPHABET: *see* ALPHABET, OLD SLAVONIC, SLAVONIC LANGUAGES, SLAVS.

CYRILLUS, Greek jurist of the 5th century, was professor in the ancient law college of Berytus, and one of the founders of the oecumenical school of jurists (τῆς οἰκουμένης διδάσκαλοι) which preceded the succession of Anastasius to the Eastern empire (A.D. 491), and paved the way for Justinian's legislation.

CYRTO-STYLE, in architecture, a semi-circular projecting portico with columns.

CYRUS, the Latinized form of a Persian name borne by two prominent members of the Achaemenid house (Gr. Κῦρος; Pers. *Kuru-sh;* Babyl. *Kurash;* Hebr. *Kōresh*).

1. CYRUS THE GREAT, the founder of the Persian empire, was the son of Cambyses I. of the clan of the Achaemenidae, the principal clan of the Persian tribe of the Pasargadae (*q.v.*). In his proclamation to the Babylonians Cyrus calls his ancestors, Teispes, Cyrus I. and Cambyses I., "kings of Anshan." But, as we know from Jer. xlix. 34 ff. (*cf.* Ezek. xxxii. 24 ff.), Elam, of which Anshan is a district, suffered a heavy defeat in 596 B.C., and it is probable that the Pasargadian dynast Teispes conquered Anshan in this year.

The Pasargadian kings of Anshan were vassals of the Median empire until the rebellion of Cyrus (who seems to have become king in 558 B.C., as Herod. i. 214 gives him a reign of 29 years) which began in 553 B.C. and ended with Astyages being taken prisoner and Ecbatana plundered. From then Cyrus called himself "king of the Persians."

The history of Cyrus soon became overgrown with legends. Herodotus (i. 95) gives four traditions about him. One makes him the son of Mandane, a daughter of Astyages (originally evidently by a god), who is exposed in the mountains, suckled by a dog and educated by a shepherd. At the same time, the rule of Cyrus and the Persians is legitimated by his family connection with Astyages. This account partly preserved in Justin i. 4. 10 (probably from Charon of Lampsacus) and in Aelian, *Var. Hist.* xiv. 42, is alluded to by Herodotus i. 95 and 122. The second account, which Herodotus follows, rationalizes the first by changing the dog into a shepherd's wife. In the later part of his story Herodotus uses the family traditions of the Median general Harpagus, whose treason is justified by the cruelty of Astyages. Harpagus afterwards stood in high favour with Cyrus, and commanded the army which subdued the coasts of Asia Minor. In a third version, preserved from Ctesias in Nicolaus Damasc., p. 66 (*cf.* Dinon *ap.* Athen. xiv. 633 C), Cyrus is the son of a poor Mardian bandit Atradates (the Mardians are a nomadic Persian tribe, Herod. i. 125), who later, as a servant, found favour with Astyages. After a Chaldaean sage prophesied his future greatness, he fled to Persia and began the rebellion. Parts of this story are preserved also in Strabo xv., p. 729, and Justin i. 6. 1–3; 7. 1; *cf.* Ctesias *ap.* Photium 2–7. With this version Ctesias and Nicolaus have connected another, in which Cyrus is the son of a Persian shepherd of Pasargadae where he fights the decisive battle. The didactic novel of Xenophon, the *Cyropaedia,* is an invention based upon the account of Herodotus and occasionally influenced by Ctesias, without any independent tradition. The account of Aeschylus, *Pers.* 765 ff., combines Greek traditions and a few oriental elements; here the first king is Medos (the Median empire); his nameless son is succeeded by Cyrus, a blessed ruler, who conquered Lydia, Phrygia, Ionia.

The principal events of the later history of Cyrus are in the main correctly stated by Herodotus. The short excerpt from Ctesias, preserved by Photius, contains useful information, and there is a brief notice in the fragments of Berossus and another in the Old Testament. The original sources are scanty; besides the cylinder containing his proclamation to the Babylonians we possess only a number of dated private documents from Babylon. These serve to fix the chronology, which agrees with the dates of the canon of Ptolemy.

Soon after the conquest of the Median empire, Cyrus was attacked by a coalition of Babylon, Egypt and Lydia, joined by Sparta, the greatest military power of Greece. But in 546, he took Sardis, thereby making the Lydian kingdom a Persian province. During the next years the Persians under Harpagus suppressed a rebellion of the Lydians under Pactyas, and subjugated the Ionian cities, the Carians and the Lycians. The king of Cilicia (Syennesis) voluntarily acknowledged the Persian supremacy. When Cyrus defeated the army of Nabonidus, Babylon itself surrendered, in Oct. 539, to the Persian general Gobryas.

From the beginning of 538 Cyrus dates his years as "king of Babylon and king of the countries" (*i.e.,* of the world). With the capital, the Babylonian provinces in Syria fell to the Persians; in 538 Cyrus granted to the Jews, whom Nebuchadrezzar had transported to Babylonia, the return to Palestine and the rebuilding of Jerusalem and its temple. (*See* JEWS, § 14.) According to Ctesias he defeated the Bactrians and the Sacae; and the historians of Alexander mention a march through Gedrosia, where he lost his whole army but seven men (Arrian vi. 24. 2; Strabo xv. 722), a tribe Ariaspae on the Etymandros (in Sijistan), who on account of their support against the Scythians, were called Euergetae (Arrian iii. 27. 4; Diod. xvii. 81; Curt. vii. 3. 1), and a town, Cyropolis, founded by him on the Jaxartes (Arrian iv. 2. 3; Curt. vii. 6. 16; Strabo xi. 517, called Cyreskhata by Ptolem. vi. 12. 5). In 530, having appointed his son Cambyses king of Babel, he set out for a new expedition against the East. In this war he was killed (Herod.) or mortally wounded (Ctesias) in 528 B.C.

In his native district Cyrus built a city with a palace, called after his tribe Pasargadae (now Murghab), and here he was buried. (*See* PASARGADAE.) In a short time he, the petty prince of an almost unknown tribe, had founded a mighty empire, which extended from the Indus and Jaxartes to the Aegaean and the borders of Egypt. Cyrus was a great warrior and statesman, humane in his treatment of the vanquished, in Babylonia behaving like a constitutional monarch. By the Persians his memory was cherished as "the father of the people" (Herod. iii. 89), and the Greek tradition preserved by Aeschylus (*cf.* above) shows that his greatness was acknowledged also by his enemies.

2. CYRUS THE YOUNGER, son of Darius II. and Parysatis, was born after the accession of his father in 424. When, after the victories of Alcibiades, Darius II. decided to continue the war against Athens and give support to the Spartans, he sent, in 408, the young prince into Asia Minor, as satrap of Lydia and Phrygia Major with Cappadocia, and commander of the Persian troops. He gave strenuous support to the Spartans in the hope that their general, Lysander, would help him to gain the throne against his elder brother, Artaxerxes. He assisted Lysander in the Peloponnesian war, and by exerting his influence in Sparta he brought it about that, after the battle of Arginusae, Lysander was sent out a second time as the real commander (though under a nominal chief) of the Spartan fleet in 405 (Xen. *Hell.* ii. 1. 14). After the accession of Artaxerxes II. in 404, Tissaphernes denounced the plans of Cyrus against his brother (*cf.* Plut. *Artax.* 3); but by the intercession of Parysatis he was pardoned and sent back to his satrapy. Meanwhile Lysander by the victories of Aegospotami and Sparta was supreme in the Greek world. Cyrus managed to gather a large army by beginning a quarrel with Tissaphernes, satrap of Caira, about the Ionian towns, and pretended to prepare an expedition against the Pisidians, a troublesome mountainous tribe in the Taurus. In the spring of 401, Cyrus started from Sardis with his forces and, joining with the Spartans, advanced into Babylonia where he met the army of Artaxerxes. Here ensued, in Oct. 401, the battle of Cunaxa in which Cyrus was slain. Afterwards Artaxerxes pretended to have killed the rebel himself, with the result that Parysatis took cruel vengeance upon the slayer of her favourite son. The Persian troops dared not attack the Greeks, but decoyed them into the interior, beyond the Tigris, and tried to annihilate them by treachery. But after their commanders had been taken prisoners the Greeks forced their way to the Black sea. By this achievement they had demonstrated the internal weakness of the Persian empire and the absolute superiority of the Greek arms.

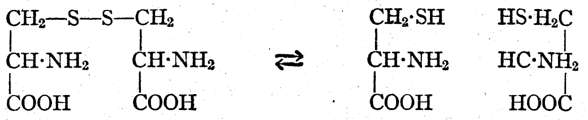
The history of Cyrus and of the Greek retreat is told by Xenophon in his *Anabasis* (where he tries to veil the actual participation of the Spartans). Another account, probably from Sophaenetus of Stymphalus, was used by Ephorus, and is preserved in Diodor. xiv. 19 ff. *See* also the excerpts from Ctesias by Photius, and Plutarch's life of Artaxerxes. Cyrus is highly praised by the ancients, especially by Xenophon (*cf.* also his *Oeconomics,* c. iv.); and certainly as a general and statesman he was much superior to his weak brother, under whom the empire decayed. (*See* also PERSIA: *Ancient History.*)

See E. Meyer, *Gesch. des Altertums,* 3rd ed. (Berlin, 1921); J. D. Prásek, *Gesch. der Meder und Perser* (Gotha, 1906) and "Kyros der Grosse" in *Der Alte Orient* (1912).

CYSTINE is one of some twenty substances (amino-acids) which are produced when the proteins of food are digested in the alimentary canal. Together with its congeners it is liberated from proteins by any process which involves hydrolysis, and it is obtained when any typical protein is boiled with mineral acids (*see* PROTEINS). It differs from all but one other among the constituent amino-acids of protein in that it contains sulphur, that element being present in relatively unstable combination.

Cystine is almost insoluble in neutral aqueous media, a circumstance which led to its discovery and affects its behaviour in the animal body. Long before it had been shown to be derived from protein, it was discovered as the main constituent of a urinary calculus removed from a human subject (Wollaston, 1810), and although relatively rare, calculi composed of cystine have since been many times observed. It is occasionally found in human urine when it tends to form a white crystalline deposit. In such cases a highly interesting anomaly of metabolism exists. While the body of a normal individual is capable of completely oxidizing all the amino-acids to which the breakdown of protein gives rise, there are rare cases in which this power is deficient. The failure applies especially to the oxidation of cystine. As a result considerable amounts of this substance appear unaltered in the urine. Because of its low solubility it may be deposited in the tissues or as calculi. Those who display this condition suffer from a definite deficiency in the chemical make-up of their bodies. A specific oxidizing mechanism fully active in normal people is in their case imperfectly developed. This is a congenital anomaly commonly transmitted (perhaps on Mendelian lines) from parents to children.

The amount of cystine contained in individual proteins varies from less than 1% to more than 3%. A due supply of cystine in the diet is essential to nutrition. Proteins deficient in this constituent may show a relatively low nutritive value. Keratin, a much modified protein, which is the basal constituent of horn and hairs, is characteristically rich in cystine, containing 8% and upwards. Natural cystine when pure is a snow-white substance consisting of highly characteristic microscopic crystals in the form of hexagonal plates. It has an exceptionally high rotatory power on polarized light $[\alpha]_D = -222°$ in normal hydrochloric acid. The structural formula and that of the related *cysteine* are as follows:



Cystine Cysteine (two molecules)

It is characteristic of compounds containing a disulphide grouping to yield upon reduction two molecules of the corresponding compound containing the thiol or —SH group. These relations are displayed in the biological behaviour of cystine (*see* GLUTATHIONE).

See A. E. Garrod, *Inborn Errors of Metabolism* (1923).

(F. G. H.)

CYSTOLITH, a botanical term for the inorganic concretions, usually of calcium carbonate, formed in a cellulose matrix in special cells, generally in the leaf of plants of certain families, *e.g., Ficus elastica,* the india-rubber plant.

CYTHERA, an island (mod. *Cerigo,* but officially *Cythera*), situated about 8 mi. from Cape Malea, the southern promontory of Greece. From north to south it is nearly 20 mi. long and its greatest breadth is about 12 mi. It is rocky, but streams abound, and there are fertile districts. Two great caves with stalactites are among its natural peculiarities. Much land is pasture, but wine and corn are produced, and the olive oil is good. The honey is highly prized, as in antiquity, and goat cheese, salt, flax, cotton and currants are exported. The people are industrious, and find employment as labourers in the Morea and Asia Minor. There is no regular harbour; sea currents are strong, and storms frequent. The best anchorage is at San Nicolo, on the eastern side. The principal village, Capsali, at the southern extremity, has a bishop, and several convents and churches.

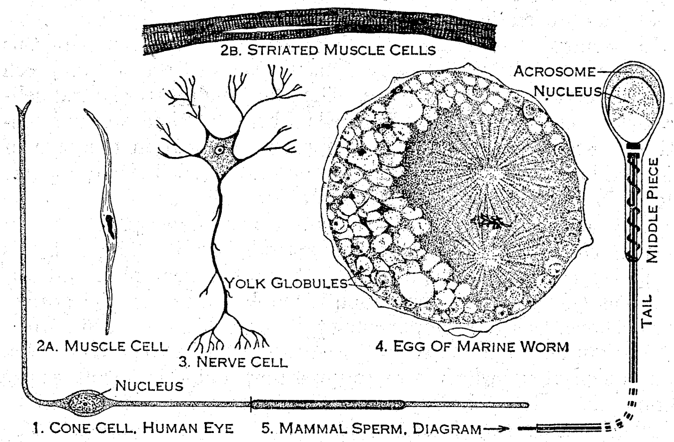
There are few traces of antiquity. The ancient capital was at Paleo-Kastro. In the church of St. Kosmas are preserved archaic Doric columns of the famous temple of Aphrodite of Cythera, who was supposed to have emerged there from the sea. Cythera was the seat of a purple fishery; hence its poetical name Porphyris and tradition of a Phoenician settlement. For a time dependent on Argos, it belonged later to the Spartans. In the Peloponnesian war, it was occupied by Athens, but in 421 it was recovered by Sparta. In mediaeval and modern history Cythera ranks as one of the Ionian Islands and shares their history; but it was subject to Venice only from 1717 to 1797.

See the works referred to under CEPHALONIA, and also Weil, in *Mittheil. d. deutsch. Inst. zu Athen* (1880), pp. 224–243.

CYTOLOGY. One of the most remarkable and fundamental facts of biology is that all living things have a common unit of structure, the cell, and are made up of the same general kind of basic substance, protoplasm. Cytology is the branch of biology which deals with these cells and this substance. Many organisms, such as the Protozoa, mostly of microscopic size, consist of single cells; but most of those which are large enough to be seen with the naked eye, including the animals and plants familiar to all of us, are multicellular, made up of millions of microscopic cell units. Although originally seen as minute empty spaces in dead plant tissue, such as cork, and consequently misnamed "cells" by their discoverers (Robert Hooke and Nehemiah Grew, 1665), cells are actually full of living protoplasm and are very complex bodies in which a multitude of delicate chemical and physiological processes take place. This means, of course, that protoplasm is not a simple substance, but is a highly organized one containing many kinds of materials and minute structures. Most biologists believe that protoplasm owes its living nature to its *organization* rather than to the possession of some one vital element. This is an important point and should be continually kept in mind. The purpose of this account is to give some idea of what the structures are like that go to make up cells, how they vary in different kinds of cells, what roles they play in some of the more important living processes and how they determine the nature of different organisms, including man himself. We are far from having a full understanding of these subjects, of course, but a great deal has been learned and our knowledge is growing at an ever increasing rate.

Cytology is one of the youngest of the biological sciences. Nevertheless, it merits special attention because it provides a common meeting ground for several other branches of biology. Our later discussion will be made easier if we first get a picture of this relationship. As is known, almost any ordinary animal starts out as a fertilized egg, from which an embryo and later the adult animal develops. This fertilized egg is a cell. It results from the union of two cells—the unfertilized egg and the sperm. It does not simply grow into an embryo. Instead, it divides into two cells, these into four, these four into eight and so on until great numbers are produced. This divisional process is known as cell division, or more technically, *mitosis.* For the most part the new cells formed at each division grow to the size of their parent cells before they, in turn, divide. Thus cell growth and cell division are ordinarily both involved in the development of an embryo from a fertilized egg. In the case of many large eggs, such as those of birds, most of the egg consists simply of food material and division involves only the cell proper, which is very small; but otherwise the process of development is essentially the same, the food material being gradually absorbed by the cells as they multiply. In either case, as the embryo is produced it comes to be made up of different tissues and organs (*e.g.,* muscles, nerves, fat, skin, glands, etc.) and the cells in these various tissues often come to differ strikingly. Study of the processes of development and differentiation reveals a close relationship between cytology and embryology.

An equally close relationship exists between cytology and the study of heredity, known as genetics. As previously stated, the sperm and the egg, which unite at fertilization to produce a new individual, are both cells. Each carries within it the hereditary materials from one parent. Combined, the two sets of materials determine the hereditary potentialities of the animal or plant which develops from the fertilized egg. Identifying the individual cell components which carry the hereditary "determiners" and



(1) FROM AREY, IN COWDRY, "SPECIAL CYTOLOGY" (HOEBER); (2A & 3) FROM SHARP, "INTRODUCTION TO CYTOLOGY" (MCGRAW-HILL BOOK CO. INC.); (2B & 4) BY COURTESY OF C. W. METZ; (5) FROM R. H. BOWEN, IN "JOURNAL OF MORPHOLOGY," VOL. 39, 1924 (THE WISTAR INSTITUTE OF ANATOMY AND BIOLOGY)

FIGS. 1-5.—EXAMPLES OF DIFFERENT KINDS OF CELLS
(1) cone visual cell from fovea of human eye (after Arey, 1928, *Special Cytology*), x (magnified) 500 diameters; (2A) involuntary muscle cell (from Sharp, 1934, after Piersol); (2B) striated muscle cells in a muscle fibre; (3) diagram of a nerve cell, neuron (from Sharp, 1934, after Obersteiner and Hill); (4) fertilized egg of *Nereis* in first cleavage division (mitosis), from a preparation by H. H. Fry, x 425; (5) diagram of a mammal sperm (after Bowen, 1924)

discovering the laws underlying their transmission from generation to generation was one of the major tasks in cytology, especially during the period from about 1870 to about 1925. Combined with breeding experiments, such studies have now been elevated to the rank of a semi-independent branch of biology known as cytogenetics which will be discussed presently. Similarly, in the study of the structure and functions of different tissues and organs (anatomy and physiology, respectively) and in the study of the relationship between different species (taxonomy) as well as in the study of the evolution of species, cytology plays an important part. In the words of E. B. Wilson (1925): "Long ago it became evident that the key to every biological problem must finally be sought in the cell; for every living organism is, or at some time has been, a cell."[1]

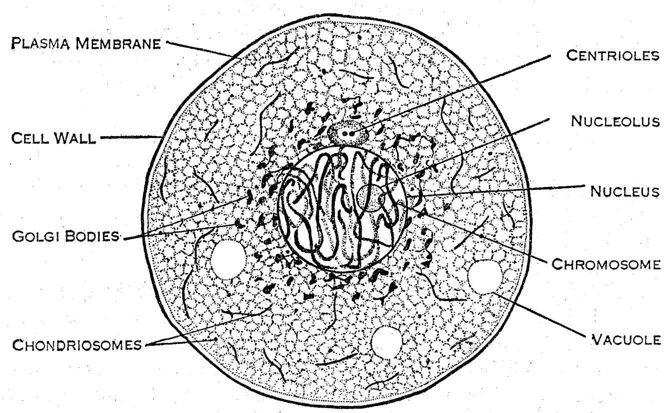
Subsequent discussion will be further simplified if we get another picture in mind at this point: Cells, like the animals and plants in which they are found, are the products of long evolutionary development and owe their present characteristics to this fact. In the earliest forms of life protoplasm was presumably a relatively simple substance, not organized into cells as we know them today, and the process of mitosis did not exist in its present form. As evolution proceeded, cells came into existence and different species of organisms arose. These species differed because of differences in their cells. In other words, evolutionary changes occur within individual cells (*see* below). It is to be expected, therefore, that although all are similar in certain respects, cells of many kinds will be found in the highly complex animals and plants now living. And so they are. Furthermore, nearly all the different structures and processes found in cells have undergone change in the course of evolution, leading to the great variety of conditions found today. One of the products of evolutionary change is the present highly complex process of mitosis, the importance of which will be brought out below.

THE CELL

There is no very satisfactory definition of the term "cell" in biology, so we may begin our account with a description rather than a definition. During the early stages in the development of an ordinary animal there is a period when all the cells are very much alike and all behave in much the same manner. It is a period of relatively rapid multiplication of cells. Following division, each cell goes through a typical series of internal changes, including growth, before it divides again. The span from one division to the next is a cell generation. It represents the life cycle of an individual cell. Since these cells are much alike and are much like those found at corresponding stages in other animals, and even in plants, they may be called "typical" cells. Most general descriptions of cells apply especially to cells of this kind. Such cells are usually found wherever growth and cell multiplication are taking place. The more highly specialized cells arise, of course, from typical cells when the time for differentiation occurs. And it is interesting to note that in the case of many kinds of specialized cells the power of cell division appears to be lost as soon as the cell becomes specialized.

Any ordinary cell consists fundamentally of two parts—a central *nucleus* and the protoplasm surrounding it. The latter is called *cytoplasm* to distinguish it from the protoplasm of the nucleus (fig. 6). This distinction is amply warranted, for studies have shown that the components of the cytoplasm differ in nature, behaviour and function from those of the nucleus. There has been discussion about which is more important, but this misplaces the emphasis. Nucleus and cytoplasm are both essential to the life of the organism; the difference is in their respective roles. The nuclear components play a primary role in heredity and in directing the course of embryonic development, while the components of the cytoplasm appear to function mainly in such processes as respiration, growth, differentiation, secretion, transmission of nerve impulses, locomotion of free moving cells (such as some of the blood cells) and contraction of muscles.

The generalized diagram of a cell shown in fig. 6 represents a typical animal cell shortly before mitosis takes place. The diagram includes most of the components found in animal cells; but it does not give any clear conception of the cell as a living structure. To get such a conception we must think of the cell not only as highly complex, but as highly active in a physiological sense. Under ordinary conditions complicated chemical processes are almost certainly taking place in it continually. In typical cells these are accompanied by, and presumably correlated with, various movements and changes in form or structure of the different cell components. Consequently, when we describe these components our description may apply only to the stage under consideration, and we may have to follow them through the whole life of the cell in order to see what they are really like. The preliminary description given below is simplified as much as possible in order to give a general picture, the details of which will be filled in later. As will be seen, some components are found in the cells of nearly all animals and plants, others are found mainly or exclusively in animals, others in plants and others only in certain groups of animals or plants. These variations or restrictions are among the factors which make it difficult to give a brief and satisfactory definition of a cell.



BY COURTESY OF C. W. METZ

FIG. 6.—GENERALIZED DIAGRAM OF AN ANIMAL CELL SHOWING MAIN COMPONENTS

Our knowledge of the internal organization of cells came from various kinds of studies. Its advance depended primarily on the development of the microscope, but was also greatly affected by other developments, such as those in illumination with high power electric lamps and in photography (photomicrography), including that with ultra-violet light (Pl., fig. 8). Much information came from direct observation of living cells under the microscope, a method which is being used to an increasing extent. Much also came from a study of moving pictures of living cells, taken through the microscope. Most of it, however, was secured through study of material that was "fixed and stained" and mounted on glass microscope slides. Many different procedures are used for the latter purpose, but most of them involve killing and hardening the tissue with chemicals, such as acids, formalin, alcohol, etc., then cutting it into very thin sections of a few thousandths of a millimetre thickness, mounting these sections on slides under very thin glass cover slips and staining them with various dyes. Since different structures in the cell differ chemically, as well as in form, individual kinds may be revealed in sharp contrast to one another or to the rest of the protoplasm through proper selection of fixing agents and stains. This permits a much more refined analysis than would otherwise be possible. It brings out clearly numerous structures which often cannot be seen at all, or can be seen only vaguely, in the living cell, where the optical properties of nearly all the components tend to be much alike.

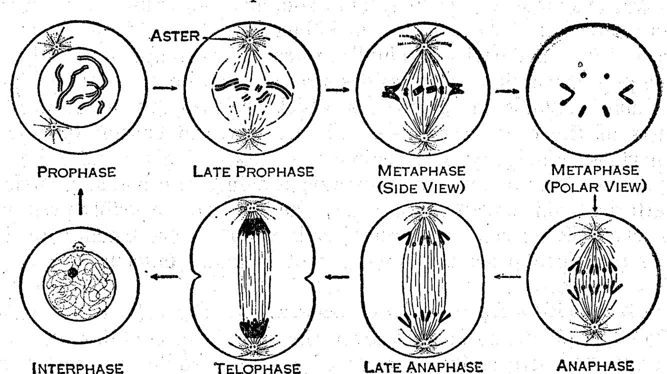
General Description of a Cell.—We will first describe a typical animal cell when it is just getting ready to divide (prophase); then we will follow it through the succeeding stages of one cell generation. **Prophase:** At the periphery of the cell (fig. 6) we find the *cell wall* or outer membrane, usually a conspicuous and resistant structure. Just beneath this is the *plasma membrane,* which is very thin and often not detectable under the microscope. Next comes the *cytoplasm* proper consisting of a basic and apparently structureless, jelly-like *ground substance* in which are found various distinct kinds of bodies or materials. Three of the latter call for special attention. They are the *chondriosomes* or mitochondria, the *Golgi bodies* and the *centrioles* or central bodies. These three types differ from one another in their chemical properties, behaviour and function and will be discussed

[1]From E. B. Wilson, *The Cell in Development and Heredity.* By permission of the Macmillan Co., publishers.

more in detail below. We need only note here that the chondriosomes and also the Golgi bodies may differ much in size and shape in different cells or even in different stages in the life of one cell. Besides these three kinds there may be other bodies or materials present, such as fat droplets, yolk spheres, granules and vacuoles of watery substance. The former two, at least, seem to be primarily food materials. In plant cells, other structures are often present, such as starch grains and the chloroplasts responsible for leaf and stem colour. Near the centre of the cell is the spherical *nucleus*. It consists of an outer *membrane*, a clear, jelly-like ground substance called *nucleoplasm* or nuclear sap, and two kinds of enclosed bodies—the *chromosomes* and the *nucleoli*. The chromosomes are relatively long and more or less thread-like, while the nucleoli are typically globular.

The preceding description applies to the early part of the prophase stage. In later prophase, conditions change rapidly, leading to mitosis (fig. 7)—one of the most remarkable and significant processes found anywhere in nature. As the process begins, the nuclear membrane is dissolved and disappears. The nucleolus also disappears. In the cytoplasm the centrioles, two in number, move to opposite sides of the cell, if they have not already done so, and between them is formed the *mitotic spindle* (figs. 4, 7, 9 and Pl., fig. 3). This consists of a spindle-shaped system of rays, at the two ends or "poles" of which lie the centrioles. Usually similar rays also radiate out in other directions from the poles, forming *asters*. The nucleus ordinarily lies between the two asters and often the nuclear membrane disappears while the spindle is forming. In some cells, however, the spindle forms in the cytoplasm at one side of the nucleus and the two later move together. In either case the chromosomes, which are steadily becoming shorter and more dense in appearance, become "attached" to rays of the spindle and gradually move into the equator as if pulled by the rays. The rays are technically called *spindle fibres*.

Metaphase (figs. 4, 7 and Pl., figs. 2 & 3): When the chromosomes come to lie at the equator of the spindle, forming the *equatorial plate*, the metaphase stage is reached. By this time, and often much earlier, each chromosome is seen to be double, the result of a preceding split from end to end. In other words, each chromosome is duplicated in an accurate manner so that



BY COURTESY OF C. W. METZ

FIG. 7.—DIAGRAMS SHOWING CHROMOSOME BEHAVIOUR AT SUCCESSIVE STAGES IN THE LIFE CYCLE OF A TYPICAL ANIMAL CELL (ARROWS INDICATE SEQUENCE)

each daughter chromosome becomes a replica of the original. This fact has great significance for, as pointed out by Wilhelm Roux in 1883, it indicates that a chromosome is not a simple, homogeneous body, but contains a linear series of qualitatively different materials, each one of which is essential and must be passed on to each daughter cell. These materials are now identified as the hereditary units or genes, and mitosis shows how they are perpetuated, as will be seen later.

Anaphase (figs. 7, 9 and Pl., figs. 4 & 5): On the metaphase plate each double chromosome is oriented so that one member lies nearer one pole and the other nearer the opposite pole (fig. 7). Then the two sister members gradually separate and move slowly toward the respective poles, as indicated in figs. 7, 9 and Pl., fig. 5. This marks the anaphase stage, which ends when the poles are reached. As a result of the chromosome division, followed by the anaphase movements of the daughter halves, the two chromosome groups at the poles are exact and complete duplicates of the original group. Thus each of the two daughter cells, to be formed shortly, will receive such a group.

Telophase (fig. 7 and Pl., fig. 6): After the two daughter chromosome groups reach the poles each chromosome gradually takes on the appearance of a delicate, coiled thread, which subsequently uncoils and extends until it is scarcely distinguishable. This thread was present all the time (fig. 17). It is the *chromonema* (coloured thread) and represents the true, permanent part of the chromosome, including the hereditary materials. As the uncoiling takes place the chromosomes in each group become clumped and around them a new nuclear membrane is formed. These transformations mark the telophase. By the time they are completed, or soon thereafter, the cell itself begins to divide, giving rise to two separate and complete daughter cells (Pl., fig. 6). During division the cytoplasm is apportioned more or less equally by a process of pinching in two and the two parts carry with them the chondriosomes, Golgi bodies and other inclusions which they contain (figs. 9, 12). Thus the cytoplasmic structures (except the centrioles) are transmitted to the daughter cells in a very inexact manner as compared with the chromosomes. Here again we see a fact of special significance in connection with the function of different cellular elements, to be considered later.

Interphase or resting stage (fig. 7): Mitosis has now been completed and the daughter cells have entered a long interphase period which will extend to the next mitosis. This period is usually called the resting stage because no very conspicuous activities seem to be going on. Like the term "cell," however, the name is misleading, for actually a period of high activity is represented, but it is metabolic (physiological) activity, not movement. The cell is at first just half the size of the preceding one and must now grow back to full stature. Likewise, the chromosomes and all the cytoplasmic structures must be restored to the proper condition. How this is done is not known, except in very crude outline. The microscopically visible changes which occur are relatively simple. The chromosomes become delicate threads, coiled about in the nucleus, and often cannot be distinguished individually. One or more nucleoli appear. The nuclear volume increases as does that of the cytoplasm and the cell as a whole. The centriole divides into two, if it has not already done so. And the various other cytoplasmic bodies (chondriosomes, Golgi bodies, etc.) become more numerous. The basic living processes are going on. Food is being taken up and transformed into living matter in the form of known structures and apparently structureless ground substance. But we are relatively ignorant of the manner in which the transformation takes place. The latter falls within the province of the cell physiologist.

By the time the interphase or growth stage is completed, the two daughter cells have ordinarily become fully restored to the condition seen in the cell which divided to produce them. Then they in turn are ready to undergo mitosis. An entire cell cycle has been completed. If we omit bacteria and the blue-green algae, we may say that, with minor modifications, the process just described is found in almost all animals and plants. The significance of this fact can hardly be exaggerated. The original discovery that every cell comes from a pre-existing cell (*omnis cellula e cellula,* Rudolf Virchow, 1858) marked one of the milestones in biology's progress. And the further realization that cell division involves such an accurate distribution of materials, especially chromosomes, brought a flood of light into the previously obscure realm of heredity and evolution. This latter realization came about gradually through the researches of many investigators, beginning around 1870 and continuing to about 1920, by which time breeding experiments securely established the fact that hereditary units (genes) are in the chromosomes and are themselves duplicated and accurately passed on from cell to cell through mitosis.

With this picture in mind it is now possible to explore further. Several questions arise immediately. For example, what is the relative importance and significance of the various cell components just described? And what, more specifically, is the relation just mentioned between the chromosomes and heredity? These and related topics will be treated below, either separately or in connection with more detailed descriptions of the different structures. The reader will observe that a large part of the account is devoted to the chromosomes. This is not only because of the great importance of these structures, but because our knowledge of them is much more clear-cut and significant than in the case of the cytoplasmic constituents.

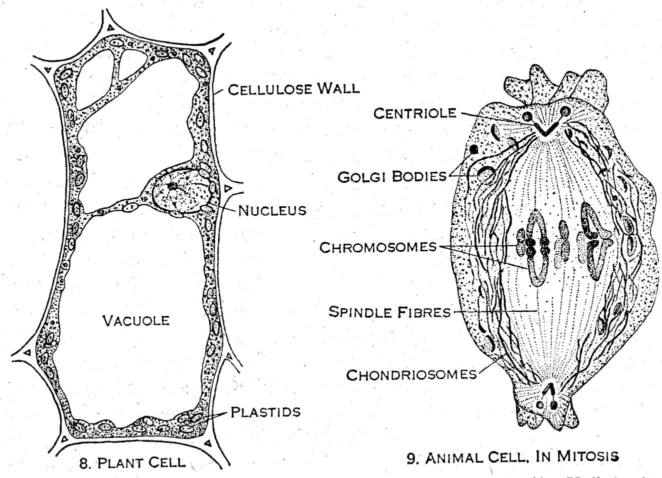
Importance and Significance of Different Cell Components.—One of the simplest ways to throw light on the relative importance and significance of the different cell components is to answer the following questions about each one: (1) How widely is the constituent distributed in nature? If it is found in all cells of animals and plants it surely is important, for nature does not perpetuate unimportant structures to that extent. If it is found in some, but not all, species it is presumably essential to the welfare of these species, but its general significance is restricted. (2) Does the constituent or its units show a significant constancy in form and number? (3) Is it self-reproducing? Constancy combined with the power of reproduction is especially significant. (4) Is it transmitted from cell to cell, and if so, how? If it is transmitted in an accurate manner we may be reasonably sure that a special mechanism is operating, and such a mechanism could hardly have evolved if the structure were not important. (5) Is the constituent susceptible to experimental modification without serious damage? This latter test is valuable at least for determining how highly organized the structure is. These criteria should be kept in mind as we give further consideration to the components listed above.

Nucleus *v.* Cytoplasm.—Although neither the nucleus nor the cytoplasm is a single constituent, a fact of broad significance may be revealed by comparing their susceptibilities to experimental modification. Many cells recover readily if part of their cytoplasm has been removed or injured. In contrast, the nucleus is unable to repair damage except within very restricted limits. Generally speaking, this means that in the nucleus each individual unit of structure is essential and self-reproducing; once lost it cannot be replaced. In the cytoplasm, on the other hand, the units making up any class of structures (chondriosomes, etc.) seem to be alike and interchangeable; if some are lost they may be replaced by their counterparts or formed anew, with the possible exception of the centrioles. This distinction between the nucleus and cytoplasm is far-reaching in its implications and will become clearer as we proceed.

CYTOPLASM

The ground substance of cytoplasm is universal in cells of all kinds and is of fundamental importance. In spite of the fact that it looks like a simple, clear or alveolar jelly under the microscope, experiments and biochemical studies all indicate that it is chemically complex and includes complex proteins of various kinds. Although having general properties in common throughout all organisms, the exact chemical nature of this material in any one species seems (at least in animals) to be different from that in every other species. Sometimes the difference apparently extends down to strains or families or even individual animals. For example, the immunity of an individual person to disease is presumably because of the particular chemical characteristics of this substance (although the characteristics may in turn be determined by genes in the chromosomes). The ground substance appears to be homogeneous and ordinarily it is simply divided into two portions by mass division at mitosis. This would indicate that usually all parts of it are alike in any one cell. In some cases, however, experiments have shown that different regions of the cell apparently contain different kinds of ground substance, even though no difference is visible under the microscope.

Vacuoles and Cell Sap.—In connection with the ground substance of the cytoplasm we may profitably consider the vacuoles and cell sap of plant cells. Vacuoles are not only common and widespread in plants, but they often become so extensive as to occupy most of the cell volume (fig. 8). They represent the seat of much metabolic activity, made possible in part by the fact that they are separated from the rest of the cell by semipermeable membranes. Their content, the cell sap, is often deceptively clear and simple in appearance but may be chemically complex. In other cases it may contain dissolved pigments which give colour to the flowers or other parts, especially the blue, purple and red colours. Or it may contain special materials which give rise to such products as gums, resins and rubber. Since this material is



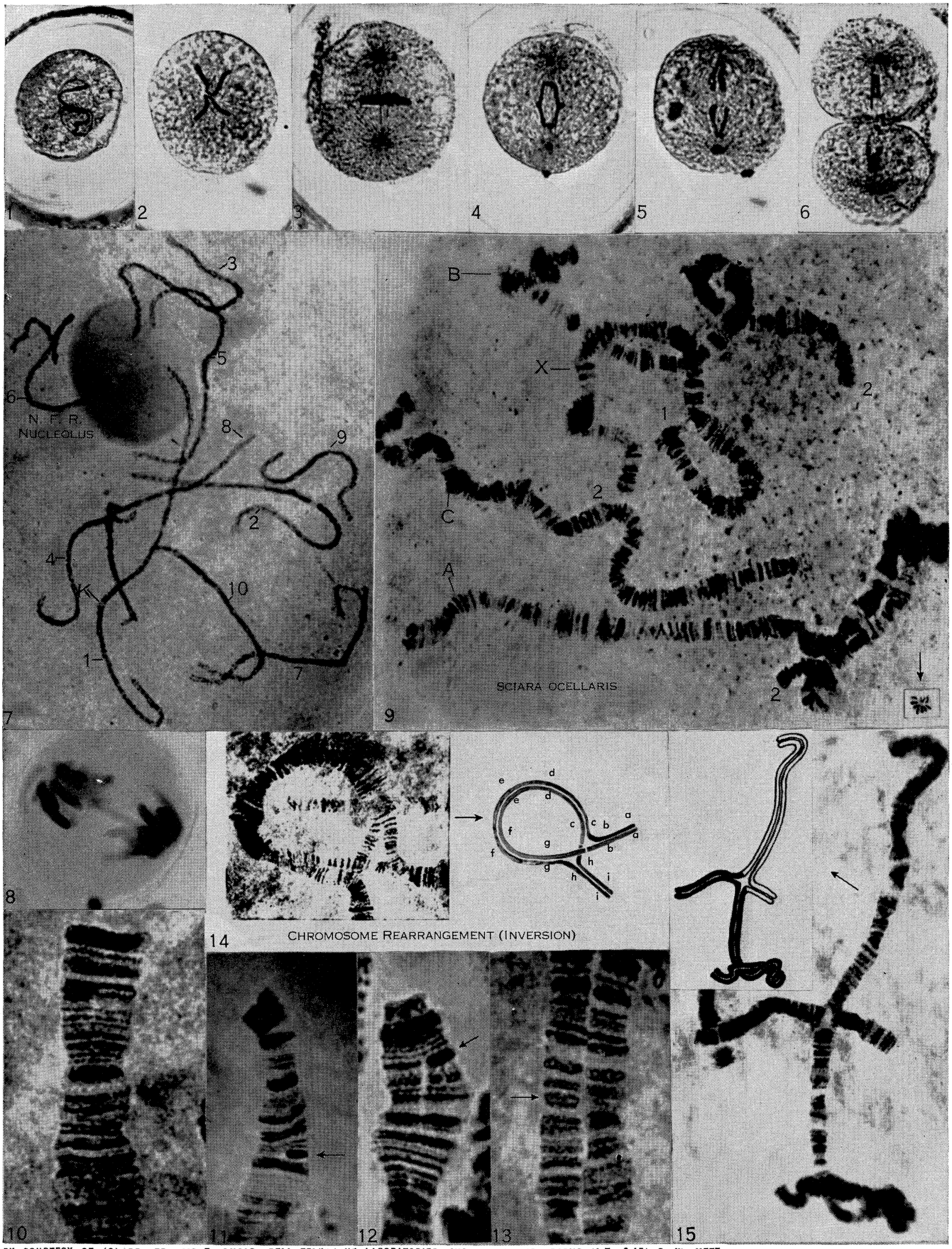
(8) FROM SEIFRITZ, "PROTOPLASM" (MCGRAW-HILL BOOK CO. INC.); (9) FROM H. H. JOHNSON, "ZEIT. WISS. ZOOL.," VOL. 140 (AKAD. VERLAGS, LEIPZIG)

FIGS. 8-9.—A PLANT CELL AND AN ANIMAL CELL, ILLUSTRATING DIFFERENT KINDS OF CELL STRUCTURES.

(8) cell of *Elodea canadensis* (after Seifritz, *Protoplasm*); (9) primary spermatocyte of tree cricket *Oecanthus nigricornis*, in mitosis, showing accurate division of chromosomes and random distribution of chondriosomes and Golgi bodies; the centrioles are of an unusual type (after Johnson, 1931), x 1800

derived mainly from the surrounding cytoplasm, its composition gives a further indication of the make-up of the latter. According to E. C. Miller (1938) the composition varies widely in different plants and under different conditions but the following materials have all been found in vacuoles: water up to 98%; inorganic salts of various kinds, especially salts of sodium, potassium, magnesium and calcium; carbohydrates, including cane sugar, maltose, glucose, fructose, dextrins and inulin; nitrogenous compounds, including proteins, amino acids, amides, proteoses and peptones; various soluble alkaloids and glucosides, which are probably waste products of the cell; gases, especially oxygen and carbon dioxide; enzymes, principally diastase, invertase, lipase, inulase and proteolytic enzymes; organic acids, including mainly oxalic, malic, citric, tartaric, tannic, acetic and formic—the last two "probably present in every living cell." In animal cells vacuoles are usually much less prominent than in plants, except in many unicellular forms (*see* PROTOZOA).

Chondriosomes or Mitochondria.—In the cells of all animals and plants, so far as known, the cytoplasm contains numerous tiny structures in the form of granules, rodlets, globules or filaments. These structures include the chondriosomes or, as they are often called, the mitochondria. But they may also include other structures, such as the plastids or proplastids in the case of plant cells, or the Golgi bodies in animal cells, or granular materials of various kinds. The accurate differentiation and identification of such structures and the study of their origin, organization, chemical constitution and function has presented a peculiarly difficult problem to the cytologist. Consequently, there is still much difference of opinion on the points mentioned. The granules or rodlets often grade in size down to, and presumably beyond, the limits of vision with the highest powers of the microscope. The globules, on the other hand, may sometimes be as large as the chromosomes, and the filaments as long. Examples of chondriosomes are shown in figs. 9, 11, 12. Chondriosomes are lipid in nature, resembling phospholipins and albumens in chemical tests. They are readily dissolved in some of the organic acids, such as acetic, and may readily be stained in the living condition with Janus green B. These characteristics, combined with those of behaviour, are usually sufficient to identify the chondriosomes when



BY COURTESY OF (8) DR. FRANCIS F. LUCAS, BELL TELEPHONE LABORATORIES, INC. PHOTOMICROGRAPHS (1-7, 9-15) C. W. METZ

PHOTOMICROGRAPHS OF CHROMOSOMES AND CELL DIVISION

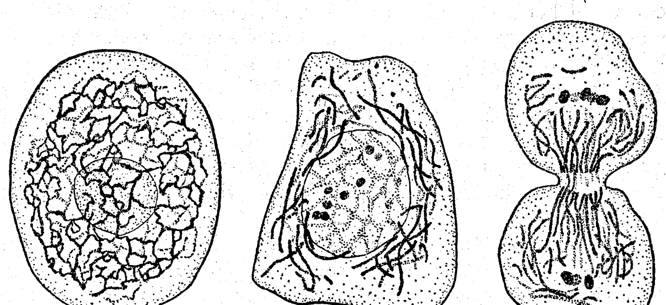
1-6, fertilization and mitosis in egg of the thread-worm, *Ascaris megalocephala:* (1) union, at fertilization, of egg and sperm nuclei, each containing one chromosome (variety *univalens*); (2-3) polar and side views, respectively, of metaphase; (4-5) early and late anaphase; (6) telophase; (7) chromosomes in a crushed pollen mother cell of maize (*Zea mays*) showing the ten pairs of chromosomes, after synapsis, and the nucleolus attached to the nucleolus-forming-region (*n.f.r.*) in pair 6 (from a preparation loaned by M. M. Rhoades); (8) mitosis in living spermatocyte of grasshopper, photographed with ultraviolet light (courtesy F. F. Lucas); (9-15) giant salivary gland chromosomes from fly larvae, all from cells which have been crushed and flattened out; (9) entire chromosome group of four pairs, with homologues closely united, from a fungus fly (arrow at lower right indicates the ordinary chromosomes of same fly at same magnification, for comparison); (10-12) parts of individual salivary gland chromosome pairs (11-12) show differences in homologues; (13) part of a pair of chromosomes in a species hybrid; (14-15) chromosome rearrangements induced by X-ray treatment (15, courtesy H. V. Crouse). Magnification: (1-6) 780 times; (7) 1,134 times; (8) 1,200 times; (9) 540 times; (10) 1,700 times; (11) 1,200 times; (12, 13) 1,700 times

they are in the form of filaments or vesicles. To determine which among the smallest granules are mitochondria, however, is often impossible.

In some cases, at least, it is clear that chondriosomes, or bodies made up of chondriosome material, divide; but whether the individual elements regularly reproduce and never arise *de novo* is not clear. Some observers maintain that they are not permanent cell organs and do arise *de novo* in the form of minute granules in the cytoplasm. A similar disagreement exists regarding the function of chondriosomes. Among the functions attributed to them are those of: giving rise to yolk spheres in some eggs; production of fatty droplets in some gland cells; development into plastids which produce starch and various pigments in plant cells; and possibly the formation of certain types of fibrils, such as nerve fibrils, during differentiation of specialized cells. Other observers, however, maintain that they are the products rather than the agents of metabolic activity. In the formation of the animal sperm they go through a series of remarkable transformations which culminate in the production of an elaborate structure in the "middle piece" of the tail (fig. 5).

As implied by the above, chondriosomes readily undergo wide changes in size and form in many cells. Likewise, they appear to change radically in number, even in individual cells. Small chondriosomes may unite to form larger ones, or may apparently multiply rapidly to form greatly increased numbers. As cells become specialized during development the number often becomes greatly reduced. Such characteristics add to the difficulty of getting a real understanding of the nature and function of these structures. The evidence leads to the conclusion, however, that the individual chondriosomes in a cell are essentially alike in composition and that the precise number is not important. In other words, they are all made of the same stuff and presumably it is merely necessary to have enough of this material present.

Plastids.—Related to chondriosomes, and possibly arising from them, are the plastids (fig. 8). These structures are characteristic of plant cells, but not animal cells. Whether plastids are permanent, self-reproducing cell structures is difficult to determine, but there is an increasing volume of evidence to indicate that they are and that they regularly multiply by division. The green plastids, containing chlorophyll, in which photosynthesis takes place, are responsible for most of the food that main-



10 11 12

GOLGI NETWORK IN GANGLION CELL — RANDOM DISTRIBUTION OF CHONDRIOSOMES IN SPERMATOCYTES

(10) FROM SHARP, "INTRODUCTION TO CYTOLOGY" (MCGRAW-HILL BOOK CO. INC.); (11 & 12) FROM R. H. BOWEN, "BIOL. BULL." (MARINE BIOL. LABORATORY)

FIGS. 10-12.—GOLGI MATERIAL AND CHONDRIOSOMES

(10) Golgi network in spinal ganglion cell of rabbit (from Sharp, 1934, after Golgi); (11 & 12) chondriosomes in primary spermatocytes of the bug *Euschistus euschistoides*, showing their position around the nucleus in the interphase (11) and their random distribution at cell division (12) (after Bowen, 1920), x 1600

tains animal life, as well as plant life, on the earth. It is in these green *chloroplasts* that carbon and oxygen from the carbon dioxide in the air are combined with hydrogen from water to produce sugar. Although photosynthesis is still not fully understood by physicists and chemists, it is clear that the green pigment, chlorophyll, has the ability to take up energy from sunlight and utilize this energy to bring about the chemical process just mentioned (*see* PHOTOSYNTHESIS). Other chloroplasts (coloured plastids) produce other colours in plants, such as the yellows and browns seen in leaves, and some of the reds. Like the chondriosomes, plastids undergo wide changes in size, form and number. Their chemical composition is not adequately known, but they appear to be relatively rich in protein and lipid materials. In addition to chloroplasts several kinds of colourless plastids, known as leucoplasts, are found, including those which produce starch grains.

Golgi Materials or Golgi Bodies (figs. 9, 10).—In animal cells a type of fatty material is known which blackens in osmic acid, is readily impregnated with silver and exists in a wide variety of morphological conditions—fibrils, canals, networks, crescents, globules, etc. This is known as the Golgi material, named after its discoverer, who first observed it (1898) in nerve cells. Its prominence in gland cells, its association with secretion droplets and its lipid nature indicate that its function is probably secretory; although just how it functions is unknown. Such a function helps to explain its widely different appearance in different types of cells. In nerve and gland cells, *e.g.,* it often forms a "reticular apparatus" of fibres or canals (fig. 10) whereas in insect spermatocytes it is represented by small, separate bodies known as Golgi bodies or dictyosomes (fig. 9) which are usually composed of two portions having unlike staining qualities. Some authors maintain that the dictyosomes should not be classed with Golgi material.

Notwithstanding the fact that in some cells the Golgi bodies resemble chondriosomes in appearance, the two types of constituents are clearly distinct in so many cases that they must, in general, be put in different categories. This is shown by behaviour as well as by physical and chemical characteristics (specific gravity, staining reactions, etc.). For example, in animal sperms the Golgi material forms the acrosome or perforatorium at the tip of the sperm head, while, as just noted, the chondriosomes form most of the "middle piece" of the tail (fig. 5).

The Golgi material is not known to be regularly self-reproducing, and at mitosis it is distributed in a random rather than an accurate manner to the two daughter cells. Some authors have maintained that Golgi material in animal cells is represented in plants by the vacuoles (considered above) but there is no general agreement on the subject. Taking the evidence all together, therefore, it would appear that the Golgi bodies have more limited significance than the chondriosomes. Likewise, it seems probable that they are involved in activities that do not occur in plant cells or are carried on there by other agents, such as the vacuoles.

Centrioles (figs. 7, 9 and Pl., figs. 3 and 4).—These structures are prominent in many animal cells and appear to be lacking for the most part in plants. They are usually dot-like in appearance and often difficult to distinguish from granules in the cytoplasm; but in some cases they are in the form of rods or filaments, or are V-shaped or dumbbell shaped (fig. 9). It is too early to determine their full significance, partly because their nature is in dispute and partly because we are not sure that they are lacking where they are not seen (as in most plant cells). There is some reason to believe that in the latter cases they are submicroscopic and possibly multiple (*see* Franz Schrader, 1944). Where evident, they show a constancy in number (usually one at each pole of the mitotic spindle) and they divide regularly and are distributed accurately at mitosis. The latter are important and significant attributes, paralleled only in the chromosomes. If it should ultimately be found that centrioles are present in essentially all cells, therefore, as suggested above, there can be little doubt of their importance. Their significance is clear, in a general sense, for they are obviously a part of the mitotic apparatus and appear to be involved somehow in the mitotic movements of chromosomes. But when we attempt to explain how they function in this latter activity we meet conflicting data and ideas, which cannot be summarized here (*see* Schrader, 1944). One interesting recent suggestion is that the centriole is the counterpart of the kinetochore, a structure found in each chromosome at the point where the spindle fibre is attached. **Other Cytoplasmic Bodies:** In addition to the kinds of structures listed above, the cytoplasm may contain various other bodies such as oil droplets and yolk spheres (fig. 4), crystals and tiny granules of unknown nature. Mention may also be made of such cell products as the cellulose walls of plant cells and the cartilage and bone produced by animal cells.

Cell Wall.—This component is placed at the end of the list because it presents a special problem. Most cells possess cell walls, and there is no question about the general importance of the structure. But whether or not we say that all cells have cell walls depends in part on how we define a cell. There are some organisms, such as the slime moulds, which do not have cell walls in the ordinary sense. And in some other organisms there may be regions or parts in which cell walls are lacking or there may be stages in development during which cell walls are absent. For example, during the early development of many insect eggs, after fertilization, mitoses occur until many nuclei are present, each surrounded by an area of cytoplasm but without a cell wall. These areas or islands move about through the yolk and other materials until they get into the right places and then a cell wall forms around each one, making a typical cell. Is such a structure a cell before the wall is formed, or not until afterward? Opinions differ. Some authors regard the entire egg as a single multinucleate cell until the walls are formed, and likewise regard the slime mould as a multinucleate but single-celled organism, even though it shows specialization of parts. Correspondingly, two different definitions of a cell are given.

According to some authors a cell consists of a mass of protoplasm enclosing a nucleus; according to others it is a mass of protoplasm surrounded by a cell membrane or cell wall and enclosing one or more nuclei.

NUCLEUS

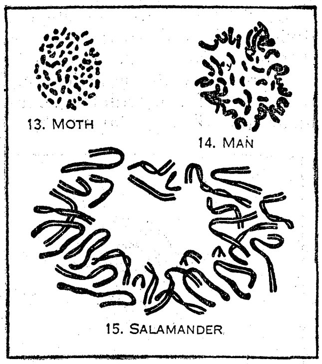
Since the nuclear membrane disappears during each cell division, the nucleus as a separate body is not a permanent cell organ. Likewise, it does not appear to exist in the bacteria. But the constituent which gives significance to the nucleus, namely the chromosome material, or chromatin, is apparently universally distributed and essential. **Nucleoplasm or Nuclear Sap:** This material is ordinarily clear and structureless in appearance and seems to be homogeneous. It differs to some extent, at least, from the ground substance of the cytoplasm, for chemical tests show it to be more acid than the latter. **Nucleoli:** Ordinarily, two kinds of nucleoli are recognized, the so-called chromosome nucleoli or *karyosomes* and the "true" nucleoli or *plasmosomes*. The former are simply dense, deeply staining parts of chromosomes and need no special treatment here. We may confine our attention, therefore, to the plasmosomes. Long listed among the least understood of cell constituents, the so-called true nucleoli are now reasonably well known, at least as regards their origin and fate. Barbara McClintock, who made major contributions in the field (1934), was able to demonstrate that in maize each nucleolus is produced in some manner by a chromosome through the agency of a "nucleolus-forming region" which occupies a specific place in the chromosome. The nucleolus arises in the form of a bleb from the nucleolus-forming region (Pl., fig. 7). The fact that the nucleoli ordinarily appear during telophase, as the chromosomes become indistinct, and then disappear in prophase as the chromosomes become condensed and deeply staining, is considered an indication of exchange of material between chromosomes and nucleoli.

Chromosomes.—The relation of chromosomes to heredity was previously mentioned. But to appreciate the chromosomes fully we must also consider them from another viewpoint, and it will be advantageous to examine that aspect first. Cytologists have long been searching for more and more exact knowledge as to what makes the cell a living unit and as to whether any of the structures it contains may in turn be regarded as living units. From this standpoint the chromosomes stand out as the most significant and remarkable. They are highly organized bodies which possess the three living properties of growth, accurate reproduction and movement characteristic of the cell itself. There is also some evidence that they possess irritability. We are concerned, therefore, with anything which will throw light on the nature of chromosomes. Practically, this means studying their form, structure, chemical make-up and behaviour as well as their role in heredity.

Chromosome Number, Size and Shape.—When the chromosomes are arranged at the equator of the spindle during mitosis it is possible, in favourable material, to see each member clearly, so the total number in the cell may be counted and the sizes and shapes of the different members observed (figs. 13-15 and Pl., fig. 2). The set as a whole is referred to as the "chromosome group" of that cell. By comparing such groups, from cell to cell, individual to individual and species to species, highly significant facts about chromosomes have been revealed. Most of these were discovered during the last quarter of the 19th century through the studies of the group of men referred to below. The following principles, laid down then, have become firmly established. Where exceptions occur they serve to throw additional light on some of the problems involved, but do not disturb the principles themselves. In the first place, as would be expected from the nature of the mitotic process already described, the chromosome group in the fertilized egg is handed on intact to all the cells during development, so all cells in the adult have the same group. Secondly, the chromosome group is constant for all the individuals of any one species of animal or plant, but differs greatly between different species. In the third place, the individual chromosomes in a chromosome group often are not all alike in size and shape; they may differ widely from one another, as seen in figs. 14, 15 and 23. Studies on such cases have shown that there are two chromosomes of each kind in each group. In other words, the chromosomes are in pairs (fig. 16). And it is known that one member of each pair comes from the mother and the other from the father. That is, the unfertilized egg has one chromosome of each kind, and the sperm brings in at fertilization the other member of each kind (fig. 16 and Pl., fig. 1). Thus, in inheritance the two parents contribute equally. Such evidence led Theodor Boveri and others to enunciate the now well established principle of the *individuality* and *continuity* of chromosomes. According to this principle the two members of each pair of chromosomes are qualitatively alike, but they differ in composition from the members of all the other pairs of the group. And each chromosome retains its identity from generation to generation in spite of the fact that it changes its form at different stages in the cell cycle and is usually lost to view when the chromonema uncoils into a delicate thread during the interphase. In terms of hereditary materials, then, we may say that each kind of chromosome in the group contains a different set of hereditary units and that therefore each kind of chromosome must be present in order to have a full complement of hereditary materials (genes). Furthermore, it is evident that each germ cell (egg and sperm) carries a full set of genes before fertilization and that the fertilized egg, which results from their union, and the cells descending from it, carry a double set of genes (fig. 16). This fact forms one of the cornerstones in the foundation of the science of genetics, as will be seen in more detail later.

Another cornerstone is provided by certain events which occur when the eggs and sperms are themselves formed. Recalling the principle that during the development of an animal or plant all the cells have the double set of chromosomes, it is evident that if these chromosomes all went into each egg and sperm, fertilization would result in again doubling the number. So unless some regulating process intervened each animal or plant would have twice as many chromosomes as its parents. Such a process does intervene, however; it occurs during what is called *meiosis*, or maturation of the germ cells, the general outline of which is shown in fig. 16. The details will concern us later. During meiosis the chromosomes undergo a *reduction* in number, such that each egg or sperm receives only one member of each pair of chromosomes—*i.e.*, one chromosome of each kind, as shown in fig. 16. This counterbalances the union of two sets of chromosomes at fertilization and keeps the number constant from generation to generation.

Like other characteristics of present day animals and plants the numbers, sizes and shapes of the chromosomes came about through evolutionary changes. Some groups of organisms tend to have certain distinctive kinds of chromosome groups. For example, in moths and butterflies (Lepidoptera) there is usually a large number of very small spherical chromosomes, such as shown in fig. 13. In man (fig. 14), in monkeys, in many birds and some other groups of vertebrates the number of chromosomes is smaller, and various sizes and shapes are represented in individual chromosome groups. In the salamanders (fig. 15) most of the chromosomes are very large and long. From the evolutionary point of view the main fact that stands out is that there was no single trend, such as that from small to large chromosomes or few to many chromosomes. Various kinds of changes evidently took place independently in different lines of descent among different groups of animals and plants. How some of these changes may have occurred will be suggested later.



(13) J. SEILER, "ARCH. F. ZELLFORSCHUNG," (VERLAG VON WILHELM ENGELMANN, LEIPZIG); (14) FROM T. S. PAINTER, IN "JOURNAL OF EXPERIMENTAL ZOOLOGY," VOL. 37, 1923 (THE WISTAR INSTITUTE OF ANATOMY AND BIOLOGY); (15) FROM C. L. PARMENTER, IN "JOURNAL OF MORPHOLOGY," VOL. 33, 1919 (THE WISTAR INSTITUTE OF ANATOMY AND BIOLOGY)

FIGS. 13-15.—EXAMPLES OF DIFFERENT KINDS OF CHROMOSOME GROUPS (13) from a moth, *Taleoporia tubulosa* (after Seiler, 1921), x 1500; (14) from man (after Painter, 1923), x 1650; (15) from a salamander *Ambystoma* (after Parmenter, 1919), x 880

Structure and Chemical Nature of Chromosomes.—In favourable material it is possible to see that during mitosis, when the chromosomes are condensed, each has somewhat the appearance represented schematically in fig. 17. It consists of a closely coiled thread, the *chromonema,* which may be double, embedded in a jelly-like *matrix.* Although important in some respects, the matrix does not appear to be a permanent part of the chromosome and may be ignored here. The chromonema is the essential part. Its structure is best revealed when it is uncoiled and extended. Then it appears (in "fixed" preparations) as a series of many tiny, deeply staining granules, called *chromomeres* (Pl., fig. 7), connected by a delicate strand of so-called linin material which may be chemically different from the material in the granules. In most chromosomes there is also a differentiated structure at the point where the chromosome is attached to its spindle fibre at mitosis. This structure

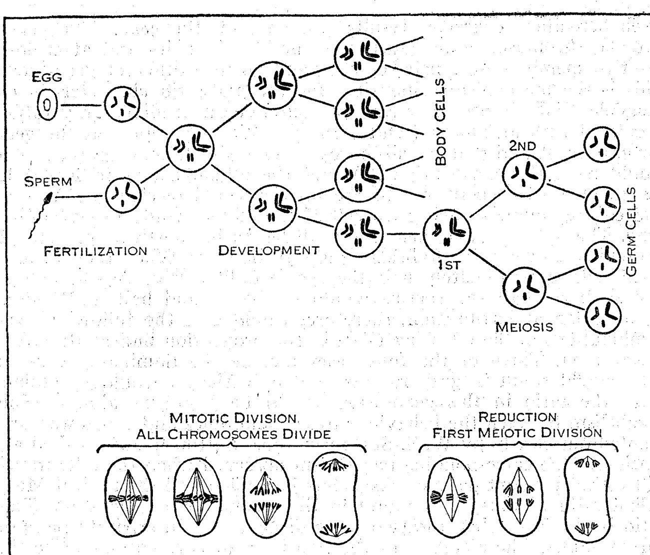


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FIG. 16.—DIAGRAMS SHOWING THE HISTORY OF THE CHROMOSOMES FROM FERTILIZATION OF THE EGG, THROUGH EMBRYONIC DEVELOPMENT (WHERE ALL CHROMOSOMES DIVIDE AT EACH CELL DIVISION, OR MITOSIS) AND FORMATION OF THE GERM CELLS (MEIOSIS), WHERE THE CHROMOSOME NUMBER IS REDUCED

is given various names, such as spindle fibre attachment, kinetochore and centromere. It usually has the appearance of a small, nonstaining vesicle as shown in the diagram (fig. 17) and at K in the photomicrograph of maize chromosomes (Pl., figs. 7 and 8). The body appears to take an active part in chromosome movement during mitosis; but how it functions is unknown. In some animals, such as most of the true bugs (Hemiptera), each chomosome has many minute kinetochores and a corresponding number of spindle fibres, instead of the usual single one.

The granules or chromomeres in the chromosome appear to be composed largely of nucleoproteins rich in nucleic acid, which accounts for their staining properties and their selective absorption of ultra-violet light. The exact nature of these granules is of great interest because they probably contain the units (genes) responsible for Mendelian heredity. The linin matherial, on the other hand, is less deeply staining and appears to react differently in chemical tests, indicating that it contains proteins, but perhaps not nucleoproteins (*see* below).

Especially noteworthy advances have been made in the study of chromosome structure since 1934 when the long known, but misinterpreted, bodies in the salivary gland nuclei of fly larvae, were recognized as true chromosomes (by E. Heitz and Hans Bauer, by T. S. Painter, and by R. L. King and H. W. Beams). These giant chromosomes call for special consideration, both here and in later paragraphs. They are found only in the salivary glands and other glands of the larvae of Diptera (two-winged flies.) The maggots of ordinary houseflies, blowflies, or fruit flies are good examples of such larvae. The salivary gland cells here grow to a relatively enormous size, and their nuclei and chromosomes become proportionately enlarged (Pl., figs. 9–15). When fully developed, in the full grown larva, these chromosomes are about 100 times as long and probably at least 2000 times as great in volume as they were originally or as the chromosomes are in the ordinary cells. Just how or why they undergo such enlargement is not yet clear. Neither is it certain that they do not become altered in other respects during enlargement, for the cells in which they are found become highly specialized and disintegrate without undergoing another division. Nevertheless, observations and experiments have shown that these chromosomes reflect to a high degree the true conditions in ordinary chromosomes and that evidence obtained from them is mostly applicable to the latter.

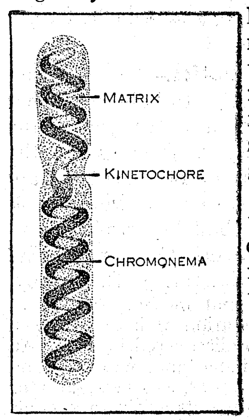

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FIG. 17. — SIMPLIFIED DIAGRAM OF A CHROMOSOME IN THE CONDENSED STAGE (AT TIME OF MITOSIS); ACTUALLY THE CHROMONEMA IS USUALLY DOUBLE

Pl. figs. 8 and 9 show a photomicrograph of the salivary gland chromosomes from a fungus fly, together with a photomicrograph (indicated by arrow at the lower right), of the chromosomes from an ordinary cell of the same fly, both taken at the same magnification. Aside from the enormous size difference, the first thing to strike the eye here is the pattern of deeply staining cross bands or disks in the giant chromosomes. This at once reveals in a convincing manner the linear differentiation postulated long ago by Roux and required by the subsequent findings of geneticists in their breeding experiments. Not only is the chromosome made up of a series of alternating deeply staining and nonstaining disks, like coins in a tube, but the pattern is highly complex and specific. No two parts of a chromosome, or of different chromosomes, have the same pattern (except a few short regions which are actual duplicates of one another and are especially interesting on that account). Evidence secured after 1934, especially from the fruit fly *Drosophila* on which so much breeding work has been done, leaves little question that the deeply staining disks contain the genes responsible for heredity. Even the exact disk which contains a given gene is known in some cases. It is not yet certain, however, whether only one gene is located in the spot occupied by one disk, or whether the total number of genes in a chromosome exceeds the number of disks and the disks are themselves compound in the linear direction. The latter possibility is suggested by the fact that when a chromosome is stretched, as often happens in the process of preparing a slide for study, some of the thicker disks are seen to be made up of two or more thinner ones.

Numerous attempts have been made to study the chemical structure of the chromosomes, from the time of F. Miescher who (in the 1870s) identified the main constituent of sperm heads as substances now known as nucleoproteins. All such attempts meet the obvious difficulties of intracellular chemistry. Methods are required for separating the desired structures from other cellular components, to permit analysis by standard chemical techniques. Likewise, the results must be supported by microchemical identification of substances in the structures themselves in the microscopic preparations. Study of sperm heads, which are composed almost entirely of chromosomes, was extended to other types of nuclei, partly through the use, after 1930, of new techniques. The nucleic acid of the chromosome has a remarkably uniform composition. It is made up of units (nucleotides) composed of a purine or pyrimidine base, combined with the phosphoric acid ester of a pentose sugar, desoxyribose (known only in chromosomes). Nucleic acids with another type of sugar (ribose) likewise occur, but they are mainly in the cytoplasm. In combination with the nucleic acids are various proteins, differing somewhat in different organisms; these include protamines, histones and others not yet identified. In ultra-violet light the chromosomes show a characteristic absorption spectrum, corresponding to that of the nucleoproteins. Among the microchemical tests are: the Feulgen reaction, which shows that desoxyribose nucleic acid is located only in chromosomes; staining tests of various kinds; and digestion with various enzymes which remove the nucleic acid and leave the underlying fibrous protein structure intact. Such studies led to the suggestion that a chromosome may be composed of nucleoprotein units, the genes, connected by, or attached to, a fibrous protein thread.

Chromosomes and Heredity—Cytogenetics.—The fact that hereditary materials are in chromosomes came to light somewhat gradually as early investigators saw more and more clearly the parallelism between the behaviour of the chromosomes and the behaviour of inherited characters. The chromosome evidence appeared largely during the period from 1870 to 1900, when cytology was advancing at a rapid rate through the labours of such investigators as H. Fol, Otto Buetschli, Boveri, O. Hertwig, W. Flemming, E. Van Beneden, Eduard Strasburger, J. B. Carnoy, C. O. Whitman and Wilson. The chromosomal mechanism was at hand, therefore, on which to base an interpretation of heredity when the Mendelian principles of inheritance were rediscovered in 1900. An account of Mendel's work and of Mendelian inheritance will be found in the article on heredity and so only the general aspects necessary for present purposes will be outlined here. These aspects apply to animals and plants alike, although subject to various modifications in special cases where the chromosome mechanism is correspondingly modified.

The chromosome mechanism with which we are concerned is the one already mentioned in connection with reduction of the chromosome number during the formation of the germ cells. It operates during meiosis. Superficially, what happens is relatively simple, as may be seen from the following outline, which treats first the history of the cells and then that of the chromosomes. Early in the embryonic development of many animals certain cells may be distinguished as the ones whose descendants will produce the eggs or sperms. These are the cells of the germ line, called *oogonia* or *spermatogonia* as the case may be. They take part in the formation of the ovaries or testes. After multiplying sufficiently by mitosis, as shown in fig. 16, they suddenly stop dividing and enter a long "growth stage." This takes the place of the ordinary resting stage or interphase. They are now called *primary oocytes,* in the ovary, and *primary spermatocytes,* in the testis. Later these divide to produce the *secondary* oocytes or spermatocytes, which in turn divide to produce the final eggs and sperms, as shown in fig. 16. The process is somewhat different in the two sexes, for in the male each primary spermatocyte gives rise to four sperms, whereas in the female the divisions are unequal as regards the cytoplasm and only one of the four cells from each primary oocyte actually gets enough cytoplasm to function as an egg. The latter result has the beneficial effect of providing the fertilized egg with a relatively large amount of cytoplasmic food material with which to begin its development.

The chromosome behaviour is essentially the same in both sexes (and in plants). For the sake of simplicity we will consider only animal spermatogenesis (meiosis), as outlined in fig. 16. In the primary spermatocyte homologous chromosomes come together side by side in pairs—a process called *synapsis.* They also divide, if they have not already done so, and each pair of chromosomes becomes a tetrad of four members (figs. 16, 20). Then two cell divisions occur without any further division of the chromosomes. These are the primary and secondary spermatocyte divisions just mentioned. They are called *meiotic* divisions to distinguish them from the ordinary mitotic divisions in preceding cell generations. At the first meiotic division two of the four members of each tetrad go to one pole, and thus into one secondary spermatocyte, and the other two go to the other. Then at the second division the two members which remained together separate and go to opposite poles. As a result of these two meiotic divisions the four sperms derived from each primary spermatocyte get just one chromosome of each kind.

By referring to the article on heredity it will be seen that the units responsible for hereditary characters show the same kind of assortment and distribution as that just described for the chromosomes.

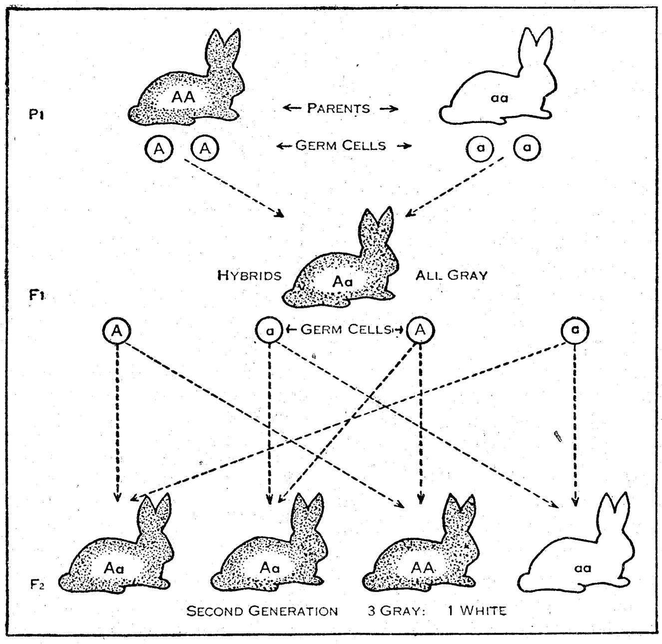

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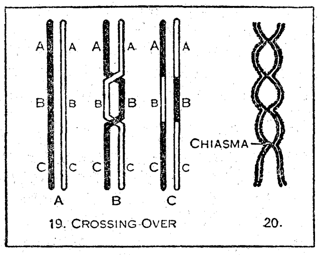
FIG. 18.—DIAGRAM ILLUSTRATING THE BEHAVIOUR OF A PAIR OF HEREDITARY GENES (MENDELIAN INHERITANCE)

A, gene for gray colour; a, gene for albino (white). This behaviour parallels that of the chromosomes. P_1, parents; F_1, first hybrid generation; F_2, second generation

Each hereditary character results from a unit, the *gene.* The genes, like the chromosomes in which they lie, are in pairs and at meiosis the two members of a pair separate and go into different germ cells. This is the mechanism responsible for the 3:1 ratio characteristic of Mendelian inheritance. For example, suppose an ordinary gray rabbit is crossed with an albino (white) rabbit. We may represent the gene for gray by A and that for albino by a. The wild-type, or gray, rabbit would have the constitution AA and the albino aa, as indicated in fig. 18 (P_1). Each germ cell of the former would receive one A gene, and correspondingly each germ cell of the albino would receive one a gene. The hybrids (F_1) then would all be Aa in constitution. Since A is dominant over a the hybrids would all be gray. When they formed germ cells, approximately half the eggs would receive A and half a, and similarly half the sperms would receive A and half a. Random combination at fertilization, therefore, would give the following gene combinations in the offspring (F_2), in the proportion indicated: 1 AA, 2 Aa, 1 aa. Three of the four cases include the dominant A gene; they would result in gray rabbits, and only the aa would be albino. Thus the ratio in this generation would be 3 gray:1 albino. This parallelism between the behaviour of chromosomes and genes was first pointed out clearly by W. S. Sutton in 1902. Sutton likewise called attention to the corresponding parallelism observed when the inheritance of two independent pairs of characters is studied and the typical Mendelian ratio of 9:3:3:1 is found in the second (F_2) generation. This ratio is obtained when the two pairs of genes are in separate pairs of chromosomes. The members of the two pairs of chromosomes, like the genes, segregate independently of one another in the hybrid. That is, the two from the mother do not regularly go into one germ cell and the two from the father into another. They are just as apt to assort so that one from the mother goes with one from the father. Thus, four types of germ cells are formed in equal numbers and sixteen combinations are produced in the F_2 generation, giving the 9:3:3:1 ratio.

But now, we may ask, what happens if two pairs of genes are in one pair of chromosomes instead of separate pairs? When this condition is found we get what is known as gene *linkage.* That is, the two genes in a chromosome tend to remain together in subsequent generations. They are said to be *linked*. But they may separate from one another occasionally, or frequently, by means of a process called *crossing over* (T. H. Morgan, 1911). As Morgan pointed out, if the genes are arranged in linear series in the chromosomes the two homologous chromosomes, making a pair, would have similar or identical series of genes, and if these chromosomes exchanged segments crossing over of genes would result, as shown schematically in fig. 19. Furthermore, since crossing over can occur at any point on the chromosome, the amount or frequency of crossing over between two genes that are far apart in the chromosome should be greater than that between two genes close together. Sturtevant (1913) found by experimental tests that definite and consistent amounts of crossing over are obtained between any two linked genes and that on this basis the actual serial order of the genes can be determined, as well as their relative distances apart.



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FIGS. 19-20.—DIAGRAMS OF CROSSING OVER, OR SEGMENTAL INTERCHANGE, BETWEEN HOMOLOGOUS CHROMOSOMES, EFFECTING EXCHANGES OF GENES

In (19), the gene series ABC and abc become changed to AbC and aBc. For the sake of simplicity only the two crossover strands are shown here. Exchanges are believed to occur at the chiasma points, when the chromosomes are in the four-strand tetrad condition shown in (20)

The discovery of the phenomena of linkage and crossing over in the banana fly, *Drosophila melanogaster*, by Morgan, and the exploration of the field by Morgan, A. H. Sturtevant, H. J. Muller, C. B. Bridges and subsequent workers, was epoch-making, in the field of cytology as well as genetics. It made possible a much more refined analysis of chromosome organization than any based on cytological observations alone. And it provides an excellent illustration of the integration which came about between cytology and genetics. Although investigations were carried further in the banana fly than in any other material, similar phenomena became well known after 1911 in numerous other organisms, several of which, such as maize, made valuable contributions to the subject. To understand these phenomena we must examine meiosis in detail.

We are especially concerned with what takes place in the primary spermatocytes or oocytes during the relatively long meiotic growth period, which involves a series of events not found in any other cell generation. Making allowance, as usual, for many minor differences in different species, and also for some major ones which cannot be treated here, we may say that in most higher animals and plants the basic pattern of events is as follows. Early in the growth period the coiled *chromonema* in each chromosome becomes fully extended into a *leptotene thread*, which may be double through previous division. Often the threads form loops marking a *bouquet stage*, as shown in figure 21A, with the ends all pointing toward a cluster of cytoplasmic bodies, called the idiozome, outside the nucleus. Then homologous threads, representing the two members of each pair of chromosomes, gradually come together side by side in an intimate synaptic union, usually beginning at the ends and progressing toward the middle of the loops (fig. 21B). When completed, this gives rise to the *pachytene* stage (fig. 21C), in which the two homologous chromosomes are often so intimately united as to look like a single structure, under the microscope. The intimate union is especially significant, for much evidence indicates that it marks the stage, or the beginning of the stage, at which an exchange of segments occurs between homologous chromosome threads. Synapsis, together with doubling of each of the two threads, produces the tetrad condition already mentioned. There has been considerable difference of opinion as to whether doubling of the threads precedes or follows synapsis. In a good many organisms, at

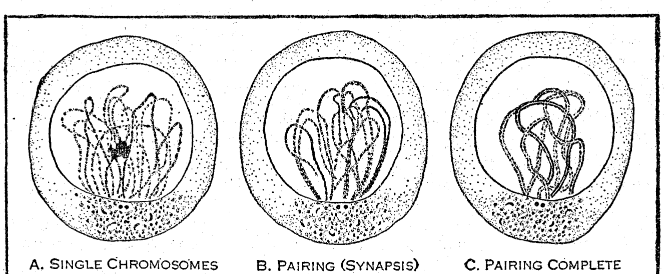

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FIG. 21.—BEHAVIOUR OF THE CHROMOSOMES (SEMIDIAGRAMMATIC) AT THE TIME OF SYNAPSIS, WHICH LEADS TO CROSSING OVER

least, it seems clearly to precede. In any event, genetic studies show that segmental interchange (crossing over) occurs when the structure is a tetrad, and that an exchange occurs between only two of the four threads at any one place. Numerous theories have been advanced as to the nature of crossing over and the mechanism which brings it about, but there is as yet no direct evidence and little agreement on the critical aspects. Following the pachytene stage, the threads of the tetrad become less intimately associated and often show that they are looped or twisted about one another in various ways. As they do this they usually remain associated in twos, and often cross connections in the form of an X are evident here and there as represented in fig. 20. Such a double connection is called a *chiasma* and its original position is believed to be the place where an interchange has taken place or will take place (depending on which hypothesis of crossing over one advocates). It is unfortunate that so far these finer details of chromosome behaviour have eluded direct observation, for they hold the key to some of the most important problems concerning the organization of the chromosomes and the nature of genes.

At present we do not know whether the chromosome threads fuse at the points of interchange before the exchange of partners occurs, or whether they break and the free ends unite in new combinations, or whether, as on another view, the new combinations are brought about during reproduction of the chromosomes, without either fusion or breakage.

If we combine the findings of genetics and cytology we may make the following statements with reasonable assurance: (1) In crossing over the exchange is so exact that it ordinarily involves precisely the same series of genes in the two chromosomes; and so it requires an accurate pairing of the threads gene for gene. (2) In most organisms such an accurate alignment occurs only during synapsis; thus the synaptic union provides not only an excellent opportunity, but the only satisfactory one, for such an exchange. (3) Direct cytological observations, on suitable material, have shown that segmental interchange actually does occur during meiosis. (4) Genetic crossing over has been shown to occur at a time when four threads are present (tetrad condition); but only two threads undergo exchange at any one place. (5) The formation of chiasmas and the configuration of the chromosomes following synapsis conform to what would be expected on the basis just outlined; therefore they are believed to reflect the actual segmental interchanges.

The Sex Chromosomes.—From ancient times people were puzzled by the fact that in man, and most of the common animals with which he is familiar, males and females are produced in approximately equal numbers. Many fanciful ideas were suggested centuries ago to account for the phenomenon; but the real answer had to wait until the rapid strides of cytology (about 1880 to 1900) focused attention on the chromosomes as probable agents in heredity. As already indicated, it was found in this period that chromosomes are ordinarily present in pairs, one member from each parent. Then it was noted that in some species one of the chromosomes in the male has no mate, whereas all the chromosomes in the female are in pairs, as indicated in fig. 22A and B. And it was found that as a result of the reduction division during meiosis in the males (fig. 22C) half the sperms receive the odd chromosome and the other half lack such a chromosome entirely. In other words, two different kinds of sperms are formed in equal numbers. This led C. E. McClung to suggest in 1902 that one of these kinds of sperms is male-determining and the other female-determining and that the odd chromosome is responsible for sex determination. Subsequent evidence supported and amplified this interpretation and led to the recognition of sex chromosomes in a wide range of animals and also in numerous dioecious plants (plants in which the sexes are separate).

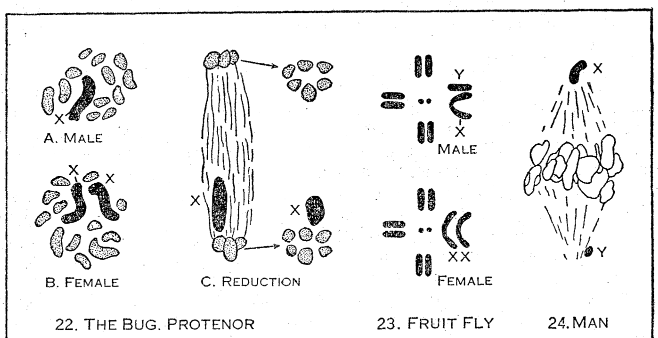
In the condition just described, the male has one X chromosome and the female two. The other chromosomes, designated autosomes, are alike in both sexes. It is evident, therefore, that sex determination rests on a quantitative basis. One X gives a male, two X's a female.

The sex chromosome conditions just described, however, are found in relatively few species. In most animals the situation is different, and at first sight the difference appears to be great. In many animals the male, instead of having an unpaired X chromosome, has two sex chromosomes one of which is an X like the two in the female, but the other a different chromosome, referred to as a Y chromosome (fig. 23). In a large number of animals the Y is much smaller than the X and so is conspicuously different from it. This is true, for example, in man (fig. 24). In others there is no difference in appearance between the two. In all cases, however, there is a qualitative difference. The Y chromosome may lack most of the hereditary materials (genes) found in the X and in any event appears to lack the main materials of the X which influence sex. So far as sex-determining genes are concerned, therefore, a male with an X and a Y chromosome is equivalent to one having only an X. Two types of sperms are produced here, one bearing an X, the other a Y. The former is "female-determining" as before, and the latter is "male-determining," like the kind having no X.

In contrast to the mechanism just described, where the male produces two kinds of sperms, we find in some groups of animals just the reverse condition. Here the male produces only one kind of sperm, but the female produces two kinds of eggs. The chromosome conditions are correspondingly modified. The male possesses a pair of sex chromosomes, both alike; the female possesses a sex chromosome of this same kind, and in addition a different one, corresponding to the Y in the male in the cases mentioned above. Such a condition is found, *e.g.,* in birds and in the group of insects (Lepidoptera) which includes the moths and butterflies. To distinguish this type of condition from the preceding one the symbols W and Z are sometimes used instead of X and Y, so that WW represents the male and WZ the female.

The sex chromosome mechanism just considered is only found in species in which the two sexes are represented by separate individuals and the eggs have to be fertilized before they will develop. The situation may be different where the eggs and sperms (or, in plants, ovules and pollen grains) are produced by one individual (*see* HERMAPHRODITE) and also where the eggs are able to develop without fertilization (*see* PARTHENOGENESIS).

Chromosome Changes, Spontaneous and Induced.—The mounting evidence that evolutionary changes, for the most part, originate in chromosomes, led to intensive studies on chromosome alteration. Comparative studies revealed the kinds of modifications which



(22) FROM E. B. WILSON, "ARCH. F. MIKROS. ANAT.," (VERLAG VON FRIEDRICH COHEN, BONN); (23) BY COURTESY OF C. W. METZ; (24) FROM T. S. PAINTER, IN "JOURNAL OF EXPERIMENTAL ZOOLOGY," VOL. 37, 1923 (THE WISTAR INSTITUTE OF ANATOMY AND BIOLOGY)

FIGS. 22-24.—SEX CHROMOSOMES IN ANIMALS

(22) from a bug, showing the complete chromosome group of a male and that of a female, together with the process of reduction during meiosis in the male as a result of which half the sperms receive the X chromosome and half get no sex chromosome at all (after Wilson 1911); (23) diagram, entire chromosome groups of a fruit fly, *Drosophila pseudoobscura,* in which the male has unlike sex chromosomes (X and Y); (24) reduction division in a spermatocyte of man, showing the segregation of the two unlike sex chromosomes, X and Y (after Painter, 1923), x 1700

occur and persist in nature, and experimental treatments, especially with X-rays and other forms of irradiation, have shown that the same kinds may be induced artificially. A great impetus was provided by Muller's discovery, in 1928, that mutations resulting in new inherited characters may be induced with X-rays. Subsequently it was found that irradiation also induces gross chromosome alterations; indeed, one type was detected by J. W. Mavor as early as 1921. Spontaneous, and also induced, changes are mainly of three types (omitting those whose effects are too small to be detected under the microscope). One involves change in chromosome number, through addition or loss of one or more whole chromosomes. This includes doubling of the chromosome group (tetraploidy) which is found especially in plants, seldom in animals. Another involves *deletion* (loss) or *duplication* (addition) of portions of individual chromosomes. These latter types are studied to best advantage in the giant salivary gland chromosomes of flies, because here a modified chromosome from one parent may be brought together with an unmodified one from the other parent, so as to reveal the modification clearly. Examples of spontaneous alterations which appear to include deficiencies and duplications are shown in Pl., figs. 11–13. The first two are from specimens within one species. The last (Pl., fig. 13) is from a species hybrid. Here the two homologous chromosomes from the two parent species lie side by side, permitting a detailed comparison of the chromosome structure. From such hybrid material it is possible to determine what changes occurred during the evolutionary divergence of the two species from a common ancestor (*see* Theodosius Dobzhansky 1941). The third type of change involves rearrangement of chromosome materials, without addition or loss. This type includes mainly *inversions* and *translocations.* In an inversion a piece of chromosome loses its connections and becomes reconnected in an inverted position. An example is shown in Pl., fig. 14, where a chromosome with an inverted section (*c-g* in the diagram) is paired side by side with a normal one, forming a loop with cross connections. A translocation involves the shifting of a piece of chromosome to an entirely new position, usually into another chromosome, and often involves a reciprocal exchange of parts between nonhomologous chromosomes. An example of the latter is shown in Pl., fig. 15, where the two modified chromosomes from one parent are paired with the corresponding parts of their normal homologues from the other parent, forming a cross figure having the constitution indicated in the inserted diagram (at upper left). In this diagram the two normal, nonhomologous chromosomes from the one parent are represented in solid black and solid white, respectively. The other two are the ones which previously exchanged segments—a short terminal portion of the white chromosome having been exchanged for a somewhat longer piece of the black one.

Aside from their more obvious role of bringing about evolutionary changes of a morphological nature, chromosome rearrangements are important in other respects. For example, they sometimes produce what is known as "position effect." The latter results in a new, inherited character believed to be the result of the changed association of the genes. In other words, the phenomenon indicates that the activity of a gene is influenced by its neighbours and may change when the gene is put into association with new neighbours.

Although cytogenetics represents one of the most recent developments in cytology it has already made rapid strides; and it holds even greater promise for the future, through extension of studies on evolutionary change and through further application of physical and chemical methods to analysis of the make-up and function of chromosomes and genes.

Other branches of cytology likewise hold great potentialities, especially where they overlap the fields of cell physiology and medecine (see *e.g.,* Lewis Heilbrunn, 1943). Indeed this ramification of cytology into the various other branches of biology ensures it a varied and ever changing future.

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CYTOLOGY OF PLANTS: *see* CYTOLOGY; PLANTS AND PLANT SCIENCE: *Anatomy of Plants.*

CYTOPLASM, the term used in biology to denote all the living contents of the cell (protoplasm) other than the nucleus (*q.v.*). (*See* CYTOLOGY, PROTOPLASM, CELL.)

CYZICENUS, an architectural term used by Vitruvius for certain large halls, facing north, in Greek houses. Such halls usually overlooked gardens and had large, low windows in order to give the widest possible view.

CYZICUS, an ancient town of Mysia in Asia Minor, situated on the shoreward side of Arctonnesus, which is said to have been originally an island in the Sea of Marmora, and to have been artificially connected with the mainland in historic times. It was, according to tradition, occupied by Thessalian settlers at the coming of the Argonauts, and in 756 B.C. the town was founded by Greeks from Miletus. Owing to its advantageous position it speedily acquired commercial importance, and the gold *staters* of Cyzicus were a staple currency in the ancient world till they were superseded by those of Philip of Macedon. During the Peloponnesian War (431–404 B.C.) Cyzicus was subject to the Athenians and Lacedaemonians alternately, and at the peace of Antalcidas (387 B.C), like the other Greek cities in Asia, it was made over to Persia. The history of the town in Hellenistic times is closely connected with that of the dynasts of Pergamum, with whose extinction it came into direct relations with Rome. Cyzicus was held for the Romans against Mithridates in 74 B.C. till the siege was raised by Lucullus: the loyalty of the city was rewarded by an extension of territory and other privileges. Still a flourishing centre in Imperial times, the place appears to have been ruined by a series of earthquakes. The principal extant ruins are:—the walls, which are traceable for nearly their whole extent, a picturesque amphitheatre intersected by a stream, and the substructures of the temple of Hadrian. Of this magnificent building, sometimes ranked among the seven wonders of the ancient world, thirty-one immense columns still stood erect in 1444.

See J. Marquardt, *Cyzicus* (Berlin, 1830); G. Perrot, *Exploration de la Galatie* (Paris, 1862); F. W. Hasluck, *Cyzicus* (1910).

CZARNIECKI, STEPHEN (1599–1665), Polish general, fought in the Prussian campaigns against Gustavus Adolphus (1626–29), and under Wladislaus IV. in the Muscovite campaign of 1633. In the invasion of Poland by Charles X. of Sweden (1655), a national army under Czarniecki ultimately drove out the Swedes, and after the Peace of Oliva (1660) also penetrated into Muscovy, winning victories at Polonka and Lachowicza. He died in 1665 just after he had been appointed Polish commander-in-chief.

See Ludwik Jenike, *Stephen Czarniecki* (Pol.) (Warsaw, 1891); Michal Dymit Krajewski, *History of Stephen Czarniecki* (Pol.)

(Cracow, 1859).

CZARTORYSKI, ADAM GEORGE, Prince (1770–1861), Polish statesman, was the son of Prince Adam Casimir Czartoryski and Isabella Fleming. After a careful education at home under tutors, one of whom was Dupont de Nemours, he first went abroad in 1786. At Gotha he heard Goethe read his *Iphigenie auf Tauris,* and met Herder and Wieland. In 1789, and again in 1793, he visited England, and made many acquaintances among the English aristocracy and studied the British constitution. In the interval between these visits he fought for his country during the war of the second partition, and would subsequently have served under Kosciuszko also had he not been arrested on his way to Poland at Brussels by the Austrian government. After the third partition the estates of the Czartoryskis were confiscated, and in May 1795 Adam and his younger brother Constantine were summoned to St. Petersburg (Leningrad), and presently ordered to enter the Russian service. Catherine restored part of their estates, and in the beginning of 1796 made them gentlemen in waiting. Adam had already met the grand duke Alexander and the youths at once conceived a strong "intellectual friendship" for each other after the accession of Alexander to the throne. As adjunct of foreign affairs, he had the practical control of Russian diplomacy. His first act was to protest energetically against the murder of the duc d'Enghien (March 20, 1804), and insist on an immediate rupture with France. On June 7 the French minister Hédouville quitted St. Petersburg; and on Aug. 11 a note dictated by Czartoryski to Alexander was sent to the Russian minister in London, urging the formation of an anti-French coalition. It was Czartoryski also who framed the Convention of Nov. 6, 1804, whereby Russia agreed to put 115,000 and Austria 235,000 men in the field against Napoleon. Finally, on April 11, 1805, he signed an offensive-defensive alliance with England. A memorial written by him in 1805, but otherwise undated, aimed at transforming the whole map of Europe. Austria and Prussia were to divide Germany between them. Russia was to acquire the Dardanelles, the Sea of Marmora, the Bosporus with Constantinople, and Corfu. Austria was to have Bosnia, Wallachia and Ragusa. Montenegro, enlarged by Mostar and the Ionian islands, was to form a separate state. England and Russia together were to maintain the equilibrium of the world. In return for their acquisitions in Germany, Austria and Prussia were to consent to the erection of an autonomous Polish State extending from Danzig to the sources of the Vistula, under the protection of Russia. But in the meantime Austria had come to an understanding with England as to subsidies, and war had begun.

In 1805 Czartoryski accompanied Alexander both to Berlin and Olmütz as chief minister. He regarded the Berlin visit as a blunder, chiefly owing to his profound distrust of Prussia; but Alexander ignored his representations and in February 1807 he lost favour and was superseded by A. E. Budberg, but continued to enjoy Alexander's confidence in private. In 1810 Czartoryski quitted St. Petersburg for ever; but the personal relations between him and Alexander were never better. The friends met again at Kalisch shortly before the signature of the Russo-Prussian alliance of Feb. 20, 1813, and Czartoryski was in the emperor's suite at Paris in 1814, and rendered his sovereign material services at the congress of Vienna.

On the erection of the congressional kingdom of Poland Czartoryski contented himself with the title of senator-palatine and a share in the administration. In 1817 the prince married Anna Sapiezanko, the wedding leading to a duel with his rival Pac. In 1823 he retired to his ancestral castle at Pulawy; but at the Revolution of 1830 he became president of the provisional government, and summoned (Dec. 18, 1830) the diet of 1831. After the termination of Chlopicki's dictatorship he was elected chief of the supreme council by 121 out of 138 votes (Jan. 30). On Sept. 16 he left the government after sacrificing half his fortune to the national cause. On Aug. 23 he joined Girolano Ramorino's army corps as a volunteer, and subsequently formed a confederation of the three southern provinces of Kalisch, Sandomir and Cracow. At the end of the war he emigrated to France, where were spent the last 30 years of his life. He died at Montfermeil, near Meaux, on July 15, 1861. He left two sons, Witold (1824–65), and Wladyslaus (1828–94), and a daughter Isabella, who married Jan Dzialynski in 1857.

The principal works of Czartoryski are *Essai sur la diplomatie* (Marseilles, 1830); *Life of J. U. Niemcewiez* (Pol.) (Paris, 1860); *Alexander I. et Czartoryski: correspondance . . . et conversations* (1801–1823) (1865); *Mémoires et correspondance avec Alex. I.,* with preface by C. de Mazade (1887); an English trans. *Memoirs of Czartoryski, etc.,* edited by A. Gielgud, with documents relating to his negotiations with Pitt, and conversations with Palmerston in 1832 (London, 1888).

See also Bronislaw Zaleski, *Life of Adam Czartoryski* (Pol.) (Paris, 1881); Lubomir Gadon, *Prince Adam Czartoryski* (Pol.) (Cracow, 1892); Ludovik Debicki, *Pulawy,* vol. iv.; Lubomir Gadon, *Prince Adam Czartoryski during the Insurrection of November* (Pol.) (Cracow, 1900).

CZARTORYSKI, FRYDERYK MICHAL, Prince (1696–1775), Polish statesman, completed his education at Paris, Florence and Rome; he then attached himself to the court of Dresden and obtained the vice-chancellorship of Lithuania. Czartoryski was one of the nobles who, on the illness of Augustus II. in 1727, signed the secret guarantee of the Polish succession to his son; but he supported Stanislaus Leszczynski when he was placed upon the throne by the influence of France in 1733. When Stanislaus abdicated in 1735 Czartoryski voted for Augustus III. (of Saxony), who employed him and his family against the Potockis. For the next 40 years Czartoryski was the leading Polish statesman. In foreign affairs he was the first to favour an alliance with Russia, Austria and England, as opposed to France and Prussia—a system difficult to sustain and not always beneficial to Poland or Saxony. In Poland Czartoryski stood for reform. Promising young men were educated at his palace. He aimed at the restoration of the royal prerogative and the abolition of the *liberum veto* which made any durable improvement impossible. The Czartoryskis were therefore unpopular with the ignorant *szlachta,* but for many years they had the firm support of the Saxon court, especially after Brühl succeeded Fleming.

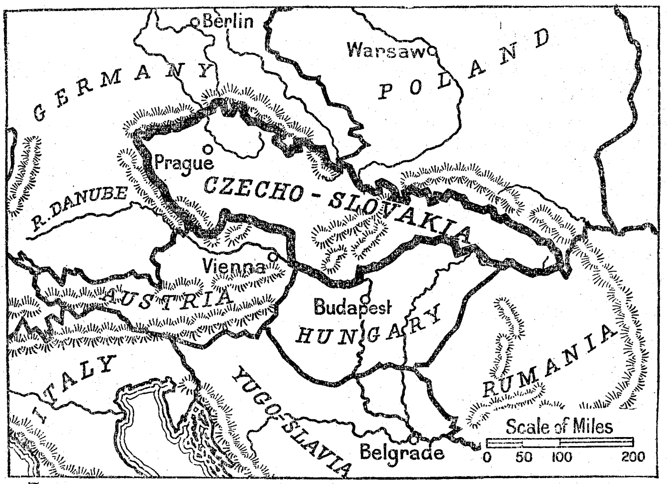
Czartoryski reached the height of his power in 1752 when he was entrusted with the great seal of Lithuania; but after that his rival, Mniszek, began to prevail at Dresden, whereupon Czartoryski sought a reconciliation with his opponents at home and foreign support in England and Russia, in the latter country unsuccessfully. Czartoryski's philo-Russian policy had estranged Brühl, but he frustrated the Saxon court by dissolving the diets of 1760, 1761 and 1762. In 1763 he proposed the dethronement of Augustus III., who died the same year. To his disgust his incompetent nephew, Stanislaus, was elected king in 1765 after an interregnum occupied by constitutional discussions. Czartoryski's foreign policy was very vacillating, and he changed his "system" more frequently perhaps than any contemporary diplomatist. But he was an able and patriotic statesman.

See the *Correspondence* of Czartoryski in the Collections of the Russian Historical Society, vols. vii., x., xiii., xlviii., li., lxvii. (1890, etc.); Adalbert Roepell, *Polen um die Mitte des XVIII. Jahrhunderts* (Gotha, 1876); de Broglie, *Le Secret du roi* (1878); Wladyslaw Tadeusz Kisielewski, *Reforms of the Czartorysccy* (Pol.) (Sambor, 1880); Ludwik Denbicki, *Pulawy* (Pol.) (Lemberg, 1887–88); Carl Heinrich Heyking, *Aus Polens und Kurlands letzten Tagen* (1897); Antoni Waliszewski, *The Potoccy and the Czartorysccy* (Pol.).

CZECH (Čech), a name signifying an inhabitant of "Čechy," the native name for Bohemia, but in use confined to the native Slavonic inhabitants of that country and of Moravia. The Czechs, with the Lusatians, Poles and Slovaks, form the western group of the Slav family; for their ethnographical position within that family, and their language, *see* Europe: *Races and Peoples.* The native home of the Czechs to-day lies in the Czechoslovak republic (*see* Czechoslovakia), in which they are the dominating race, occupying about two-thirds of Bohemia, four-fifths of Moravia, and the districts which formerly were known as Austrian Silesia. North-west, west and south they are neighbours with a Germanic population; to the north-east, in the district of Teschen (*q.v.*) they border on the Poles, the ethnographical dividing line being difficult to draw in this region. East, the Czechs have for neighbours the Slovaks, a race closely akin to them, who inhabit the southern slopes of the northern Carpathians, in what until 1918 was northern Hungary. While dogmatic statement is difficult, there was probably no real distinction between the original "Czechs" and "Slovaks." The accident of history, the former forming, first an independent state, and later a part of Austria, while the latter remained for a thousand years under Hungarian rule, led to separate development, which was accentuated by religious differences. The Slovaks contributed some of the most prominent Panslavist and Czech national apostles of the late 18th and early 19th centuries. Political considerations, however, led some of them to crystallize Slovak into a literary language, distinct from Czech, and this feeling of Slovak individuality afterwards became a confusing political factor, some of the Slovaks being prepared to sink their differences in their community with the Czechs, even at the cost of some sacrifices, while others considered that the Czechoslovak republic, in which the two nations were united, should have made much greater allowance for the differences between them.

The early history of the Czechs is very obscure, and cannot be discussed apart from that of the Slavs in general. Czech legend, as preserved by the chronicler Cosmas of Prague, relates that Čech, a noble of Croatia (probably White Croatia, or Galicia), having committed homicide, fled with his followers to Bohemia, and first settled on the Řip mountain, near Roudnice. The youngest of Krok's three daughters, Libuša, became ruler of Bohemia, founded Prague, and married a ploughman, who became the founder of the Přemyslides, or first native Bohemian dynasty.

It is probable that the Slavs arrived in Bohemia, which was then tenanted by Germanic tribes, not later than the 7th century A.D., perhaps earlier. They are first mentioned unmistakably in A.D. 805 and the first certain historical state in these provinces is the kingdom of Great Moravia (*see* MORAVIA), destroyed by the Magyars in 904–905. While Slovakia now passed under Magyar rule, the Czechs founded the kingdom of Bohemia (*q.v.*), which for centuries was among the most powerful and glorious in Europe. During this early period the religious movement among the Czechs (*see* HUSSITES) influenced all Europe. The Czechs were always in close contact with the Germans who with them inhabited Bohemia, and Germanic influence undoubtedly accounted for their cultural development, which in many ways was far in advance of that of any other Slavonic race. Under the Habsburgs, however, and especially in the days of the Counter-Reformation, the Czech national life and language were almost eliminated. The national revival began in the 18th century, and its manifestations



THE FRONTIERS OF CZECHOSLOVAKIA AS ESTABLISHED JUNE 12, 1919

filled much of the public life of Austria-Hungary in the 19th century (*see* AUSTRIA). At last the nation achieved independence, with the Slovaks, in 1918 (*see* CZECHOSLOVAKIA).

According to the official census of 1918, the Czechs and Slovaks of Czechoslovakia numbered 8,760,937, or 65.5% of the population of that state. There were also considerable colonies in Canada, the United States of America, and other countries, a large Czech colony in Vienna, and many Slovak settlements in Hungary. Czechs supplied a very high proportion of the domestic servants and of the tailors in Central Europe, Czech tailors, in particular, thriving even in England. The romantic national calling of the Slovaks was that of itinerant broom-binders. Besides this, however, Czechs supplied a high proportion of distinguished names in the history of the Austrian empire. They have a fine national literature (*see* CZECH LANGUAGE AND LITERATURE) and art, while in music they are particularly distinguished. It is sufficient to mention the names of the Czech composers Dvořák and Smetana. Business in Bohemia and Moravia was largely in the hands of Germans or Jews until the 20th century, when the Czechs began to make rapid progress in this field also.

(C. A. M.)

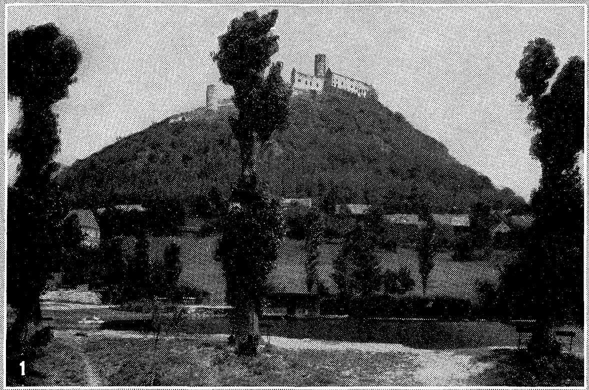
CZECHOSLOVAKIA is an independent republic in Central Europe, proclaimed on Oct. 28, 1918, and confirmed by the peace treaties after World War I. It comprised Bohemia (*q.v.*), Slovakia (*q.v.*) and Ruthenia (*q.v.*) In Oct. 1938, the Germans, Hungarians and Poles annexed about one-third of the country's territory and the nation was transformed into a federated state of Czechs, Slovaks and Ruthenians. This state ceased to exist in March 1939, the Germans annexing the lands of Bohemia, Slovakia becoming nominally independent and Hungary seizing Ruthenia. After Germany's defeat in May 1945, the Czechoslovak republic was reborn. Ruthenia was ceded to the U.S.S.R.

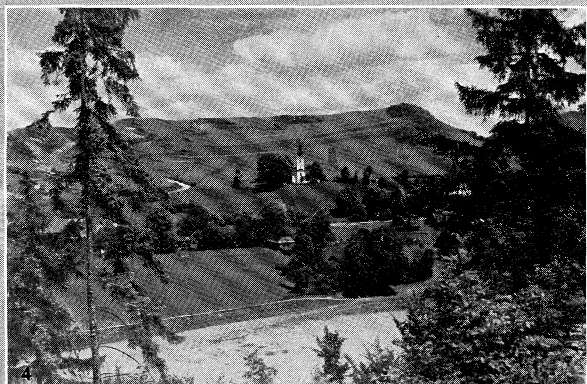
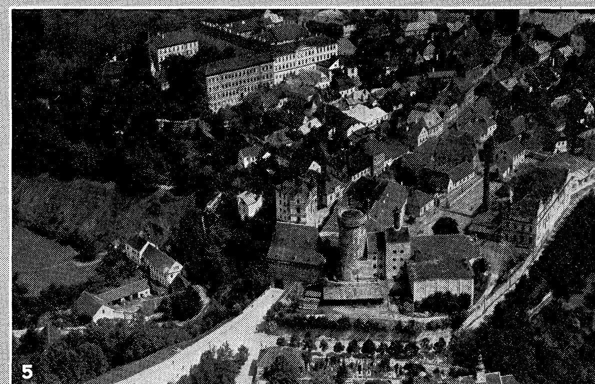
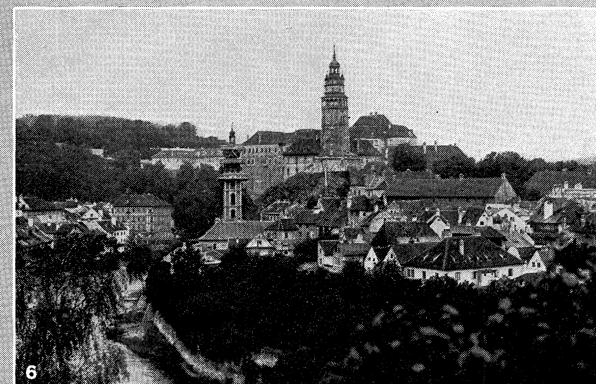
The republic of Czechoslovakia occupies a position of greatest strategic and political importance in the heart of Europe. The territory it occupies lies athwart a maze of frequented routes and forms a zone of contact between the Germanic and Slav worlds. It comprises two highly contrasted types of land form, each having a characteristic natural endowment. One, the old resistant upland region including Bohemia and parts of Moravia and Silesia, on account of the surrounding mountain ranges a natural bastion in Central Europe, gravitates mainly towards the North sea, is rich in mineral wealth and has deeply experienced the force of French and Germanic cultural influences, which are reflected in its advanced agriculture and industrialization, dense population and network of communications, and the modernism of its outlook which is definitely Western, progressive and democratic. The other, the folded ranges of the Carpathians (*q.v.*), has been naturally and politically drawn toward the Danube and the less progressive pastoral and agricultural region of Europe. Here, a sparse and disseminated population still clings to the old customs and primitive methods which are fostered by an isolation in mountain-girt basins. The administrative problem, faced by Czechoslovakia, of reconciling the divergent interests within the country was difficult, and the shape and physical structure of the country combined to increase the severity of the task. The W.-E. length amounted to 594mi., whereas the breadth varied from 175mi., to less than 45 miles. The capital, Prague (*q.v.*), had a peripheral location and was difficult of access from the remote and self-contained eastern districts with which it had originally few affinities and whose wider contacts had been traditionally established in the direction of the middle Danube. In spite of these difficulties Czechoslovakia succeeded in building up a modern and progressive state based upon an appreciation of the demands arising from diversity of natural endowment and historical experience and of the necessity of combining regional autonomy with the needs of a common protection of progressive standards of democracy and national development.

Climate and geographic formation are equally advantageous for agriculture. Climatically the country is transitional from oceanic to continental, as the following table shows:

Place	Long.	Height in ft.	Average temp. in Fahr. deg.			Rain-fall in inches
			Jan.	July	Year	
Prague . . .	14°25′E.	650	29.6	66.2	48.2	19.6
Prešov . . .	21°10′E.	850	25.7	66.6	46.8	25.6

Variations in altitude and exposure, however, prevent uniformity and are important in agriculture. Thus, in the sheltered parts of the valleys of the Morava and Elbe and in the basins of the Carpathians that open southward the vine appears, while fruits and



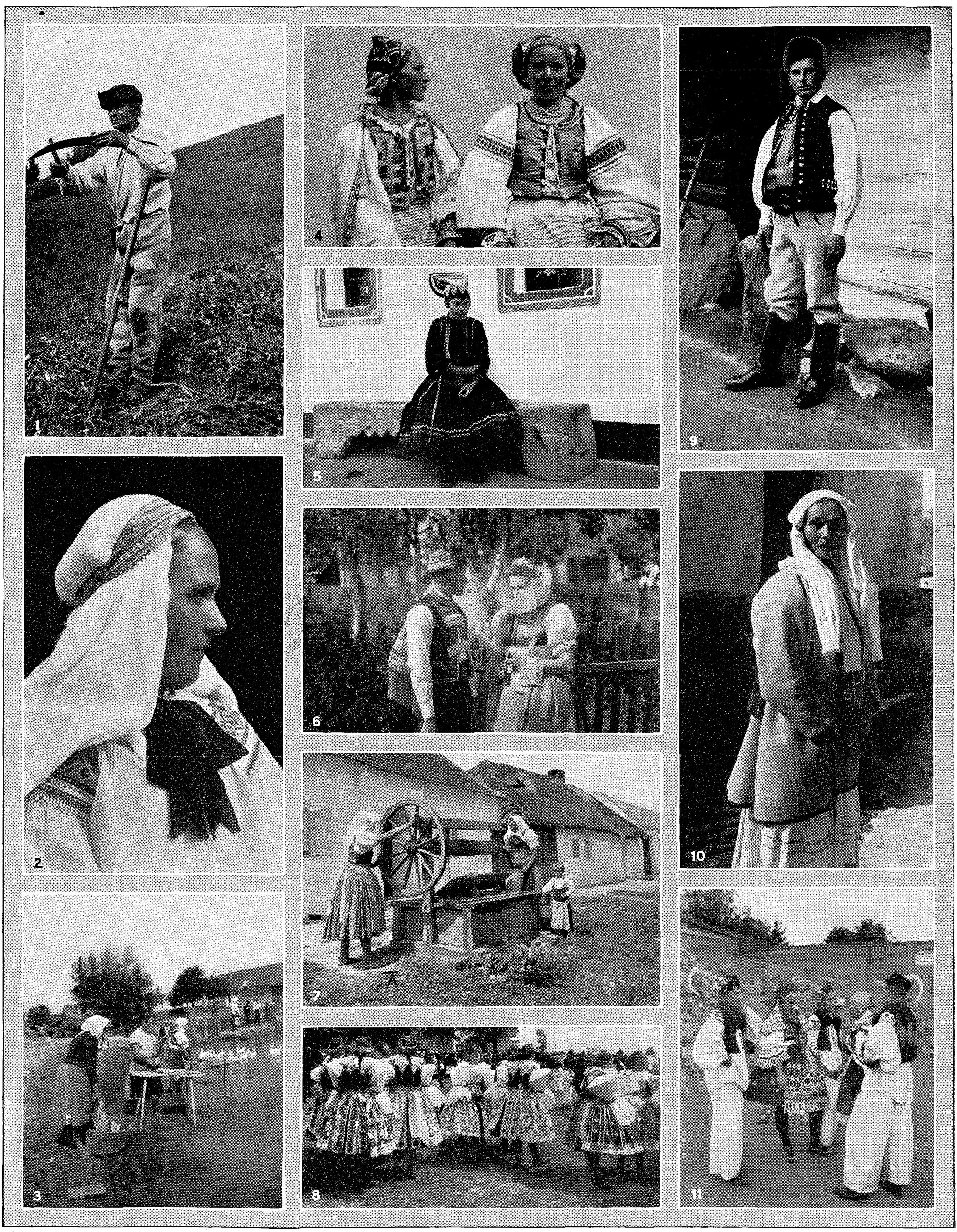






BY COURTESY OF THE CZECHOSLOVAKIAN CONSULATE

VIEWS OF BOHEMIA AND SLOVAKIA

1. Ruins of the royal castle of Bezdež, in north Bohemia
2. Town square in the historic city of Pisek, north Bohemia
3. Centre of Košice, an industrial city of Slovakia, showing theatre
4. General view of the country in vicinity of Orava, Slovakia
5. Tábor, south Bohemia, founded by Hussites in 14th century
6. Krumlov, an ancient city of south Bohemia
7. Jáchymov, health resort near radium mines of north Bohemia
8. Carlsbad, Bohemia, a resort noted for its medicinal springs
9. Centre Carlsbad, showing town hall; next to it the palace well

CZECHOSLOVAKIA



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PROVINCIAL TYPES OF MORAVIA AND SLOVAKIA

1. A farmer from the town of Stvola, in the province of Slovakia. 2. Peasant woman from Zliechov, Slovakia. 3. Women washing clothes near Bratislava, Slovakia. 4. Slovakian peasants from Helpa, in national costume. 5. A woman from vicinity of Levice, in Slovakia. 6. A bride and groom from the province of Moravia. 7. Peasants drawing water from street well, Slovakia. 8. Moravian peasants from the village of Blatnice, in holiday costume. 9. A man from Stvola, Slovakia, in Sunday dress. 10. An old woman from Zliechov, Slovakia. 11. Moravians in holiday costume

maize ripen and the lower slopes and plains offer striking contrasts to the raw and rainy highlands. As in the Eastern Alps enclosed basins suffer from inversions of temperature, but settlement and cultivation here rise to a height fully 600ft. above the limit in the former region. Precipitation is distributed advantageously for agriculture, fully two-thirds of the annual total falling in the spring and summer months. Heavy winter snowfalls are common in the highland regions and navigation on both Elbe and Danube is usually interrupted by ice for six to eight weeks.

Relief and climate combine to make Czechoslovakia one of the richest forest lands in Europe; conifers cover 55% of the forested area, deciduous growth 30%, the remainder being mixed woodland. The limit of tree growth varies from 5,000ft. in the Tatra mountains to 4,000ft. in the East Carpathians.

Population, Religion and Settlement.—The population of the republic at the 1930 census was 14,729,536, of whom 249,971 were foreigners. The following table shows the distribution of the native population according to provinces, together with the percentage figures for the principal nationalities represented:—

Province	Population (citizens)	Nationality					
		Czecho-slovak	German	Magyar	Ruthene	Jew	Pole
Bohemia	7,109,376	67·1	32·3	0·1	0·1	0·18	....
Moravia & Silesia	3,565,010	74·1	22·8	0·1	0·1	0·5	2·3
Slovakia	3,329,793	72·0	4·5	17·5	2·8	2·0	....
Carpathian Ruthenia	725,357	4·8	1·9	15·4	63·0	12·9	....
Czechoslovakia	14,729,536	66·9	22·3	4·8	3·8	1·3	0·6

This ethnic variety of the population presented a great difficulty for Czechoslovakia. The young state, however, succeeded gradually in overcoming these difficulties by a strict application of its democratic constitution and of the principle of the equality of all citizens before the law, by providing all the minorities as amply with schools and cultural institutions in their own languages as the Czechoslovaks themselves enjoyed, and by trying to draw the minorities into active and constructive participation in the administration. Nevertheless the large German minority which lived mostly in compact blocks along the north-western and south-western frontiers in the most highly industrialized zones of the country, and the Magyar minority living compactly in the southern plains of Slovakia contiguous with Hungary, continued to demand the grant of more extensive autonomy.

A similar demand for autonomy was also raised by part of the Slovak population which amounted to some 25% of the 9,688,770 persons classified as Czechoslovaks. The Slovaks, although racially and linguistically most closely related to the Czechs, nevertheless had been separated from them politically for many centuries and for historical as well as economic reasons their cultural level was in general much lower than that of the Czechs. In fact, passage eastward through the country marks a decrease in density of population consequent upon the change from industry to agriculture, a change from Roman to Greek form of religion, the appearance of more primitive house-types and a rapid increase in the proportion of illiterates. The house-types and village-forms reflect the differences of peoples and occupations as well as the physical contrasts from region to region. The modern ferro-concrete buildings of the industrialized western towns scale down to the rude wooden hutments of pastoral Ruthenia; the solid four-square form of the German varies only in the height and nature of its roof according to local climatic conditions and is an informative contrast to the smaller half-timbered house of the Czech and the thatched wooden structures of the Slovak. Correspondingly customs, social organization and dress vary considerably from those of advanced civilization to others that have scarcely altered through the centuries and recall vividly patriarchal times.

According to the census of 1930, 10% of the population lived in the five cities of over 100,000 inhabitants and 69·9% of the population lived in rural or small urban communities of less than 5,000 inhabitants. Of the whole population of the country 7,143,116 were men, 7,586,420 were women. The population had shown a considerable natural increase in the decade from 1920 to 1930. This natural increase amounted for the whole republic to 9·67%. Characteristically it was lowest in the most western part of Czechoslovakia, in the province of Bohemia, where it amounted only to 6·11%. And it rose from there until it reached 22·50% in the most eastern part of the republic, in Ruthenia.

The dominant religion was Roman Catholicism which was professed in 1930 by 73·54% of the population. Of the other Christian denominations the Protestants numbered 7·67%, the Czechoslovak Church 5·39% and the Greek Catholic Church 3·97%. The number of Jews amounted to 2·42%. Their percentage was lowest in Bohemia with 1·07%, higher in Slovakia with 4·11% and highest in Ruthenia with 14·14%. (W. S. L.; H. Ko.; X.)

FINANCE AND CURRENCY

In no other department of the state activities was there so energetic an endeavour to ensure the independent existence of the new republic as in that of finance and currency. In this respect there was a twofold aim: to achieve an equilibrium of the state finances and establish a stable currency. In both respects the administration was highly successful.

The budget estimates for the four years 1935–38 amounted in millions of crowns:

	1935	1936	1937	1938
Revenue	7,985	8,033	8,456	10,120
Expenditure	7,983	8,032	8,454	10,117

The total national debt amounted in 1938 to 47,094 million crowns as against 37,969 million crowns in the year 1933. Of this debt 36,843 million were internal debts, 8,251 million foreign debt, and 2,000 million note debt as a result of the monetary reform.

Currency.—One of the most important acts of the first Government of Czechoslovakia was the establishment of an independent currency early in 1919. For this purpose it was decided to collect and stamp all the bank-notes of the Austro-Hungarian Bank, which were then circulating upon Czechoslovak territory, as well as the deposit accounts in Czechoslovak branches of the Austro-Hungarian Bank, totalling about 10 milliard crowns. During the process of stamping, about 2.7 milliard crowns were retained as a compulsory state loan in order to reduce the amount of paper money in circulation, and the stamped bank-notes were declared to be state notes with a face value in Czechoslovak crowns. At the same time a temporary bank of issue was established under the title of "Banking Office of the Finance Ministry." The stamped bank-notes were later replaced by independent state notes in equal proportion. In order to defray the value of the uncovered state notes and the deposit accounts taken over from the Austro-Hungarian Bank, a tax on capital was levied, the estimated yield of which was 7.5 milliard crowns. Of this sum nearly 5½ milliards had been paid off by the end of 1927, leaving a remainder of the "State Notes Debt" of about 4½ milliard Czechoslovak crowns. Neither was the Banking Office, managed by a board of directors appointed by the finance minister, nor was the National Bank of Czechoslovakia, which took over the former's functions on April 1, 1926, permitted to grant the state any loan, either direct or indirect.

The financial and economic difficulties after the World War, the chaos prevailing in the currencies in the neighbouring states, and the comparative ignorance of Czechoslovakia abroad caused the exchange rate of the Czechoslovak crown to fluctuate up to 1922, although the financial administration continued to pursue sound principles. From the year 1922, however, the exchange rate of the crown was stabilized at about 100 crowns to $3 (U.S.). Thus, as a result of the energetic and judicious currency policy inaugurated by Dr. Rašín, the Czechoslovak crown maintained its stability and its relatively high exchange value at a period when the currencies of the neighbouring states were hopelessly unstable and depreciated. This caused Czechoslovakia to be described as "an island in a sea of inflation."

The National Bank of Czechoslovakia was set up in 1926 with a share capital of originally $12,000,000 which was, however, changed in 1934 to 405,000,000 crowns. The bank was under legal obligation to maintain the currency at the exchange level of 100 crowns to $2.90–$3.03 on the New York Stock Exchange. Thus Czechoslovakia was brought into line with the countries possessing a gold exchange standard. The gold and gold exchange cover ratio to the bank-note circulation and sight liabilities amounted to 42% on Dec. 31, 1926. In Oct. 1929 the final aim of the administration, to establish an effective gold standard currency, was realized and the value of the crown was fixed at 44·58 milligrams of fine gold. The gold content was, however, reduced in Feb. 1934 to 37·15 milligrams, and was further reduced in Oct. 1936 to between 30·21 and 32·21 milligrams. The cover of notes was reduced legally in 1934 to 25%, to consist only of gold.

Banking and Credit.—Among the oldest financial institutions existing upon the territory of the former republic were the communal savings banks. As a result of the development of industry, notably about the middle of the 19th century, these were followed by deposit banks, and as agriculture continued to progress a number of co-operative institutions were established in the rural districts. At the end of 1935 the savings banks, the activities of which were strictly defined by special regulations, numbered 356, their total book deposits amounted to 18,810 million crowns, as against 5,326 million crowns at the end of 1919. There were also in 1935, 174 district agricultural deposit banks in Bohemia and more than 7,000 co-operative credit banks in existence.

In 1937 Czechoslovakia contained 23 joint-stock banks with a total paid-up share capital of 1,274 million crowns and 55 smaller establishments in the eastern part of the republic with a share capital of 252 million crowns. The financial and credit organization of Czechoslovakia was supplemented by a State-managed postal cheque office in Prague, which was complemented by a postal savings bank.

Czechoslovakia had a highly developed system of public social insurance. On July 1, 1926, the Central Social Insurance Institution started its operations based on the capital scheme. This insurance covered accident, sickness, disability, old age and death. In view of the complex character the social insurance was not uniformly regulated. In the year 1935 the number of persons insured against sickness amounted to 3,051,000, those insured against disability and old age to 2,201,000. In taking into account their families, the number of persons covered by social insurance in Czechoslovakia amounted to about 8,000,000. The total sum spent by institutions of social insurance in the year 1935 for their members amounted to 2,450 million crowns, their total capital to 14,540 million crowns. (V. P.; H. Ko.)

DEFENCE

Compulsory service in Czechoslovakia was introduced by a law of 1920 and was universal for all male citizens. A French military mission was established in 1919, to remain for ten years, and to this mission a high standard of military efficiency can be attributed. Liability to service lasted from the age of 17 to 60, but began normally at the age of 20. The president of the republic was the supreme head of the army under the constitution. The army was organized into 4 military areas and comprised 12 infantry divisions and a number of special brigades and troops. Particular attention was devoted to military education. The Czechoslovak army was regarded as one of the finest in Europe, both as regards training and equipment. The average strength of the army in 1937 was 10,059 officers and 153,356 other ranks, in addition to 12,647 gendarmerie. There were 6 regiments in the air force, having 566 aeroplanes. There was a small force of armed motor boats for river service on the Danube. (H. Ko.)

ECONOMICS AND TRADE

Occupations.—According to the census of 1930, 34·64% of the population of Czechoslovakia were occupied in agriculture, 34·94% in industry, 7·43% in commerce, 5·53% in transportation and 4·86% in public service and the professions. These figures compare with 45·97%, 32·13%, 5·35%, 3·03% and 3·71% respectively, according to the census of 1900. In Bohemia 24·06% were occupied in agriculture as against 56·82% in Slovakia, and 41·78% in industry as against 19·07% in Slovakia.

According to the data of 1936 the total area of the country comprised 5,855,000 hectares of arable land, 1,268,401 hectares of permanent meadows, 102,735 hectares of vegetable gardens, 25,090 hectares of vineyards, 1,066,000 hectares of pastures and 4,587,393 hectares of forests.

Sugar beet, corn and high-grade barley for beer-brewing are cultivated in the low-lying areas, while in the more elevated regions the cultivation of potatoes, rye and oats predominates; the high lands, except those covered by forests, are used for growing fodder crops or for grazing.

The productivity of the soil varies considerably. Thus, in the west, where there is a high technical standard in agriculture, the productivity often exceeds the general maximum figures for Europe as a whole. But in the eastern areas (Slovakia and Carpathian Ruthenia) the productivity is much lower.

The distribution of cattle, which forms 75% of the total number of animals, exhibits similar variations. Productivity decreases from west to east, and while in the western regions there are 62 head of cattle per sq.km. a figure surpassed in Europe only by Denmark, Belgium and Holland, the number per sq.km. in the eastern areas is considerably less; the average for the whole republic is 52 head per square kilometre.

The prominent position occupied by Czechoslovakia among the most progressive agricultural states is due to the high standard of Czechoslovak agriculture.

Agrarian Reform.—The Act of Parliament of April 16, 1919 gave the State the right to take over for partition estates in so far as they exceeded 150 hectares of arable land, or 250 hectares of land of any other category, indemnification being based on the average value between 1913–17. The total area affected by this Act was 926,817 hectares. By the end of 1924, 654,710 hectares had been taken over and redistributed. Of the agricultural land, 52% was allotted to small farmers and 25% to landless peasants. During 1925 a further 253,000 hectares were distributed.

Minerals and Mines.—The mineral wealth of Czechoslovakia was of great importance. The most important items are pit coal and lignite. The former has its chief centres in the Ostrava-Karvinná coal-field, which is connected with the German and Polish coal-fields of Upper Silesia. In addition, there are the coal-fields of Kladno and Plzeň. Other important coal-fields are near Brüx, Komotau and Falkenau. The coal production amounted in 1937 to 16,777,000 tons of hard coal and 17,895,000 tons lignite. Coal was an important article of export. Besides coal there are to be found iron, graphite, silver, copper, lead and rock salt in Czechoslovakia. Native iron ore was, however, inadequate for the native iron industry, and accordingly much had to be imported.

The abundance of excellent porcelain raw materials, particularly of kaolin, is of great importance both for home industry and for export purposes. The annual yield is about 400,000 tons, obtained chiefly from western Bohemia and southern Moravia. Systematic attention is being devoted to the exploitation of water-power resources, together with a systematic process of electrification, and large steam-driven central power stations have been erected.

(V. B.; H. Ko.)

Industry.—It has already been pointed out that the agricultural products of Czechoslovakia provide the raw materials for important agricultural industries. The most important of these is the old-established sugar industry, which is carried on in some 119 sugar factories. The beer-brewing industry had attained a world-wide reputation by reason of the excellent quality of its products. The agricultural industries include also flourishing spirit, malt and foodstuffs industries. Czechoslovakia's smoked-meat products, especially hams, are of world-wide reputation. In 1935 there were 403 breweries producing 7,744,444 hectolitres of beer.

The abundance of coal and the presence of iron-ore provided the necessary conditions for the development of the metallurgical industries. The output of pig-iron in 1937 was 1,675,064 metric tons and that of raw steel 2,317,634 tons. The glass, porcelain and pottery industries also depended mainly upon the home supply of raw materials. All kinds of glass goods were produced; in addition there were about 70,000 workers, who in their own homes made glass jewellery and beads which are known under the generic name of Gablonz ware. Crystal, ground and coloured Bohemian glass, all of high-grade quality, was largely exported to all parts of the world. The manufacture of porcelain was concentrated mainly in western Bohemia. The large forest areas provided the raw material for the flourishing timber, paper and cellulose industries. A great part of the output was exported.

Similarly highly developed were the textile industries which occupied in 1930 more than 360,000 workers and the shoe industry of which the most famous establishment was the Bat'a works in Zlin. The textile industries comprised cotton, wool, flax and jute production. The leather industry was making great progress.

Communications and Transport.—In 1935 there were 69,903km. of roads in Czechoslovakia; the number of automobiles amounted to 91,797 passenger cars, 29,616 trucks and 3,943 buses. There were 15,506km. of railway of which 12,385 were owned by the State. These railways formed a direct connection between the systems of Western and Eastern Europe and made Czechoslovakia an important centre of communication. This was as true of the highly developed air service. There were 13 lines operated in the national service and 21 in the international service.

The peace treaties had internationalized the most important waterways. The Vltava and the Elbe (Labe) connected Bohemia with the North sea, and Czechoslovakia had the right to use certain wharves in the ports of Hamburg on the North sea and of Stettin on the Baltic sea. The Danube, where Bratislava was the chief port, connected Czechoslovakia with the Black sea. The total length of navigable waterways amounted to 418km., of which 206km. were represented by the Elbe and Vltava, and 172km. by the Danube. In 1935 the traffic on the Danube amounted to 627,326 tons, on the Vltava and Elbe to 1,905,110 tons.

The number of post offices amounted in 1937 to 4,591, that of the telegraphic offices to 4,784; in the same year there were 157,079 telephone stations and 683,822mi. of telephone wire.

Foreign Trade.—The large export and import trade of Czechoslovakia required it to build up a system of commercial treaties with foreign powers. The guiding principle of Czechoslovak trade policy was that of the most-favoured-nation clause. Upon this principle it constructed its whole system of agreements, which it supplemented by means of tariff conventions for customs purposes. A customs tariff of the former Austro-Hungarian empire, drawn up in 1906, was adapted to the changed economic conditions by means of a system of co-efficients and became the basis of Czechoslovak customs policy as far as not replaced by any new items. The tariff agreements concluded with France, Italy, Austria, Poland, Greece, Spain, Belgium and Hungary led to a reduction of from 50% upwards in the customs rates applicable to more than two-thirds of the industrial products which formed the subject of trade.

Imports and exports amounted in millions of crowns to:

	1922	1929	1932	1935	1937
Imports . . .	12,696	19,987	8,155	6,738	10,981
Exports . . .	18,086	20,498	7,399	7,418	11,982

Principal articles of import in 1937 were cottons, woollen goods, iron and steel, fruit and vegetables, fats and oils; principal articles of export were iron and steel, woollen goods, cotton goods, coal, glass-ware, sugar, cereals, timber and leather. Of the countries of origin the most important were the following, arranged according to their importance in 1937: Germany, United States of America, Great Britain, France, Rumania, Austria, The Netherlands and Yugoslavia. Of the countries of destination the most important arranged in the same way were: Germany, United States of America, Great Britain, Austria, Rumania, Yugoslavia, The Netherlands, Switzerland and France. (J. D.; H. Ko.)

CONSTITUTION

Czechoslovakia was a democratic republic. Legislative authority was exercised by parliament elected by universal, equal, secret and compulsory suffrage, based on the principle of proportional representation, and consisting of two chambers: a chamber of deputies of 300 members, elected for six years, and a senate of 150 members, elected for eight years. The franchise was open to all citizens without distinction of sex who were over 21 or 26 years respectively. Cabinet ministers, who did not need to be members of parliament, were responsible to the chamber of deputies which by a vote of non-confidence could compel the resignation of the Government. A measure passed by the chamber of deputies became law despite an adverse decision of the senate if the chamber of deputies adhered to the original decision by an absolute majority of all its members.

The president of the republic was elected in a joint session of the chambers for a period of seven years. He could be re-elected immediately for a second period; for a third term, however, only after the expiration of seven years after the end of his second term. This restriction did not apply to President Masaryk. The president signed all laws enacted by parliament and had the right to return with his comments any measure enacted by it; such a measure could become law only if repassed by an absolute majority of members of each of the two houses, or by three-fifths of all the members of the chamber of deputies.

The judiciary was separated from and independent of the administration. The judges were appointed permanently and could not be recalled. The constitution guaranteed all citizens of the republic full equality before the law and equal civil and political rights, whatever be their race, language or religion, full personal freedom, inviolability of domestic rights and of the mails, freedom of the press, the right of free assembly and of association, and of the expression of opinion by word, writing or print, freedom of scientific research, of instruction, of conscience and religious creed. All religions were equal before the law. Wedlock, family and motherhood were placed under special protection; and special provisions of the constitution protected the rights of all minorities of language, religion or race, guaranteed to them the public maintenance of their schools, and forbad every manner of forcible denationalization. All these guarantees and rights were protected by the supreme administration court; a constitutional court decided whether laws promulgated by parliament were in harmony with the character of the constitution.

HISTORY

THE RISE OF THE REPUBLIC

Czechs and Slovaks in the Dual Monarchy.—During the 19th century the problem of nationality in central Europe, and particularly in Austria-Hungary, became more and more acute as the process of national revival advanced, notably in the revolutionary period of 1848. The Poles and Czechs awoke to the knowledge of historical state rights, and all nationalities felt the right to self-determination.

The leading German circles in Austria endeavoured to maintain their hegemony over the non-German nations in the empire and neglected the possibility of solving the nationality problem in the spirit of federalism with equal justice for all. The Czech nation, though possessed of a political consciousness, and with it also the other central European nations, entered the 20th century subjected to a foreign regime, the domination of the Germans, the German-Austrians and the Magyars.

It was partly the wars of liberation in the Balkans, but especially the World War, which brought about a radical improvement in this state of affairs, bringing the political aspect of Europe more in accordance with its ethnographical aspect.

The Outbreak of War, 1914.—The Czech nation, which in consequence of the Thirty Years' War had been deprived of its political independence, had never abandoned the idea of recovering it, and in the 19th century did much to remove the far-reaching traces which the severe anti-reformation regime of the Habsburgs had left in its organism. Having successfully withstood the absolutist pressure of Germanization in Bohemia, Moravia and

Silesia, while its Slovak kindred were slowly succumbing to the Magyarizing endeavours of the Hungarian state, it clearly saw that the outcome of the World War would have a decisive effect upon its existence. By its traditions, its sympathies and its whole political outlook the Czech nation was on the side of western European democracy and Slavonic Russia and Serbia against the central autocracies for whom the Czechs were called to fight. The opposition of the Czech nation to its political oppressors assumed the form of passive resistance, the passing over of Czech troops in great numbers to the Allies, and secret organizations, the purpose of which was to prepare for the decisive moment. The brunt of the Czechoslovak revolutionary movement was, however, borne by the political exiles who, having escaped abroad at the beginning of the World War, began to carry on in the Allied and neutral countries an extensive anti-Austrian action of a diplomatic, propagandist and military character, which aimed at achieving independence for the Czech and Slovak territories.

Organization Outside Austria-Hungary.—The necessity for systematic action abroad, and mainly in western Europe, was soon realized by Prof. Masaryk, the leader of the small Realist Party, who, as a member of parliament and of the Austro-Hungarian delegations, had for many years past—especially during the Bosnian annexationist crisis—been an opponent of reactionary Austria and especially of its provocative and dishonourable foreign policy. As early as the autumn of 1914 it was clear to him that the World War would not be decided on the Russian front, but in the west, and that it would last longer than was imagined by those who, guided by Slavonic sympathies, relied mainly on the strength of Russia. Being warned, on returning by way of Switzerland from an informative journey to Italy in Dec. 1914, that the Austrian police had orders to arrest him on his return, Masaryk decided to remain abroad and to organize the Czech campaign against Austria-Hungary, keeping, as far as possible, in continual touch with the underground activities of his friends at home to make the Czechoslovak question a subject of diplomatic negotiations on the part of the competent official circles of the Entente, which would effect its solution on international lines. For this purpose Masaryk proceeded to organize Czechoslovak settlers or residents abroad in order to make use of their resources and their influence in favour of his program. When the Czechoslovaks abroad were joined by a large number of Czechoslovak soldiers who crossed over to the Allied side, it was possible to consider the formation of special military units and a separate Czechoslovak army within the framework of the Allied armies. In all the Entente States there were spontaneous organizations of Czechs and Slovaks for the purpose of actively supporting the Allies in the struggle against the Central Powers. Czechs and Slovaks in the United States of America soon had an opportunity of doing important work, particularly in taking upon themselves the major part of the financial burden of the campaign.

In the political public opinion of western Europe Austria-Hungary was regarded as an element in the maintenance of European equilibrium. The Czechoslovak problem was looked upon as being an internal problem of the dual monarchy, which certain circles in the Entente were unwilling to alienate by formulating the final and extreme war aims, endeavouring rather to isolate Austria-Hungary from Germany and thus weaken the latter, who was regarded as the sole culprit in bringing about the world catastrophe. Up to the moment when Austria-Hungary collapsed it was necessary to fight against Austrophilism, which was powerful both in the neutral states as well as in the Allied countries and Russia. It was also necessary to struggle against the intensive Austrophile propaganda, by revealing the pseudo-constitutionalism and minority rule which were the true foundations of Austria-Hungary.

The Formation of Foreign Committees.—The year 1915 resulted in a mobilization of resources and the distribution of work for the Czechoslovak movement abroad, rather than in any positive successes. Up to the arrival of Dr. Beneš (*q.v.*) in the autumn of 1915 the headquarters of this work were in Switzerland, but after his arrival Masaryk chose London as his seat of action, while Beneš, as secretary of the Central Foreign Committee, proceeded to Paris with Štefánik, the Slovak scientist, who served as an aviator in the French army. Durich, a Czech agrarian deputy, was entrusted with the task of concentrating the work that had hitherto been accomplished in Russia by means of a unified Czech committee.

Steps were very soon taken to form a Czechoslovak foreign committee for the purpose of carrying on a united struggle against Austria. On Nov. 14, 1915 a manifesto was issued, signed by Masaryk and Durich, by the leaders of the Czech colonies in the Entente states and notably also by the Czechs and Slovaks in America. This was the first official pronouncement by the Czechs abroad against Austria-Hungary, in favour of the Entente, and of the independence of the Czechoslovak state. At the beginning of Jan. 1916 the Foreign Committee was transformed into a National Czech Council, the president of which was Masaryk, the vice-president Josef Durich, and the general secretary Dr. Beneš. The Slovaks were represented on this Council by Gen. Štefánik.

The Czechoslovak Legions.—Considerable success and marked progress were achieved by the Czechoslovak movement in Jan. 1917, when the Allies in their reply to President Wilson's note on the peace conditions included the liberation of the Czechoslovaks from foreign rule among their chief war aims. In Russia a Czech brigade had in the meantime made further developments, and in June 1916 the tsar consented to the release of the Slav prisoners of war, but at the instigation of Stürmer, supported by the tsaritsa, the consent was withdrawn at the beginning of August. In October an independent Czechoslovak division in the Russian army was sanctioned, but scarcely a month later this concession was also withdrawn. The Russian revolution of March 1917 did not bring any immediate advantage to the Czechoslovak movement there. It was not until the Czech regiments distinguished themselves at Zborov on July 2, 1917 that Kerensky was induced to allow additional troops to be recruited from among the Czech prisoners of war. Unfortunately the Russian army was already in a state of collapse and the Government of the March revolution was only short-lived. An agreement was concluded between the French Government and the Czechoslovak National Council to transport Czech troops to France, and by a decree signed by President Poincaré on Dec. 19, 1917 an independent Czechoslovak army was established in France.

In Russia, where in the meantime Masaryk had taken charge of the Czechoslovak movement, having left England in May 1917, the establishment of the first independent Czechoslovak body was reached during the interim Government in Oct. 1917.

Developments Within the Dual Monarchy.—In Bohemia in 1916 the Austrian persecution reached its culminating point. Under the military and police pressure no public political life was possible there. Conditions improved, however, after the death of Francis Joseph and the outbreak of the Russian revolution in March 1917. The May manifesto of the Czech authors and the proclamation of the Czech deputies on May 30, at the first meeting of the Reichsrat in Vienna, demanding the transformation of the Austro-Hungarian monarchy into a federative state with equal rights for the various nationalities, were the first signs of the coming spring. The representatives of the Czech Social Democrats at the Socialist Peace Congress at Stockholm in June 1917 advocated the right of self-determination and a demand for a sovereign Czechoslovak state within a Danubian federation.

The Czech Legions in Siberia.—The autumn Bolshevik revolution complicated the situation of the recognized Czechoslovak units of the Russian army. Masaryk had already announced the Czechoslovak policy there as one of neutrality and non-intervention in Russian affairs. On the principle of armed neutrality it was arranged with the Bolsheviks that the Czechoslovak troops should be transported via Vladivostok to France and the first detachment was dispatched at the beginning of November. In France, in Feb. 1918, the National Council had organized among the Czechoslovaks there a system of general conscription for the Czechoslovak legions. At the same time, the representatives of the Czechoslovak armies left France for Italy, where in April 1918 an agreement was reached between Orlando and Gen. Štefánik for organizing legions among the numerous Czechoslovak fugitives there on the Russian model.

The clear relationship between the Czechoslovak command and the Bolsheviks, conditioned by the rejection of any plans aiming at intervention against the Bolsheviks, was complicated by the lack of loyalty shown by the Bolshevik Government, which during the transport of the Czechoslovak divisions demanded their disarmament. The incident at Chelyabinsk with the local Soviet in the second half of May 1918, led to the internment of the representatives of the National Council at Moscow and the instruction issued by the Soviet authorities and Trotsky for the forcible disarmament of the Czechs. At the end of May hostilities began between the Czechoslovak troops and the Bolsheviks, during which the Czechoslovaks occupied the whole of the railway line as far as Irkutsk and gained possession of the Baikal and Chita railway, 5,000mi. in length.

Masaryk, who in March 1918 left Russia and arrived in May in America, opposed all idea of armed intervention in Russian affairs, but when the Bolsheviks provoked an armed conflict with the Czechoslovak troops in Siberia, he asked America and the rest of the Allies for military and material help for the Siberian legions, who were suffering especially from lack of equipment. The Allied Governments decided at Washington, notably by an American-Japanese agreement, to grant the military and material assistance asked for (Aug. 3). The military help promised by the Entente was not forthcoming, with the exception of a small Japanese contingent, but abundant quantities of supplies and equipment were given. The victory of the Czechoslovak troops on the Volga and in Siberia caused a sensation in the Allied states, so that the Czech success had a considerable moral significance and denoted the strengthening of the Czech cause. What made the Czech achievement particularly valuable was that it had prevented the Soviet Government, and thus also Germany, from obtaining the keenly desired contact with the Siberian supplies of raw materials and foodstuffs, and also that the vast numbers of German prisoners of war in the Siberian camps could not be used for strengthening the German army. Lloyd George (Sept. 11, 1918) thanked the National Council in a telegram for the inestimable services rendered by the legions to the Allies.

Recognition by the Powers.—Great Britain had previously, in a pronouncement of Lord Robert (Viscount) Cecil on May 22, 1918, officially recognized the right of the Czechoslovak nation to complete independence. When on May 29, 1918 the Government of the United States approved the anti-Austrian resolution passed by the Congress of Oppressed Nations in Rome, which had been organized in April of that year by Dr. Beneš on the initiative of Professor Denis, the War Council at Versailles associated itself with this American proclamation, while the prime ministers of France, Britain and Italy, and indeed of all the Allied nations, declared their sympathies with the Czechoslovak and Yugoslav aims for liberation. At the same time, the British Government announced its willingness to recognize the National Council as the leading body of the Czechoslovak movement and also of the army that was fighting on the side of the Entente. The first country to grant actual recognition in this sense was France (June 29, 1918). On June 30 President Poincaré, with the representatives of the French cabinet, handed over the colours to the 21st Czechoslovak regiment at Darney, and on the following day the British Government expressed its agreement with the speech made by President Poincaré on this occasion.

About the same time a second, supplementary agreement was reached with Italy concerning a Czechoslovak army within the framework of the Italian army, and the Government of the United States in its pronouncement identified itself with the complete liberation of all branches of the Slav race under German and Austrian domination. About 50,000 Czechs and Slovaks then offered themselves as volunteers for the army of the United States, apart from those in the Canadian army and in France. By a declaration on Aug. 9 the Government of Great Britain recognized the Czechoslovaks as an Allied nation, the three Czechoslovak armies as a single Allied army carrying on regular warfare against Austria-Hungary and Germany, and the National Council as the supreme body controlling national interests. On Sept. 3, 1918 the British Government recognized the future Czechoslovak Government upon the basis of the National Council and negotiated a convention with the National Council concerning an army and diplomatic relationships on the basis of the analogous international position of Serbia and Belgium. On the same day a similar recognition was obtained from the United States Government, and on Sept. 9, 1918 the recognition of the Japanese Government in the same sense was obtained.

The success of this intensive diplomatic struggle for independence, carried on partly from Paris by the headquarters of the National Council, partly by Masaryk at Washington, and achieved to a considerable extent through the merits of the Czechoslovak legions, was promoted in no small degree by the resolute action of the Czech political leaders in Austria-Hungary itself. Important in this respect are the manifestos of the Czech deputies of Jan. 6, 1918, the vow made by representatives of all sections of the nation on April 13, 1918 that the struggle for Czech independence should not cease until the final victory, and the May celebrations of the National theatre at Prague, which were attended by representatives of other oppressed nations in Austria, especially the Yugoslavs, Poles and Italians—all this enhanced the movement abroad, which in the autumn of 1918 was reaching its final goal.

Declaration of Independence.—Finally, on Oct. 14 Dr. Beneš notified the Entente states of the establishment of an interim Czechoslovak Government in Paris in accordance with the decision of the president of the National Council on Sept. 26, and Dr. Beneš as minister for foreign affairs was appointed the first Czechoslovak minister to the Entente states. This interim Czechoslovak Government was recognized by the French Government on Oct. 15, and by the Italian Government on Oct. 24, while on Oct. 18, 1918 the interim Government itself proclaimed the independence of the Czechoslovak nation by a declaration dated at Washington. On the same day President Wilson rejected the Austro-Hungarian peace offer of Oct. 7 on the ground that since the issue of his Fourteen Points (*q.v.*) on Jan. 8, 1918 the Government of the United States had recognized a state of war between the Czechoslovaks and Austria-Hungary, and intimated to the Austrian Government that it should apply to the National Council which had already been recognized as the *de facto* Government of the Czechoslovak nation.

In Bohemia the socialist parties, especially in the rural districts, had attempted to proclaim a republic on Oct. 14. Wilson's reply, rejecting a peace offer by the Emperor Charles, was published in Austria-Hungary on Oct. 21, and within a week, notably through the collapse of the army, all the conditions were furnished for the capitulation of Austria-Hungary, which took place in the night between Oct. 27 and 28. On Oct. 24 the Czech deputies had already obtained permission from the emperor to proceed to Geneva for the purpose of conferring with Beneš there. The National Committee at Prague, however, did not await their arrival but drew its own conclusions from the Austrian capitulation, and on Oct. 28, by its first law, proclaimed the independence of the Czechoslovak state, taking into its hands the administration of the Czech territories without encountering any considerable opposition from the army or from the authorities. Two days later, on Oct. 30, by a manifesto of the Slovak National Council at Turčanský Sv. Martin, Slovakia pronounced itself in favour of Czechoslovak unity.

Oct. 28 remains the symbol of the national liberation from the centuries of Habsburg bondage, although the actual transformation was carried out early in the subsequent days by an agreement between the Government of the Czechoslovak state in Paris and the National Committee, which took over all the commitments of the former. The conferences at Geneva also gave the renewed state its definite form of a democratic republic. On Nov. 13 the National Committee issued an interim constitution and a day later there was a meeting of the Czechoslovak National Assembly constituted in accordance with the proportional numerical strength of the individual political parties, containing 256 (later 270) members, of which 44 were Slovaks. There were no Germans among them, the German representatives having refused participation. At this first meeting of the National Assembly Masaryk was unanimously elected the first president of the Czechoslovak republic, and on the basis of the interim constitution the National Assembly elected its first Government. The prime minister was Kramář, the foreign minister Beneš, and the minister for war Gen. Štefánik. On Dec. 21 the president returned to Prague, and his inaugural message, pronounced in the National Assembly on the following day and containing a concise survey of the Czechoslovak movement for independence abroad and a plan for the further consolidation of the republic, concludes the revolutionary period and begins the constructive period of the state. The Peace Conference had yet to define only a few details of the relations of Czechoslovakia to its neighbours and to the other members of the comity of nations. (T. G. M.)

1918–1935

The Kramář Ministry.—The first ("Revolutionary") Czechoslovak ministry consisted of four Agrarians, three Czechoslovak (national) Socialists, three Social Democrats, three National Democrats, one People's Party and one Slovak member. Beneš and Štefánik were non-party. During its eight months of office the Government had to maintain the integrity of the national territory, to keep the administration working and to defend the interests of the country at the Peace Conference. Further, it had to face the problems arising out of the economic difficulties of the period, especially as regards provisioning, and out of the international situation of the new state. It dealt with all these tasks successfully.

First, it put down the attempted insurrections in the German-speaking districts of Bohemia and Moravia, which had attempted to unite with Austria. In Slovakia there were grave difficulties owing to the departure of most of the Hungarian bureaucrats, the hostility of the Magyar and Magyarophile elements of the population and to the fact that the frontiers were not yet regulated. On Feb. 1, 1919 the Slovak Government was formally installed at Bratislava. After the Communist Party came to power in Hungary there were further grave complications. The Hungarian communist troops invaded Slovakia, which Czech troops were occupying. They were repelled with the help of the Allies, who, as a result of this episode, fixed a provisional line of demarcation which was maintained without great change when the frontier was finally traced on June 12, 1919. Similarly in Teschen (Těšín) the situation was grave owing to the conflict with the Poles, who had occupied part of this territory. The Czech Government in its turn occupied Teschen and there were conflicts attended by bloodshed. The Peace Conference had to intervene. An armistice was concluded on Feb. 19 and the dispute was referred to diplomatic negotiations (*see* TESCHEN).

This Government carried through much important financial and social legislation. It effected the financial and economic separation of Czechoslovakia from Austria (notably by Rašín's legislative measures of Feb. 1919), secured the food supply, temporarily threatened by the effects of the World War, through purchases from abroad, and laid the foundations of political and economic democracy. The chief measures included the new communal suffrage, the eight-hour day, and the commencement of the land reform; measures which both realized the ideals held by the nation and averted the danger of an extremist social movement.

The First Tusar Cabinet.—The municipal elections of June 15, 1919 clearly showed that the composition of the Government and of the National Assembly did not correspond with the real numerical importance of the different parties. The cabinet accordingly resigned, and on July 8, 1919 President Masaryk appointed a second cabinet under Tusar, a leader of the Social Democrats. The new Government represented a coalition of the parties which had been most successful in the elections. Besides Tusar (minister president) it included three other Social Democrats, four Czechoslovak Socialists, four Agrarians and two Slovaks, Beneš retaining his portfolio.

During the period of office of Tusar's cabinet Czechoslovakia consolidated her international situation. The interests of the country were successfully defended at the Peace Conference. On Sept. 10, 1919 the Treaty of St. Germain with Austria had been signed and on the same day the so-called "little treaty" of St. Germain, which guaranteed the rights of minorities in Czechoslovakia. Under the guidance of Beneš commercial relations were developed between Czechoslovakia and her neighbours. The relations between Austria and Czechoslovakia soon became friendly and the ground was prepared for future political agreements.

In its financial and social policy this Government continued the work of its predecessor. A number of foreign loans were raised to meet urgent requirements, a fiscal reform was carried through and an extraordinary levy on capital imposed. The chief social measures were the Works Councils Act and the act establishing profit-sharing in the mining industry. The most important task of Tusar's cabinet was the elaboration of the constitution. In view of the attitude adopted by most of the German population it was resolved that this should be voted by the revolutionary National Assembly rather than by a nationally elected parliament. A special commission elaborated its general principles and its text. Several points—the question of a second chamber, of the separation of church and state, of the system of military organization, and especially of the incorporation of the language laws in the constitution—gave rise to vehement debate before the constitution was finally adopted on Feb. 29, 1920.

The Second Tusar Cabinet.—The general elections were held in April 1920. The result showed that the Czechoslovak Socialists and Agrarians commanded a majority in the country. Tusar therefore formed a second cabinet, in which Beneš again held the portfolio of foreign affairs.

Assembling in May, the new National Assembly, in joint session of both chambers, re-elected M. Masaryk as president of the republic by 284 votes out of 411. On June 1 the new cabinet read its program, which envisaged an advanced democratic and social policy. Appealing to the German representatives, Tusar declared that if the two nations had hitherto failed to co-operate, this was not due to the fault or the wishes of the Czechoslovak majority but to the attitude of the Germans themselves. The reply of the German bourgeois parties, however, which was repeated in a modified form by the German Socialists, showed their intention of persisting in their negative policy towards the republic. The German problem remained as far as ever from a solution.

A split in the Social Democratic Party, with the left wing joining the Third International, forced the resignation of the cabinet in Sept. 1920. It was replaced by a cabinet under Černý, made up largely of high public officials. The new situation paved the way for a coalition of five Czechoslovak parties, the Social Democrats, the Czechoslovak Socialists, the National Democrats, the Agrarians and the People's Party. These five parties formed a Council of Five, the so-called Pětka, to insure contact and organized collaboration between the Government and the majority. This paved the way for the formation of a new parliamentary Government.

The Beneš Cabinet.—As soon as the Social Democrat Party had reconsolidated itself after its break with the Communists, it expressed its readiness to re-enter the Government. The cabinet of officials was accordingly replaced by a new parliamentary Government in the shape of the Beneš cabinet, which was constructed on Sept. 27, 1921. The Government majority included the five great Czechoslovak parties, and also enjoyed the support of the minor Czechoslovak parliamentary groups, so that it could thus command a secure majority of 180 votes in the chamber against the 78 of the national minorities and the 25 Communists. Beneš became premier, his cabinet included three Social Democrats, three Agrarians, two Czechoslovak Socialists and one National Democrat. The premier, who also acted as foreign minister, and the ministers of finance, the interior and Slovakia, were non-party men. Beneš' appointment was in general well received; the German press and deputies regarded it as a hopeful symptom.

The Government remained in office from Sept. 26, 1921 to Oct. 7, 1922. The foreign situation during this year was particularly full of incident, including the second attempt at restoration (Oct. 20, 1921) of the ex-King Charles in Hungary, as a result of which Czechoslovakia commenced mobilization, the conclusion of a political convention with Poland (Nov. 6, 1921), which, however, remained unratified (*see* LITTLE ENTENTE), of a treaty of guarantee and arbitration concluded on Dec. 16, 1921 at Lány (Lana) with Austria, the Conference of Genoa in March and April 1922, the negotiations for the expansion and strengthening of the Little Entente and the difficulties arising out of the fresh financial collapse in Austria in 1922. These questions preoccupied the attention of the Government somewhat to the exclusion of internal affairs. The internal economic situation was difficult and the cost of living high, both for general reasons and owing to the sudden rise of the Czech crown. There were serious labour troubles, such as the miners' strike of Feb. 1922 and the strike in the metal industry in May 1922.

The history of the Beneš cabinet so conclusively proved the feasibility of a concentration cabinet that when it resigned, on Oct. 5, 1922, the system was maintained on an even broader basis. The new ministry was formed on Oct. 7, its head being Švehla, leader of the Agrarian Party and one of the most influential members of the Pětka.

The Švehla Cabinet.—The new cabinet consisted of five Agrarians (including the premier), five Social Democrats, three Czechoslovak Socialists (including Beneš, who retained the portfolio of foreign affairs), two members of the People's Party and two National Democrats (including Rašín, who again took the ministry of finance). Its program was presented on Oct. 24 in the form of three exposés by Švehla, Beneš and Rašín respectively. This Government was successful in decreasing the coal tax and the tax on property, to the benefit of industry and agriculture, and it was also able to maintain the stability of the exchange and to carry through the important measure of social insurance of both workmen and independent persons. It failed, however, to solve by inter-party agreement the question of agricultural tariffs, a point on which Agrarian interests, and especially the Agrarian Party, laid the greatest stress. In June 1925 a temporary solution was reached by the introduction of the so-called sliding customs tariff; yet this expedient, while representing the maximum of concessions which the Socialists were willing to grant, was not permanently satisfactory to the Agrarians. The result was a permanent discord, which was even increased by the events of July 1925.

The chamber met on Sept. 18 to discuss the budget estimates, which, for the first time, provided for a surplus of revenue. The budget was passed (the Germans abstaining), but the chamber was unable to carry through a bill which introduced a slight amendment in the electoral system (dividing Prague into two constituencies). It was obliged to abandon the rest of its program. The two chambers were dissolved on Oct. 16, and new elections for both fixed for Nov. 15.

Second Švehla Cabinet and Second Cabinet of Officials.—The results of the elections brought about a considerable rearrangement of the strength of the parties of the coalition. The People's Party gained greatly, the Agrarians to a lesser extent, the Social Democrats were weakened, mainly because Communist candidates split the labour vote. The National Democratic Party was also weakened. In general, however, the five coalition parties did not lose their ability for government, especially as they were joined by the Traders' Party as a sixth member, which almost made up for the losses which they had sustained.

On Dec. 9 Švehla's second cabinet was formed, its constitution being as follows: Agrarians four, Social Democrats three, Czechoslovak Socialists three, Czechoslovak People's Party three, Traders' Party one, National Democrats one. Two places were occupied by non-party ministers, one of these being Engliš, the minister of finance. The position of the socialist parties in this Government was much weaker, and their collaboration with the non-socialists more difficult. After the Government had passed the decree of Feb. 1926 for the enforcement of the Minorities law, the growing tension led to its resignation.

It was succeeded by a fresh Government of officials under Dr. Jan Černý, only Beneš, Engliš and Kállay being included from the former Government. The Czechoslovak bourgeois parties, the Czechoslovak-German Farmers' Party and the Christian Socialists formed the Government coalition, all socialist parties being in the opposition. The customs Tariff bill was approved, after a heated struggle, on June 12, 1926, being followed by the State Employment bill, the Congrua bill (ministerial salaries) and the "refunding bills" (sugar tax and increase of the tax on alcohol).

(K. SE.; H. KO.)

The Development after 1927.—On Oct. 12, 1926 a new parliamentary Government was appointed, which for the first time was based on the collaboration of Czech and German bourgeois parties. Two Germans, representing the German Catholic Party and the German Agrarians, participated in the cabinet, the head of which was again Švehla. The adherence of the Germans, who from 1926 until 1938 participated actively in the administration of the country, seemed to bring the solution of the German minority problem nearer. The Slovak Peasant Party which was autonomist and clerical in its outlook, also joined the Government in Jan. 1927 and as one of its representatives Josef Tiso entered the cabinet. On July 1, 1927 the republic was divided for administrative purposes into four parts, Bohemia, Moravia and Silesia, Slovakia, Carpathian Ruthenia. This division allowed the granting of larger regional autonomy, thus trying to fulfil the wishes of the Slovak autonomists.

The good relations with the Slovak Popular Party were, however, disturbed, when in 1929 one of its leaders, Dr. Tuka, was tried for separatist agitation and treasonable relations with Hungary, and was condemned to fifteen years of imprisonment. New elections on Oct. 31, 1929, changed the composition of the parliament, and on Dec. 8, 1929, a new cabinet was appointed under Udržal, a Czech Agrarian as prime minister, and with the participation of Czech and German bourgeois and socialist parties. The number of German representatives in the cabinet remained at two, a Social Democrat and an Agrarian, but was later raised to three by the inclusion of a German clerical. President Masaryk had been re-elected on May 27, 1927 for a second period of seven years. The Government of Mr. Udržal was followed by a cabinet under Malypetr, a Czech Agrarian himself, and the composition of the cabinet did not fundamentally differ from the preceding one. It had been appointed on Oct. 30, 1932, and was re-appointed with a somewhat changed personnel on Feb. 14, 1934.

New elections were held on May 19, 1935. These elections were held largely in the shadow of the changed international situation. The problem of the German minority in Czechoslovakia was transformed from a problem of internal policy which was well on its way toward solution, into a problem of international policy and was made subservient to the German attempt at expansion and domination over central Europe.

FROM 1935 TO THE END OF WORLD WAR II

The New President.—The remarkable stability of Czechoslovak democracy expressed itself also in the unbroken continuity of the leadership of the republic. The first president, Thomas G. Masaryk, the president liberator, remained the head of the state he had done so much to create and to shape, from the fall of 1918 until Dec. 1935. When he had to resign on account of his advanced age (he was then in his 86th year) he was succeeded by Dr. Eduard Beneš, who was elected by a large majority on Dec. 18, 1935 for the presidential term of seven years. Dr. Beneš had been the closest disciple and collaborator of Masaryk for more than twenty years, and had since 1918 been minister of foreign affairs of Czechoslovakia. As a statesman, as a sociologist and as a student of ethics, Beneš followed closely the line of his predecessor. Masaryk, although in failing health, lived on for two more years; his death on Sept. 14, 1937 united the whole nation in an impressive demonstration for the great humanitarian democrat. On Nov. 5, 1935, Dr. Milan Hodža, a member of the Agrarian Party and a Slovak, became prime minister. Dr. Kamil Krofta, a distinguished historian, took over the foreign office on March 1, 1936. Both continued in office until the September crisis of 1938.

The Rise of National Socialism.—The accession to power of the National Socialist Party in Germany, the growing strength of

Nazi Germany in international relations, the spread of fascist influence and of a chauvinistic and exaggerated nationalism throughout central Europe, the weakening of the League of Nations and of the ideals for which it stood, all that was reflected in the attitude of the German minority in Czechoslovakia. Since 1926 German ministers had participated in Czechoslovak cabinets. This rapprochement between the two races coincided with a general improvement created by the Locarno Pact. But the German minority continued to feel themselves treated as second-rate citizens. Undoubtedly some of their grievances were legitimate. Czech influence and numbers were constantly growing in predominantly German districts. The Czech language was given a prominent place, Czech officials and police were employed in German cities and districts. In economic enterprises, financed by the Government, Czech employers and workers were given preference in German territory. But viewed in the light of the position of minorities generally throughout central and south-eastern Europe there is no doubt that the situation of the German minority in Czechoslovakia was relatively good, and that the democratic liberties were shared equally by the Germans with all the other nationalities of Czechoslovakia. The discontent of the Germans was aggravated by the general economic crisis which hit the predominantly industrial and less fertile parts of Czechoslovakia, inhabited by the Germans, much more heavily than the more agrarian districts.

The Czechoslovak Government dissolved on Oct. 4, 1933 the two extremist German nationalistic parties, the Nationalists and the National Socialists. A few days later a young teacher of gymnastics, Konrad Henlein, formed a new party, the Sudetendeutsche Heimatfront, later called the Sudetendeutsche Partei, or Sudetic German Party (the Sudeten is the name for the mountains separating Bohemia from Germany). The new party professed loyalty to the Czechoslovak state, but imitated the German National Socialist Party in its authoritarian totalitarianism, in its racial interpretation of history and in its fight against liberalism and socialism. This party became at the parliamentary elections of May 1935 the strongest German party, gaining about two-thirds of the German vote. The other three German parties, the Agrarian Party, the Clerical Christian Social Party and the Social Democrats, co-operated with the Government and entered a coalition cabinet with the Czech parties. The Sudeten Party demanded the autonomy of the Sudetenland and above all a complete change in Czechoslovakia's foreign policy and her re-orientation into the German orbit. These demands of the Sudeten Party were supported by the German press in the Reich which launched from time to time vehement attacks against Czechoslovakia.

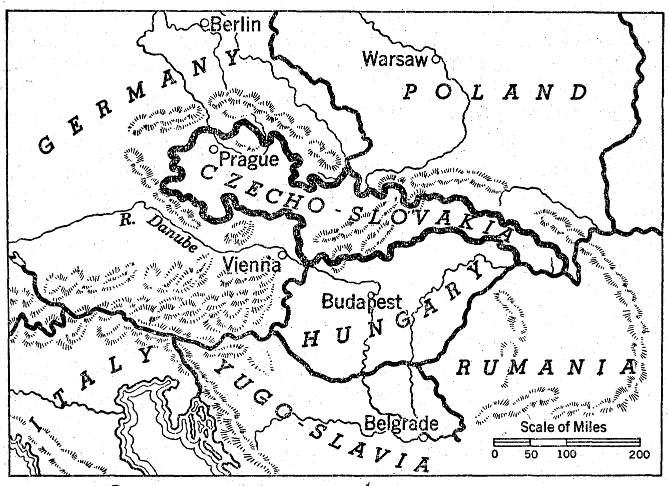
International Policy.—By her geographic position Czechoslovakia was the pivotal point in the struggle for a balance of power in Europe and in the efforts to maintain democracy in central Europe. This strategic position of Czechoslovakia grew in importance, as Germany resumed her expansion eastward in an effort to establish her control over the Danubian basin, to strengthen her *potentiel de guerre* by the economic resources of central and south-eastern Europe and by helping fascism to become the dominating political philosophy in all the countries which would fall under her influence. Against this drive for the expansion of Germany's strategic and economic power Czechoslovakia relied upon the League of Nations to which she always had faithfully adhered, and made her relations with the other members of the Little Entente, Yugoslavia and Rumania, closer by the pact of Feb. 16, 1933. The alliance with France, which had been a cornerstone of Czechoslovak policy since her foundation, became more intimate and was reaffirmed in a number of solemn declarations. Under the influence of France Czechoslovakia altered also her attitude toward the Soviet Union, being one of the last states to extend recognition. After France had concluded a defensive pact of mutual assistance with the Soviets, Czechoslovakia followed suit on May 16, 1935.

At the same time the Czech Government concentrated its attention on strengthening its army which was raised to a very high standard and was in training, equipment and efficiency equal to the best armies of Europe. A line of most modern fortifications, a second "Maginot" line, was built along the German frontier to protect the country against any surprise attack. The armament works of Czechoslovakia, especially the famous Skoda Works in Pilsen, were world renowned. In addition to her reliance upon world democracy, upon her friends and upon her army, Czechoslovakia pursued an active policy for improving her relations with her neighbours. The Czechs tried to promote the ideal of an economic and a diplomatic co-operation between the states of central Europe for the maintenance of their independence and their traditions. The relations with Austria became more cordial, and better relations with Hungary were established than there had existed since the end of the World War. Definite prospects of a peaceful consolidation and development of the central European situation appeared toward the end of 1937.

Efforts at Czech-German Conciliation.—To lessen the prevailing tension the Government of Dr. Hodža started negotiations with the three German parties who were co-operating with the Government. Only three major parties remained outside the coalition, the Sudeten German Party, the Communist Party and the Slovak People's Party, the latter a reactionary clerical party with fascist tendencies under the leadership of Father Andreus Hlinka. On Feb. 18, 1937 an agreement was concluded between the Government and the three German parties within, whereby the Germans were promised their just share in public economic enterprises, their due representation in civil service and certain improvements in the thorny question of the inequality of the Czech and German languages. Certain steps were taken toward satisfying the demands of the Slovaks and of the Carpatho-Russians for autonomy. But all these measures were carried out only slowly and did not keep pace with the rapidly changing international situation where Germany was striding fast to attain her ends.

After the Annexation of Austria.—Chancellor Hitler in his speech on Feb. 20, 1938 had declared that the German minority in Czechoslovakia as well as the Germans in Austria should feel confident of the Reich's support. Nine days later Field Marshal Göring warned that "since the Fuehrer made the proud statement that we would no longer tolerate that ten million of our German brothers across the frontier should be oppressed," the soldiers of the German air force knew that they must "stand for this word of the Fuehrer until the end." Ten days later German aeroplanes and troops moved into Austria and the country was annexed. This fact rendered the situation of Czechoslovakia even more precarious. It aroused in the German minority the definite expectation that within a brief time Chancellor Hitler would "liberate" them. In this mood many Germans joined the Nazi Party. Of the three German parties co-operating with the Government, the Agrarians and the Christian Social Party dissolved and joined the Sudeten Party, the German Social Democrats also withdrew from the cabinet. The demand of the Sudeten Germans for autonomy was now taken up by the Hungarian and Polish minorities and by the Slovak People's Party. The Czech Government promised to grant further concessions to the German minority, but the eight demands laid down by Henlein in a speech at Carlsbad on April 24, proved unacceptable, because they included not only a complete autonomy for the Germans, but an insistence upon the acceptance of the totalitarian Nazi philosophy, incompatible with the democratic character of Czechoslovakia. The Sudeten German Party, which on May 13 created its own uniformed storm troopers, became more and more insistent, frequent incidents resulted, governmental authority in the Sudeten districts was undermined, the followers of Henlein terrorized the German Socialists and Democrats. A general feeling prevailed that on May 21 German troops would move into the Sudetenland to support a Sudeten revolt. A quick mobilization of part of the Czech army, carried through with greatest preciseness and efficiency, forestalled, at least for the time being, any such move. But the German Government ordered on May 29 a sharp increase in the German army which was raised during the early summer to the strength of 1,500,000 men under arms, and concentrated about 500,000 conscripted labour upon the rapid construction of impregnable fortifications on Germany's western front.

Meanwhile negotiations continued between the Czech Government and the different minorities, especially the Sudeten Germans, about a general revision of the status of the minorities in Czechoslovakia. These negotiations were hindered by the violent campaign of abuse and hatred carried on by the German press and radio against Czechoslovakia. Under these circumstances and with Germany's threat of war against Czechoslovakia more and more imminent, the British Government sent, at the end of July, Lord Runciman to mediate between the Czechs and the Sudeten Germans. The Czech Government submitted proposals for far-reaching concessions to the Sudeten Germans, embodying most of their demands for self-government. But the Sudeten Germans refused, under the pretext of minor incidents, to negotiate. At the same time Chancellor Hitler in his speeches during the month of September sounded a more and more warlike note. With the danger of armed conflict rapidly growing the British and French Governments started negotiations with Germany. As the result of these negotiations they forced Czechoslovakia to accept the German demands for a dismemberment of Czechoslovakia. The Czech Government had not even been consulted during these negotiations. Finding itself forsaken by its allies, it had no other choice than to become resigned to the establishment of German undisputed hegemony in central Europe at the expense of Czechoslovakia, but also at the expense of democracy, of the prestige and position of Great Britain and France, and of the League of Nations.



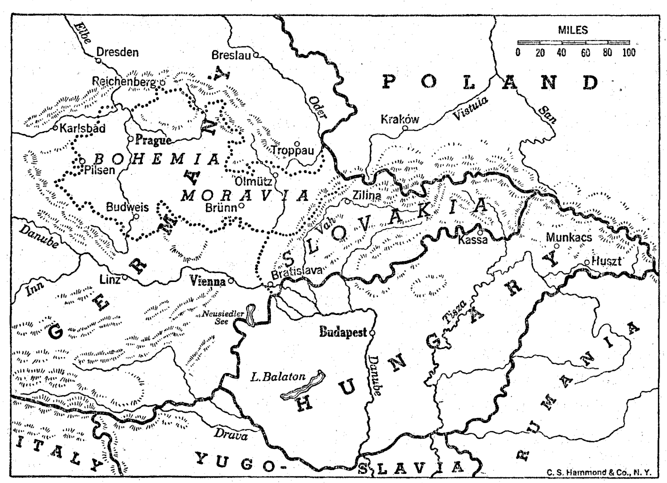
CZECHO-SLOVAKIA AFTER THE MUNICH PACT, 1938

After the Pact of Munich.—The accord of Munich of Sept. 30, 1938 sealed the fate of Czechoslovakia. On September 22 the Government of Dr. Hodža had resigned and General Jan Syrovy, the inspector general of the army, had formed a new cabinet. This cabinet was now faced with the task of carrying through the cession of all the territory inhabited, according to the census of 1910, by a German majority, to Germany, and to face similar claims on the part of Poland and Hungary. The Polish claims were fully granted, those of Hungary, after long negotiations, were settled on November 2 by a judgment of the German and Italian foreign ministers who acted as arbiters. Meanwhile, on October 5, Dr. Beneš resigned as president of the republic, a second cabinet of General Syrovy's was formed with Dr. František Chvalkovský as foreign minister, who was well known for his sympathetic attitude toward Germany and Italy. This cabinet carried through the difficult transition from a democratic Czechoslovakia, relying upon the League of Nations and the western democracies, to a new federative state Czecho-Slovakia, with fascist tendencies and entering entirely the political, economic, strategic and cultural orbit of Germany. Thus the First Czechoslovak Republic created by Masaryk was followed by a Second Republic the tendencies and ways of life of which differed fundamentally from its predecessor.

The Second Czecho-Slovak Republic.—Czechoslovakia lost 28,680 sq.km. to Germany, 11,830 to Hungary, and 1,086 to Poland. Her area after the Pact amounted to 98,912 square kilometres. Of her population she lost 3,576,719 to Germany, 992,496 to Hungary and 230,282 to Poland. Among this population lost there were about 1,202,000 of Czech and Slovak nationality who now formed minorities in Germany, Hungary and Poland. The total population of the new Czecho-Slovakia amounted to 9,807,096 or two-thirds of the original population.

The new Czecho-Slovakia was a federal state consisting of Bohemia and Moravia with 49,362 sq.km., Slovakia 38,456 and Ruthenia 11,094. Bohemia and Moravia contained more than two-thirds of the present population, namely 6,804,876. The three federated Slav nationalities, the Czechs (6,453,857), the Slovaks (2,055,802) and the Ruthenes (512,289), formed together 93·4% of the whole population. The remaining national minorities, the Germans, Hungarians, Jews and Poles, were numerically insignificant.

The relations between the Czechs and the Slovaks were regulated in a way similar to that existing in the Dual Monarchy of the Habsburgs after 1867. Although numerically much inferior, the Slovaks set the pace of the development of the Second Republic and led the distinct swing to right-wing fascism which became characteristic of the Second Republic. The Slovak Government under Monsignor Josef Tiso, the successor of Father Hlinka who had died in Aug. 1938, established a one-party rule, created a fascist militia, and started a violent anti-Semitic campaign copying the German example. The development in the western part of the country went in the same direction although much slower and under preservation of certain features of an "authoritarian" democracy. The Czechs knew that they depended for their survival entirely upon the goodwill of Nazi Germany. They had therefore to adapt their whole economic, political and cultural life to this new situation. The Czech parties were dissolved, the Communist Party outlawed, anti-Semitism grew rapidly under German propaganda. The democratic period of Czechoslovakia, the memory of Masaryk, the personality of Beneš, were violently attacked by the new forces which had come to the fore among the Czechs. The Czech Conservative parties formed a party of National Unity which became the majority party in the Czech parliament, opposed by a Czech labour party which tried to maintain, as far as it was possible in the new situation, certain traditions of the democratic past.



DIVISION OF CZECHO-SLOVAKIA AFTER AUG. 1939

The Czecho-Slovak parliament accepted on Nov. 22, 1938 the autonomy statute for Slovakia. On Nov. 30 it elected Dr. Emil Hacha, the president of the supreme administrative court, president of the new republic. A new cabinet was appointed under Rudolf Beran, who had been for many years an advocate of a Germanophile policy. The new Government sanctioned the building of a German corridor across Czecho-Slovakia, to connect German Silesia with Vienna. This corridor was to be regarded as part of the German political and customs territory, and to be under German sovereignty. In addition to this road a canal was to be built by Germany across Czecho-Slovakia, connecting the Danube with the Oder, and thus to bring the countries of central and south-eastern Europe into the German economic and political orbit.

German influence made itself also heavily felt in Carpatho-Ruthenia which was, under the new premier, Monsignor August Vološin, transformed into the spear-head for the "liberation" of all Ukrainians, living in Poland and the Soviet Union, by Germany.

The whole Second Republic tried to adapt herself rapidly to the changed situation. She tried, too, to maintain against increasing demands on the part of Germany and of the numerically insignificant German minority still in the country, at least a semblance of independence. In spite of the fascist character and the subservience of the new Czecho-Slovak Government, the German Government did not accept the situation created by the Pact of Munich. Internal disputes arose between the Government in Prague and the autonomists in Slovakia and Ruthenia, who had been encouraged by Germany to an attitude irreconcilable with the maintenance of even a formal union between the three parts, and were supported by Germany in their open defiance of the Central Government. With German help Slovakia proclaimed her independence on March 14, and charging that Germans had been mishandled, German troops entered Bohemia and Moravia, dissolved the Czecho-Slovak Republic and put an end to Czech independence. The British and French, who had undertaken at Munich to guarantee the new frontiers of Czecho-Slovakia, refused to act at this violation of the Pact of Munich. The Czech president, Dr. Hacha, was forced in Berlin to demand the protection of the German Government for Bohemia and Moravia. At that time, on March 15, 1939, German troops were already on the march towards Prague and on the evening of the same day Chancellor Hitler in person came to Prague and stayed in the historic castle of Hradčany. Bohemia and Moravia were incorporated into the German Reich as "autonomous protectorates." The Czech army was disbanded, the Reich took over the conduct of the foreign affairs of Czecho-Slovakia, and acquired the great military equipment, economic wealth, resources and productive potentialities of the former republic. Baron Constantin von Neurath was named protector of the new protectorate, and one of the leaders of the former Sudeten German Party, H. K. Frank, was named secretary of the protectorate.

Subsequently, it became clear that the Germans intended to restrict even further the remnant of authority left to the Czechoslovaks. A German decree, issued in June 1939, empowered the protector to modify the existing autonomy without any reference to the Czechoslovak authorities. Under these circumstances, the resistance of the Czechs to the new regime increased. During World War II, German rule became more severe and the Czechs, because of their Slavic origin, were treated as "second-class" citizens. In 1944–45, Russian armies liberated first Ruthenia, then Slovakia and finally Bohemia from the reich grip. Several days after Germany's surrender (May 8, 1945), President Beneš and his government returned to Prague. The new prime minister, Zdenek Fierlinger, outlined a radical program of social reforms, which included state control of monopolies and the large banks. In foreign policy, Fierlinger adhered to the alliance with the soviet union. It was announced on June 29, 1945, that Czechoslovakia had agreed to cede Ruthenia (or the Carpatho-Ukraine) to the soviet union. (*See* WORLD WAR II.)

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(H. Ko.)

CZECH LANGUAGE AND LITERATURE. The name Czech has always been used by the Slavs themselves and by their eastern neighbours. In Western countries derivations of the Latin name of their chief land, Bohemia (Čechy), were in use until recently. To avoid associations with "Bohemianism" the native form Czech and, since the World War, Czechoslovak has been almost universally adopted. The former word is properly spelt *Čech* (*ch* as in Scottish *loch*). The spelling *cz* which has prevailed in English is found in Latin, old Czech, Polish and occasionally in German. The origin of the name is obscure. Tradition records it as the name of the chief who led the Slavs into Bohemia. It is usually considered an abbreviation of a personal name (Česlav?). The latter form—*československý jazyk,* in Latin *bohemoslavica*—has been current for the language since the beginning of the eighteenth century, especially in Slovakia. Up to the thirteenth century the Bohemian Slavs called their language *slověnský,* a name preserved among the Slovaks. The political prestige of the central tribe established a supremacy over the whole of Bohemia towards the close of the tenth century and the name Czech became a generic term. The Slovaks are called *natio Slavica seu bohemica* in old records (*cf.* Verbötzi, 1609 etc.). The expression Moravian language (*moravský*) is common among the Czechs who came under Prussian rule in 1742.

Affinities and Structure.—Czech is a member of the western group of the Slavonic branch of the Indo-European family of languages (*q.v.*). It has preserved the archaic characteristics of an inflectional tongue. It has no article; there are three grammatical genders and seven cases. Instead of an elaborate system of tenses there are verbal aspects (perfective and imperfective) to express complete and incomplete action (*e.g. padati*—to be falling, to fall repeatedly; *padnouti*—to fall once; *psáti*—to write; *napsati*—to write down). There is no subjunctive. Czech forms the passive, whenever possible, by the aid of a reflexive (*Jmenuje se Jan*—He is called John). It is syntactically akin to the ancient Aryan languages, though less conservative than Russian. The word-order is free (except for unstressed words like *by, se, mi*). The principles of derivation are essentially the same as in other Slavonic languages. Compounds are comparatively rare.

The old dual number and the aorist and imperfect, which survive in Wendish and Southern Slavonic, were lost; the simple tenses were replaced throughout in the 16th century by the compound l-preterite, which distinguishes gender.

Phonetics.—Czech exhibits the specific features of Western Slavonic: *c* and (*d*)*z* for *tj* and *dj* (*placen* from *platiti,* to pay; *mezi,* amid); the group *dl* (*mýdlo,* soap *cf.* Russian, *mylo*); *š* for *ś* (*vše*—all). As in Polish, the two primitive semi-vowels (*jer*) became *e,* or were dropped (*pes,* dog, gen. *psa*); the initial *i* was dropped in *z* (out *cf.* Latin *ex*), *míti* (to have). *Co,* from *česo,*—what. The declension of animate and inanimate masculines is differentiated. Nasal vowels, however, have been lost in Czech (*Venceslaus,* a 10th-century Latinized form, is now *Václav*).

It agrees with Southern Slavonic in the treatment of the groups *or, er, ol, el.* (*král*—king, from *karl*); *břeh*—bank (*cf.* German *Berg*); *hlava*—head (*cf.* Lithuanian *galvā*); *mlíti*—to grind (from **mel-ti*). As in Little Russian, *g* became voiced *h.* (*hora* cf. Sanskrit *girịḥ*—mountain). As in Upper Wendish, its nearest relative, the principal accent falls on the first syllable.

The characteristic distinction of literary Czech as compared with the original form of the language and with its more conservative eastern dialects is mutation and other vowel changes, through which the dialects of Bohemia passed between the 12th and 16th centuries. *Duša* became *duše* (12th c.); *dušu* became *duši* (14th c.); *viera* gradually became *víra; ó* became *uo* and later *ů* (*sůl*—salt); *ú* was diphthongized into *au,* later *ou* (*moucha,* fly).

The most characteristic features of modern Czech phonology are; clear, somewhat staccato pronunciation without obscuration of the unstressed syllables; a simple vowel system; rigorous preservation of the marked distinction between long and short vowels (*páni*—gentlemen; *paní*, ladies); the vowel-like *r* and *l*, capable of assuming syllabic functions (as in Sanskrit, but never initially), even in stressed syllables (*trn*-thorn, *Vltava;* but *černý*, black, where Serb. has *crn, dlouhý*, long, not *dlhý* as in Slovak); *r* is rolled, the peculiar soft sound of *ř* is voiced or voiceless (*Řehoř*—Gregory). The difficult sounds *ł* and *y*, preserved in Polish, have been long discarded (*y* is pronounced as *i*). The difference between hard and soft consonants, which makes Polish phonetics so difficult, has practically disappeared (except in soft *d', t', ň*). *P, t* and *k* are never aspirated. In colloquial Czech *ý* is pronounced *ej*, initial *o*—*vo* (*oko*, eye, becomes *voko*).

Czech spelling is phonetic. A form of Latin alphabet modified by means of diacritics is used. Vowels are sounded as in Italian; vowel-length is represented by an acute accent, and in the case of long *ú* (medially and finally) by *ů* (*Bůh*, pron. *búch*—god). The sign ˇ placed over *e* softens it (*věk*—*vyek*—age). *Ou* as in soul. Most consonants have a similar sound value as in English. The following letters require special attention: *C*—ts (wi*ts*); *h* voiced (per*h*aps); *j* (hallelu*j*ah); *g* (in foreign words) always guttural (get); digraph *ch* as in loch; *š*—sh; *ž*—z in azure; *ř* like *rš* or *rž*; *č*—tš (church); *d', t', ň*, soft as in dew, tube, new. The same sound is heard in *di, ti, ni, dě, tě, ně*.

The position of the original free stress left its traces in the vowel quantity. Another source of long vowels is the primitive intonation (*bláto* Russ. *bolóto*), contraction (*státi* from *stojati*) or the nature of the following consonant (*můj* from *moj*).

Vocabulary.—The Czech vocabulary is homogeneous. Common words like *bratr* (brother), *myš* (mouse), *tři* (three), *nový* (new), *peku* (bake), throw light on the Aryan affinities of Czech. As a result of contact with the Teutonic race certain words of German origin are found (*barva*, Ger. *Farbe; hejtman*, Ger. *Hauptmann*), besides such early common Slavonic loan-words as *kněz*—priest (etym. related to Eng. *king*), *chléb*—bread (*cf.* loaf). Western Christianity brought in many Latin words such as *oltář*—altar, *řehole*—regula, while only a few traces remained of the original Slavonic liturgy (*církev*—church, *blahoslaviti*—to bless, *prorok*—prophet). In modern times international terminology is freely used; *republika, objektivnost, politický, telefonovati.* Slang is mainly derived from German: *kumšt, fotr.* Czech additions to the Western vocabulary are: pistol (from *pišťala*), howitzer (from *houfnice*), polka, robot. Czech style and structure of the sentences suffered through the imitation of German models in the period of decline but the racy idiomatic language has survived on the lips of the people and in good writers.

Dialectical Divisions.—The Czech dialects are broadly divided into four main territorial groups. Bohemia is almost unified in speech. Her most interesting dialect is *Chodský*, near Domažlice, in the southwest (*bul* for *byl*—he was). The "Doric" of Central Moravia, *Hanácký*, is distinguished by its broad vowel sounds (*bel* for *byl, lóka* for *louka*—meadow). The Silesian dialect is a transition to Polish (*był*, no long vowels, accent on the penult). The Slovak group, by far the most important, is spoken in E. Moravia and in Slovakia proper, where there is an extraordinary richness of dialectical types (28 expressions for potato). Its distinctive feature is the absence of *ř* (*reka* for *řeka*—river), and the generalization of the ending *m* in the 1st person of verbs. The melodious Central dialect (*bol* for *byl*) has been standardized for literary use (1852); but Czech has retained its traditional prestige among the Slovak Protestants. The Slovak vernacular is merely a dialect of Czech, and is easily understood by the Czechs. An attempt (about 1835) to form a Moravian language artificially out of local dialects was thwarted by F. Palacký, the well-known historian.

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LITERATURE

In Czechoslovakian, which is the oldest of Slavonic literatures, literary monuments exist from the beginning of the 14th century. Before that time Czech literature consisted of glosses of religious texts and religious songs. Czechoslovakian literature had its beginnings in rhymed legends, the products of priestly culture, but for a time West-European chivalry of Franco-German origin, modified to suit Czech conditions, prevailed throughout the country. This state of affairs is reflected in the verse translation of the Latin *Alexandreid*, written about 1310; in a rhyming chronicle of about 1310, erroneously known as *Dalimil's Chronicle*, which was patriotic and anti-German in spirit; and in the witty satires of the noble Smil Flaška of Pardubice (1349–1403). In the Easter mysteries and farces, and in short lyrics, frolicsome priests and university students found self-expression. The prose of the period is remarkable, both for its religious and educative qualities, and, in the *Kniha Rožmberská* and in the work of Ondřej of Dubá, for the records it has preserved of the earliest known Czech laws. Foreign culture was, however, already dissolving the national traditions of Czech literature during the reign of Charles IV. of the Lucemburg family.

The Reformation and the Renaissance.—By the end of the 14th century, Czech literature had grown richer in form and variety, and two aspects of the Czech soul became more pronounced and found manifold expression. The first was that of meditation on religion, and discontent with the contemporary scholastic system: the second was the revolt against feudalism, and the moral enthusiasm which permeated the public mind in its efforts to find a juster social order. From these two roots, watered by Waldensian teaching and by Wyclif's theology, there grew up the Czech Reformation, known at first as the Hussite movement, and later identified with the Bohemian Brethren. Its forerunners were the learned theologian and reformer Matěj of Janov (b. 1393) who wrote in Latin, and the squire Tomáš of Štítné (1331–1401), a popularizer of learning and the founder of Czech philosophical prose. The influences of these two men were later embodied in the personality of Jan Hus who elaborated their teachings, and set the seal on them by his martyrdom in 1415. He was an able writer, both in Czech and Latin, and by his eloquence as academical orator and popular preacher he made Wyclif's teachings widely known. By shunning archaisms he adapted the language to the needs of the day, and placed the love of religion in the forefront of all literary activities. For a time it seemed that secular literature had disappeared from Bohemia. Religious inspiration, however, produced powerful spiritual and warlike lyrics, of which the battle hymn "Kdož jste boží bojovníci" acquired great fame, and made a deep impression on the mind of a disciple of Hus, Peter Chelčický (1390–1460). This Gothic spirit from the people was a radical critic, not only of the church, but of the whole social and cultural system. Spiritually he was akin to Rousseau and Tolstoy, and from his ideal of a restored Apostolic Church and the foundation of the Kingdom of God on earth sprang the wonderful Union of Bohemian Brethren. The Brethren were given a stable constitution by Brother Lukáš at the end of the 15th century, and a primitive and anarchistic chiliasm was thus reconciled with the realities of life. The Union of Brethren then began to cultivate literature and science; mastered the art of printing; studied educational methods; pursued historical researches; and cherished and developed the mother-tongue.

The influences of the Renaissance are now discernible, but the humanities which penetrated into Bohemia from Italy seemed at first to be the privilege of the Roman Catholic nobility, of the emperor's diplomats and foreign officials, and resulted in a further latinization of the literature. That a happy compromise was eventually reached between Latin and Czech culture may be seen from the masterly prose of Viktorin Kornel of Všehrdy, who codified the ancient Czech laws. In Moravia at the same time Ctibor Tovačovský of Cimburk was engaged on similar work. In the Union of Bohemian Brethren the reconciliation of Christianity and Humanism was achieved by the pious and scholarly Jan Blahoslav (1523–71), who was an historian, grammarian, musical theorist and sacred poet. With his name is connected the Brethren's greatest literary work, a masterly translation of the Scriptures, known as the *Bible of Kralice,* which was completed in 1588 and remains a perfect example of classical Czech.

In the 16th and 17th centuries the influence of the Renaissance spread through the nation, and Daniel Adam of Veleslavín (1545–99), famous as a printer, literary man, orator, philologist and historian, may be mentioned as typical. During this age didactic prose flourished, and in addition to books of travel, historical works of all kinds abounded. These extended from the popular chronicle of Václav Hájek of Libočany to the psychological and pragmatic art of Bartoš Písař. Even during the period of decline two emigrants Pavel Skála of Zhoře and Pavel Stránský maintained the old tradition. Drama, poetry and the novel were, however, utterly neglected.

In 1620, with the defeat on the White Hill of the rebellion against the emperor, the national schism was complete. On one side stood the victorious Roman Catholics; on the other, the defeated Protestants. The latter soon emigrated and carried with them nearly the whole of Czech literary and scholastic culture. Among the emigrants was the last bishop of the Union of Brethren, Jan Amos Komenský (Comenius, 1592–1670), the great pedagogical reformer and language teacher. He was a devout Christian and a loyal Czech, as well as an ardent pansophist and a forerunner of the encyclopaedists. Like Hus, he was a great writer both in Czech and Latin, while his works, which show a strong foreign influence, reveal him as not only a philosopher and philologist, but as a poet. At the time of the Roman Catholic baroque Reformation a decline set in both in literature and language, which the efforts of the noble-minded clerical patriots, Bohuslav Balbín (1621–88), the learned historian, and Václav Šteyer (1630–92), the popular teacher, were unable to stay.

Revival in the 18th and 19th Centuries.—Towards the end of the 18th century, when the Austrian Government suspended the rights of the Czech State and by decree abolished the national language, it seemed that the gradual decline would become absolute ruin. A powerful revival set in, however, and the economic and social liberation of the country people gave new strength to the nation, while the enlightenment of Western Europe which penetrated into Bohemia strengthened this unexpected re-awakening. The nobility now began to defend their own rights and those of the Czech State against the centralizing influence of Vienna, and the clergy resumed the efforts of their patriotic predecessors of the previous century. The historical and philological studies which scholars, trained by new methods, were now pursuing were soon used as weapons against the Germanizing efforts of the Government, and against the prevailing ignorance of the masses. Scholars and writers, who themselves had sprung from common stock, roused the people from their apathy, while Western science, coupled with Slavonic enthusiasm, developed in the Czech mind the sense of unity with the whole Slav race. The first stage of this collective movement, known as the National Awakening or Revival, which was contemporary with the enlightenment of France and Germany, belongs to the 18th century and is extremely modest. Apart from scientific works, in Latin and German, it consisted of efforts to publish literature and periodicals for the people. Josef Dobrovský (1753–1829), a systematic philologist and historian, and founder of Slavonic studies, wielded the greatest influence, and his study of past literature, of the philological kinship of the language with the other Slav tongues, and of the laws of prose and verse, revealed an enlightened mind. His influence was very considerable, and bore fruit in the journalistic work of Václav Matěj Kramerius, and in that of Antonín Jaroslav Puchmajer, the first Czech poet.

Influence of Romantic Movement.—It was, however, the Romantic movement in Europe at the beginning of the 19th century, following upon the French Revolution and the Napoleonic wars, which set free the latent powers of the country and made the victory of the Czechoslovakian national revival complete. The importance of the national language was by now fully realized, and there was a general movement toward the serious cultivation of Czech science and poetry. A sense of history and tradition entered into the soul of the people, and an appreciation of nature, together with a growing emancipation of imagination and feeling, led to literature and poetry throwing off the chains of didacticism and entering the field of artistic creation. Three great historians and philologists, inspired by philosophy and love of poetry, were the leaders of this intellectual revolt, and their legacy remains the foundation of the culture of Czechoslovakia. The oldest of them, Josef Jungmann (1773–1847), the patriarch of Czech literature, who came from central Bohemia, is famous as a lexicographer, literary historian and critic of poetry, while his followers Pavel Josef Šafařík (1795–1861) and František Palacký (1798–1876) introduced new elements of Slovakian thought. The former elaborated Dobrovsky's studies in the sphere of Slavonic history and ethnography; the latter, who rightly bears the name of "Father of the Nation," wrote popular philosophical works on Czech history, in which he presented an inspiring picture of the past, and also laid foundations for the political development that was to follow. Their common ideal of Czech classical poetry being recognized at its true worth was not for many years to be realized, but a body of enthusiasts with Václav Hanka at their head resolved to follow "Ossian" Macpherson's example and manufacture such poetry. Thus did the famous literary forgeries *Rukopis Královédvorský* and *Zelenohorský* originate, and though the imitation of the language was poor, the poems were rich in feeling for the ancient heroic period of the nation. Real poets were soon forthcoming. The conception of Slavonic brotherhood was eloquently expressed by Jan Kollár (1793–1852), a rhetorician, classical in style, who hailed from Slovakia, in the poetic allegory *Slávy dcera.* In his footsteps followed Jan Hollý (1793–1844), an epic poet alive to the grandeur of the past. Next came František Ladislav Čelakovský (1799–1852), a clever imitator of Czech and Russian native poetry, and Karel Jaromír Erben (1811–70), the writer of tragic moral ballads which, though more restricted in scope, were more intense in feeling. Karel Hynek Mácha (1810–36), an imaginative poet whose verses are charmingly melodious, followed a new romanticist path, leading to the metaphysical conflicts of modern man, but he did not live to maturity. The novel and the drama, which were still largely historical, cannot compare in interest with this poetry, and even Josef Kajetán Tyl, the author of the national anthem, and Václav Kliment Klicpera were but popular writers of the day.

The Beginnings of Literary Realism.—In the '40s of the 19th century, the romantic era in Czech literature gradually drew to an end and was replaced by a period in which attempts were made to reproduce realistically the problems of contemporary public and social life. Literature now began consciously to attempt to influence society. This general movement was connected with the increasing political activity which occurred about the year 1848; with the democratic ideas of the age; and with the progress of journalism. National culture was, however, handicapped by the separation of the "dialect" Slovak literature, which had been effected in 1844–46 by the ardent Slovak leader Ludevít Štúr. These new tendencies were personified in the classic Czech journalist, Karel Havlíček-Borovský (1821–56), who was an excellent satirist, epigrammatist and critic; in the sphere of the novel, Božena Němcová (1820–62), a master of idyllic narrative, played a similar part. It was not, however, until about the year 1860, which brought its measure of political freedom, that a young literary school, called the school of Máj, revolutionized Czech poetry, conforming it to the new spirit of realism and social and moral reform. Leader of the group was Vítězslav Hálek (1835–74), the brilliant peasant-type psychologist and the author of love and nature poems. His friend Jan Neruda (1834–91) was a prolific journalist, a melancholy lyric poet, a clever critic and a brilliant *feuilleton* writer, who with his keen gift for observation, his love of truth, his deep humanity and original style, laid the foundations of modern Czech literature. His inspiration is still alive to-day while the work of his intimate companion, Adolf Heyduk, is forgotten. Jan Neruda in his critical capacity directed special attention to that branch of the novel and the drama which concerns itself with social problems. His action was fruitful. Karolina Světlá (1830–99), the idealist thinker and tragic authoress, dealt with moral problems in the novel, and her literary *confrères,* Gustav Pfleger Moravský (1835–75), Jakub Arbes (1840–1914) and Antal Stašek (1843–1931), studied the life and environment of the working classes, and the problem of the discord between capital and labour. In originality of character drawing and effectiveness of style these, however, were all surpassed by Alois Vojtěch Šmilovský (1837–83), the psychologist of the country town. In the world of drama, Emanuel Bozděch (1841–89) failed to emancipate himself from his French models, and continued to write witty comedies of intrigue, but František Věnceslav Jeřábek (1838–93) made good use of the realities of his native soil and produced impressive works.

National Tendencies and Artistic Aims.—In the '70s and '80s of the last century there appeared two independent literary groups of the schools of Neruda and Hálek. One, named after the periodical *Ruch,* supported the tendency in contemporary politics to strengthen nationalist feeling, to recover old rights, and to foster friendly relations with the rest of the Slav race. The other, contributing to the magazine *Lumir,* worked for the ideal of literature for its own sake, and demanded the incorporation of the thought and creative art of Western Europe in Czech literature. Both schools introduced into rhetorical poetry the element of meditation, both sacrificed sound to literary images, and led literature from popular simplicity to learned artificiality, which was popular among the educated classes.

Svatopluk Čech (1846–1908), a follower of Byron and the Slav Byronic poets, an epic poet rich in colour and varied in music, master of the political song and eloquent preacher on poetic themes, was the most famous poet of the period. The poetess and critic Eliška Krásnohorská (1847–1926), the leader of Czech feminists, though inferior as a poet, was his equal in patriotic fervour. The depths of the Czech soul were plumbed by the lyric poet, Josef V. Sládek (1845–1912), who is famous as the translator of Shakespeare and of other English and American poets: master both of lyric and contemplative poetry, he wrote of love, faithfulness, death and eternity, for the most part in simple classical form. Though every manifestation of national life was persecuted by the Magyar Government, Slovakia possessed two ardent patriotic poets. The first, Svetozar Hurban Vajanský (1847–1916), the more vehement and less profound, wrote chiefly lyrical songs, while Hviezdoslav (Pavel Országh), an original thinker, wrote broad epics of the history of the race.

The historical novel, based on thorough historical research and devoted to the cultivation of patriotism, was by far the most popular product of the National school. Its pioneers were the elegiac and pathetic Václav Beneš Třebízský (1849–84) and Alois Jirásek (1851–1930) whose studies of the Hussite Wars, of the national decline, and of the Revival period, all greatly detailed and yet wide in vision, are dear to every Czech from childhood. Nevertheless, in artistic force and delicacy of treatment, he was surpassed by the archaic and pithy Zigmund Winter (1846–1912).

That the members of the other group, whom their opponents dubbed cosmopolitans by way of reproach, advocated the principle of "art for art's sake" was only a temporary self-deception; that by their predilections for the cultures of France, Italy and England they liberated Czech literature from the long tutelage of German influences was an undeniable service; that they extended the scope of subjects, ideas and imagery was a token of their artistic powers. They derived new inspiration from the sea, from the fine arts, from feminine beauty; they learned to absorb the cultures of foreign countries and of bygone ages and to imitate the metrical forms employed by them; they enriched the Czech poetical style with unprecedented verbal resources and obtained musical effects which had not hitherto been achieved in Czech verse.

Julius Zeyer (1841–1901), the elder of the two leaders of this group, was permeated by the Gothic spirit of the English pre-Raphaelites. In novels, short stories, epics and dramas, he evoked the exotic colours of the East and the romantic tales of the middle ages. His younger companion, Jaroslav Vrchlický (Emil Frida, 1853–1912), occupied two positions of equal significance in the literature of his nation. As a literary scholar of unrivalled erudition and as an adept at translation, this tireless worker made accessible to the Czechs all the chief products of Romance poetry from the time of the Renaissance onwards. As a poet with the prolific qualities of a Lope de Vega, he was the author of a whole library of lyrics and epics as well as of dramas and stories. By nature he was a hedonist with predilections for classical antiquity and the Renaissance, but life awakened in him an instinct for suffering, sorrow and the Christian scale of values. As a pupil of Victor Hugo he dreamed of a huge epic of humanity, conceived on evolutionary and humanitarian lines, half picturesque, half rhetorical in style, but this gigantic task was carried out only in fragments and in feverish haste, its progress having been interrupted by his lyric compositions, the melodious utterances from the depths of a spirit overwhelmed but also purified by the visitations of destiny. The incisive influence of Vrchlický left its traces on the whole of Czech poetry during the '80s and '90s of the 19th century and his followers were numerous. Of them may be mentioned Jaroslav Kvapil (b. 1868), a master of stagecraft, who as a poet is distinguished by beauty of form.

Realism and the Reaction.—A violent reaction from Vrchlický is represented in the early works of scholarship and criticism produced by T. G. Masaryk, who later devoted himself wholly to politics. The new tendency was given the not altogether appropriate name of realism. Against the cult of personality it placed the social consciousness, against the charm of art the serious occupation with public questions, against the interest in form the exclusive criteria of ideas and subject matter. It continued the process of emancipation from German influences, but it preferred the English and the Russians to the French. It disregarded the Renaissance and identified itself with the religious Reformation. It imposed upon authors the duty of studying the life around them, not merely on the surface, but in accordance with the ideas underlying it and of expressing the results of their observations in plain, concise language without adornment or rhetoric.

The chief poet who followed these principles was Jan Svatopluk Machar (b. 1864). He began with love poetry and political or social verses, the pitilessly analytical spirit of which is provocative rather than satisfying. His striving after an objective attitude led him to a versified epic of mankind. This consists of fragmentary poems, the best of which are concise and graphic, but the general tone of the work is dry and didactic. To his influence can be traced the work of a great political poet, Petr Bezruč (Vladimír Vašek, b. 1867), the author of only one book, the fiery spokesman of the Silesian miners, who is equally sincere whether enunciating the anguish of a dying race or rallying the victims of social injustice to defiance.

Realism in Czech prose was satisfied mostly with the search for human documents and with the depicting of remarkable types.

More rarely it illuminates the complex questions affecting the social structure. This applies particularly to the village novel, which was then much in vogue. Two writers of the older generation must be mentioned here. The Slavophil author Josef Holeček (1853–1929) returned, by way of his interest in the Yugoslav heroic legends and Russian orthodoxy, back to the Czech peasant, from whose stock he was descended. In a novel which consisted of several volumes and which was written with great verbal skill, he depicted the old Czech peasant virtues in an idealistic light. Teréza Nováková (1853–1912), a very complex feminine personality, achieved an understanding of the spirit of the people slowly, but she then discovered that the moody highland peasants, whom she knew, were, at bottom, animated by a moral and religious fervour which attained an almost tragic intensity. In her stories the idealism of the conception is coupled with a realism of treatment.

Jan Herben (b. 1857) and Alois Mrštík (1861–1924) wrote chronicle-like narratives, rich in incident, from which an invaluable knowledge of Moravia can be obtained, and the racy tales of Martin Kukučín (M. Bencúr, 1860–1928) render the same service for Slovakia. They are surpassed by Karel V. Rais (1859–1926) whose sensitive sketches from the Krkonoše (Giant Mountains) district are distinguished by the economy of their structure. Considerable success was attained by the novel of city life, notably with a Prague setting. Ignát Hermann (b. 1854) revealed a richly humorous vein in his descriptions of lower middle-class life in Prague. M. A. Šimáček (1860–1913) gave first-hand accounts of factory-life, for the sociological aspect of which he showed a sound instinct. F. X. Svoboda (b. 1860), who was of rural origin, but became acclimatized to Prague, handled feminine psychology with poetical understanding, and his novels, written with an abundance of impressionistic imagery, generally centre upon some phase of moral or family tradition. All these authors, however, were thrown into the shade by the crude naturalist K. M. Čapek-Chod (1860–1927). With an unbridled instinct for grotesque effects and pessimistic mockery, he portrays present-day Prague in a wealth of ruthless but faithful detail.

From the beginning of the 20th century there was a manifest decline in realism. This transition to a more spiritualized art is associated with the name of F. X. Šalda (1867–1937), creator of modern Czech criticism and a scholar who was, fundamentally, a poet. The change was first exhibited in lyric poetry which has always formed the leading feature of Czech literature. In the case of Antonín Sova (1864–1928), a master of melody and metaphor, his whole work reflects the reactions of an altogether unusually sensitive temperament to the solitude of nature, to its own emotions and to the many-sided social phenomena of modern life.

This sensitive reaction to the internal and external world is found also in the work of such diverse poets as Jiří Karásek ze Lvovic (b. 1871), who has written elegiac verses of impeccable form and decadent subject-matter, Stanislav K. Neumann (b. 1875), eloquent and barbaric in his advocacy of unfettered instincts, who extols rustling forests, flowing waters, amorous women and turbulent multitudes, and Karel Toman (Antonín Bernášek, b. 1877), admirably concise and suggestive in his melodious, profoundly emotional verses. This sensitiveness forms only one of the elements in the personality of Ottokar Březina (Václav Jebavý, 1868–1929), whose lyric poetry was prompted by a cosmic consciousness and exhibits a unique inventiveness of metaphor. In hymn-like poems, which are remarkable on account of their elaborate design and brilliant imagery, the poet, whose life was spent in philosophical seclusion, extols the flight of the soul through the universe to God and its return thence to the everyday world, clutched by myriads of praying and toiling hands. His influence is seen in the work of Otakar Theer (1880–1917), who in the end subordinated his sensual temperament to fertile ideas concerning will and suffering, eternity and God, patriotism and moral liberty. Viktor Dyk (1877–1931), a poet who occupies a place apart, was closely attached to his nation as a living entity which uplifted him from nihilism and imparted a fervid charm to his simple and epigrammatic diction.

Novel and Drama.—In prose fiction the new sensitiveness made its appearance as a strengthening of the picturesque element, and later as an enhanced feeling for the subtleties of psychology, together with a close and sometimes exaggerated cultivation of style. It was on such lines as these that Vilem Mrštík (1863–1912) dealt with the unfettered destinies of youth, Růžena Svobodová (1868–1920) with the sorrows, yearnings and dreams of modern women, Karel Sezima (Karel Kolář, 1876–   ), with the tragic aspect of everyday life in small towns. Here also a reference should be made to Fráňa Šrámek (1877–   ), ecstatically revelling in the beauty of the world and celebrating in luminous prose and also in melodious lyric poems the grief and enchantment of youth. More recently, however, the tendency of the Czech novel has been towards a simplification as regards style and emotional content, and it shows signs of becoming richer in ideas. Inspiration is also being derived from the facts of science, and there is an obvious return towards realism. Thus, Anna Maria Tilschová (1873–   ) is remarkably precise in analysing the decadence of urban society, while Karel Čapek (1890–1938), a whimsical philosopher of the commonplace, combined phantasy with warmth and delicacy of sentiment.

Although the drama has always formed the height of Czech literary ambitions and although the handsome National Theatre, ever since its establishment in 1883, has been regarded as the supreme artistic institution, Czech drama did not thrive in the desired manner. Several of the authors who have already been mentioned tried their hands at writing for the stage. Vrchlický and Zeyer produced scenic poems, the subject-matter of which was derived from myths and history; Ladislav Stroupenický (1850–92) applied the method of realistic *genre* in rural comedies and historical miniatures; Jirásek wrote dramatic chronicle-plays from Czech history or based upon legends and village life; F. X. Svoboda realistic dramas from the life of the contemporary bourgeoisie. But it is only quite recently that the Czech drama has developed greater briskness and a sense of reality, both as regards the problems chosen and the language in which they are treated. Jaroslav Hilbert (b. 1871) and František Langer (b. 1882) are skilful psychologists in the modified realistic manner. Arnošt Dvořák (1881–1932) handled historical subjects with picturesque elaboration; Karel Čapek, beneath whose satirical grimace was concealed the heart of an humanitarian, was a bold contriver of scenic utopias.

Scholarship.—Czech scholarship in the fields of history and linguistics kept close touch with literature from the beginning of the National Revival, and the work of Palacký and Jungmann exercised considerable influence. A direct follower of Palacký was Václav V. Tomek (1818–1905), the historian of the city of Prague, a tireless political historian and founder of the so-called Austrian history. With him was Josef Kalousek (1838–1913), the expert in Czech common law. In the '70s and '80s, Jaroslav Goll (1848–1929), an expert in critical method and the author of valuable studies on the Bohemian Brethren, gave a new direction to Czech historical research, and was responsible for the training of three distinguished scholars: Josef Pekař (1870–1937), shown to be a man of originality of mind by his researches into economic history, popular legends, the National Revival, and the Hussite Wars; Josef Šusta (1874–   ), who has outlined the development of the Czechs against the hitherto neglected background of the history of Western Europe; and finally Václav Novotný (1860–1932), a student of the religious Reformation. Slavonic archaeology has been enriched by the studies of Lubor Niederle (b. 1865). The grammatical studies of Dobrovský and Šafařík were superseded by those of Jan Gebauer (1838–1907) who constructed a logical and systematic history of the Czech language upon the basis of the extensive material he had collected. This was later supplemented by the work of František Bartoš (1837–1906), a Moravian who recorded and analysed the Moravian dialects. Philology and history were united in the work of Jaroslav Vlček (1860–1930), the founder of modern literary history and an exponent of the ideas underlying the age of enlightenment. New light was thrown on the literature of the National Revival by Jan Jakubec (b. 1862), and Václav Flajšhans

(b. 1866) is famous for his studies on the life and work of Jan Hus.

See Count Lützow, *A History of Bohemian Literature* (1899); W. R. Morfill, *Slavonic Literature* (1883); F. Chudoba, *A Short Survey of Czech Literature* (1924); H. Jelínek, *La Littérature tchèque contemporaine* (1912); J. Jakubec and Arne Novák, *Geschichte der Čechischen Literatur* (1913). There are modern histories of Czechoslovakian literature written in the national language by Jar. Vlček, Jan Jakubec and Arne Novák. (A. No.)

CZERNIN, OTTOKAR, COUNT (1872–1932), Austro-Hungarian statesman, was born on Sept. 27, 1872, and became in Feb. 1912 a member of the Austrian upper house, attaching himself to the Constitutional party.

In Oct. 1912 he went as Austro-Hungarian minister to Bucharest. Even at that time he was convinced that, despite the treaty signed by the king with the Triple Alliance, Rumania would not support the Central powers in the event of war except at a price; and on the outbreak of World War I he attempted to persuade his government to pay such a price. He was unsuccessful, but kept Rumania neutral for a long time. At the end of 1916 Czernin succeeded Burian as minister of foreign affairs, and from the first endeavoured to persuade the German emperor and high command to seek the conclusion of a peace which should preserve Germany and Austria-Hungary as great powers, even though Germany must make sacrifices in Alsace-Lorraine and Belgium, for which he suggested that she should receive compensation in the east, chiefly by the acquisition of Polish territory. He was cognizant and approved of the peace negotiations which the emperor, Charles, opened with Britain and France through his brother-in-law, Prince Sixtus of Parma, although he knew nothing of the wording of the letter of March 24, 1917, in which the emperor, Charles, spoke of his willingness to support the "just demand" of France for the return of Alsace-Lorraine by any means and by the use of his whole personal influence with his ally.

During the negotiations at Brest-Litovsk from Dec. 1917 to March 1918 the opposition between the views of the Austro-Hungarian delegation, led by Czernin, and the German delegation became strikingly manifest. In the negotiations leading up to the convention between Russia and the Quadruple Alliance, signed on March 3, 1918, Czernin took a conspicuous part. A few weeks earlier peace had been concluded at Brest-Litovsk with the newly founded republic of the Ukraine. The fact that Czernin, in order to secure this "bread peace," had ceded to Ukraine the district of Chelm, to which the Poles laid claim, aroused the most violent resentment among the latter, and led to unsparing attacks upon him by the Austrian Poles. In the beginning of April 1918 his position was no longer tenable. The immediate cause of his resignation on April 15, 1918, was the conflict between him and the emperor, Charles, over the "Sixtus letter."

BIBLIOGRAPHY.—For Czernin's activity in Bucharest and in the World War *see* his *Im Weltkriege* (1919). His despatches from Bucharest are printed in the Austro-Hungarian "Red Book," *Diplomatische Aktenstücke betreffend die Beziehungen Oesterreich-Ungarns zu Rumänien, 22 Juli 1914 bis 27 August 1916.* A favourable view of Czernin's attitude in the "Sixtus affair" is taken by Count August Demblin in *Czernin und die Sixtus Affaire* (1920); the standpoint of Prince Sixtus is represented in *Prince Sixt de Bourbon, L'offre de la paix séparée de l'Autriche* (1920).

CZERNOWITZ (Rum. *Cernăuti*), a city of Rumania, capital of the Bukovina (*q.v.*), and situated on the main Lemberg-Bucharest railway. Pop. (1930) 111,122; (est. 1939) 109,698. Czernowitz lies on an eminence on the right bank of the Pruth. Its most conspicuous building is the archiepiscopal palace of the Greek orthodox metropolitan of the Bukovina—a notably ugly erection in the Byzantine style. The Orthodox cathedral, completed in 1864, is modelled on the church of St. Isaac in Leningrad. The Armenian church, in mixed Gothic and Renaissance style, was consecrated in 1875. The university, opened in 1875, was formerly a brilliant outpost of Germanic culture in the extreme east of the Austrian empire. The language of instruction is now Rumanian. The main Austrian monument, a statute of Maria Theresa, was wrecked in 1918. An active trade is carried on in agricultural produce, wood, wool, cattle and spirits. The marketplace, with its Ruthenian peasantry, is a very picturesque sight.

At the time of the Austrian occupation (1775), Czernowitz was an unimportant village, but the Austrian colonization of the Bukovina made of it a centre of some importance. It was created a town in 1786. With Bukovina, it was ceded by Rumania to the U.S.S.R. in June 1940 but was regained during the campaign against Russia the following year.

CZERNY, KARL (1791–1857), Austrian pianist and composer, was born at Vienna, where he remained throughout his life. His father, who was a teacher of the piano, trained him for that instrument from an early age with such success that he performed in public at the age of nine, and commenced his own career as a teacher at fourteen. He was brought under the notice of Beethoven, and was his pupil in the sense in which that great master had pupils. He became famous as a teacher of the piano, and among his pupils he numbered Liszt, Theodor Döhler (1814–43) and many others who afterwards became famous. His works, which include every class of composition number nearly a thousand, but none are as well known as those to which he probably attached least importance, namely his admirable educational studies and exercises which still hold their own with the best.

CZESTOCHOWA, a town of Poland, in the province of Kielce, on the left bank of the Warta, 143 mi. S.W. of Warsaw, on the railway between that city and Cracow. Pop. (1931) 117,588; (est. 1939) 138,000. Here is a celebrated monastery on the steep eminence called Jasna Gora. It was founded by King Wladyslaw of the Jagiello dynasty and was at one time fabulously wealthy. In 1430 it was attacked and plundered by the Hussites; in 1655, and again in 1705, it bravely resisted the Swedes; but in 1772 it was forced to capitulate to the Russians and in 1793 to the Prussians. This monastery, which is occupied by monks of the order of Paul the Hermit, contains over the altar in its church a painted image of the Virgin, traditionally believed to have been painted by St. Luke, and visited annually by throngs of pilgrims. The town manufactures cotton, cloth and paper, and does a lively business in rosaries, images, scapularies and so forth. It fell to German troops in the first week of World War II.

D

THIS letter has retained the fourth place in the alphabet from the earliest point at which it appears in history. It corresponds to Semitic ◁ (*daleth*) and Greek Δ (*delta*). The rounded form D occurs in the Chalcidic alphabet, from which it passed into the Latin, as well as in the Etruscan. The Umbrian and Oscan forms, written from right to left, are respectively ꟼ and Я. The letter has retained the rounded form that it had in the Latin alphabet until the present day.

Latin cursive forms were ∂ (5th century) and ɑ (6th century.) In these the right-hand rounded line of the majuscule letter is carried far above the level of its junction with the stroke. From these forms and from uncial arose the Carolingian ∂ and our own miniscule *d*.

The sound consistently represented by the letter in Semitic, Greek, Latin and the modern languages of Europe is the voiced

NAME OF FORM	APPROXIMATE DATE	FORM OF LETTER
PHOENICIAN	B.C. 1,200	◁
CRETAN	1,100-900	Δ
THERAEAN	700-600	Δ
ARCHAIC LATIN	700-500	▷
ATTIC	600	Δ
CORINTHIAN	600	Δ
CHALCIDIAN	600	D
IONIC	400	Δ
ROMAN COLONIAL	PRE-CLASSICAL AND CLASSICAL TIMES	D
URBAN ROMAN		D
FALISCAN		ɑ
OSCAN		Я
UMBRIAN		(ꟼ)
CLASSICAL LATIN AND ONWARDS		D

DEVELOPMENT OF THE LETTER "D" FROM THE PHOENICIAN THROUGH CLASSICAL GREEK AND LATIN TO THE PRESENT TIME

dental stop. In English this sound, as well as the unvoiced sound represented by *t*, has become alveolar, that is to say, is pronounced by the pressure of the tongue upon the gums rather than upon the teeth.

In music, D is the fourth note of the musical alphabet and the second note of the scale of C. In former times it gave its name also to one of two or three clefs which are now no longer in use. (*See* CLEF.) Used as an abbreviation, D has several meanings, e.g., *m.d.*=*main droite; d.c.*=*da capo; d.s.*=*dal segno.*

DAB (*Limanda limanda*), a species of flat-fish belonging to the family Pleuronectidae and distinguishable from plaice and flounder by the distinct arch in the lateral line at the anterior end. It is of a brown or ashen gray colour with irregular dark markings and close-set scales, and is to be found on sandy shores in the north of Europe, the length attained being 12 in. Another species is the sand dab or rusty dab (*L. ferruginea*) found on the coasts of North America. *See* also FLAT-FISH.

DABCHICK, the popular name of the little grebe (*Podiceps fluviatilis*) a member of the family Podicipedidae. It has a wide range in the Old World. *See* GREBE.

D'ABERNON, EDGAR VINCENT, 1ST VISCOUNT (1857–1941), British diplomat, was born at Slinfold, Sussex, on Aug. 19, 1857, the youngest son of Sir Frederick Vincent, 11th Bart., of Stoke D'Abernon, Surrey. He was educated at Eton. In 1882 he was sent to Constantinople as the representative of Great Britain, Holland and Belgium on the council of the Ottoman public debt, of which in 1883 he became president. In 1883 he went to Cairo as financial adviser to the Egyptian government, remaining there until 1889, when he returned to Constantinople as governor of the Imperial Ottoman bank, a post which he resigned in 1897. He entered parliament in 1899 as Conservative member for Exeter, but lost this seat in 1906. In 1914 he was raised to the peerage as Baron d'Abernon. From 1920 to 1926 he was ambassador to Germany. His own financial experience helped the temporary settlement of the debt question under the Dawes plan. His works include *The Economic Crisis—Its Causes and the Cure* (1931) and *Portraits and Appreciations* (1931). In Jan. 1926 he was made a viscount. He died at Hove, Sussex, Nov. 1, 1941.

D'ABRANTÈS, DUCHESSE: *see* JUNOT, LAURE.

DABROWA, a Polish town in the province of Kielce and centre of the coal basin bearing its name. It combines with the basins of Cracow and Polish Silesia to form one of the greatest coalfields of Europe. Pop. (1931) 36,987. The Dabrowa basin, 200 sq.km., produced 6,738,348 tons of coal in 1938. Germany occupied Dabrowa in Sept. 1939.

DA CAPO (It.) or d.c., "from the beginning," a direction used in musical scores to indicate that the first part of a composition is to be repeated. A similar direction, equally often employed, is *dal segno* (or *d.s.*), meaning "from the sign," indicating the return to a 𝄋, or some similar character, placed either at the beginning or at some other point in the piece.

DACCA, a city of British India, giving its name to a district and division of Bengal situated on the Buri-Ganga river with a railway station, 10 mi. from the terminus of the river steamers at Narayanganj. Pop. (1941) 213,218. Dacca has twice been a provincial capital. In 1608 Islam Khan, nawab of Bengal, removed his capital there from Rajmahal and it continued to be the capital till 1704. It was also the capital of the short-lived government of Eastern Bengal and Assam (1905–12). The principal Mohammedan public buildings are the Bara Katra and the Lal-bagh fort. The Lal-bagh ("beautiful garden") fort was begun by Azam Shah, the third son of the emperor Aurangzeb, but it appears never to have been completed; and when Tavernier visited Dacca (*c.* 1666) the nawab was residing in a temporary wooden building in its court. Other buildings of the Mogul period are the Chota Katra (1663), Husaini Dalan (1642) and several mosques. Except for these there are few buildings of any great age and interest: even in Tavernier's time the houses were "no more than paltry huts built up with bamboos and daubed over with fat earth." The English established a factory in the city in the 17th century, but it was pulled down in 1829 or 1830. The French and Dutch factories have also disappeared. Of modern buildings the finest are those built during the years when Dacca was the capital of Eastern Bengal and Assam; these are grouped round a large park called the Ramna, a mile from the centre of the city. Some, such as the residence of the lieutenant-governor and the secretariat, have been appropriated to the use of the University of Dacca. The university was established in 1921 and had 1,325 full-time students in 1925: the students reside in halls and hostels, such as the Curzon hall, Dacca hall and Jagannath hall. Among other institutions may be mentioned the Mitford hospital and Dacca medical school. There are four Christian churches, Anglican, Roman Catholic, Greek and Armenian, a Sikh temple and many Hindu temples, of which the most notable is that of Dhaleswari. The famous manufacture of fine muslins, which was the chief article of local trade, is almost extinct, but the carving of shells, carried on from ancient times, is an important industry.

The District of Dacca has an area of 2,738 sq.mi. and a population of (1941) 4,222,143. The district consists of a level plain bounded on three sides by the Meghna, the Ganges or Padma, and the Jamuna, or main stream of the Brahmaputra, and watered by a network of rivers and streams, such as the Dhaleswari, the Buriganga and the Lakshya. About 20 mi. N. of Dacca city, small ridges are met with in the Madhupur jungle, stretching into Mymensingh district. These ridges, however, are mere mounds not over 50 ft. to 60 ft. high, composed of red soil containing a considerable quantity of iron ore; and the whole tract is for the most part unproductive. The country lying to the south of the Dhaleswari is the most fertile part of the district. It consists entirely of rich alluvial soil, annually inundated to a depth varying from 2 to 14 ft. of water. Villages here are built on artificial mounds of earth, so as to raise them above the flood level.

Rice is the principal crop, followed by jute. The industries consist of jute pressing, weaving, embroidery, gold and silver work and shell-carving; soaps, mother-of-pearl buttons and horn combs are also made locally, and some oil mills have been started. The weaving industry and the manufacture of fine Dacca muslins have greatly fallen off, owing to the competition of European piece goods. The manufacture of Kasidas, *i.e.*, muslins embroidered with silk, which used to be exported to Turkey, has also been declining since World War I. Narayanganj is the centre of the jute trade.

The Division of Dacca lies in the east of Bengal within the delta formed by the Brahmaputra and the Ganges. It consists of the four districts of Dacca, Mymensingh, Faridpur and Bakarganj. Its area is 15,498 sq. miles. Its population in 1941 was 16,683,714.

University of Dacca.—The creation of the University of Dacca was brought about owing to the Government of India's wish to provide increased educational facilities for the Muslims of eastern Bengal, to set up a new residential and teaching type of university and to relieve the congestion of the (affiliating) University of Calcutta. After reports from a special committee in 1912 and the Calcutta University Commission in 1919, it was opened on July 1, 1921. The university has fine buildings, and an estate of nearly a square mile, with large playing fields, three residential halls, well equipped chemical and physical laboratories, and residences for the staff. The constitution is similar to that of the English provincial universities, but on the residential side it is more akin to Oxford and Cambridge. Research is carried on in all departments. The library contains about 44,000 volumes.

DACE, DARE or **DART** (*Leuciscus leuciscus*), a Cyprinid fish of the rivers of Siberia, Europe north of the Alps and Pyrenees, and England. It is closely related to the chub, but has a smaller head and smaller mouth. It is a graceful fish, silvery in coloration, and an active swimmer; it rarely reaches a length of more than 12 in. In America the name is given to other Cyprinidae, *e.g.*, the Horned Dace (*Semotilus atromaculatus*).

DACH, SIMON (1605–1659), German lyrical poet, was born at Memel in East Prussia on July 29, 1605. Educated in the classical schools of Königsberg, Wittenberg and Magdeburg, he entered the university of Königsberg in 1626 as a student of theology and philosophy. He was professor of poetry at Königsberg from 1639 until his death on April 15, 1659. At Königsberg he formed with Heinrich Albert (1604–51), Robert Roberthin (1600–48) and Sibylla Schwarz (1621–38), the so-called *Königsberger Dichtergruppe.* He sang the praises of the house of the electors of Brandenburg in a collection of poems entitled *Kurbrandenburgische Rose, Adler, Löwe und Scepter* (1661), wrote excellent hymns, and also produced many occasional poems; the most famous of them is *Anke von Tharaw öss, de my geföllt* (rendered by Herder into modern German as *Ännchen von Tharau*).

DACHAU, a town in Upper Bavaria, Germany, 8 mi. N.W. of Munich on the railway from Munich to Ingolstadt. Pop. (1939) 17,594. It has extensive fortifications, a castle and a museum of antiquities, and makes paper, sawmill machinery and beer. It formerly had a colony of artists. After 1933 one of the most notorious of the nazi concentration camps was located there.

DACIA, a large district of central Europe, bounded on the north by the Carpathians, on the south by the Danube, on the west by the Pathissus (Theiss) and on the east by the Tyras (Dniester), thus corresponding in the main to the modern Rumania and Transylvania. The inhabitants of this district were a Thracian stock, originally called Δᾶοι (after the 4th century B.C., Δακοί). The Getae (*q.v.*) were most akin to them in language and manners; by the Greeks the Dacians were usually called Getae, by the Romans Daci. Δᾶος and Γέτα (Davus, Geta) were common as names of slaves in Attic comedy and in the adaptations of Plautus and Terence. The Dacians had attained a considerable degree of civilization when they first became known to the Romans. They believed in the immortality of the soul, and regarded death as merely a change of country. They were divided into two classes —an aristocracy and a proletariat. The first alone had the right to cover their heads and wore a felt hat (*pilleus,* hence *tarabostesei*= πιλοφόροι *pilleati*), the second class, who comprised the rank and file of the army, the peasants and artisans, wore their hair long (κομηταί, *capillati*). Their chief occupations were agriculture and cattle breeding; horses were mainly used as draught animals. They also worked the gold and silver mines of Transylvania, and carried on a considerable outside trade.

A kingdom of Dacia was in existence at least as early as the beginning of the 2nd century B.C. under a king Oroles. Conflicts with the Bastarnae and the Romans (112–109, 74), had greatly weakened the resources of the Dacians. Under Burbista (Boerebista), who thoroughly reorganized the army, the limits of the kingdom were extended; indeed the Dacians appeared so formidable that Caesar contemplated an expedition against them, which was prevented by his death. About the same time Burbista was murdered, and the kingdom was divided under separate rulers. One of these was Cotiso, to whom Augustus betrothed his five-year-old daughter Julia. The Dacians are often mentioned under Augustus, according to whom they were compelled to recognize the Roman supremacy. But they were by no means subdued, and seized every opportunity of crossing the frozen Danube and ravaging the province of Moesia. From A.D. 85 to 89 the Dacians were engaged in two wars with the Romans, under Duras and Decebalus. After reverses, the Romans gained the advantage, but were obliged to make peace owing to the defeat of Domitian by the Marcomanni. Decebalus received the crown from Domitian's hands, an apparent acknowledgment of Roman suzerainty. But the Dacians were really left independent, as is shown by the fact that Domitian agreed to purchase immunity from further Dacian inroads by the payment of an annual tribute.

To put an end to this disgraceful arrangement, Trajan resolved to crush the Dacians once and for all. The result of his first campaign (A.D. 101–102) was the occupation of the Dacian capital Sarmizegethusa, of the second (105–107), the conquest of the whole kingdom and its conversion into a Roman province. It was under a governor of praetorian rank, and the legio xiii. *gemina* with numerous auxiliaries had its fixed quarters in the province. To make up for the ravages caused by the recent wars colonists were imported to cultivate the land and work the mines, and the old inhabitants gradually returned. Forts were built as a protection against the incursions of the surrounding barbarians, and three great military roads were constructed to unite the chief towns, while a fourth, named after Trajan, traversed the Carpathians and entered Transylvania by the Roteturm pass. The two chief towns were Sarmizegethusa (afterwards Ulpia Traiana) and Apulum (Karlsburg).

In A.D. 129, under Hadrian, Dacia was divided into Dacia *Superior* and *Inferior,* the former comprising Transylvania, the latter Little Walachia, with procurators, both under the same praetorian legate. Marcus Aurelius redivided it into three (*tres Daciae*), Porolissensis, Apulensis and Maluensis. The *tres Daciae* had a common capital, Sarmizegethusa, and a common diet, which discussed provincial affairs, formulated complaints and adjusted the incidence of taxation; but in other respects they were independent provinces, each under a procurator, subordinate to a governor of consular rank.

The Roman hold on the country was, however, still precarious. Hadrian contemplated its abandonment and was only deterred by consideration for the safety of the numerous Roman settlers. In A.D. 256 the Goths crossed the Carpathians and drove the Romans from Dacia, with the exception of a few fortified places. Aurelian (A.D. 270–275) withdrew the troops altogether and settled the Roman colonists on the south of the Danube, in Moesia, where he created the province Dacia Aureliani. (*See* also Vlachs.)

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DACIER, ANDRÉ (1651–1722), French classical scholar, was born at Castres in upper Languedoc. In 1672 he went to Paris, and was appointed one of the editors of the Delphin series of the classics. In 1683 he married Anne Lefèvre, the daughter of his old tutor (*see* below). As payment for his share in the "medallic" history of the king's reign, he was appointed keeper of the library of the Louvre. The most important of his works were his editions of Pompeius Festus and Verrius Flaccus, and his translations of Horace (with notes), Aristotle's *Poetics,* the *Electra* and *Oedipus Coloneus* of Sophocles, Epictetus, Hippocrates and Plutarch's *Lives.*

His wife, Anne Lefevre (1654–1720), French scholar and translator from the classics, was born at Saumur. On her father's death in 1672 she removed to Paris, carrying with her part of an edition of Callimachus, which she afterwards published. She was engaged as one of the editors of the Delphin series of classical authors, in which she edited Florus, Dictys Cretensis, Aurelius Victor and Eutropius. In 1681 appeared her prose version of Anacreon and Sappho; in the next few years she published prose versions of Terence and some of the plays of Plautus and Aristophanes. In 1684 she and her husband retired to Castres to devote themselves to theological studies, and in 1685 they became Roman Catholics. In 1699 appeared the prose translation of the *Iliad* (followed nine years later by a similar translation of the *Odyssey*), which gained for her the position she occupies in French literature. The appearance of this version, which made Homer known for the first time to many French men of letters, gave rise to a famous controversy with A. Houdar de la Motte and others on whether so ancient a poet still retained merit.

See P. J. Burette, *Éloge de Mme. Dacier* (1721); *Mémoires de Mme. de Staël* (1755); J. F. Bodin, *Recherches historiques sur la ville de Saumur* (1812–14); R. Rigault, *Histoire de la querelle des anciens et des modernes* (1856); E. Egger, *L'Hellenisme en France,* ii. (1869); *Mémoires de Saint-Simon,* iii.; C. A. Sainte-Beuve, *Causeries du lundi,* vol. ix.

DACITE (from Dacia, mod. Transylvania), in petrology, volcanic rocks which may be considered a quartz-bearing variety of andesite. Like the latter they consist for the most part of plagioclase felspar with biotite, hornblende, augite or enstatite, and have generally a porphyritic structure, but they contain also quartz as rounded, corroded phenocrysts, or as an element of the ground-mass. Their felspar ranges from oligoclase to andesite and labradorite; sanidine occurs also in some dacites, and when abundant gives rise to rocks which form transitions to the rhyolites. From this list of minerals it is readily seen that the dacites are the volcanic equivalent of the plutonic tonalites. Many of the hornblende- and biotite-dacites are grey or pale brown and yellow rocks with white felspars and black crystals of biotite and hornblende; others, especially augite- and enstatite-dacites, are darker coloured. The rocks of this group occur in Hungary, Almeria (Spain), Argyllshire and other parts of Scotland, Victoria, New Zealand, the Andes, Martinique, Nevada and other districts of western North America, Greece, etc. They are mostly associated with andesites and trachytes, and form lava flows, dikes and in some cases massive intrusions in the centres of old volcanoes. Among continental petrographers the older dacites (Carboniferous, etc.) are often known as "porphyrites."

DACOIT, a term used in India for a robber belonging to an armed gang. The word is derived from the Hindustani *dakait,* and being current in Bengal got into the Indian penal code. By law, to constitute *dacoity,* there must be five or more in the gang committing the crime. In Burma also the word dacoit came to be applied in a special sense to the armed gangs which maintained a state of guerilla warfare for several years after the defeat of King Thibaw in Nov. 1885. (*See* Burmese Wars.)

DA COSTA, ISAAK (1798–1860), Dutch poet and theologian, was born at Amsterdam on Jan. 14, 1798. His father was a Jew of Portuguese descent, and claimed kindred with the celebrated Uriel D'Acosta. He studied at Amsterdam and at Leiden, where he took his doctor's degree in law in 1818, and in literature in 1821. In 1814 he wrote *De Verlossing van Nederland,* a patriotic poem, which placed him in line with the contemporary national romantic poets in Germany and in France. His *Poëzy* (2 vols., 1821–22) revealed his emancipation from the Bilderdijk tradition, and the oriental colouring of his poems, his hymn to Lamartine, and his translation of part of Byron's *Cain,* establish his claim to be considered as the earliest of the Dutch romantic poets. In 1822 he became a convert to Christianity, and towards the close of his life was a director of the seminary established in Amsterdam in connection with the mission of the Free Church of Scotland. He died at Amsterdam on April 28, 1860. Da Costa ranked first among the poets of Holland after the death of Bilderdijk. His principal poetical works were: *Alphonsus I.* (1818), a tragedy; *Poëzy* (Leyden, 1821); *God met ons* (1826); *Festliedern* (1828); *Vijf-en-twintig jaren* (1840); *Hagar* (1852); *De Slag bij Nieuwpoort* (1857). He also translated *The Persians* (1816) and the *Prometheus* (1818) of Aeschylus, and edited the poetical works of Bilderdijk.

His complete poetical works were edited by J. P. Hasebroek (3 vols., Haarlem, 1861–62). *See* G. Groen van Prinsterer, *Brieven van Mr I. da Costa, 1830–1849* (1872), and J. ten Brink, *Geschiedenis der Noord-Nederlandsche Letteren in de XIXe Eeuw* (vol. i., 1888, bibl.).

DACTYL, in prosody, a long syllable followed by two short (Gr. δάκτυλος "a finger"). (*See* Verse.)

DADO, a decorative band running horizontally along the lower portion of a wall above the base; a wainscot that does not cover the entire height of the wall. The dado is frequently separated from the rest of the wall by a moulding known as a chair rail or surbase.

DADU PANTHIS. The Dadu Panthi sect of western India (following Dadu's path) founded by Dadu about the year 1600, has many followers in Ajmir and Marwar, one section of whom, the Nagas, engage largely in military service, while the others are either householders or mendicants. The followers of this creed wear no distinctive sectarial mark or badge except a skull-cap; nor do they worship the visible image of any deity, the repetition (*japa*) of the name of Rama being the only kind of adoration practised by them.

DAEDALUS, a mythical Greek architect and sculptor, who was said to have built the labyrinth for Minos of Crete, to have made a wooden cow for Pasiphaë and a bronze man who repelled the Argonauts. Falling under the displeasure of Minos, he fashioned wings for himself and his son Icarus and escaped to Sicily. These legends seem primarily to belong to Crete, and the Athenian element, which connected Daedalus with the royal house of Erechtheus, is a later fabrication. To Daedalus the Greeks of the historic age were in the habit of attributing buildings and statues the origin of which was lost in the past. In many cities of Greece there were rude wooden statues, said to be by him. Later critics ascribed to Daedalus such improvements as separating the legs of statues and opening their eyes. In fact, the name Daedalus is a mere symbol, standing for a particular phase of early Greek art, when wood was the chief material and other substances were let

BY COURTESY OF THE ANDERSON GALLERIES, NEW YORK

REPRESENTATION OF THE LEGENDARY FLIGHT OF DAEDALUS AND HIS SON, ICARUS, WITH ARTIFICIAL WINGS OF WAX AND FEATHERS. AFTER A WOODCUT 1493, IN RIEDRER, "SPIEGEL DER WAHREN RHETORIK"

into it for variety. In a later verse in the *Iliad* he is mentioned as the maker of a dancing-place in Crete.

This Daedalus must not be confused with Daedalus of Sicyon, a great sculptor of the early part of the 4th century B.C., none of whose works is extant.

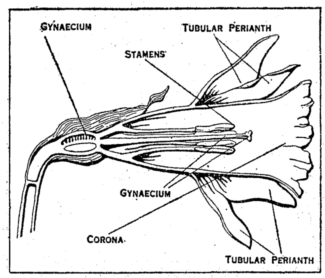
DAENDELS, HERMAN WILLEM (1762–1818), Dutch general, was born on Oct. 21, 1762, at Hattem in Gelderland. He began his career as a solicitor, but during the revolution of 1787 went to France, and fought against Holland in 1793. When the Batavian republic was proclaimed three years later Daendels was made a lieutenant-general. He fought against the English and Russians in north Holland in 1799, and for his conquest of East Friesland and Westphalia in 1806 was made a marshal. He was governor-general of Dutch East India from 1807 to 1811. He defended Modlin in the Russian campaign of 1812–13. From 1815 Daendels administered the Dutch possessions on the Gold Coast, dying at Saint George del Mina on May 2, 1818.

Daendels published a 4-volume work on his administration of Java in 1814.

DAET, a municipality (with administration centre and 30 *barrios* or districts) and capital of the province of Camarines Norte, Luzon, Philippine islands, situated in the northeast part of the province near the coast. It is the chief commercial place in the province and does most of its business direct with Manila. Pop. (1939), 20,066, of whom only 19 were whites. Of the 10 schools, 5 were public. According to the census of 1939, 19,457 persons speak Bikolano, 11,211 speak Tagalog, 7,829 speak English, and 675 speak Spanish.

A Franciscan convent was established there early in the 17th century.

DAFFODIL, the common name of a group of plants of the genus *Narcissus*, of the family Amaryllidaceae (*see* NARCISSUS). The common daffodil, *N. pseudo-narcissus*, is frequent in woods and thickets in most parts of northern Europe, but is rare in Scotland. It is sparingly naturalized in the eastern United States as an escape from cultivation. Its leaves are five or six in number, are about a foot in length and an inch in breadth, and have a blunt keel and flat edges. The flower stalk is about 18 in. long, the spathe single-flowered. The flowers are large, yellow, scented and a little drooping, with a corolla deeply cleft into six lobes, and a central bell-shaped nectary, which is crisped at the margin. They appear early in the year. The stamens are shorter than the cup, the anthers oblong and converging; the ovary is globose, and has three furrows; the seeds are roundish and black. Many horticultural varieties, some with double flowers, are cultivated in gardens. The bulbs are large and orbicular, and have a blackish coat.



FROM GROOM'S "ELEMENTARY BOTANY" (G. BELL & SONS LTD.)

DAFFODIL (NARCISSUS PSEUDO-NARCISSUS), DIAGRAM OF SECTION OF THE FLOWER

The daffodil is a native of England and is widely cultivated in America. Each stem has one yellow trumpet-shaped blossom

The Peruvian daffodil and the sea daffodil are species of the genera *Hymenocallis* and *Pancratium*.

DAFLA HILLS, a tract of hilly country on the border of Assam, occupied by an independent tribe called Dafla. It forms part of the sub-Himalayan hills to the north of the Darrang and Lakhimpur districts, and is bounded on the west by the Bhareli river and on the east by the Ranganadi river. The Daflas are akin to both the hill Miris and the Abors. They are divided into exogamous clans claiming descent from the moon ♂ and sun ♀ extremely democratic in polity, but slave owners; burying their dead, whose spirits go to an underground world except in the case of unnatural deaths when they ascend to the sky. They use cane helmets, hide armour, long sword, spear and arrows poisoned with aconite.

In 1872 the Daflas attacked a colony of their own tribesmen in British territory, which led in 1874 to a punitive expedition. Several small expeditions have since been made. The Daflas continually raid one another; occasional petty forays in the plains are made by malcontents and escaped slaves.

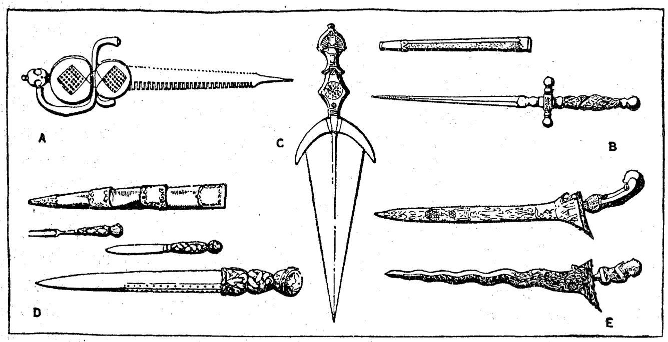
See Nevill, *The Daflas; Assam Census Report* (1921) I., Apdx. B. i.

DAFYDD AB GWILYM (14th century), Welsh poet, a contemporary of Chaucer, was born at Bro Gynin, Cardiganshire, about 1340, and died about 1400. He was elected chief bard of Glamorgan, and was household bard to his kinsman, Ivor Hael of Maesaleg.

After an unsuccessful attempt to elope with Morfudd Lawgam, to whom he addressed 147 odes, he was imprisoned, but was ransomed by his friends in Glamorgan. He wrote nature poems, the best of which are: "The Lark," "The Wind" and "The Mist." George Borrow, who called him the Horace of Wales, translated some of his verses, most of which were written in the *cywydd* form; *i.e.*, a short ode not divided into stanzas, each line having the same number of syllables.

DAGENHAM, a municipal borough in the Romford parliamentary division of Essex, England, 12 mi. from Whitechapel (London) church and served by the London Passenger Transport board and the L.M.S.R. Pop. (est. 1938) 107,400. Area, 10.51 sq.mi. The rapidity of Dagenham's growth is unique in Britain. In the period 1926–38 it rose from parish council to municipal borough, and in 1921 its population was only 9,127. This phenomenal rise was partly due to the building of the London County council's housing estate at Becontree, 15,000 houses being in Dagenham, the opening of the Ford Motor company's factory in the parish on the north bank of the Thames in Nov. 1931 (factory completed 1932) and subsequent extensive private development.

DAGGER, a hand weapon with a short blade. The derivation is obscure (*cf.* Fr. *dague* and Ger. *Degen*), but the word is related to *dag,* a long pointed jag such as would be made in deeply nicking the edge of a garment. The war knife in various forms and under many names has of course been in use in all ages and amongst all races. But the dagger as generally understood was not a short sword, but a special stabbing weapon which could be used



BY COURTESY OF METROPOLITAN MUSEUM OF ART, NEW YORK

TYPES OF DAGGERS FROM THE 16TH. TO THE 19TH. CENTURY
A. Italian or French dagger, 16th century. B. Italian stiletto, 17th century. C. Italian dagger, late 15th century. D. Scottish dirk, with scabbard, knife and fork, early 19th century. E. Malay kris, 18th–19th centuries

along with the sword. The distinction is often difficult to establish in a given case owing to the variations in the length of the weapon. The principal mediaeval dagger was the *miséricorde,* which from the end of the 12th century was used to penetrate the joints of the armour of an unhorsed adversary (hence Ger. *Panzerbrecher,* armour-breaker). It was so called either because the threat of it caused the vanquished to surrender "at mercy," or from its use in giving what was called the *coup de grâce.* From about 1330 till the end of the succeeding century, in many knightly effigies it is often represented as attached on the right side by a cord or a chain to the sword-belt. This weapon and its sheath were often elaborately adorned. It was customary to secure it from accidental loss by a guard-chain fastened to the breast-armour. Occasionally the *miséricorde* was fixed to the body-armour by a staple; or, more rarely, it was connected with a *gypcière* or pouch. The *miséricorde* may be called a poniard. The distinction between the dagger and the poniard is arbitrary, and in ordinary language the latter is taken as being the shorter and as having less resemblance to a short sword or cutlass. A weapon, with a longer blade than the *miséricorde,* was habitually worn by civilians, including judges, during the middle ages; such weapons bore the name of *anlace* (from *annulus,* as it was fastened by a ring), *basilarde* or *langue de bœuf,* the last from the broad ox-tongue shape of the blade. This had often a small knife fixed on the scabbard, like a Highland officer's dirk of the present day. By nobles and knights the dagger or poniard was worn when they had exchanged their armour for the costume of peace. It is recorded besides that when they appeared at a tournament and on some other occasions, ladies at that time wore daggers depending, with their *gypcières,* from their girdles. Thus, writing of the year 1348, Knighton speaks of certain ladies who were present at jousts as "habentes cultellos, quos *daggerios* vulgariter dicunt, in powchiis desuper impositis." A longer and heavier dagger with a broad blade (Italian) is called *cinquedea.* The Scottish "dirk" was a long dagger, and survives in name in the dirk worn by midshipmen of the royal navy, and in fact in that worn by officers of Highland regiments. In the 15th and 16th centuries the infantry soldiers (Swiss or *landsknecht*) carried a heavy poniard or dagger. This and the earlier Spanish dagger with a thumb-ring were distinctively the weapons of professional soldiers. The rise of duelling produced another type, called the *main gauche,* which was a parrying weapon and often had a toothed edge on which the adversary's sword was caught and broken. One form of this dagger had a blade which expanded into a triple fork on pressing a spring; this served the same purpose. The satellites of the *Vehmgericht* had a similar weapon, in order, it is suggested, that their acts should be done in the name of the Trinity. The smaller poniards are generally called "stilettos." Much ingenuity and skill have been lavished on the adornment of daggers, and in rendering the blades more capable of inflicting severe wounds. Daggers also were sometimes made to poison as well as to wound. Of oriental daggers may be mentioned the Malay "crease" or "kris," which has a long waxed blade; the Gurkha "kukri," a short curved knife, broadest and heaviest towards the point; and the Hindu "khuttar," which has a flat triangular-shaped blade, and a hilt of H-shape, the cross-bar forming the grip and the sides the guard.

DAGHESTAN (Dagestan), an autonomous S.S.R. in the Russian Soviet Federated Socialist Republic. Area 13,124 sq.mi. Pop. (1939) 930,527, urban 196,480, rural 734,047. Its boundaries are:—north, Orjonikidze territory; east, the Caspian Sea; south, the Azerbaijan S.S.R.; west, the Checheno-Ingushetia A.S.S.R. and the Georgian S.S.R. It was created in January, 1921, and then included mainly the former Daghestan province, a mountainous area, with a narrow coastal strip. But later, in view of the need for winter pasture for the *transhuman* hill shepherds, the Kizlyar and Kara-Nogai steppes were incorporated in the republic. The republic falls into four structural divisions.

The Plains.—North of the Terek river lies an area of continuous salty sands, sparsely peopled, and of use mainly as winter pasture for the hill sheep and goats. The delta of the Terek consists of salt marshes, while from the right bank to the hills is a stretch of chestnut coloured soil, favourable for agriculture, fruit and vine culture if irrigation supplements the too scanty rainfall. In its lower course the river deposits much alluvium and its bed is high above the neighbouring fields—at Kizlyar it is on a level with the spire of the church. Consequently, when the hill snows melt in spring, the river frequently overflows its banks and the area is subjected to devastating floods. From Makhach-Kala (Petrovsk) to the Samur river is a coastal strip of sandy, clayey, or salty grey earth. The alluvial patches are fertile and rice is grown in the river deltas, while in the southern sub-tropical area the vine, almond, peach, apricot and other fruits grow well. Cotton is cultivated, an early kind near Makhach-Kala and a later kind near Derbent. The only forested area is on the damp bog soil of the Samur area.

The Foothills.—This zone consists of the lower ridges 1,300 to 3,300 ft. and the valleys and basins between them, and is about 14 to 27 miles in width. The climate is milder than that of the plains or mountains, and has a greater rainfall, mainly in autumn. Its milder, wetter winter and dry hot summer make it favourable to vineyard, fruit and garden produce, and it contains the greatest forest wealth of Daghestan.

The Mountain Zone.—A belt from 26 to 33 m. in width, running in a south easterly direction, and consisting mainly of limestone. Its climate is very dry, with a maximum rainfall in summer and a sharp, cold winter with little snow. There is, however, a marked contrast between the damp, cool summer of the heights and the hot, dry summer of the valleys. These inland mountains of Daghestan are wild and sterile, but the hill people, with enormous labour, have cultivated tiny irrigated patches on rocky ledges. In autumn, after the harvest, the younger men stream out into the surrounding areas, especially the Baku industrial region, to try to find work to supplement their tiny harvest, while the women work at *koustar* (peasant) industries, thread, cloth, carpets, gold and silver embroidery and the older men at metal, wood and leather. This system inevitably has bad social results, and the diseases of the industrial areas have spread with devastating rapidity through the hill country.

The High Mountain Area.—The border between the limestone hills and the slate outcrop is very sharp: steep rocky walls lying on a base of black, clayey slate rise above the limestone dolomite mass. Glaciers and perpetual snow cover their summits, and the climate is very severe, with a long, cold winter and a short, cool summer. The valleys and lower slopes are more richly forested than those of the limestone area, while the treeless alpine meadows of the south east provide rich summer pasture for the nomadic herdsmen. The ancient glacial valleys, with their wide flat bottoms, are favourable for cultivation and cattle rearing.

The main features of Daghestan are that inaccessible mountains occupy four-fifths of its area and that, of the remaining plain, much is salt or marsh. Pasture and hayfields occupy most of the republic which is not bare, stony or sandy, forests come next, and the small remaining area suitable for crops and fruit cultivation is liable to drought and needs careful irrigation.

During the Civil War Daghestan probably suffered more severely than any other part of Russia. Various political parties exploited the fierce love of liberty of the illiterate hill folk and their passionate devotion to Islam. Their fighting powers were well known and they were enlisted by the National Independents, by the Denikin group, by the Georgian Menshevists, by the Pan-Islam and Pan-Turk leaders, and for a short time an emirate of the North Caucasus under the Sultan of Turkey existed. The Bolshevists, like the Imperial government, attached great importance to the area because of its links with Baku and finally succeeded in conquering its wild peoples. But the cost was terrible; roads, bridges, primitive irrigation schemes and the simple implements of peasant industry were completely destroyed. Of 60 villages and one town, Khasav-Yurt, not a trace was left, while in other towns, notably Derbent, more than three quarters of the buildings were destroyed. The impossibility of moving the herds to winter pasture led to the starvation of more than 75% of them, and an equal proportion of vineyards and fruit orchards was ruined by the destruction of irrigation works. The famine of 1921–2 was specially severe in Daghestan, cattle plague broke out among the remnants of the herds in 1922 and locusts and field mice, enormously increased by the lack of vigilance in the troubled years, injured the crops in 1923, while the hurricanes and hailstorms of that year completed their ruin. The partial drought of 1924 was severe in Daghestan. Typhus, famine diseases, malaria and social diseases have wrought havoc among the survivors of these terrible times. The unemployed workers from the ruined towns fled to the hills to swell the numbers of land-less and cattle-less, half-starved hill peasants.

The new republic thus starts its existence under heavy handicaps. Capital is needed, but is not yet forthcoming, to provide new irrigation works, to replace the destroyed sheep and cattle, to rebuild the ruined towns, villages, roads and bridges and to provide seeds and implements for the poverty stricken cultivators; while the shattered *morale* and physique of the natives are added disabilities. A problem of much longer standing is the fact that among the bleak uplands of Daghestan, isolated by deep gorges and arid ridges, more than thirty nationalities, speaking different languages, some bearing historic names, *e.g.*, Avars and Huns, have survived to modern times, and thus difficulties of linguistic communication are added. Attempts are being made to introduce Azerbaijan Turkish, which seems easiest for most of these nationalities to assimilate, into the schools, but under present conditions education is difficult and many children receive no school education. Relief works include the construction of the October canal, supplying 15 villages with the means of irrigation, the making of irrigation canals in the Kara-Nogai steppe, the regulation of the Terek river and draining of the Sulak marsh, while cotton, maize and sun-flower seed cultivation is reviving, and the cotton factories at Tagier and Makhach-Kala have been reopened. A scheme of electrification for the latter town and the railway to the Sulak river is planned, and small cotton, glass, leather, food-preserving and nail factories are working there, and oil refineries are being constructed. The fishing industry has been financed by credit banks and is reviving rapidly. Co-operative movements are attempting to finance the scattered peasant cultivators and their home industries of silver and tin working, bootmaking, cloth, felt and carpet making; the latter were temporarily ruined by the destruction of sheep and consequent lack of wool supply. Possible future sources of revenue may be the establishment of health resorts and the working of the great mineral wealth, but this needs capital. In pre-war times French capital was working the sulphur, and English capital the quicksilver and cinnabar mines, while the Nobel firm worked the naphtha and natural gas. The coastal railway forms part of the line linking Baku with the Black Sea, but turns westward at Makhach-Kala; a branch from Shakhmaya, just north of Makhach-Kala goes south-west to Buinaksk (Temir-Khan-Shura), situated on the north to south road, while another branch from the inland town of Cherelennaya on the Terek goes north-east as far as Kizlyar, at the head of the Terek delta. The administrative centre is Makhach-Kala (Petrovsk), pop. (1939) 86,847, a port on the Caspian through which naphtha from Grozny is exported to the Volga. The town has cold storage facilities, a lighthouse, and routes to various Caspian ports. It has small manufactures (*see* above) and recently a factory for extracting soda from Glauber salts has been established, and sulphur extraction has re-commenced. South of it is a health resort with sulphur springs. Derbent, also a port on the Caspian, has wool spinning mills, and like Makhach-Kala, is a centre for the fishing industry. Kizlyar, at the head of the Terek delta, is a centre for the vine and fruit of the district and should increase in importance if the plans for irrigating the area and settling the poverty stricken hill-peasants in the surrounding district are successful. An electric station was established at Akhty, in the heart of the mountains, on the Samur and efforts were being made to drain the Samur delta marshes, while another electric station was established near Gunib in the central mountain area. Buinaksk (Temir-Khan-Shura) is increasing in importance owing to the establishment of fruit preserving works, the products of which can be sent by rail to Makhach-Kala.

Bibliography.—N. Samurski, *Daghestan* (Moscow, 1925); Atlas of the Union of Soviet Socialist Republics (Moscow, 1928); *see* also Russia, *Bibliography*.

DAGIS: *see* Caste.

DAGNAN-BOUVERET, PASCAL ADOLPHE JEAN (1852–1929), French painter, born in Paris on Feb. 7, 1852. He studied under Gérome at the École des Beaux Arts, and first attracted notice by his picture "A Wedding at the Photographers" in the Salon of 1879. He joined the movement, initiated by Bastien-Lepage in France, which took up the study of contemporary life. From 1880 onwards he made Brittany with its rustic types his special sphere of study. A harmonious green tone pervades his open-air effects. He is a fine draughtsman and also practises lithography. For the Sorbonne he painted a large panel representing Apollo and the Muses.

DAGO, a name given somewhat contemptuously to Spanish, Portuguese and Italian sailors. In America the word is generally confined in its use to designate the poorer class of Italian immigrants. The word is apparently a corruption of the common Spanish and Portuguese Christian name "Diego."

DAGOBERT I. (d. 639), king of the Franks, was the son of Clotaire II. In 623 his father established him as king of the region east of the Ardennes, and in 626 revived for him the ancient kingdom of Austrasia, *minus* Aquitaine and Provence. As Dagobert was yet but a child, he was placed under the authority of the mayor of the palace, Pepin and Arnulf, bishop of Metz. At the death of Clotaire II. in 629, Dagobert wished to re-establish unity in the Frankish realm, and in 629 and 630 made expeditions into Neustria and Burgundy, where he succeeded on the whole in securing the recognition of his authority. In Aquitaine he gave his brother Caribert the administration of the counties of Toulouse, Cahors, Agen, Périgueux and Saintes; but at Caribert's death in 632 Dagobert became sole ruler of the whole of the Frankish territories south of the Loire. Under him the Merovingian monarchy attained its culminating point. He restored to the royal domain the lands that had been usurped by the great nobles and by the Church; he maintained at Paris a luxurious, though, from the example he himself set, a disorderly court; he was a patron of the arts and delighted in the exquisite craftsmanship of his treasurer, the goldsmith St. Eloi. His authority was recognized through the length and breadth of the realm. The duke of the Basques came to his court to swear fidelity, and at his *villa* at Clichy the chief of the Bretons of Domnoné promised obedience. He intervened in the affairs of the Visigoths of Spain and the Lombards of Italy, and was heard with deference. Indeed, as a sovereign, Dagobert was reckoned superior to the other barbarian kings. He entered into relations with the eastern empire, and swore a "perpetual peace" with the emperor Heraclius; and it is probable that the two sovereigns took common measures against the Slav and Bulgarian tribes, which ravaged in turn the Byzantine state and the German territories subject to the Franks. Dagobert protected the Church and placed illustrious prelates at the head of the bishoprics—Eloi (Eligius) at Noyon, Ouen (Audoenus) at Rouen, and Didier (Desiderius) at Cahors. His reign is also marked by the creation of numerous monasteries and by renewed missionary activity in Flanders and among the Basques. He died on Jan. 9, 639, and was buried at St. Denis. After his death the Frankish monarchy was again divided. In 634 he had been obliged to give the Austrasians a special king in the person of his eldest son Sigebert, and at the birth of a second son, Clovis, in 635 the Neustrians had immediately claimed him as king. Thus the unification of the realm, which Dagobert had re-established with so much pains, was annulled.

See the *Chronicon* of Fredegarius; "Gesta Dagoberti I. regis Francorum" in *Mon. Germ. hist. Script. rer. Meroving.* vol. ii. edited by B. Krusch; J. H. Albers, *König Dagobert in Gesch., Legende, und Sage* (2nd ed. Kaiserslautern, 1884); E. Vacandard, *Vie de Saint Ouen, évêque de Rouen* (Paris, 1901); and H. E. Bonnell, *Die Anfänge des karoling, Hauses* (Berlin, 1866). (C. Pf.)

DAGOMBA, the Hausa name of the Dagbamba in the Dagong district of Tamale and Yendi in the northern parts of the Gold Coast, probably parent stock of the Mossi, having the same physical, linguistic and social characters; once a powerful kingdom which in the 18th century fought against the Ashanti and placed the Gondja and Bassari in subjection. They are warriors and cultivators; engaged in cattle-raising and trade, and remain animists, with a certain proportion of Muslims.

See Graf, von Zech, "Land und Leute an der Nord-West Grenze von Togo," *Mitt. der deutsch. Schutzgebiete* (1904).

DAGON, a native Semitic deity, adopted by the Philistines after their settlement in Canaan (Judg. xvi. 21, 23; 1 Sam. v. 1; *cf.* Josh. xv. 41, 1 Chron. x. 10, 1 Macc. x. 83, 84, xi. 4). Identical with the Babylonian god Dagan. The name popularly connected with the Hebrew word *dag,* "fish," more closely resembles *dagan,* "corn," and either the name of the deity came to be used to denote "corn," or it has the more general meaning of "food." *See* Robertson Smith, *Rel. of the Semites,* 3rd ed. p. 578. Little is known of the cult of this god.

DAGUERRE, LOUIS JACQUES MANDE (1789–1851) French painter and physicist, inventor of the daguerreotype, was born at Cormeilles, in the department of Seine-et-Oise, and died on July 12, 1851, at Petit-Brie-sur-Marne, near Paris. He was at first an inland revenue officer and then a scene-painter for the opera. In 1822, in conjunction with Bouton, he opened at Paris the Diorama, an exhibition of pictorial views, the effect of which was heightened by changes in the light thrown upon them. A similar establishment was opened by Daguerre in Regent's Park, London; it was destroyed by fire on March 3, 1839. This reverse was more than compensated by the success of his daguerreotype photographic process. J. Nicéphore Niepce, who since 1814 had been seeking to obtain permanent pictures by the action of sunlight, learned in 1826 that Daguerre was similarly occupied. The two investigators worked together on their "heliographic pictures" from 1829 until the death of Niepce in 1833. Daguerre, continuing his experiments, discovered eventually the process connected with his name. On Jan. 9, 1839, at a meeting of the Academy of Sciences, Arago emphasized the importance of the discovery; and Daguerre was appointed an officer of the Legion of Honour. A law of 1839 assigned to Daguerre and the heir of Niepce annuities of 6,000 and 4,000 francs respectively, on condition that their process should be communicated to the Academy. Daguerre's process, together with his system of transparent and opaque painting, was accordingly published by the government (*see* Photography).

Daguerre's works are *Historique et description des procédés du daguerréotype et du diorama* (1839); and *Nouveau moyen de préparer la couche sensible des plaques destinées à recevoir les images photographiques* (1844).

DAGUPAN, a municipality (with administrative centre and 20 *barrios* or districts), and the most important commercial centre of the province of Pangasinan, Luzon, Philippine islands, on a branch of the Agno river near its entrance into the gulf of Lingayen, 125 mi. by rail N.N.W. of Manila. Pop. (1939) 32,602, of whom only 54 were whites. It is served by the Manila and Dagupan railway. Salt is manufactured in the marshes along the coast where also alcoholic liquors are distilled from the nipa palms which grow in abundance. Besides these products there are extensive exports of sugar, maize (corn), palay (rice) and copra, which are produced abundantly in the fertile region of which Dagupan is the chief port. It is also a point of transfer from rail to automobile en route to Baguio, and has a meteorological station. Of those inhabitants aged 6 to 19, inclusive, 48·4% were reported in 1939 as attending school, while of those ten years old and over, 61·7% were reported as literate. The Pangasinan language is the vernacular.

DAHABEAH, an Arabic word for a passenger boat used by natives on the Nile. The typical form is that of a barge-like house-boat provided with sails, resembling the painted galleys represented on the tombs of the Pharaohs. Similar state barges were used by the Mohammedan rulers of Egypt, and to the circumstance that these vessels were ornamented with gilding is attributed the usual derivation of the name from gold. Before the introduction of steamers, dahabeahs were generally used by travellers ascending the Nile, and they are still the favourite mode of travelling for the leisured and wealthy classes. The modern dahabeah is often made of iron, draws about 2ft. of water, and is provided with one very large and one small sail. According to size it provides accommodation for from two to a dozen passengers. Steam dahabeahs are also built to meet the requirements of tourists.

DAHL, HANS (1849–1910), Norwegian painter, was born at Hardanger on Feb. 19, 1849. After serving in the Swedish army he studied art at Karlsruhe and at Düsseldorf in Germany, being a notable painter especially of landscape and *genre.* In 1889 he settled in Berlin. His work had considerable humour, but his colouring was hard and rather crude. His pictures were very popular in Norway.

DAHL, JOHANN KRISTEN CLAUSEN (1788–1857), Norwegian landscape painter, was born in Bergen on Feb. 24, 1788, and died in Dresden on Oct. 14, 1857. He settled in Dresden in 1818. Dahl is usually included in the German school, although he was nearly 40 when he finally took up his abode in Dresden, where he became professor. At Dresden may be seen many of his works, notably a large picture called "Norway" and a "Storm at Sea."

See A. Aubert, *Maleren Professor Dahl* (1788–1857).

DAHL, MICHAEL (1656–1743), Swedish portrait painter, was born at Stockholm. In 1688 he settled in England, and became for some years a dangerous rival to Kneller. He painted portraits of Princess Anne (afterwards queen), Prince George of Denmark and others. Through Prince George, he obtained a commission to paint the portraits of many naval officers for Greenwich Hospital. Much of his best work is at Hampton Court and at Petworth. He died in London on Oct. 20, 1743, having out-lived his great popularity.

See W. Nisser, *Michael Dahl and the Contemporary School of Painting in England* (1928).

DAHLAK ISLANDS, an Archipelago consisting of a group of islands off the Bay of Massawa forming part of the Italian colony of Eritrea. They are chiefly of coral formation, three islands only being inhabited. A trade in pearl and sponge fishing has been conducted since Roman times. *See* also Eritrea.

DAHLBERG (Dahlbergh), **ERIK JOHANSEN,** Count (1625–1703), Swedish soldier and engineer, was born at Stockholm on Oct. 20, 1625. As adjutant-general and engineer adviser to Charles X. (Gustavus) he had a great share in the famous crossing of the frozen Belts, and at the sieges of Copenhagen and Kronborg he directed the engineers. In spite of these distinguished services, Dahlberg remained an obscure lieutenant-colonel for many years. In 1676 he became director-general of fortifications, and in the wars of the next 25 years he rendered distinguished service, alike in attack (as at Helsingborg in 1677, and Dünamünde in 1700) and defence (as in the two sieges of Riga in 1700), and his work in repairing the fortresses of his own country, not less important, earned for him the title of the "Vauban of Sweden." He retired as field-marshal in 1702, and died at Stockholm on Jan. 26, 1703.

See H. Heden, *Erik Dahlberg* (1900).

DAHLGREN, JOHN ADOLF (1809–1870), admiral in the U.S. navy, was the son of the Swedish consul at Philadelphia, Pa., and was born in that city on Nov. 13, 1809. He entered the navy in 1826, and saw some service in the Civil War in command of the South Atlantic blockading squadron, but was chiefly notable as a scientific officer. His knowledge of mathematics caused him to be employed on the coast survey in 1834. In 1847 he was transferred to the ordnance department. In this post he applied himself to the improvement of the guns of the navy. He was the inventor of the smooth bore gun which bore his name, but was from its shape familiarly known as "the soda water bottle." It was used in the Civil War, and for several years afterwards in the U.S. navy. Dahlgren's guns were first mounted in a vessel named the "Experiment," which cruised under his command from 1857 till 1859. They were "the first practical application of results obtained by experimental determinations of pressure at different points along the bore, by Colonel Bomford's tests—that is by boring holes in the walls of the gun, through which the pressure acts upon other bodies, such as pistol balls, pistons, etc." When the Civil War broke out, he was on ordnance duty in the Washington navy yard, and he was one of the three officers who did not resign from Confederate sympathies. His rank at the time was commander, and the command could be held only by a captain. President Lincoln insisted on retaining Commander Dahlgren, and he was qualified to keep the post by special act of Congress. He became post-captain in 1862, rear-admiral in 1863, and was in command of the Washington navy yard when he died on July 12, 1870.

A memoir of Admiral Dahlgren by his widow was published at Boston in 1882. (D. H.)

DAHLGREN, KARL FREDRIK (1791–1844), Swedish poet, was born at Stensbruk in Östergötland on June 20, 1791. At a time when literary partisanship ran high in Sweden, and the writers divided themselves into "Goths" and "Phosphorists," Dahlgren made himself indispensable to the Phosphorists by his polemical activity. In the mock-heroic poem of *Markalls sömnlösa nätter* (Markall's Sleepless Nights), in which the Phosphorists ridiculed the academician Per Adam Wallmark and others, Dahlgren, who was a genuine humorist, took a prominent part. In 1825 he published *Babels Torn* (The Tower of Babel), a satire, and a comedy, *Argus in Olympen;* and in 1828 two volumes of poems. In 1829 he was appointed to an ecclesiastical post in Stockholm, which he held until his death. In a series of odes and dithyrambic pieces, entitled *Mollbergs Epistlar* (1819, 1820), he strove to emulate the wonderful lyric genius of K. M. Bellman, of whom he was a student and follower. From 1825 to 1827 he edited a critical journal entitled *Kometen* (The Comet), and in company with Almqvist he founded the *Manhemsförbund,* a short-lived society of agricultural socialists. In 1834 he collected his poems in one volume; and in 1837 appeared his last book, *Angbåts-Sånger* (Steamboat Songs). He died at Stockholm on May 1, 1844. Dahlgren is one of the best humorous writers that Sweden has produced; but he was perhaps at his best in realistic and idyllic description. His little poem, *Zephyr and the Girl,* which is to be found in every selection from Swedish poetry, is a good example of his sensuous and ornamented style.

His works were collected and published after his death by A. J. Arwidsson (5 vols., Stockholm, 1847–52).

DAHLIA, a genus of tuberous-rooted herbs of the family Compositae (*q.v.*), containing 12 species indigenous to the high plateaus of Mexico and Central America. The dahlia was first introduced into Britain from Spain in 1789 by the marchioness of Bute. The species was probably *D. pinnata,* from which many of the forms now common have originated. The cactus dahlias, however, are derived from *D. Juarezi,* a species from Mexico and Guatemala, or from *D. popenovi.* The flowers, at the time of the first introduction of the plant, were single, with a yellow disk and dull scarlet rays; under cultivation, flowers of numerous brilliant hues have been produced. The flower has been modified also from a flat to a globular shape, and the arrangement of the florets has been rendered quite distinct in the peony and anemone-like kinds.

The ordinary natural height of the dahlia is about 7 or 8 ft., but one of the dwarf races grows to only 18 in. With changes in the flower, changes in habit have been brought about by cultivation; varieties of the plant have been produced which require more moisture than others; and the period of flowering has been much extended.

FROM CURTIS BOTANICAL MAGAZINE
DAHLIA (DAHLIA PINNATA), A NATIVE OF MEXICO NAMED IN HONOUR OF THE SWEDISH BOTANIST DAHL AND THE ORIGIN OF MANY GARDEN FORMS

The hundreds of varieties are classed under 13 different types, of which the best known are: (1) *Single dahlias.* These have been derived from *D. coccinea;* they have a disk of tubular florets surrounded by the large showy ray florets. (2) *Show dahlias,* large and double, quilled flowers self-coloured or pale-coloured and edged or tipped with a darker colour. (3) *Fancy dahlias,* resembling the show but having the florets striped or tipped with a second tint. (4) *Bouquet* or *Pompon dahlias,* with much smaller double, quilled flowers of various colours. (5) *Cactus dahlias,* probably derived from *D. Juarezi,* a form which has given rise to a beautiful race with pointed starry flowers. (6) *Peony-flowered dahlias,* a race with large, floppy heads, broad florets and several disk florets in centre.

New varieties are procured from seed, which should be sown indoors in pots or pans towards the end of March, or placed in a hotbed or propagating pit, the young plants being pricked off into pots or boxes, and gradually hardened off for planting out in June; they will flower the same season if the summer is genial. The older varieties are propagated by dividing the large tuberous roots, in doing which care must be taken to leave an eye to each portion of tuber, otherwise it will not grow. Valuable varieties are sometimes grafted on the roots of others. Another mode of propagation is by cuttings, to obtain which, young non-flowering shoots are taken off with a heel, and planted singly in small pots filled with fine sandy soil. They root speedily, and are then transferred to larger pots in light rich soil, and their growth encouraged until the planting-out season arrives, about the middle of June, when the pots are plunged. In the fall the pots are dug and stored in a frost-free place. The tubers are then ready for growth the following spring. Dahlias succeed best in an open situation, and in rich deep loam, but there is scarcely any garden soil in which they will not thrive, if it is manured. Dahlias flower on till they are interrupted by frost in autumn. The tubers are then taken up, dried, and stored in some place where they may be secure from frost and moisture. Earwigs are very destructive, eating out the young buds and florets. Small flowerpots half-filled with dry moss and inverted on stakes placed among the branches form a useful trap. The tarnished plant bug, sometimes a troublesome pest, can be controlled by arsenical sprays.

DAHLMANN, FRIEDRICH CHRISTOPH (1785–1860), German historian and politician, was born at Wismar on May 13, 1785; he came of an old Hanseatic family of Wismar, which then belonged to Sweden. He studied classical philology at Copenhagen and Halle, and again at Copenhagen. After finishing his studies, he translated some of the Greek tragic poets, and the *Clouds* of Aristophanes. But he was also interested in modern literature and philosophy, and in the political developments of his time. In 1809, on the news of the outbreak of war in Austria, Dahlmann, together with the poet Heinrich von Kleist, whom he had met in Dresden, went to Bohemia, and was afterwards with the Imperial army until the battle of Aspern. After taking his doctor's degree at Wittenberg (1810) he qualified at Copenhagen in 1811 as a lecturer on ancient literature and history, on which he delivered lectures in Latin. In 1812 he received a chair at Kiel university.

From 1815 onwards, as secretary to the perpetual deputation of the estates of Schleswig-Holstein, he began in memoirs, or articles in the *Kieler Blätter,* which he founded himself, to advocate the half-forgotten rights of the Elbe duchies, as against Denmark. The Danes afterwards accused him of having invented the Schleswig-Holstein question (*q.v.*). After his transference to the chair of history at Göttingen in 1829, he had a share in framing the Hanoverian constitution of 1833; and when in 1837 the new king Ernest Augustus declared the constitution invalid, Dahlmann inspired the famous protest of the seven professors of Göttingen. He was deprived of his position and banished, but German national feeling had been stimulated by his action.

After some years spent in Leipzig and Jena, King Frederick William IV. appointed him in Oct. 1842 to a professorship at Bonn. His *Politik* (1835) had already made him a great name as a writer; he now published his *Dänische Geschichte* (1840–43), a historical work of the first rank; and this was soon followed by histories of the English and French revolutions, which advocated constitutional monarchy. After the revolution of 1848 broke out, the "father of German nationality" was appointed one of the committee of 17 nominated to draw up a draft constitution for submission to the national assembly summoned at Frankfurt. Dahlmann represented Prussia on this committee, and with the jurist Albrecht drafted a scheme. (*See* also GERMANY.) Dahlmann was also a member of the parliament. His object was to make Germany as far as possible a united constitutional monarchy, with the exclusion of the non-German Austrian dominions. Prussia was to provide the emperor, but at the same time—and in this lay the doctrinaire weakness of the system—was to give up its separate existence, consecrated by history, in the same way as the other States. When Frederick William IV. was elected hereditary emperor (March 28, 1849), Dahlmann was one of the deputation which offered the crown to the king in Berlin. The king's refusal was less of a surprise to him than to most of his colleagues. He counted on being able to compel recognition of the constitution by the moral pressure of the consent of the people. It was only when the attitude of the Radicals made it clear to him that this course would lead to a revolution, that he decided, after a long struggle, to retire from the national parliament (May 21). He was still, however, one of the chief promoters of the conference of the imperial party at Gotha; and he took part in the sessions of the first Prussian chamber (1849–50) and of the parliament of Erfurt (1850). But finally, convinced that for the moment all efforts towards the unity of Germany were unavailing, he retired from political life and again took up his work of teaching at Bonn. His last years were, however, saddened by illness, bereavement and continual friction with his colleagues. He died on Dec. 5, 1860.

Dahlmann's chief works were:—*Quellenkunde der deutschen Geschichte nach der Folge der Begebenheiten geordnet* (1830, 7th edition of Dahlmann-Waitz, *Quellenkunde,* Leipzig, 1906); *Politik, auf den Grund und das Mass der gegebenen Zustände zurückgeführt* (1835); *Geschichte Dänemarks* (3 vols., 1840–43); *Geschichte der englischen Revolution* (1844); *Geschichte der französischen Revolution* (1845).

See A. Springer, *Friedrich Christoph Dahlmann* (2 vols., 1870–72); and H. v. Treitschke, *Histor. und polit. Aufsätze,* i. 365 *et seq.;* Christern, *F. C. Dahlmann's politische Entwicklung bis 1848* (1921).

DAHLSTJERNA, GUNNO (1661–1709), Swedish poet, whose original surname was Eurelius, was born at Öhr, Dalsland, where his father was rector. He studied at Uppsala, became a land-surveyor, and in 1681 was sent on professional business to Livonia, then under Swedish rule. Returning to Sweden he became in 1699, head of the land survey department. In 1702 he was ennobled under the name of Dahlstjerna. His death, which took place in Pomerania, is said to have been hastened by the disastrous news of the battle of Poltava. Dahlstjerna's patriotism was touching in its pathos and intensity, and during his long periods of professional exile he comforted himself by the composition of songs to his beloved Sweden. At his best he easily surpasses all the Swedish poets of his time. His best-known original work is *Kungaskald* (Stettin, 1697), an elegy on the death of Charles XI. It is written in alexandrines, arranged in *ottava rima,* and contains many passages full of melody. Dahlstjerna was a reformer in language, and it has been well said by Atterbom that in this poem "he treats the Swedish speech just as dictatorially as Charles XI. and Charles XII. treated the Swedish nation." In 1690 was printed at Stettin his paraphrase of the *Pastor Fido* of Guarini. His most popular work is his *Götha kämpavisa om Konungen och Herr Peder* (The Goth's Battle Song, concerning the King and Master Peter; Stockholm, 1701). The king is Charles XII. and Master Peter is the tsar of Russia. This spirited ballad lived almost until our own days on the lips of the people as a folk-song.

The works of Dahlstjerna have been collected by P. Hanselli, in the *Samlade Vitterhetsarbeten af svenska Författare från Stjernhjelm till Dalin* (Uppsala, 1856, etc.).

DAHN, JULIUS SOPHUS FELIX (1834–1912), German historian, jurist and poet, was born on Feb. 9, 1834, in Hamburg, where his father, Friedrich Dahn (1811–89), was a leading actor at the city theatre. His mother, Constance Dahn, *née* Le Gay, was a noted actress. In 1834 the family moved to Munich. Felix Dahn studied law and philosophy in Munich and Berlin from 1849 to 1853. His first works were in jurisprudence, *Uber die Wirkung der Klagverjährung bei Obligationen* (Munich, 1855), and *Studien zur Geschichte der germanischen Gottesurteile* (Munich, 1857). In 1857 he became *docent* in German law at Munich university, and in 1862 professor-extraordinary, but in 1863 was called to Würzburg to a full professorship. In 1872 he removed to the University of Königsberg, and in 1888 settled at Breslau, becoming rector of the university in 1895. Meanwhile in addition to many legal works of high standing, he had begun the publication of a long series of histories and historical romances. His chief histories, besides many monographs and shorter works, were *Die Könige der Germanen* (vols. i.–vi., Munich and Würzburg, 1861–70, vols. vii.–xi., Leipzig, 1894–1908); *Die Urgeschichte der germanischen und romanischen Völker* (1881–90) and *Geschichte der deutschen Urzeit* (Gotha, 1883–88), all of which combine a wealth of learning and critical skill with great imaginative insight. Many of his essays were collected in the series of *Bausteine* (6 vols., 1879–84). His historical romances, although immensely popular, have less enduring value. The best known are *Ein Kampf um Rom.* (4 vols., 1876); *Odhins Trost* (1880); *Die Kreuzfahrer* (1884); *Bis zum Tode getreu* (1887); *Odhins Rache* (1891); *Julian der Abtrünnige* (1894). Dahn also published some poetry. His wife Therese, *née* Freiin von Droste-Hülshoff, was joint-author with him of *Walhall, Germanische Götter und Heldensagen* (Leipzig, 1898). Dahn's fictional work, prose and verse, was published in a collected edition (21 vols., 1898 and 1901). Dahn also published four volumes of memoirs, *Erinnerungen* (Leipzig, 1890–95).

DAHOMEEN, a people living in Dahomey in the Abomey—Allada—Wida district of Africa. The hierarchical monarchy formerly comprised king, ministers and high court functionaries, an organized standing army comprising several regiments including one composed of women (Amazons), with distinct social ranks of princes, high dignitaries, people and slaves. The extended patrilineal family group (*hennu*) had property in common under the headship of the patriarch (*Hennu-daho*), with individual ownership of personal possessions. Marriage was prohibited between members of the same family. Succession passed to the son, thence to the brother, afterwards to the nephew. They practised husbandry, arboriculture and trade. They were animists, who long practised human sacrifice and there are traces of totemism (leopard and serpent cults). Secret societies and male and female sacerdotal organization existed.

See Le Hérissé, *L'Ancien Royaume du Dahomey* (1911).

DAHOMEY, one of the colonies of French West Africa. Dahomey is bounded south by the Gulf of Guinea, east by Nigeria (British), north by Niger, and on the west by Togo, the eastern portion of which was placed under French mandate by an Anglo-French agreement of July 10, 1919. With a coast line of only 75 mi. (1° 38′ E. to 2° 42′ 30″ E., from the vicinity of Anecho to the longitude of the mouth of the Ajara [Adjara] river), the area of the colony is 46,300 sq.mi. and the population 1,424,220 (1941), of whom 1,150 are European. As far as 9° N. the width of the colony is no greater than the coast line. From this point, the colony broadens out both eastward and westward, attaining a maximum width of 200 mi. It includes the western part of Borgu (*q.v.*), and reaches the Niger at a spot a little above Illo. Its greatest length north to south is 430 mi.

Physical Features.—The littoral, part of the old Slave Coast (*see* GUINEA), is very low, sandy and obstructed by a bar. Behind the seashore is a line of lagoons, where small steamers can ply; east to west they are those of Porto Novo (or Lake Nokoué), Ouidah and Grand Popo. The Ouémé (300 mi. long), the most important river running south, drains the colony from the Bariba country to Porto Novo, entering the lagoon so named. The Zon is a western affluent of the Ouémé. Farther west is the Couffo (150 mi. long), which, before entering the Ouidah lagoon, broadens out into a lake or lagoon called Ahémé, 20 mi. long by 5 mi. broad. The Niger forms the northeast frontier of the colony (*see* NIGER).

For some 50 mi. inland the country is flat, and, after the first mile or two of sandy waste is passed, covered with dense vegetation. At this distance (50 mi.) from the coast is a great swamp known as the Lama marsh. It extends east to west some 25 mi. and north to south 6 to 9 miles. North of the swamp the land rises by regular stages to about 1,650 ft., the high plateau falling again to the basin of the Niger. In the northwest a range of hills known as the Atacora forms a watershed between the basins of the Ouémé, the Niger and the Volta. A large part of the interior consists of undulating country, rather barren with occasional patches of forest. The forests contain the baobab, the coconut palm and the oil palm. The fauna resembles that of other parts of the west coast, but the larger wild animals, such as the elephant and hippopotamus, are rare.

Climate.—The climate of the coast regions is very hot and moist. Four seasons are well marked: the harmattan or long dry season, from Dec. 1 to March 15; the season of the great rains, from March 15 to July 15; the short dry season, from July 15 to Sept. 15; and the "little rains," from Sept. 15 to Dec. 1. Near the sea the average temperature is about 80° F. The harmattan prevails for several days in succession, and alternates with winds from the south and southwest. During its continuance the thermometer falls about 10°, there is not the slightest moisture in the atmosphere, vegetation dries up or droops, the skin parches and peels, and all woodwork is liable to warp and crack with a loud report. Tornadoes occur occasionally. During nine months of the year the climate is tempered by a sea breeze, which is felt as far inland as Abomey (60 mi.). It generally begins in the morning, and in the summer it often increases to a stiff gale at sundown. In the interior there are but two seasons: the dry season (November to May) and the rainy season (June to October). The rains are more scanty and diminish considerably in the northern regions.

Inhabitants.—The inhabitants of the coast region are of pure Negro stock. The Dahomeyans (Dahomi), who inhabit the central part of the colony, form one of 18 closely allied clans occupying the country between the Volta and Porto Novo, and share a common tongue with the Ewe-speaking tribes. In their own tongue Dahomeyans are called Fons or Djedjés. They are tall and well formed, proud, reserved, polite in their intercourse with strangers, warlike and keen traders. The Mina, who occupy the district of the Popos, are noted for their skill as surf men, which has gained for them the title of the Krumen of Dahomey. Porto Novo is inhabited by a tribe called Nago, which has an admixture of Yoruba blood and speaks a Yoruba dialect. The Nago are a peaceful tribe and even keener traders than the Dahomi. In Ouidah and other coast towns are many mulattos, speaking Portuguese and bearing high-sounding Portuguese names. In the north the inhabitants—Mahi, Bariba, Gurmai—are also of Negro stock, but scarcely so civilized as the coast tribes. Settled among them are communities of Peulhs and Hausas. There are many converts to Islam in the northern districts, but the Mahi and Dahomeyans proper are nearly all fetish worshippers.

The chief port is Cotonou (1936 pop. 5,500), the starting point of a railway to the Niger completed as far as Parakou (272 mi.). An iron pier, which extends well beyond the surf, affords facilities for shipping. Cotonou was originally a small village which served as the seaport of Porto Novo and was burned to the ground in 1890. It has consequently the advantage of being a town laid out by Europeans on a definite plan. Situated on the beach between the sea and the lagoon of Porto Novo, the soil consists of heavy sand. Good dirt roads have been made. Owing to an almost continuous, cool, westerly sea breeze, Cotonou is, in comparison with the other coast towns, decidedly healthy for white men. Porto Novo (1936 pop. 23,500), the seat of government and chief business centre, is on the northern side of the lagoon of the same name and 19 mi. northeast of Cotonou by road. The town has had many names, and that by which it is known to Europeans was given by the Portuguese in the 17th century. It contains numerous churches and mosques, public buildings and merchants' residences. Ouidah, 28 mi. west of Cotonou, is an old and formerly thickly populated town. Its population was 10,500 in 1936. It is built on the north bank of the coast lagoon about 2 mi. from the sea. There is no harbour at the beach, and landing is effected in boats made expressly to pass through the surf, particularly heavy there. In consequence of the thousands of orange and citron trees which adorn it, Ouidah is called "the garden of Dahomey." West of Ouidah, on the coast and near the frontier of Togoland, is the trading town of Grand Popo. Inland in Dahomey proper are Abomey (*q.v.*), the ancient capital, Allada, Kana (formerly the country residence and burial place of the kings of Dahomey) and Dogba. In the hinterland are Savalou (1936 pop. 20,200), Nikki and Parakou, Borgu towns, and Kandi, on the road leading north to the Niger.

Agriculture and Trade.—The agriculture, trade and commerce of Dahomey proper are essentially different from that of the hinterland (*Haut Dahomey*). The soil of Dahomey proper is naturally fertile and is capable of being highly cultivated. It consists of a rich clay of a deep red colour. Finely powdered quartz and yellow mica are met with, denoting the deposit of disintegrated granite from the interior. The principal exports in order of their value are palm kernels, palm oil, peanuts, corn, cotton and shea nuts. The district of Toffo is particularly noted for its oil palms. Palm wine is also made, but the manufacture is discouraged as the process destroys the tree. Next to palm oil the principal vegetable products are maize, guinea-corn, cassava, yams, sweet potatoes, plantains, coconuts, oranges, limes and the African apple, which grows almost wild. The country also produces coffee, castor beans, kola nuts, pineapples, guavas, spices of many kinds, ginger, okras, sugar cane, onions, tomatoes and papayas. Cattle, sheep, goats and fowl are scarce in the coastal region. There is a large fishing industry in the lagoons. Around the villages, and here and there in the forest, are clearings which are cultivated in places, but agriculture is in a backward condition. In the grassy uplands of the interior cattle and horses thrive, and cotton is grown by the inhabitants. The prosperity of the country depends chiefly on the export of palm oil and palm kernels. Copra, kola nuts and dried fish are also exported, the fish going to Lagos. Trade is mainly with France and Great Britain. Cotton goods (chiefly from Great Britain), machinery and metals, tobacco and petroleum products are the chief imports.

Communications.—The Dahomey railway from Cotonou to Parakou (272 mi.) is of metre gauge (3.28 ft.). This line is to be carried on as far as the Niger. A branch railway from the main line serves the western part of the colony. It goes via Ouidah to Segboroué on Lake Ahémé, whence a 1.97 ft. line continues to Adjaha and Athiémé. Another line (66 mi.) runs from Cotonou to Porto Novo and through the market town of Adjara to Pobé, close to the British frontier. A branch connects Lagbé and Sakété. This line serves a belt of country rich in oil palms. At Bohicon one branch line goes to Abomey and the other to Zagnanado. Cotonou is a regular port of call for steamers from

Europe to the west coast, and there is also regular communication along the lagoons between Porto Novo and Lagos. Cotonou is an important cable station. Telegraph, telephone and radio communications are government owned and operated. Air services link the colony with main lines serving the continent of Africa.

Administration.—The colony is administered by a governor (responsible to the governor-general at Dakar), assisted by a secretary-general and a council composed of official and unofficial members. It is divided into eight circles or provinces. Over each circle is an administrator with extensive powers. Native laws and customs are as far as possible retained. Natives, however, may place themselves under the jurisdiction of the French law. In general the administrative system is the same as that for all the colonies of French West Africa (*q.v.*). The chief source of revenue is the customs, while the capitation tax contributes most to the local budget.

HISTORY

The recorded history of Dahomey begins about the commencement of the 17th century. At that period the country now known as Dahomey was included in the extensive kingdom of Allada or Ardrah, of which the capital was the present town of Allada, on the road from Ouidah to Abomey. Allada became dismembered on the death of a reigning sovereign, and three separate kingdoms were constituted under his three sons. One state was formed by one brother round the old capital of Allada, and retained the name of Allada or Ardrah; another brother migrated to the east and formed a state known under the name of Porto Novo; while the third brother, Tacodonou, travelled northward, and after some vicissitudes established the kingdom of Dahomey. About 1724–28 Dahomey, having become a powerful state, invaded and conquered successively Allada and Ouidah.

The name Dahomey (Dan-homey—stomach of Dan) supposedly commemorates the slaying of Dan, king of the Fons, in accordance with a legend that Aho Tacodonou continually harassed Dan with demands, and the latter, enraged, finally demanded of Aho "if he did not wish to set himself up on his stomach." Aho then attacked and overcame Dan and, after carrying him prisoner to Agbome, decapitated him and threw his body into the foundations of the palace which he was building, whereupon Aho was proclaimed king of the Fons, and it was one of his descendants whom the French found on the throne of Abomey at the time of the conquest.

King Gezo ascended the throne about the year 1818, and during a reign of 40 years raised the power of Dahomey to its highest pitch, extending greatly the border of his kingdom to the north. He boasted of having first organized the Amazons, a force of women to whom he attributed his successes. The Amazons, however, were state soldiery long before Gezo's reign, and what he really did was to reorganize and strengthen the force.

European Rivalry.—In 1851 Gezo attacked Abeokuta in the Yoruba country and the centre of the Egba power, but was beaten back. In the same year the king signed a commercial treaty with France, and undertook to preserve "the integrity of the territory belonging to the French fort" at Ouidah. The fort was one built in the 17th century, and in 1842 made over to a French mercantile house. England, Portugal and Brazil also had "forts" at Ouidah—all in a ruinous condition and ungarrisoned—and when in 1852 England, to prevent the slave-trade, blockaded the Dahomeyan coast, energetic protests were made by Portugal and France, based on the existence of these "forts." In 1858 Gezo died. He had greatly reduced the custom of human sacrifice, and left instructions that after his death there was to be no general sacrifice of the palace women. Gezo was succeeded by his son Gléglé (or Gélélé), whose attacks on neighbouring states, persecution of native Christians, and encouragement of the slave-trade involved him in difficulties with Great Britain and France. It was, as Lord Russell said, to check "the aggressive spirit of the king of Dahomey" that England in 1861 annexed the island of Lagos. Nevertheless, in the following year Gléglé captured Ishagga and in 1864 unsuccessfully attacked Abeokuta, both towns in the Lagos hinterland. In 1863 a step was taken by France which was the counterpart of the British annexation of Lagos. The kingdom of Porto Novo accepted a French protectorate, and an Anglo-French agreement of 1864 fixed its boundaries. This protectorate was soon afterwards abandoned by Napoleon III, but was re-established in 1882. At this period the rivalry of European powers for possessions in Africa was becoming acute, and German agents appeared on the Dahomeyan coast. However, by an arrangement concluded in 1885, the German protectorate in Guinea was confined to Togo, save for the town of Little Popo at the western end of the lagoon of Grand Popo. In Jan. 1886 Portugal—in virtue of her ancient rights at Ouidah—announced that she had assumed a protectorate over the Dahomeyan coast, but she was induced by France to withdraw her protectorate in Dec. 1887. Finally, the last international difficulty in the way of France was removed by the Anglo-French agreement of 1889, whereby Cotonou was surrendered by Great Britain. France claimed rights at Cotonou in virtue of treaties concluded with Gléglé in 1868 and 1878, but the chiefs of the town had placed themselves under the protection of the British at Lagos.

French Conquests.—With the arrangements between the European Powers the Dahomeyans had little to do, and in 1889, the year in which the Anglo-French agreement was signed, trouble arose between Dahomey and the French. A French force was landed at Cotonou, and severe fighting followed, in which the Amazons played a conspicuous part. In Oct. 1890 a treaty was signed which secured to France Porto Novo and Cotonou, and to the king of Dahomey an annual pension of £800. It was unlikely that peace on such terms would prove lasting, and the slave-raiding expeditions of Behanzin, Glégle's son, who succeeded in 1889, led in 1892 to a new war with France. General Dodds was placed in command of a strong force of Europeans and Senegalese, and after a sharp campaign during September and October completely defeated the Dahomeyan troops. Behanzin set fire to Abomey (entered by the French troops on Nov. 17) and fled north. Pursued by the enemy, abandoned by his people, he surrendered unconditionally on Jan. 25, 1894. Thus ended the independent existence of Dahomey. The French divided it into two parts—Abomey and Allada—placing on the throne of Abomey a brother of the exiled monarch. Ouidah and the adjacent territory were annexed to France on Dec. 3, 1892, and the rest of Dahomey placed under a French protectorate at the same time. The prince who had been made king of Abomey was found intriguing against the French, and in 1900 was exiled by them to the Congo.

Dahomey conquered, the French at once set to work to secure as much of the hinterland as possible. On the north they penetrated to the Niger, on the east they entered Borgu (a country claimed by the Royal Niger company for Great Britain), on the west they overlapped the territory claimed by Germany as the hinterland of Togo. The struggle with Great Britain and Germany for supremacy in this region forms one of the most interesting chapters in the story of the partition of Africa. In the result France succeeded in securing a junction between Dahomey and her other possessions in West Africa, but failed to secure any part of the Niger navigable from the sea. (*See* Africa: *History,* and Nigeria.) A Franco-German convention of 1897 settled the boundary on the west, and the Anglo-French convention of 1898 defined the frontier on the east. In 1899, on the disintegration of the French Sudan, the districts of Fada N'Gurma and Say, lying north of Borgu, were added to Dahomey, but in 1907 they were transferred to Upper Senegal-Niger, with which colony they were closely connected both geographically and ethnologically. From 1894 onward the French devoted great attention to the development of the material resources of the country. In 1911 they deposed the chief, a member of the old royal family, whom they had installed at Abomey. His territory was divided among petty chiefs under the direct control of the French resident, and the whole country became the colony of Dahomey and dependencies. In 1912 a Franco-German convention delimited the Dahomey-Togo boundary; but two years later Togo was invaded and conquered by the French and British.

The "Customs."—The Dahomey "customs," no longer practised, have given the country an infamous notoriety. They appear to date from the middle of the 17th century, and were of two kinds: the grand customs performed on the death of a king; and the minor customs, held twice a year. The horrors of these saturnalia of bloodshed were attributable not to a love of cruelty but to filial piety. Upon the death of a king human victims were sacrificed at his grave to supply him with wives, attendants, etc., in the spirit world. The grand customs surpassed the annual rites in splendour and bloodshed. At those held in 1791 during January, February and March, it is stated that no fewer than 500 men, women and children were put to death. The minor customs were first heard of in Europe in the early years of the 18th century. They formed continuations of the grand customs, and "periodically supplied the departed monarch with fresh attendants in the shadowy world." The actual slaughter was preluded by dancing, feasting, speechmaking and elaborate ceremonial. The victims, chiefly prisoners of war, were dressed in calico shirts decorated round the neck and down the sleeves with red bindings, and with a crimson patch on the left breast, and wore long white night caps with spirals of blue ribbon sewn on. Some of them, tied in baskets, were at one stage of the proceedings taken to the top of a high platform, together with an alligator, a cat and a hawk in similar baskets, and paraded on the heads of the Amazons. The king then made a speech explaining that the victims were sent to testify to his greatness in spiritland, the men and the animals each to their kind. They were then hurled down into the middle of a surging crowd of natives, and butchered. At another stage of the festival human sacrifices were offered at the shrine of the king's ancestors, and the blood was sprinkled on their graves. This was known as *Zan Nyanyana* or "evil night," the king going in procession with his wives and officials and himself executing the doomed. These semi-public massacres formed only a part of the slaughter, for many women, eunuchs and others within the palace were done to death privately. The skulls were used to adorn the palace walls, and the king's sleeping chamber was paved with the heads of his enemies. The skulls of the conquered kings were turned into royal drinking cups, their conversion to this use being esteemed an honour. Sir Richard Burton insists (*A Mission to Gelele, King of Dahome*) that the horrors of these rites were greatly exaggerated. He denies that the king floated a canoe in a tank of human blood or that the victims were tortured, and affirms that, on the contrary, they were treated humanely, and in many cases even acquiesced in their fate. It seems that cannibalism was a sequel of the customs, the bodies of the slaughtered being roasted and devoured smoking hot. On the death of the king the wives, after the most extravagant demonstrations of grief, broke and destroyed everything within their reach, and attacked and murdered each other, the uproar continuing until order was restored by the new sovereign.

Amazonian Army.—The training of women as soldiers was the most singular Dahomeyan institution. About one-fourth of the whole female population were said to be "married to the fetich," many even before their birth, and the remainder were entirely at the disposal of the king. The most favoured were selected as his own wives or enlisted into the regiments of Amazons, and then the chief men were liberally supplied. Of the female captives the most promising were drafted into the ranks as soldiers, and the rest became Amazonian camp followers and slaves in the royal households. These female levies formed the flower of the Dahomeyan army. They were marshalled in regiments, each with its distinctive uniform and badges, and they took the post of honour in all battles. Their number has been variously stated. Sir R. F. Burton, who, in 1862, saw the army marching out of Kana on an expedition, computed the whole force of female troops at 2,500, of whom one-third were unarmed or only half-armed. Their weapons were blunderbusses, flint muskets, and bows and arrows. A later writer estimated the number of Amazons at 1,000, and the male soldiers at 10,000. The system of warfare was one of surprise. The army marched out, and when within a few days' journey of the town to be attacked, silence was enjoined and no fires permitted. The highways were avoided, and the advance was by a road specially cut through the bush. The town was surrounded at night, and just before daybreak a rush was made and every soul captured if possible; none were killed except in self-defense, as the first object was to capture, not to kill. The season usually selected for expeditions was from January to March, or immediately after the annual "customs." The Amazons were carefully trained, and the king was in the habit of holding "autumn manoeuvres" for the benefit of foreigners. Many Europeans have witnessed a mimic assault, and agree in ascribing a marvellous power of endurance to the women. Lines of thorny acacia were piled up one behind the other to represent defenses, and at a given signal the Amazons, barefooted and without special protection, charged and disappeared from sight. Presently they emerged within the lines torn and bleeding, but apparently insensible to pain, and the parade closed with a march past, each warrior leading a pretended captive bound with a rope.

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DÁIL EIREANN: *see* IRISH FREE STATE.

DAILLE (DALLAEUS), **JEAN** (1594–1670), French Protestant divine, was born at Châtellerault and educated at Poitiers and Saumur. In 1625 he became minister of the church of Saumur, and in 1626 of the church of Charenton. Of his works the best known is the treatise *Du vrai emploi des Pères* (1631), translated into English by Thomas Smith under the title *A Treatise concerning the right use of the Fathers* (1651). He was president of the last national synod held in France, which met at Loudun in 1659 (H. M. Baird, *The Huguenots and the Revocation of the Edict of Nantes*, 1895, i. pp. 412 ff.), when he defended the universalism of Moses Amyraut.

DAINGERFIELD, ELLIOTT (1859–1932), American painter, was born at Harper's Ferry, Va. (now W.Va.), March 26, 1859. He received his early education at Fayetteville, N.C., and went to New York city in 1880 to study art. He exhibited first at the National Academy of Design in 1880. Among his best-known pictures are "Christ Stilling the Tempest" and "Slumbering Fog," in the Metropolitan museum, New York city; "Storm Breaking Up," in the Toledo museum; "The Child of Mary," in the National gallery, Washington; "The Midnight Moon," in the Brooklyn museum; "The Valley of the Dragon," in the Chicago Art institute. He executed the beautiful mural decorations in the Lady Chapel of the Church of St. Mary the Virgin, New York city. He won the Clarke prize of the National Academy of Design, 1902. He was the author of monographs on George Inness (1911), and on R. A. Blakelock (1914). He died Oct. 22, 1932.

DAIREN, the port of the Kwantung peninsula, which is the southern end of the Liaotung peninsula in south Manchuria. Its name is the Japanese version, as Dalny was the Russian, of the Chinese name Ta-lien. The Kwantung Leased Territory is that region of Manchuria leased by China to Russia in 1898 and assigned by transfer to Japan after the Russo-Japanese War. The seat of government, formerly at Port Arthur, was transferred to Dairen in 1937 after a series of administrative changes following upon the formation of "Manchoukuo" and culminating in the transfer of extra-territorial rights by Japan to that state. Dairen after 1907 was a free port, duties being collected by an office of the Chinese maritime customs there upon only those imports leaving the free zone, until the formation of "Manchoukuo" which operates (1944) the customs office. The port has 36 ft. of water at the entrance, and has been well equipped under Japanese administration with wharves, dry docks, warehouses and special loading facilities for coal and oil. It has extensive storage facilities for soybeans, the principal export, and has since 1931 gained special importance as a port of entry for military supplies for the Japanese forces in Manchuria and for material for the intensive industrialization of that region. It was until recently the headquarters of the South Manchuria railway and remains the site of important industrial enterprises, notably the manufacture of rolling stock.

The population in 1938 was 515,743 of whom 351,919 were Manchurians, 158,223 Japanese and 3,900 Koreans.

DAIRY FARMING. History reveals that many species of mammals have been used as a source of milk for human consumption. The most common references to sources other than that of the human mother were to the cow, ewe, goat, and the mare. Today the ewe and the goat are extensively used in many countries. In France Roquefort cheese is produced from ewe's milk. In Italy many varieties of cheese are produced from goat's milk. Almost every city in the United States has a limited supply of goat's milk, the result of a demand created by physicians who recommend its use for those who cannot assimilate cow's milk. When milk is mentioned, however, the reference is to cow's milk unless otherwise specified.

Meat and milk products have been used abundantly by most of the European countries. Butter and cheese are mentioned in the earliest recorded references to human food products. The animals used as a source of meat and milk by the people of the old world were as varied as the history of the people themselves. The influence of immigration, conquest, and environmental conditions such as climate, topography, and fertility of the land has resulted in the development of a large number of types of animals of the same species. Up to the 17th century little attention had been paid to the improvement of livestock or to the development of breeds for special uses. The year 1770 is mentioned as the beginning of livestock improvement. It was around this time that interest was aroused in Great Britain in the improvement of cattle and other domestic animals. The demonstrations of improvement by selection of livestock were so striking that the movement spread rapidly throughout the world and formed the beginning of improved breeds of livestock. This interest in improving livestock was timed to be of greatest benefit to livestock development in the United States. It made possible improved and specialized breeds of livestock for this new market. The early colonists had brought some livestock with them, but few of these survived. The foundations of most of the American breeds of livestock were brought to the United States early in the 18th century from Europe.

It can be said for dairy farming that when properly managed it will maintain or increase fertility to a greater extent than most systems of livestock farming. It is for this reason that dairy farming is followed on some of the oldest and highest priced land in the world. The dairy farmer not only feeds most of the crops produced on his farm, but he also purchases feeds which are high in protein and thus enriches the manure produced by his animals. A dairy cow fed properly will produce about 12 tons of solid and liquid manure in a year. This manure when properly handled will increase farm crop yields sufficiently so that a farmer can realize from $2 to $6 per ton for manure. A dairy farmer by feeding his crops to his cows sells less fertility from his farm than when he sells crops. The value of fertilizing elements—nitrogen, potash, and phosphoric acid—in a ton of butter is about 32 cents and in a ton of milk $1.46. In a ton of alfalfa hay the value of fertilizing elements is $6.68, in a ton of corn $4.88, and in a ton of wheat $6.16. This is based on a price of 10 cents per pound for nitrogen, 6 cents for phosphoric acid, and 5 cents for potash. Dairy farmers in recent years have taken advantage of research in crop improvement and are using high yielding clovers and alfalfa to the exclusion of non-legumes. This plan also is conducive to maintaining soil fertility and reduces the need of purchasing protein supplements to feed their animals.

The dairy cow has an advantage over some types of livestock in her ability to consume large amounts of roughage. High producing cows are generally fed all the roughage they will consume and grain supplements to make up the nutrients required. In the European dairy countries the dairy cows are fed mostly on hay and pasture, while in the United States dairy cows are fed more liberally on farm-grown grains. An efficient dairy cow will return more edible food nutrients from food eaten than will other classes of livestock. For each 100 pounds of digestible nutrients in her feed she will return 18 pounds of edible milk solids.

In spite of the many factors favourable to dairy farming, the amount of labour and the daily routine of painstaking labour involved are objectionable to many farmers. Perhaps this condition is an advantage in that it limits the number of dairy farmers. The milking machine and labour saving barns and equipment have made dairy farm labour less irksome on many farms. Because dairy farming is a year round job, labour is utilized to better advantage than on some other types of farms. Dairy farming is generally a safer type of farming because it means a daily income for the farmer. On most dairy farms the world over the labour involved in handling dairy cattle becomes a family enterprise, and labour may be used that would not otherwise be used to advantage. The extent to which dairy farming is followed in the United States may be indicated by the fact that, of a total of 6,096,799 farms in 1940, 4,663,431 reported cows were kept for milk production. Almost every farmer keeps a few cows. When their production becomes more than the needs of the family, the surplus is sold. The United States census defines a dairy farm as one where more than 40% of the income is from dairy cattle. This reduces the number of specialized dairy farms to about 600,000 in the United States. The leading states in total milk production in the United States are Wisconsin, Minnesota, New York, and Iowa.

The Dairy Herd.—The dairy cattle population of the United States has increased rapidly since 1940 as a result of the demand for dairy products resulting from the war. The same can be said for cattle kept for the production of beef. In 1944, there were approximately 27,000,000 dairy cows in production. The number of cattle of all breeds and ages was 82,000,000. Of this number, approximately 44,000,000 were dairy cattle and 38,000,000 were beef cattle.

The term "dairy cows" refers to dairy cows two years old or over kept for milk production. By "dairy cattle" is meant dairy animals of all ages and both sexes. The term "pure bred cattle" refers to animals whose ancestry came from the original home of the breed mentioned and whose record of descent has been recorded in the herd books of the breed.

A grade or unregistered animal may show the characteristics of one of the breeds, but its ancestry has been mixed with unregistered animals or for other reasons it cannot be registered. Most of the dairy animals in the United States are classed as grades. Less than 4% of dairy cattle are pure bred.

Pure bred dairy cattle registered in the United States during 1942 were: Ayrshire 17,713; Guernsey 63,674; Holstein-Friesian 106,624; Jersey 71,821; Brown Swiss 14,019.

In the United States more than one-fifth of the total annual agricultural income comes from dairy cows. A big proportion of our farms not only keep cows for milk production but they sell dairy products. The degree to which a farmer engages in dairy farming is subject to a large number of ever changing conditions. It is common knowledge that the most productive type of farming over a long period of time is the type that utilizes most of the crops produced on the farm in producing livestock or livestock products. The type of livestock used will depend upon the operator. The specialized dairy farmer will probably keep either grade or pure bred cattle of one of the special breeds of cattle. Even the general farmer may have dairy cattle, the number depending upon the extent to which he engages in dairy farming.

Some factors that may determine the extent to which a farmer engages in dairying are: nearness to special markets; the size of his farm; the kind of land; availability of labour; and type of farming in the locality.

A dairy farmer generally chooses one of the following markets: (1) sell to a pasteurizing plant for use as fluid milk; (2) bottle and sell his own milk either raw or pasteurized; (3) sell milk to a condensery, cheese factory, or creamery; (4) separate the milk and sell the cream to a creamery or other dairy plant; (5) churn the cream and sell butter in a nearby town.

Most of the specialized dairy farmers have a special market for their products. By far the greatest amount of cream for butter is produced by the farmer who separates his milk on the farm and sells cream. This leaves the skimmed milk, nutritionally the most valuable part of the milk, for feeding livestock on the farm. To utilize the skimmed milk to advantage, a farmer should have some hogs and chickens, in addition to the calves he raises for replacements, to consume this by-product. It is this type of dairy farming that encourages a diversified system of farming and has made pork production and poultry raising a valuable adjunct to dairy farming. It is for this reason that dairy farming is so generally followed in the agricultural section of the United States. The dairy stock may consist of 12–15 cows in milk, 5–6 heifers, a herd sire, and a few young calves. To house these cattle a rectangular barn with a cement floor and stalls for the cows in milk is desirable. The hay is commonly stored in a mow above the cattle, and a silo is located near the barn for convenience in feeding. On the specialized dairy farms certain requirements must be met in housing the animals and handling the milk. It is common to build a milk house near, or under certain specifications a part of the milking barn, with facilities for cooling the milk and washing utensils. Regulations covering the production of milk for the fluid milk market are formulated by state laws, city ordinances and special conditions specified by the purchaser. In the case of the producer of cream, the regulations are less rigid but it is desirable that he too have a milk room for separating the milk, cooling the cream, and washing the utensils. The cream should be kept cool and delivered to the creamery sweet or only slightly sour. Cream is generally delivered or picked up by trucks at the farmer's door, twice a week in winter and every other day in the summer.

The cream is paid for on the basis of its butterfat content as determined by the Babcock method. Cream testing 30–35% butterfat is desired. Each delivery of cream is tested for butterfat and in some states laws specify that a differential in price will be paid for cream of different grades of quality. Low grade cream is rejected. One hundred pounds of milk when separated will produce between 82–85 lb. of skimmed milk and 15–18 lb. of cream, depending upon the per cent of fat in the milk and the per cent of fat in the cream. A comparison of normal milk and skimmed milk is given below:

Table I.

	Normal milk	Skimmed milk
Water	87.1%	90.5%
Butterfat	3.9	0.1
Proteins	3.4	3.57
Milk sugar	4.75	4.95
Ash	0.75	0.78

Not only is most of the protein of milk left in the skimmed milk, but this protein is of the highest quality for human or livestock feeding.

The butterfat removed from the milk is valuable commercially, but as a feed for livestock it can be replaced by corn at a material saving. In feeding calves between one month and six months of age, two pounds of corn are equal to a pound of butterfat as a source of energy. Skimmed milk is a valuable food for human consumption since it contains everything in milk except the butterfat and the accessory elements in the butterfat. Skimmed milk becomes valuable commercially only when it is dried. The development and use of dried skim milk may eventually cause more milk to be delivered to creameries where the milk can be separated and dried. The utilization of skimmed milk on a general dairy farm may determine the profit or loss of the dairy herd. The management of the dairy herd has an important bearing on the production of the herd, the use of labour, and the success of the entire venture. In most of the dairy states in the United States outside of the milk shed, the cows are bred to freshen in the fall of the year. This means that the cows will produce best during the winter months when butterfat is highest in price and when the farmer has more time to spend with the herd. This also means that many of the cows will be dry during the busy crop season. This plan of winter dairying is not suitable when milk is sold and a constant supply throughout the year is necessary. It is common knowledge that fall freshening cows turned to grass in the spring will produce more in the year than spring freshening cows.

The specialized breeds of dairy cattle in the United States are: Jersey, Guernsey, Ayrshire, Holstein-Friesian, and Brown Swiss. The Milking Shorthorn, Red Polls, and Polled Durhams are listed as dual purpose or milk and beef breeds. In England and in some herds in the United States, the Milking Shorthorns have all the characteristics of the special dairy breeds. The advantage a dairy farmer has in using a specialized dairy breed is that he gets the benefits of years of selection for the characteristics of a special dairy animal. There is no one breed that is especially better than another in efficiency of production. The breeds vary in colour, size, per cent of butterfat, and amount of milk produced. When it comes to efficiency of production, it is a matter of individual animals.

The only sure way to measure a cow's ability is to use some means of estimating the amount of milk she produces and the amount of feed eaten. This may be done by weighing the milk from each milking or by weighing the milk one day of each month and using this as a basis for estimating the milk for the period. The feed eaten may be estimated in a like manner. This may be done by the owner, by a representative of the cow testing association, or by a representative of the breed association.

In the United States at the present time less than 3% of the cows have any records of production, and records were kept on more cows in 1942 than for any year to date. In Denmark, prior to the war, some districts had as many as 50% of their cows in cow testing associations.

A cow testing association, or dairy herd improvement association, as used by the United States department of agriculture is an organization of dairy farmers, 25 or 26 in number, who employ a man to spend one day of each month with each herd. While at the farm he estimates the milk produced by each cow and the feed consumed during the same period. A sample of each cow's milk is tested for butterfat by the Babcock method. Using this day's production as the average for the month, the estimate for the month can be determined by multiplying by the number of days in the month. At the end of a year a summary may be made on each cow. The tester also helps the farmer with his feeding and management problems. Cow testing associations originated in Denmark and are very common in all dairy countries. In the United States each dairy breed association, in addition to recording the ancestry and issuing registration certificates on pure bred animals, has a system of advanced registry for supervising and recording records of production. The records are supervised in co-operation with the agricultural college in each state at the request and expense of the breeder.

Some exceptionally high records have been made by representatives of each breed. These records are important to the end that they show the possibilities of maximum production without regard to economy of production. The cows are liberally fed, milked three or four times a day, and handled to produce to the maximum. The records in Table II were made under the uniform rules adopted by the breed associations in the United States. Two of the records were made in Canada, but under supervision similar to that in the United States.

The average butterfat production of the cows kept for dairy purposes in the United States was 188 lb. of butterfat in 1942. It is generally assumed in the United States that a cow should produce 200 lb. of butterfat in a year to pay for her feed. United States cows in co-operative cow testing associations in 1942 produced an average of 8,323 lb. of milk and 339 lb. of butterfat. In unselected herds of dairy cows in the United States, or in most any state of the United States, one-third of the dairy cows are kept at a loss, another one-third will about pay for their feed, and the remaining third will produce profitably if properly fed and cared for.

TABLE II.—*High Cow for Mature Butterfat Production in Each of the Dairy Breeds, 1944. (365-day division)*

	Lb. Milk	Lb. Butterfat	Test
Holstein—Carnation Ormsby Butter King 1165152	38606.6	1402.0	3.6%
Ayrshire—Ardgowan Valda	31156	1356	4.35
Jersey—Brampton Basilua 48490	19012	1312.8	6.9
Guernsey—Cathedral Rosalie 33499	23714	1213	5.12
Brown Swiss—Illini Nellie 26578	29589	1200	4.07

A dairy cow should be bred in the third month after calving. This will permit her to milk ten months and be dry two months before giving birth to a calf. During this ten-months' period, a cow should produce at least a pound of butterfat per day to pay for her feed, labour, and overhead costs. It cost about $78 per year to feed the average cow testing association cow in 1942; this is only one-half of the total cost of keeping a cow.

The chances of getting high producing animals can be increased by carefully selecting the ancestors of our cows. The ability of a herd sire is reflected in the progeny of every cow in the herd.

Here again we cannot measure a sire's ability until his daughters have freshened. In a study of 3,100 pure bred bulls proved in United States cow testing associations in 1943, the results demonstrated that with cows averaging 375 lb. of butterfat, approximately half of the bulls sired heifers that produced as much as their dams.

With the present plan of handling dairy sires, only one sire out of five is alive when his value is known.

The method of measuring a bull's ability is to compare the records of at least five of the bull's daughters with the records of their dams.

The average production of a bull's daughters may be used as a basis for an index of the bull's ability. As yet, record keeping in dairy herds is not common enough to make mass selection possible.

The control of disease in dairy herds is one of the problems of management. In the United States, federal and state funds have provided funds for payment of farmers for animals known to be tubercular. As a result of an intensive campaign in all of the states, this disease has been practically eliminated. A similar campaign is about to be launched to combat Bang's disease.

Mastitis, or garget, is another disease that is troubling dairy farmers.

A typical daily ration for a 1,000-lb. dairy cow giving 25 lb. of 5% milk would be 10 lb. alfalfa hay, 30 lb. of corn silage, and 6–8 lb. of a mixture of farm-grown grains.

As the cow's production is decreased the grain may be eliminated until at 12 lb. of milk daily the hay and silage will be sufficient.

The Utilization of Milk.—In the United States in 1940, the entire volume of milk produced was used as follows: factory dairy products 48.6%; fluid consumption 30.9%; other uses on the farm 13.2%; farm butter 7.3%. The use of milk for factory dairy products was as follows: creamery butter 66.2%; cheese 13.4%; evaporated and condensed 10.2%; ice cream 6.9%; minor uses 3.3%.

The utilization of milk in the United States was changed by World War II demands of the armed services, lend-lease and the civilian population. In 1943, the United States produced 118,000,000,000 pounds of milk. This was an increase of 14,000,000,000 pounds of milk above the average annual production for the ten years prior to 1940. In spite of this increase, rationing and other regulations were necessary to assist in making a fair allocation of the supply of dairy products. The increased buying power of the civilian population and wartime restrictions on foods caused an increase in fluid milk consumption. The production of concentrated milks and cheese was increased and butter production reduced. Dried skim milk, currently called "nonfat dry milk solids," was in great demand for human food with a corresponding reduction in its use for animals. The same can be said for dried buttermilk. The facilities for producing dried whole milk, dried skim milk, and dried buttermilk were greatly expanded in the butter producing sections of the United States.

To stress the wholesomeness of dairy products it has been necessary to carefully regulate the conditions under which milk and dairy products are produced. Two important factors in the production of high quality dairy products are (1) to produce them under clean conditions and (2) hold in clean cold rooms.

Dairy products are generally sold on the wholesale market on the basis of a score that will give the trade a guide as to quality. In the case of butter the score is determined by flavour, body and texture, colour and package.

Milk is now commonly sold on grade. The grade is determined by the requirements met as indicated by its bacterial content and delivery temperature and the farm conditions where the milk originated. In the sale of milk, rapid strides have been made in the United States in uniform laws and regulations covering the production, processing, and distribution of milk. The United States public health code is used as a guide. More than half of the cities over 100,000 in population have between 90 and 100% of the milk pasteurized. In some cities all milk is required to be pasteurized except certified or grade A milk. Pasteurized milk as defined on most markets is milk that has been heated to 143° F. and held at this temperature for 30 minutes and then cooled, or milk that has been heated to 160° F. for 15 seconds and then cooled. These are the minimum temperatures required to kill disease-producing bacteria.

Certified milk is milk produced and handled under conditions specified by the American Association of Medical Milk Commissions. This is the highest quality of raw milk offered for sale. In 1937 the pasteurization of certified milk was approved. The high price of certified milk and the abundance of high quality grade A raw and grade A pasteurized milk at a much lower price has minimized the importance of certified milk. Grade A raw milk, as defined on most markets, complies with most of the requirements of certified milk but some of the more elaborate requirements have been eliminated to reduce the price to somewhat near the regular market milk. Usually the market requires grade A raw milk to contain less than 50,000 bacteria per c.c. Grade A pasteurized milk has about the same requirements as grade A raw except that after pasteurization it must have a bacterial content of less than 30,000 per c.c.

Other market grades are used, but they are so variable that they cannot be discussed here. A few definitions of different kinds of milk as given in the U.S. public health code follow:

Milk.—Milk is hereby defined to be the lacteal secretion obtained by the complete milking of one or more healthy cows, excluding that obtained within 15 days before and 5 days after calving, or such longer period as may be necessary to render the milk practically colostrum free; which contains not less than 8% of milk solids not fat, and not less than 3¼% of milk fat.

Cream and sour cream.—Cream is a portion of milk which contains not less than 18% milk fat. Sour cream is cream the acidity of which is more than 0.20%, expressed as lactic acid.

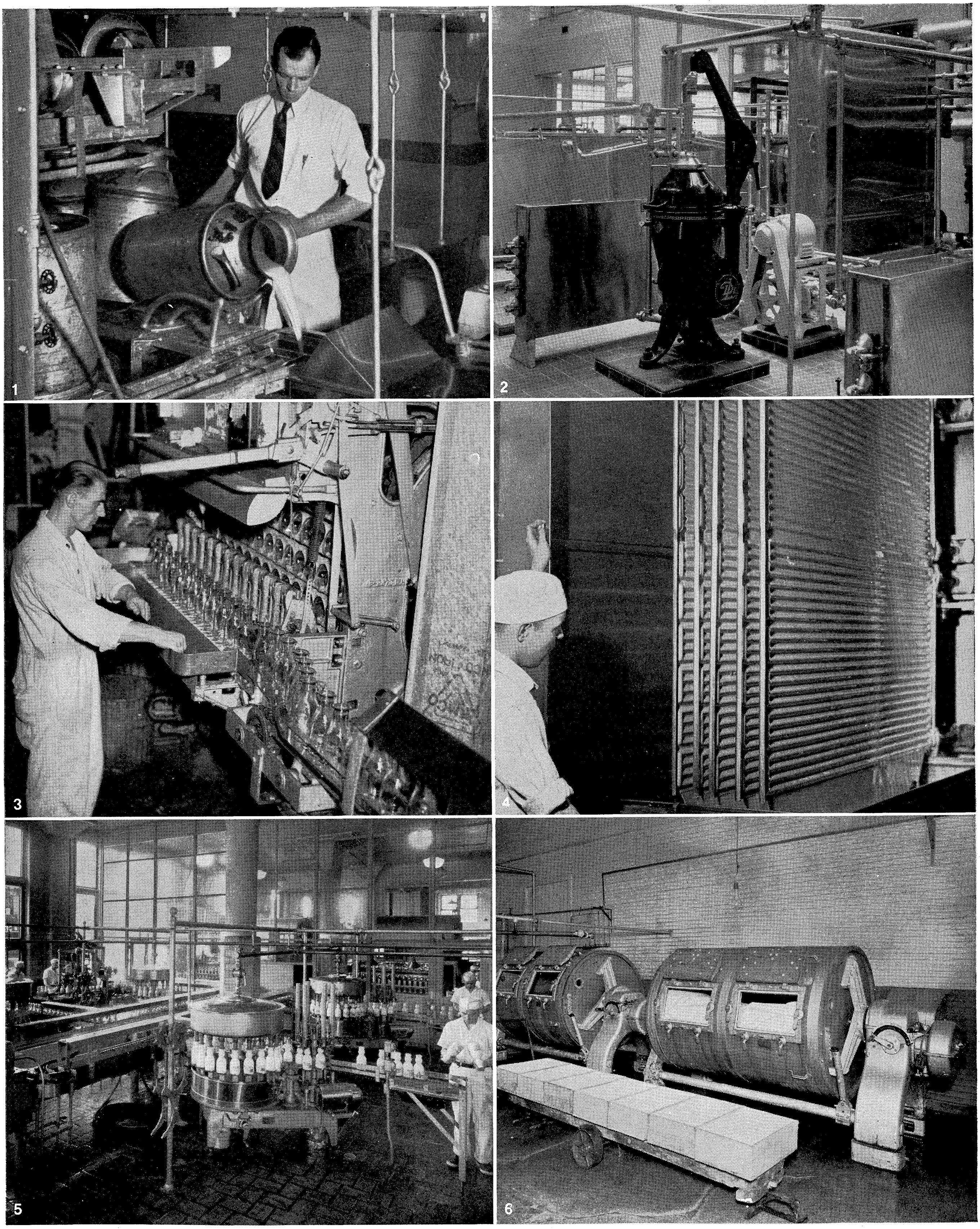
Skimmed milk.—Skimmed milk is milk from which a sufficient portion of milk fat has been removed to reduce its milk-fat percentage to less than 3¼%.

Buttermilk.—Buttermilk is a product resulting from the churning of milk or cream, or from the souring or treatment by a lactic acid or other culture of milk, skimmed milk, reconstituted skimmed milk, evaporated or condensed milk or skimmed milk, or milk or skimmed-milk powder. It contains not less than 8% of milk solids not fat.

Homogenized milk.—Homogenized milk is milk which has been treated in such manner that after a storage period of 48 hours tests of the 100-cc. portion decanted from the top of a quart bottle of milk will not show a difference in fat content over tests of the remainder of the milk after thorough mixing exceeding 5% of the total fat content. For example, on 4% milk the difference shall not exceed 0.2%. In homogenized milk the globules of butterfat are more finely dispersed than in normal milk. This condition is brought about by forcing the milk under high pressure through a specially designed homogenizer valve.

Vitamin D milk is milk in which the vitamin D content has been increased. Three methods are commonly used: (1) by direct irradiation of the milk, (2) by feeding irradiated yeast to the cows, (3) by the addition of vitamin D concentrates. The amount desired is 400 U.S.P. units of vitamin D per quart of milk.

Colostrum milk is the milk secreted by a cow during the first three or four days after calving. It is especially designed for the use of the



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PREPARATION OF DAIRY PRODUCTS FOR MARKET

1. Receiving and weighing milk from dairy farms
2. Power-driven separators which separate milk and cream
3. Milk bottles are washed and sterilized mechanically. An employee inspects the bottles for flaws and cracks as they pass along conveyors
4. After pasteurizing, the milk flows over a cooler (shown with sides open) and is cooled rapidly to 40° F. or lower
5. Filling and capping machines which automatically fill any size milk bottle without spilling a drop and place the sealing cap or cover on each bottle
6. Combined churns and butterworkers which deliver 1,000 lb. of butter with each churning

young calf. It is high in vitamin A and contains more than twice the amount of total solids found in whole milk. This difference is due in a large part to the increased amount of globulin in the colostrum milk.

In recent years the dairy breed associations have exploited the milk from their cattle. For example, we have the following trade-marked breed milks: (1) Golden Guernsey milk produced from herds of which at least one-half are pure bred Guernsey cattle and which meets the local requirements for raw milk; (2) Jersey Creamline milk produced by pure bred Jersey cattle and which also meets the local ordinance for raw milk; (3) Ayrshire Health milk produced by pure bred Ayrshire cattle and which also meets the local requirements.

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DAIRY MACHINERY AND EQUIPMENT. The development of modern dairy machinery has been influenced by several factors, a few of which are: (1) expansion in the use of dairy products and dairy by-products; (2) the urge to save labour; (3) development of large volume production and distribution agencies; (4) greater use of pasteurization; (5) use of stainless steel; (6) the development of larger dairy farm units; (7) greater use of the milking machine on the farm; (8) changes in transportation resulting from better roads and the use of trucks.

The above factors have influenced the extent and use of dairy machinery in all countries of the world where dairying is a major enterprise. The greatest changes, however, have taken place in the United States where the industry is relatively new.

Milking Machines.—The shortage and the high price of desirable labour for milking cows has extended the use of milking machines. It is difficult to estimate the proportion of cows milked by machine but estimates from men selling milking machines in the United States varied from 25 to 30% in 1944.

The milking machine has been developed to imitate the suction of the calf on the cow's teat. There have been many refinements in the machines that have not only made them more efficient, but more easily cleaned and more durable. When properly operated a milking machine will milk as efficiently as the average hand milker.

The cows are usually stripped by hand after the machine is removed, but many milkers strip with the machine.

The usual type of milking machine has a central suction pump and the vacuum line is piped throughout the barn where the cows are housed. The milker unit may be attached any place in the suction line. The milking unit consists of a metal bucket with the pulsator on the cover. A rubber tube runs from the pulsator to the suction line. Another tube runs from the pulsator to the cow's udder where it ends in four teat cups. The suction is applied, then released.

The rapidity of the pulsation is controlled by the operator. Portable suction pumps using electric motors or small gasoline engines have been developed which are pushed through the barn and become a part of the milker unit.

This type of milker reduces the cost of installation by eliminating the suction line.

The success of the milking machine on a dairy farm depends to a great extent on the ability of the operator to adjust the machine to the individual cow so that she will give her maximum production and at the same time save enough time and labour with the machine to justify the expense of the machine.

Milk Coolers.—When milk comes from the cow it is about 100° F. It is important that this milk be cooled immediately to a point below that at which bacteria grow rapidly. It is desirable to cool to 50° F. as soon as possible. On the dairy farm this is usually accomplished by allowing the milk to run in a thin film over a cooled metal surface where it is cooled and aerated. Most coolers consist of a series of tubes through which cold water is passing. In some cases the milk may first contact water-cooled tubes and in the lower half tubes cooled with brine. The thin film of milk may also cause undesirable odours to pass out of the milk.

When the milk is held on the farm before delivery, it is placed in 8- or 10-gallon cans and put into a tank of water with some provision for holding the temperature at a desirable level. When the milk is separated at the farm it is best to separate it soon after milking and without cooling.

Milk is skimmed more efficiently by a centrifugal separator at about 90° F., and the skim milk at this temperature is about right for feeding calves.

The Cream Separator.—The centrifugal separator has replaced the gravity systems of separation of cream from the rest of the milk. The separation of milk by centrifugal force is based on the fact that the butterfat in milk is in the form of small globules which are lighter than the rest of the milk. The specific gravity of milk is 1.032 and of butterfat is .93 at 60° F. (15.5° C.). In the early development of the separator the cost of separators was high, and as a result whole milk was hauled to skimming stations or to creameries where it was skimmed and each farmer was given a proportionate amount of skimmed milk. In 1890 the hand separator was put on the market. This changed the type of creameries from whole milk to gathered cream creameries, reduced the hauling of milk and made skimmed milk more easily available. In all parts of the world the separator is an essential item of equipment where cream is sold. Even on the farms where whole milk is sold it is necessary to separate some milk for raising calves.

The essential feature of the centrifugal cream separator is a rapidly revolving bowl which contains a series of discs. The bowl is mounted on a spindle under a supply can holding the milk. Openings at different locations at the top of the bowl permit the milk to enter, and the cream to come out one outlet and the skimmed milk another in a continuous flow. The bowl of a hand separator revolves between 6,000–8,000 r.p.m. The discs divide the milk into thin layers, and the centrifugal force developed in the rapidly revolving bowl causes the heavier part of the milk to be forced to the outside of the bowl and out of the skim milk outlet. The butterfat, being lighter than the rest of the milk, comes to the centre and is moved out of the cream outlet. The richness of the cream may be regulated by the position of the cream outlet. As previously stated, cream testing 30–35% butterfat is desirable. When properly handled, the skimmed milk should not contain more than .1% butterfat.

The Milk Clarifier.—It is common knowledge to users of the centrifugal separator that the inside of the bowl frequently gathers foreign particles from the milk. This fact formed the basis for the construction of the centrifugal clarifier, for removing foreign material from market milk. The clarifier resembles the separator with the exception that the bowl is constructed so there will be no separation in the milk and there is more room between the discs and the inside of the bowl. The milk flows through the rapidly revolving bowl and out a single outlet.

Pasteurizers are used in milk plants or creameries where large volumes of milk and cream are pasteurized for market milk or for some operation in processing milk or cream. The type of pasteurizer and cooling equipment will depend upon whether the holding method (143° for 30 min.) or the flash method (160° for 15 sec.) of pasteurization is used. A commonly used pasteurizer is a rectangular insulated vat made of stainless steel with a tight cover of the same material. Some device for slow agitation is mounted in the vat. The vat is equipped so that hot water may be applied to heat the milk to the proper temperature. After this, water or brine may be turned into the vat for cooling, or the warm milk may be pumped over a tubular cooler. A recording thermometer may record the temperature cycle. In the case of high temperature pasteurization, special machinery is necessary to apply heat at a higher temperature for a short period.

Bottle Fillers.—The bottling of milk may be the final plant operation in a system of pasteurization of milk where the warm milk flows over a tubular cooler into an automatic bottle filler and capper. The inspected bottles are fed onto a revolving table where the bottles are filled and capped at the end of the revolution. The capping of bottles by hand is a source of contamination prohibited on most markets. In addition to the usual paraffined cap some grades of milk require a paper or metal cover to protect the top of the bottle. In this event this is made another operation of the machine. Hand operated filling and capping machines are available for small dairies. In 1943 many milk distributors were using single service paper bottles.

Creamery Machines.—Shortly after the adoption of the hand separator the butter factory in the United States changed from receiving whole milk to handling cream for churning. Creameries were built to handle cream from farmers who delivered their own cream in an area having 1,000 or more cows. Now automobiles and all-weather roads have extended the area available to any one creamery. In the state of Minnesota in 1943 there were 778 creameries. Of this number 601 were co-operative creameries.

For each 100 lb. of 35% cream delivered to a creamery there are approximately 57 lb. of buttermilk that is sold to nearby farmers for feeding to animals or may be trucked to a central drying plant.

Dried buttermilk or partially dried buttermilk, known as semisolid buttermilk, may be used for feeding animals. Dried buttermilk, meeting specified sanitary requirements, is used for human food when milk solids are scarce. In many plants the drying equipment is used for producing both dried buttermilk and dried skimmed milk.

The churning of cream into butter depends on the fact that the butterfat in cream is in the form of small globules. At the proper temperature (around 50° F.) and with sufficient agitation, the butter will gather together in the form of granules and separate from the buttermilk. When the butter particles reach the size of a kernel of corn, the buttermilk can be drawn off without an appreciable loss of butterfat. The butter is then washed with water of about the same temperature as the buttermilk. After the wash water is removed, salt may be added if desired and the butter worked. During working, the butter is kneaded into a compact mass, the salt incorporated and the moisture content standardized. In the United States, butter must contain 80% of butterfat by weight.

In a creamery the cream is churned in a barrel-like combined churn and worker that will handle approximately 1,000 lb. of finished butter. The churn is commonly made of wood and is mounted so that it will revolve.

The butter is washed, salted and worked in the churn, and is ready for packing into tubs or for printing when taken from the churn. The upright dasher churns so common on farms in the past have been eliminated in favour of some kind of revolving barrel churn.

The making of butter on the farm is gradually being eliminated due to the ease of trading butter fat for butter at the dairy plant and for the reason that farm-made butter is generally inferior in quality to creamery butter.

Cheesemaking.—In the making of cheddar cheese, whole milk is coagulated with rennet. The liquid portion or whey is removed and the curd is heated and allowed to drain. The curd is then cut, salted and packed in cloth-lined hoops, and placed in a press for about 24 hours to mould the cheese into the desired shape. The cheese is then moved to a curing room where a desirable temperature for curing may be maintained. This may vary from 40° F. to 60° F. The length of time and temperature determine the ripeness of the cheese. Usually 6–8 months are required to insure satisfactory ripening. The equipment for cheesemaking is more simple than that required for other dairy products. Rectangular vats for holding the milk, presses and a curing room are the most essential items. The development of process cheese has stimulated the cheese industry in the United States. In making process cheese the rind is removed and the cheese is ground, heated and packaged when hot. Cheese of various ages and types are blended to secure the desired flavour and body. In the United States a large amount of cheddar cheese is made from pasteurized milk.

Ice Cream Making.—Ice cream has changed from a luxury to a delicious food product universally used. Centralized methods of manufacture and distribution have extended the use of ice cream at a price within the reach of all. The tub freezer requiring ice has been replaced by the continuous freezer made of stainless steel and using brine or ammonia as a refrigerant. The ice cream mix is partially frozen and whipped in the freezer and then placed in a low temperature room (below −10° F.) to harden. The very general adoption of electrical refrigerators in the home has made it possible to carry a supply of ice cream in the home. Refrigerated trucks and the use of dry ice have facilitated the distribution of ice cream.

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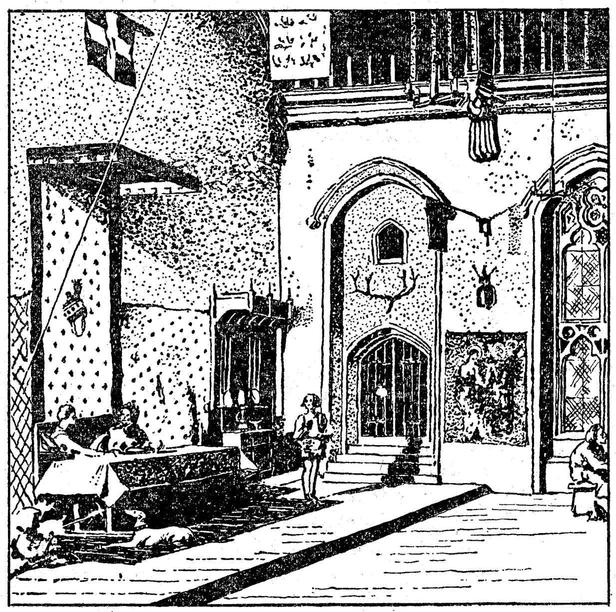
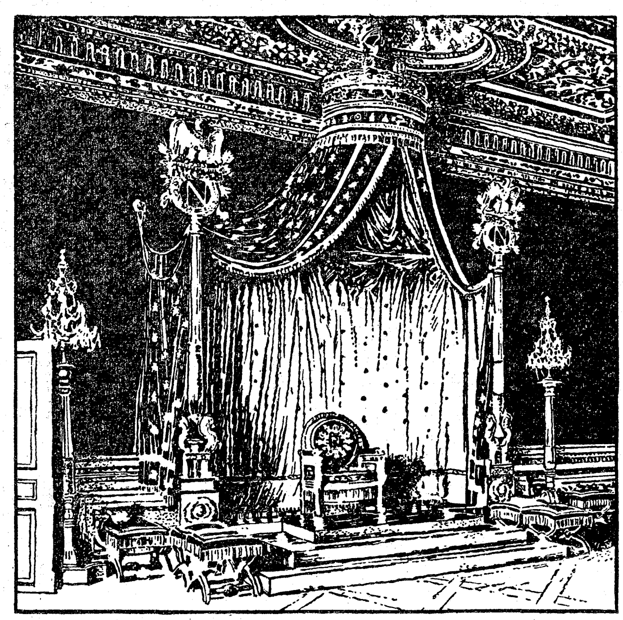
DAIS, originally the raised part of the floor at the end of a mediaeval hall. On this the lord of the mansion dined with his



English Gothic, 14th Century



French Empire, Early 19th Century
Napoleon's Throne Room
Fontainebleau Chateau

Top: after a model by Dwight Franklin, in the Metropolitan Museum of a Mediaeval Hall, England friends at the high table, apart from the retainers and servants. There was generally a deep-recessed bay window at one or at each end of the dais to give greater privacy than the open hall could afford. In France the word is understood as a canopy or hanging over a seat, probably from the fact that the seats of great men were often surmounted by such a feature. In ordinary usage the term means any raised platform in a room, for ceremonial use (*see* CANOPY).

DAISY, the name applied to many plants with showy rays, and in England practically restricted to the genus *Bellis,* of the family Compositae. The word is derived from the Anglo-Saxon and means day's eye. The genus contains ten species found in Europe and the Mediterranean region. The common daisy, *B. perennis,* is the only representative of the genus in the British Isles. It is a perennial, abundant everywhere in pastures, lawns and on banks in Europe, except in the most northerly regions and in Asia Minor, and occurs sparingly as an introduced plant in North America where it is always called English daisy or bachelor's-button. The stem is short; the leaves, which are numerous and form a rosette, are slightly hairy, obovate-spatulate in shape, with rounded teeth on the margin in the upper part; and the rootstock is creeping and of a brownish colour. The flowers are to be found from March to November, and occasionally in the winter months. The heads of flowers are solitary, the outer or ray florets pink or white, the disk florets bright yellow. The size and luxuriance of the plant are much affected by the nature of the soil in which it grows. The cultivated varieties bear finely-coloured flowers, and make very effective borders for walks. What is known as the "hen-and-chicken" daisy has the main head surrounded by a brood of sometimes as many as ten or twelve small heads, *i.e.,* proliferous. The ray florets curve inwards and "close" the flower head in dull weather and towards evening.

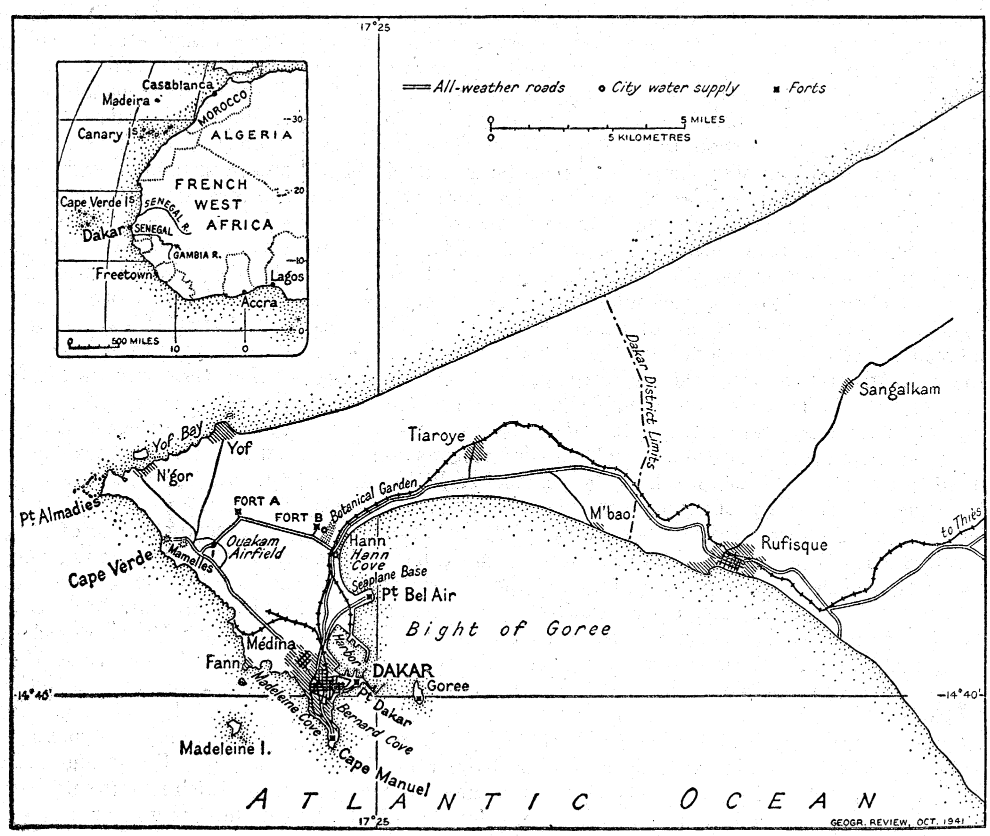
In French the daisy is termed *la marguerite,* and "herb margaret" is stated to be an old English appellation for it. In Scotland it is popularly called the gowan, and in Yorkshire it is the bairnwort, or flower beloved by children.

The Christmas and Michaelmas daisies are species of *Aster;* the ox-eye daisy is *Chrysanthemum leucanthemum,* a common weed. *B. perennis floreplenо,* the double daisy, consists of dwarf, showy, 3 to 4 in. plants, flowering freely in spring if grown in rich light soil.

DAKAR, capital of French West Africa (*q.v.*), chief seaport of Senegal (*q.v.*), port of call for ships and aeroplanes, and a fortified naval and air base. It stands on Cape Verde peninsula, westernmost extension of the African continent (*see* map). Being in the part of the old world nearest to South America, it became and remains the eastern terminus of the first transatlantic air route. Not far offshore lies the fork in the ocean routes connecting Europe with Brazil-Argentina, and with Africa and the Indian ocean. The peninsula includes the bit of coast most readily improved with large-scale harbour works anywhere in West Africa. It lies between the Senegal and the Gambia, the two rivers by way of which the western Sudan was opened to European occupation, and was made the ocean terminal of the railroads which have inherited most of the river-borne trade. Fanned by ocean breezes, it is the most comfortable spot on the coast of French West Africa, and almost the nearest to Europe of suitable sites for a large city; France chose it for the colonial capital. Its bold cliffs warranted fortification and gave it the sobriquet "The African Gibraltar."

In appearance and character Dakar is more like a European city than any other in West Africa, and its European population is the largest—*c.* 10,000 of the total 92,634 in 1936, and perhaps 15,000 of more than 100,000 during World War II. Seasonal migration of both Europeans and Africans swells these figures during the dry season. In spite of its natural advantages and their ultimate fulfillment, the only settlements on the peninsula were native villages subsisting meagerly on sandy soil and seafish, until after French conquest of the western Sudan made the mainland safe for permanent European settlement. In 1857 the French government took possession and built a fort on Dakar point, thereby safeguarding the interests of merchants who had been settling there for 20 years and of residents of the nearby island of Goree, who had depended upon the mainland for water, firewood and some of their food. By 1862 a short breakwater had been built in the lee of the point and a town laid out on the low limestone platform behind the curve of sandy beach. Another generation elapsed, however, before Dakar established its supremacy over rival Cape Verde settlements.

Predecessors and Rivals.—The earliest European foothold in the vicinity was Goree, on a waterless island in the lee of the peninsula. Protected from depredations of the indigenes by $1\frac{1}{4}$ mi. of water and favoured with a tiny natural harbour, Goree had been occupied by the Dutch in 1588. It was seized by the French in 1677 and thenceforth held by them except for four terms of British military occupation, three of them during the 18th century struggle for colonial supremacy. Until the abolition of slavery in 1848, its chief activity was the slave trade, but it also housed all the other establishments doing business on the Petite Côte, the low-lying coast threaded with broad estuaries and short streams that lies between Cape Verde and the Gambia river. At times it administered the Petite Côte, and from 1903–08 it



COURTESY OF THE GEOGRAPHICAL REVIEW

THE CAPE VERDE PENINSULA: SCALE APPROXIMATELY 1:300,000. BASED ON THE 1:100,000 MAP OF THE SERVICE GÉOGRAPHIQUE DE L'AFRIQUE OCCIDENTALE FRANÇAISE À DAKAR, 1928.

was the temporary residence of the governor-general of French West Africa. Removal of the government to the peninsula had been preceded by departure of the business houses, and left only a garrison and a few minor government departments. After having been a commune since 1872, Goree was absorbed by Dakar in 1929. Its significance, apart from its historic role, is conversion of the island into a modern fort during World War II. For this purpose its cliffed southern half, facing the seaward approach to Dakar, is eminently suited.

Dakar's rise was further retarded by the commercial rivalry of Rufisque, 13 mi. along the coast of the peninsula and only 6 mi. from the African mainland. The Portuguese had discovered its stream of fresh water in the 15th century, naming it Rio Fresco. In 1849 the first African-grown groundnuts (peanuts) were shipped from this neighbourhood, and the place became a lighterage port with piers projecting beyond the surf. Peanuts spread inland and soon became the chief export business of West Africa. Commercial houses deserted Goree for Rufisque, which monopolized the peanut trade and was made a commune in 1880. Its decline began when, in 1885, Dakar's superior harbour was connected with the Senegal river. A score of years later, further improvements in Dakar's port facilities withdrew more traffic and started a transfer of business houses from Rufisque. After 1923, when railroad extensions through the heart of the peanut country tapped the upper Niger basin, Rufisque became moribund. Ports of the more distant Petite Côte, however, have prospered on increased groundnut shipments. Among them, Kaolack (pop. [1936] 40,000, 650 being Europeans) is the second city in French West Africa.

The Port.—Until about 1900, Dakar's chief function was to serve as a port of call for ocean shipping otherwise unconnected with West Africa. The first jetty adequate to protect the anchorage from the surf and to withstand the tempests of the rainy seasons was finished in 1866. Thenceforth the Messageries Maritimes used Dakar as port of call for its liners instead of St. Vincent on the Cape Verde Islands. Between 1898 and 1912 this jetty was extended to 2,740 ft. Beyond an entrance 820 ft. wide a new breakwater was built to the opposite shore of the bay, the shoreward half being awash. The harbour so formed comprises 555 ac. In addition to lighterage, two piers with warehouses were built to accommodate commercial shipping. The naval installations consisted of a marine arsenal and repair yard, a drydock serving ships up to 10,000 tons, and a basin for destroyers. Further improvements were begun in the 1930s, and amplified in the early years of World War II. Both jetties were widened to serve as quays, and four or five new commercial piers were built. Just within the harbour entrance an anchorage has been dredged to 33 ft. to accommodate warships and other vessels refueling with petroleum. A coaling pier is adjacent. A 28-foot channel runs to the navy yard. Depth of water along some of the commercial wharfs is 23 ft., alongside others 28 ft. Spur tracks from the railroad terminal serve the entire quayage. A new jetty was built outside the harbour from Point Dakar toward Goree, forming an outer road and further protecting the entrance to the harbour. From it a boom to ward off submarines was run eastward to Goree, and thence north to the peninsula a little west of Rufisque. For further protection paired batteries of 240-mm. guns were emplaced on the highest surroundings of the city: Goree, a basalt cliff 145 ft. high; Cape Manuel, another, 130 ft. high, which forms the south tip of the peninsula; and the Cape Verde hill itself, 345 ft. high. All round the headland are lesser batteries (5 of 155 mm. and 9 of 75 mm.), those on the low north shore being mobile units. An aerodrome, a seaplane airport, and radio sending stations complete the fortification of the "African Gibraltar."

Ships of nearly all lines trading to West Africa call at Dakar, as do also many in the South African and South American trade. The port handles 75–80% of the total overseas trade of Senegal and French Sudan, except the export of groundnuts, which it shares with river ports of the Petite Côte. By volume of traffic it ranks next after Havre and Marseilles in the entire French empire but most of this is accounted for by groundnut exports and the importation of coal and petroleum, used mainly for servicing passing ships. Import commodities absorbed by Africa fall far short of exports in value, and still farther in tonnage.

The Town.—The business centre of the city stands some 25 ft. above the harbour, on gently undulating ground. Southward the land rises in a long slope and the cape narrows. There stand most of the government offices, including the governor's palace, most conspicuous structure in town, on a bluff 100 ft. above the Bight of Goree. The spacious official section and the associated European residential quarter are laid out to take advantage of whatever breeze may blow. Nearby is the imposing domed Roman Catholic cathedral. Some 20,000 Africans live scattered about the city, but more than half the total population of Dakar now dwells in the suburb Médina, regularly laid out as an African settlement on flat land northwest of the business centre.

Between the harbour and Médina, business houses run by, and catering to, Europeans give way to a quarter in which business catering to Africans is in the hands of "Syrians" from North Africa and the Levant. In Médina itself Africans chaffer in open-air markets. Manufacturing, other than repairing, is confined to making perishable goods sold locally, except for an oil and soap factory and the naval base. Handicrafts are more wide-spread—chiefly garment making with the aid of foot-power sewing machines, cabinet work, and jewellery. In the country, beyond Médina, most of the arable land is devoted to market gardens. Ancient fishing villages on the Atlantic coast send their catch to the new metropolis.

Services.—Safeguards to public health are paramount in the layout and operation of the city. Potable water is brought from several groups of sanddunes as far as 12 mi. from town. Seawater is used to flush the streets frequently, to keep them clean and also free from the larvae of mosquitoes. Public shower baths and latrines are distributed through the city. Marshes have been drained, so as to reduce the number of mosquitoes, to a line 12 mi. out.

The medical centre is the largest in middle Africa. It includes hospitals for Europeans and Africans, an out-patient clinic for Africans, and a school granting certificates for assistants in the medical service of the colony. Other advanced schools: administration and teaching (especially for urban teachers); marine engineering (for naval service); a secondary school granting a certificate equivalent to the *baccalauréat* of France.

Besides shipping lines Dakar is linked to Paris, Natal (Brazil) and Khartoum (Anglo-Egyptian Sudan) by air routes. Cables run to Brest, Pernambuco (Brazil) and the other French African colonies. Besides railroads, dry-season motor roads ramify throughout Senegal and connect Dakar with all the eight subcolonies which it governs. Telegraph lines reach every centre of French West Africa.

Political Status.—In 1887 Dakar was made one of three communes in French Africa south of the Sahara. All persons born within the commune before 1906 and their descendants are French citizens. Other adult Africans may become citizens under specified conditions that prove adherence to the European manner of life. Adult male citizens elect a commune council in which Africans form the majority, but which has limited functions (as is also the case in France). Citizens may vote for a member of the French chamber of deputies, elected jointly by the three communes. After 1932 this body of citizens lived under a special civil code and was exempt from French laws that apply only to natives. Citizens who are Moslems are also subject to local Moslem law.

In 1902 Dakar was designated capital of the seven-year-old colony of French West Africa, in succession to Saint-Louis (*q.v.*). Offices were removed thither or to Goree shortly thereafter, and by 1908 the entire government was housed on the peninsula, largely in buildings constructed for the purpose.

In 1924 Dakar and neighbouring villages, including the area from which it draws its water supply, were withdrawn from Senegal, and set up as a district (*Circonscription*) administered by a governor. The boundary crosses the peninsula a little west of Rufisque. The functions of the government-general of West Africa which are located at Dakar include all the usual executive offices, the high court of appeal, and the African headquarters of the Bank of French West Africa, which issues banknotes. The city is the seat of a Roman Catholic bishop. Because of undeniable natural advantages, the natural handicaps of Dakar have been reduced or converted into assets. After World War I it was one of the key points in the French empire. World War II made evident its significance as a major world focus.

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DAKIN'S SOLUTION or **CARREL-DAKIN SOLUTION** is an antiseptic containing free chlorine and designed for the treatment of infected wounds. First used during World War I, it was the product of long study by Henry Drysdale Dakin and Alexis Carrel in search of the ideal wound antiseptic. The stronger germicidal solutions, such as carbolic acid and iodine, damage living cells, or lose their potency in the presence of blood serum. Dakin's solution avoids both these defects and in addition has a solvent action on dead tissue which hastens its separation from living tissue. By combination between the slowly liberated chlorine and the tissue proteins, Dakin believes that a chloramine is formed, to which is due the extraordinary antiseptic power exhibited by Dakin's solution *in vivo*. The solution now commonly used is a modification proposed by Dufresne and embodied in the U.S. Pharmacopoeia as *Liquor Sodae Chlorinatae Chirurgicalis*. It is prepared from bleaching powder and the carbonate and bicarbonate of soda, and must contain 0.45 to 0.50% of sodium hypochlorite and no free alkali. It is unstable and will not keep more than a few days. The Carrel-Dakin treatment consists in flooding the entire wound surface every two hours, by means of small tubes connected with a reservoir. Used in this way, Dakin's solution is the best preparation now known for controlling infection in wounds and abscess cavities.

DAKOTA, a tribe, or confederated aggregation of tribes, of Siouan family in the northern plains of the United States. The name, now applied to two States, means "allies"; the popular designation is Sioux, abbreviated from Nadowessioux, from Ojibwa via French. As the largest group in the Siouan family, the Dakota have given their name to this. They number in the aggregate some 25,000, not much less than at first white contact, probably. There are three main divisions: Santee, Yankton, Teton, calling themselves respectively Dakota, Nakota and Lakota. The Santee comprise the Mdewakanton, Wahpeton, Wahpekute, Sisseton; the Yankton includes the Yankton and the Yanktonai. This makes seven divisions, recognized by the Dakota themselves as "seven council fires"; but the Teton outnumber the other six combined.

First encountered by the whites in Minnesota, the Dakota have drifted westward, under pressure first from the Ojibwa, who were early armed with French guns, and later from the whites. During the latter half of the 18th century the Teton established themselves west of the Missouri river. They are now on ten reservations in several States. The Dakota have always been a spirited, brave, somewhat turbulent people, upstanding and outright in character. Tall in stature and picturesque in costume, they have in recent generations impressed civilized imagination perhaps more than any other American tribe. All the Teton and part of the other divisions adhered to the plains Indian type of life: buffalo hunting, tepee dwelling, nomadic, non-agricultural, raiding, and proud of their war exploits. Their greatest ceremony was the so-called sun dance. (A. L. K.)

DALADIER, EDOUARD (1884–), French politician, who was a school teacher in early life, was elected Radical-Socialist deputy for Vaucluse in 1919. After holding several cabinet posts, he became premier in 1933; he also headed the short-lived government that was toppled by the Stavisky scandal in 1934.

Daladier became premier again in 1938, and in September of that year he returned from Munich with high hopes for peace. But a year later, Hitler invaded Poland and destroyed his illusions. After declaring war on Germany, Daladier formed a war cabinet Sept. 13, 1939; but his vacillating policy led to his downfall March 20, 1940. He was minister of defense and war in the Reynaud cabinet but was dropped June 6. Daladier was arrested Nov. 17, 1940, stood trial at the Riom war-guilt hearings Feb. 1942, and together with Leon Blum, led a vigorous attack on the Pétain regime. After the trials were suspended April 1942, Daladier was placed under house arrest.

DALAGUETE, a municipality (with administrative centre and 23 *barrios* or districts) of the province and island of Cebu, Philippine islands, at the mouth of the Tapón river on the east coast, 50 mi. S.S.W. of Cebu, the provincial capital. Pop. (1939) 27,284, of whom only one was white. The climate is healthy, the coolest months being those of November to February, inclusive. Abacá, corn, coffee, sibucao, cacao, coco-nuts and sugar are the principal agricultural products. Manufactures include rough fabrics, clay pots and jars, salt, soap and tuba wine. Fisheries afford a leading source of livelihood for the inhabitants, of whom 20.8% of those aged 6 to 19, inclusive, were reported in school and 31.9% of those ten years old and over were reported literate. The vernacular is Cebuano.

DALBEATTIE, a small burgh, Kirkcudbrightshire, Scotland. Pop. (est. 1938) 3,160. It lies on Dalbeattie burn, 14½ mi. S.W. of Dumfries by the L.M.S.R. The town dates from 1780 and owes its rise to the granite quarries at Craignair and elsewhere in the vicinity, from which was derived stone used for the Thames embankment, docks at Odessa and Liverpool and other works. Besides quarrying, the industries include concrete (crushed granite) works, paper, bobbin, corn and timber mills, brickmaking and glove manufacture. The estuary of the Urr, known as Rough firth, is navigable by ships of 150 tons, and small vessels can ascend as far as the mouth of Dalbeattie burn, within a mile of the town. The Mote of Urr, 3 mi. N., is the most notable Anglo-Norman earthwork in Scotland. It is on a natural circular hillock, cone-shaped, with an encircling trench and is situated at one end of a base court, or bailey. It was once a river island.

DALBERG, the name of an ancient and distinguished German noble family, derived from the hamlet and castle (now in ruins) of Dalberg or Dalburg near Kreuznach. In the 14th century, the original house of Dalberg became extinct in the male line, the fiefs passing to Johann Gerhard, chamberlain of the see of Worms, who married the heiress of his cousin, Anton of Dalberg, about 1330. His own family was of great antiquity, his ancestors having been hereditary ministerials of the bishop of Worms since the time of Ekbert the chamberlain, who founded in 1119 the Augustinian monastery of Frankenthal and died in 1132. By the close of the 15th century the Dalberg family had grown to be of such importance that, in 1494, the German King Maximilian I granted them the honour of being the first to receive knighthood at the coronation; this part of the ceremonies being opened by the herald asking in a loud voice "Is no Dalberg present?" (*Ist kein Dalberg da?*). This picturesque privilege the family enjoyed till the end of the Holy Roman Empire. The elder line of the family of Dalberg-Dalberg became extinct in 1848, the younger, that of Dalberg-Herrnsheim, in 1833. The male line of the Dalbergs was then represented only by the family of Hessloch, descended from Gerhard of Dalberg (*c.* 1239), which in 1809 succeeded to the title and estates in Moravia and Bohemia of the extinct counts of Ostein. The following are the most noteworthy of the family:

1. JOHANN VON DALBERG (1445–1503), chamberlain and afterwards bishop of Worms, son of Wolfgang von Dalberg. He studied at Erfurt and in Italy, where he took his degree of doctor *utriusque juris* at Ferrara and devoted himself more especially to the study of Greek. Returning to Germany, he became privy councillor to the elector palatine Philip, whom he assisted in bringing the university of Heidelberg to the height of its fame. He was instrumental in founding the first chair of Greek, which was filled by his friend Rudolph Agricola, and he also established the university library and a college for students of civil law. He was an ardent humanist, was president of the *Sodalitas Celtica* founded by the poet Konrad Celtes (*q.v.*), and corresponded with many of the leading scholars of his day, to whom he showed himself a

veritable Maecenas.

2. Karl Theodor Anton Maria Von Dalberg (1744–1817), archbishop-elector of Mainz, arch-chancellor of the Holy Roman empire, and afterwards primate of the Confederation of the Rhine and grand-duke of Frankfurt. Karl had devoted himself to the study of canon law, and entered the Church. He was made governor of Erfurt (1772), elected coadjutor of Mainz and of Worms (1787) and of Constance (1800); in 1802 he became archbishop-elector of Mainz and arch-chancellor of the empire. Dalberg tried to galvanize the atrophied machinery of the empire into some sort of effective central government of Germany. Failing in this, he turned to the rising star of Napoleon, believing that he had found in him the only force strong enough to save Germany from dissolution. On the dissolution of the empire in 1806 he was appointed by Napoleon prince primate of the Confederation of the Rhine. In 1810, after the peace of Vienna (Schönbrunn), the grand-duchy of Frankfurt was created for his benefit out of his territories, which in spite of the cession of Regensburg to Bavaria were greatly augmented. Dalberg's fortunes fell with those of Napoleon, and, when he died on Feb. 10, 1817, of all his dignities he was in possession only of the archbishopric of Regensburg. He was a notable patron of letters, and was the friend of Goethe, Schiller and Wieland.

See Karl v. Beaulieu-Marconnay, *Karl von Dalberg und seine Zeit* (Weimar, 1879).

3. Wolfgang Heribert Von Dalberg (1750–1806), brother of the above, was intendant of the theatre at Mannheim, and was the first to stage Schiller's earlier dramas. The poet's *Briefe an den Freiherrn von Dalberg* (Karlsruhe, 1819) are addressed to him. He himself wrote several plays, including adaptations of Shakespeare. His brother, Johann Friedrich Hugo von Dalberg (1752–1812), canon of Trier, Worms and Spires, was a composer and writer on musical subjects.

See Alafberg, *Von Dalberg als Bühnenleiter und Dramatiker* (1907).

4. Emmerich Joseph, Duc de Dalberg (1773–1833), son of Baron Wolfgang Heribert, was born at Mainz on May 30, 1773. In 1803 he entered the service of Baden, which he represented as envoy in Paris. After the peace of Schönbrunn (1809) he entered the service of Napoleon, who, in 1810, created him a duke and councillor of state. In 1814 he was a member of the provisional Government by whom the Bourbons were recalled, and he attended the congress of Vienna, with Talleyrand, as minister plenipotentiary. At the second restoration he became a minister of state and a peer of France. In 1816 he was sent as ambassador to Turin. He died at Herrnsheim on April 27, 1833.

The duc de Dalberg had inherited the family property of Herrnsheim from his uncle the arch-chancellor Karl von Dalberg, and this estate passed, through his daughter and heiress, Marie Louise Pelline de Dalberg, by her marriage with Sir R. E. Acton, 7th baronet (who assumed the additional name of Dalberg), to her son the historian, John Emerich Edward Dalberg-Acton (1834–1902), 1st Baron Acton (*q.v.*).

D'ALBERT, EUGEN FRANCIS CHARLES (1864–1932), Anglo-French pianist and composer, was born in Glasgow, April 10, 1864, being the son of Charles Louis Napoleon d'Albert, whose dance music enjoyed great popularity in its day. D'Albert studied at the National Training school, London (later the Royal College of Music), eventually winning the Mendelssohn scholarship and going to Vienna to continue his studies. He succeeded Joachim as director of the Hochschule in Berlin in 1907. As pianist d'Albert excelled in the interpretation of Beethoven; as composer he composed chiefly operas, *Tiefland* being the best known of his many works in this form.

DALE, DAVID (1739–1806), Scottish manufacturer and philanthropist, was born at Stewarton on Jan. 6, 1739, the son of a grocer. He began business by buying up homespun linen and yarn, and then imported French and Dutch yarn. Together with Arkwright in 1785 he opened a cotton mill at New Lanark near the Falls of Clyde, but the partnership was dissolved in the same year. The enterprise, however, was so successful that Dale built a village for the workers. The mill was afterwards sold to a Manchester firm who appointed Robert Owen as manager. About 1770 Dale organized the "Old Independents," a religious community on Congregational lines, of which he was chief minister. He died in Glasgow on March 17, 1806.

DALE, RICHARD (1756–1826), United States naval officer, was born in Norfolk county, Virginia, Nov. 6, 1756, and went to sea at the age of 12. During the early months of the American Revolution, he led a checkered career as a lieutenant in the Virginia provincial navy, a prisoner of war on Governor Dunmore's British fleet in the Chesapeake, and a mate in a Tory brig. The brig was taken by John Barry on July 27, 1776, and that same day Dale entered on board Barry's Continental brig "Lexington" as a master's mate. He served on the "Lexington" under three captains, and went to Mill prison, Plymouth, England, along with the rest of the crew when the brig was taken by the British cutter "Alert" in the English Channel on Sept. 19, 1777. Escaping to France more than a year later, Dale entered on board the "Bon Homme Richard," Captain John Paul Jones commanding, and as first lieutenant of that famous ship distinguished himself at the taking of the "Serapis" off Scarborough in Sept. 1779. He followed Jones's fortunes as first lieutenant on the "Alliance" and the "Ariel," and, in Aug. 1781 was on board the "Trumbull" when that frigate was captured by two British ships. After the war, Dale engaged as a shipmaster in the London and East Indies trades until he was appointed fourth ranking captain in the United States navy in 1794. Later, in a dispute over rank, he secured a leave of absence and went back to the merchant marine. In May 1801 he was recalled to duty and appointed to the command of a squadron of observation sent to the Mediterranean. With limited powers and a small force, Dale maintained a successful blockade of Tripoli, and prevented the piratical depredations of the Barbary powers for a period of six months. He returned to the United States in 1802. That same year he refused to take out a second squadron, when the navy department would not allow him a captain for the frigate "President" upon which he was to hoist his broad pennant, and resigned from the navy on Dec. 17, 1802. Dale lived in retirement in Philadelphia until his death on Feb. 26, 1826.

See "Biographical Memoir of Richard Dale," *The Port Folio* (June 1814); *Quasi-War with France and Barbary War Documents,* 11 vols. (Washington, 1935–42). (W. B. Ck.)

DALE, SIR THOMAS (d. 1619), British naval commander and colonial deputy-governor of Virginia. From about 1588 to 1609 he was in the Netherlands with the English army originally under Robert Dudley, earl of Leicester; in 1606 he was knighted by James I.; from 1611 to 1616 he was actually though not always nominally in chief control of the colony of Virginia either as deputy-governor or as "high marshall," and he is best remembered for the energy and the extreme rigour of his administration there, which established order and in various ways seems to have benefited the colony. Under him began the first real expansion of the colony with the establishment of the settlement of Henrico on and about what was later known as Farrar's Island; about 1614 he took the first step toward abolishing the communal system by the introduction of private holdings, and it was during his administration that the first code of laws of Virginia was effectively tested. This code, entitled "Articles, Lawes, and Orders—Divine, Politique, and Martiall," but popularly known as Dale's Code, was notable for its pitiless severity, and seems to have been prepared in large part by Dale himself. He left Virginia in 1616 and shortly after his return to England was given command of a fleet sent against the Dutch, defeated the enemy near Batavia in the East Indies late in the year 1618, arrived at Masulipatam in July 1619, and died there on Aug. 9, following.

An account of Dale's career in Virginia is given in Alexander Brown's *The First Republic in America* (1898); a scholarly discussion of "Dale's Code" by W. F. Prince may be found in vol. i. of the *Annual Report of the American Historical Association* for 1899 (1900), and the code itself is reprinted in Peter Force's *Historical Tracts,* vol. iii., No. 11.

DALECARLIA (*Dalarne,* "the Dales"), a west midland region of Sweden, extending from the mountains of the Norwegian frontier to within 25 m. of Gefle on the Baltic coast. It is a region of historical associations and local peculiarities. The Dalecarlians have their own dialect and colourful costumes. In 1434, led by Engelbrecht, they rose against the tyranny of Eric XIV. of Denmark, and in 1519–1523 they strongly supported Gustavus Vasa in freeing Sweden from the Danes. The districts around Lakes Runn and Siljan ("the Eye of the Dales"), are consequently classic ground. The people are for the most part small peasant proprietors. They eke out their scanty existence based on agriculture by a variety of home industries, such as making scythes, saws, bells, wooden wares, hair goods, etc. About three-quarters of the whole district is covered with forest. Besides the wealth of the forests, Dalarne contains some of the largest iron mines in Sweden, notably those of Grängesberg. Copper has been mined since the 13th century at Falun (*q.v.*), and other minerals have been found. Much of the area is consequently industrial.

DALÉN, GUSTAF (1869–1937), Swedish inventor, was born at Stenstorp Nov. 30, 1869. After passing his examination as an engineer at Göteborg in 1896 he completed his studies at Zürich. On his return home he invented hot-air turbines, milking and other machines. In 1906 he became chief engineer to the Gas Accumulator Co., which was exploiting in Sweden the French invention of dissolved acetylene. In 1909 he was appointed managing director of this company and then succeeded in composing a product called "Agamassan" which has the property of absorbing acetylene without any danger of explosion. Dalén's cleverest invention was what is called Solventil, which when placed in a fire kindles it automatically when twilight sets in and extinguishes it at daybreak. In 1912 he was awarded the Nobel Prize for physics. During an experiment in 1913 he became blind in consequence of an explosion, but nevertheless he continued to conduct his experiments until his death at Stockholm Dec. 9, 1937.

DALGAIRNS, JOHN DOBREE (1818–1876), English Roman Catholic priest, was born in Guernsey on Oct. 21, 1818, and educated at Exeter college, Oxford. Dalgairns became a Roman Catholic in 1845, and with Newman became a member of the Congregation of the Oratory at Rome. On his return to England in 1848 he was attached to the London Oratory, becoming superior on Fr. Faber's death in Sept. 1863. Dalgairns was a prominent member of the well-known "Metaphysical Society." He died on April 6, 1876. His chief works are *The Devotion to the Sacred Heart of Jesus, with an Introduction on the History of Jansenism* (1853); *The German Mystics of the Fourteenth Century* (1858); *The Holy Communion, its Philosophy, Theology and Practice* (Dublin, 1861).

See J. Gillow's *Bibliog. Dict. of English Catholics.*

DALGARNO, GEORGE (*c.* 1626–1687), British writer, was born at Old Aberdeen. For 30 years a schoolmaster at Oxford and at Elizabeth school, Guernsey, he wrote *Ars Signorum* (1661), an attempt to formulate a philosophical language in which ideas were represented by letters of the alphabet, and *Didascalocophus* (1680), the first explanation of the deaf and dumb alphabet. His chief works were reprinted for the Maitland Club in 1834.

DALHOUSIE, FOX MAULE RAMSAY, 11TH EARL OF (1801–1874), was the eldest son of William Ramsay Maule, 1st Baron Panmure (1771–1852), and a grandson of George, 8th earl of Dalhousie. Born on April 22, 1801, and christened Fox as a compliment to the great Whig, he served for a term in the army, and then in 1835 entered the House of Commons as member for Perthshire. In Lord Melbourne's ministry (1835–41) Maule was under-secretary for home affairs, and under Lord John Russell he was secretary-at-war from July 1846 to Jan. 1852, when for two or three weeks he was president of the board of control. In April 1852 he became the 2nd Baron Panmure, and was secretary of State for war from 1854–58, being at the war office during the concluding period of the Crimean War and having to meet a good deal of criticism, both just and unjust. In Dec. 1860 he succeeded his kinsman, the marquess of Dalhousie, as 11th earl of Dalhousie, and died childless on July 6, 1874. On his death the barony became extinct, but his earldom passed to his cousin, George Ramsay (1806–80), an admiral who, in 1875, was created a peer of the United Kingdom as Baron Ramsay.

See the *Panmure Papers,* a selection from Panmure's correspondence, edited in two vols. (1908), by Sir G. Douglas and Sir G. D. Ramsay. These letters throw much light on the concluding stage of the Crimean War.

DALHOUSIE, JAMES ANDREW BROUN RAMSAY, 1ST MARQUESS and 10TH EARL OF (1812–1860), British statesman and Indian administrator, was born at Dalhousie Castle, Scotland, on April 22, 1812. He was the third son of George Ramsay, 9th earl of Dalhousie (1770–1838), one of Wellington's generals, who, after holding the highest offices in Canada, became commander-in-chief in India. Several years of his early boyhood were spent with his father and mother in Canada. After two years (1825–27) at Harrow, he was placed under a tutor, and in 1829 entered Christ Church, Oxford. On leaving Oxford in 1833 he spent some time abroad. He married in 1836 Lady Susan Hay, daughter of the marquess of Tweeddale, and in 1837 entered the House of Commons as member for East Lothian.

He succeeded to the peerage in 1838, and made his mark in the House of Lords by a clever defence (June 16, 1840) of Lord Aberdeen's Church of Scotland Benefices Bill. In May 1843 he became vice-president of the board of trade, succeeding Gladstone as president in 1845. In the struggle over the corn laws he ranged himself with Peel, and after the failure of Lord John Russell to form a ministry he resumed his post at the board of trade, entering the cabinet on the retirement of Lord Stanley. When Peel resigned office in June 1846, Lord John offered Dalhousie a seat in the cabinet, an offer which he declined. But in 1847 he accepted the post of governor-general of India in succession to Lord Hardinge, on the understanding that he was to be left in "entire and unquestioned possession" of his own "personal independence with reference to party politics."

Governor-General of India.—Dalhousie assumed charge as governor-general of India and governor of Bengal on Jan. 12, 1848. In writing to the president of the board of control, Sir John Hobhouse, he assured him that everything was quiet. This statement, however, was to be falsified by events almost before it could reach England. For on April 19 Vans Agnew of the civil service and Lieutenant Anderson of the Bombay European regiment, having been sent to take charge of Multan from Diwan Mulraj, were murdered there, and within a short time the Sikh troops and sardars joined in open rebellion. Dalhousie agreed with Sir Hugh Gough, the commander-in-chief, that the Company's military forces were not prepared to take the field immediately. He also foresaw the spread of the rebellion, and the eventual necessity, not merely for the capture of Multan, but also for the entire subjugation of the Punjab. He therefore organized a strong army for operations in November. For the course of the second Sikh War and Gough's victory at Gujrat *see* INDIA: *History.* For his services the earl of Dalhousie received the thanks of parliament and a step in the peerage, as marquess.

The Punjab and Burma.—Dalhousie, now, without waiting for instructions from home, annexed the Punjab, and made provision for the custody and education of the infant maharaja. The province was temporarily administered by a triumvirate under the personal supervision of the governor-general, and later, a place having been found for Henry Lawrence in Rajputana, by John Lawrence as sole commissioner. Twice Dalhousie toured the province, settling on the spot all matters of importance, and when he left India no province could show a better record of progress.

Another addition to the British possessions was made by conquest. The Burmese court at Ava was bound by the treaty of Yandabo, 1826, to protect British ships in Burmese waters, but the outrageous conduct of the governor of Rangoon towards the masters of the "Monarch" and "Champion" met with no redress from the king. Dalhousie tried to settle the dispute by diplomacy. When that failed he made vigorous preparation for the campaign to be undertaken in the autumn, which he placed in charge of General Godwin. Martaban was taken on April 5, 1852, and Rangoon and Bassein shortly afterwards. A second campaign opened in October, and after the capture of Prome and Pegu the annexation of the province of Pegu was declared by a proclamation dated Dec. 20, 1853. To any further invasion of the Burmese empire Dalhousie was firmly opposed, being content to "consolidate" the Company's possessions by uniting Arakan to Tenasserim. By his wise policy he pacified the new province, placing Colonel Arthur Phayre in sole charge of it, personally visiting it, and establishing a complete system of telegraphs and communications.

Reforms.—These military operations added force to the conviction which Dalhousie had formed of the need of consolidating the Company's ill-knit possessions, and as a step in that direction he decided to apply the doctrine of "lapse," and annex any Hindu native states, created or revived by the grants of the British government, in which there was a failure of male lineal descendants, reserving for consideration the policy of permitting adoptions in other Hindu chiefships tributary and subordinate to the British government as paramount. Under the first head he recommended the annexation of Satara in Jan. 1849, of Jaitpur and Sambalpur in the same year, and of Jhansi and Nagpur in 1853. In these cases his action was approved by the home authorities, but his proposal to annex Karauli in 1849 was disallowed, while Baghat and the petty estate of Udaipur, which he had annexed in 1851 and 1852 respectively, were afterwards restored to native rule.

Other measures with the same object were carried out in the Company's own territories. Bengal, too long ruled by the governor-general or his delegate, was placed under a separate lieutenant-governor in May 1854; a department of public works was established in each presidency, and engineering colleges were provided. An imperial system of telegraphs followed; the first link of railway communication was completed in 1855; well-considered plans mapped out the course of other lines and their method of administration; the Ganges canal, which then exceeded "all the irrigation lines of Lombardy and Egypt together," was completed; and despite the cost of wars in the Punjab and Burma, liberal provision was made for metalled roads and bridges. The useless military boards were swept away; selection took the place of seniority in the higher commands; an army clothing and a stud department were created, and the medical service underwent complete reorganization. "Unity of authority coupled with direct responsibility" was the keynote of his policy. In nine masterly minutes he suggested means for strengthening the Company's European forces, calling attention to the dangers that threatened the English community, "a handful of scattered strangers"; but beyond the additional powers of recruitment which at his entreaty were granted in the last charter act of 1853, his proposals were shelved by the home authorities, who scented no danger and wished to avoid expense. In his administration Dalhousie vigorously asserted the control of the civil government over military affairs, and his insistence on this point caused the resignation of General Charles Napier.

Dalhousie created an imperial system of post-offices, reduced the rates of carrying letters and introduced postage stamps. To him India owes the first department of public instruction; it was he who placed the gaols under proper inspection, abolishing the practice of branding convicts; put down the crime of *meriahs* or human sacrifices; freed converts to other religions from the loss of their civil rights; inaugurated the system of administrative reports; and enlarged and dignified the legislative council of India. His wide interest in everything that concerned the welfare of the country was shown in the encouragement he gave to the culture of tea, in his protection of forests, in the preservation of ancient and historic monuments. He closed the useless college in Calcutta for the education of young civilians, establishing in its place a proper system of training them in technical (*mufasal*) stations, and subjecting them to departmental examinations. He provided the European soldier with healthy recreations and public gardens. To the civil service he gave improved leave and pension rules, while he purified its *moral* by forbidding all share in trading concerns, by vigorously punishing insolvents, and by his personal example of careful selection in the matter of patronage. The high standard thus set became a settled tradition.

Foreign Policy.—His foreign policy was guided by a desire to recognize the "independence" of the larger native states, and to avoid extending the political relations of his government with foreign powers outside India. Pressed to intervene in Hyderabad, he refused to do so, laying down the doctrine that interference was only justified "if the administration of native princes tends unquestionably to the injury of the subjects or of the allies of the British government." Protection in his view carried no right of interference in the affairs of what he called "independent" states. In this spirit he negotiated in 1853 a treaty with the nizam, which provided funds for the maintenance of the contingent kept up by the British in support of that prince's authority, by the assignment of the Berars in lieu of annual payments of the cost.

The same spirit induced him to tolerate a war of succession in Bahawalpur, so long as the contending candidates did not violate British territory. This reluctance to increase his responsibilities further caused him to refrain from punishing Dost Mohammed for the part he had taken in the Sikh War, and resolutely to refuse to enter upon any negotiations until the amir himself came forward. Then he steered a middle course between the proposals of his own agent, Herbert Edwardes, who advocated an offensive alliance, and those of John Lawrence, who would have avoided any sort of engagement. He himself drafted the short treaty of peace and friendship which Lawrence signed in 1855, that officer receiving in 1856 the order of K.C.B. in acknowledgment of his services in the matter. While, however, Dalhousie was content with a mutual engagement with the Afghan chief, binding each party to respect the territories of the other, he saw that a larger measure of interference was needed in Baluchistan, and with the khan of Kalat he authorized Major Jacob to negotiate a treaty of subordinate co-operation on May 14, 1854. The khan was guaranteed an annual subsidy of Rs. 50,000, in return for the treaty which "bound him to us wholly and exclusively." To this the home authorities demurred, but the engagement was duly ratified, and the subsidy was largely increased by Dalhousie's successors. On the other hand, he insisted on leaving all matters concerning Persia and Central Asia to the decision of the queen's advisers. The frontier tribesmen it was obviously necessary to coerce into good behaviour after the annexation of the Punjab. "The hillmen," he wrote, "regard the plains as their food and prey," and the Afridis, Mohmands, Black Mountain tribes, Waziris and others had to be taught that their new neighbours would not tolerate outrages. But he proclaimed to one and all his desire for peace, and urged upon them the duty of tribal responsibility.

Oudh.—The settlement of the Oudh question was reserved to the last. In 1854 Dalhousie appointed Outram as resident at the court of Lucknow; the latter reported on the condition of the province in March 1855. But in spite of the revelation of disorder and misrule, Dalhousie, looking at the treaty of 1801, considered that he was bound to proceed in the matter of reform with the king's consent. He proposed the transfer to the Company of the entire administration, the king merely retaining his royal rank, certain privileges in the courts and a liberal allowance. A general rising was almost certain to follow refusal and then the British Government would of necessity intervene on its own terms. On Nov. 21, 1855 the court of directors instructed Dalhousie to assume the powers essential to the permanence of good government in Oudh, and to give the king no option unless he was sure that he would surrender the administration rather than risk a revolution. Dalhousie was in wretched health and on the eve of retirement when the belated orders reached him; but he laid down instructions for Outram in every detail, moved up troops, and elaborated a scheme of government with particular orders as to conciliating local opinion. The king refused to sign the treaty put before him, and a proclamation annexing the province was therefore issued on Feb. 13, 1856. Only one important matter now remained to him before quitting office. The insurrection of the half-civilized Kolarian Santals of Bengal against the extortions of landlords and money-lenders had been severely repressed, but the causes of the insurrection had still to be remedied. By removing the tract of country from the ordinary regulations, enforcing the residence of British officers there, and employing the Santal headmen in a local police, he ensured a system of administration which proved successful. For a criticism of Dalhousie's policy of annexation *see* INDIA: *History*.

Bengal.—After seven years of strenuous labour, Dalhousie, on March 6, 1856, set sail for England reaching Spithead, on May

13. The outbreak of the mutiny led to bitter attacks at home upon his policy, and to strange misrepresentation of his public acts, while on the other hand John Lawrence invoked his counsel and influence, and those who really knew his work in India cried out, "Oh, for a dictator," and his return "for one hour!" To all these cries he turned a deaf ear, refusing to embarrass those who were responsible by any expressions of opinion, declining to undertake his own defence or to assist in his vindication through the public press, and by his last directions sealing up his private journal and papers of personal interest against publication until 50 years after his death. Dalhousie died at Dalhousie Castle on Dec. 19, 1860; he was buried in the old churchyard of Cockpen. Dalhousie had two daughters, and the marquessate became extinct at his death.

Bibliography.—*See* Sir E. Arnold, *Dalhousie's Administration of British India* (1862); Sir C. Jackson, *Vindication of Dalhousie's Indian Administration* (1865); C. Campbell, duke of Argyle, *India under Dalhousie and Canning* (1865); L. J. Trotter, *Life of the Marquis of Dalhousie* (1889); Sir W. W. Hunter, *Dalhousie* (1890); Sir W. Lee-Warner, *Life of the Marquis of Dalhousie* (1904); Broughton mss. (British Museum); and parliamentary papers.

(W. L.-W.; X.)

DALIN, OLOF VON (1708–1763), Swedish poet, was born in the parish of Vinberg in Halland, where his father was the minister. He was nearly related to Rydelius, the philosophical bishop of Lund and was sent at a very early age to be instructed by him, Linnaeus being one of his fellow-pupils. While studying at Lund, Dalin had visited Stockholm in the year 1723, and in 1726 entered one of the public offices there. In 1733 he started the weekly *Svenska Argus,* on the model of Addison's *Spectator,* writing anonymously till 1736. His next work was *Tänkar öfver Critiquer* (Thoughts about Critics, 1736). With the avowed purpose of enlarging the horizon of his cultivation and tastes, Dalin set off, in company with his pupil, Baron Rålamb's son, on a tour through Germany and France, in 1739–40. On his return the shifting of political life at home caused him to write his famous satiric allegories of *The Story of the Horse* and *Aprilverk* (1738), which provoked countless imitations. His didactic epos of *Svenska Friheten* (Swedish Liberty) appeared in 1742. Hitherto Addison and Pope had been his models; in this work he draws his inspiration from Thomson, whose poem of *Liberty* is emulated. On the accession of Adolphus Frederick in 1751 Dalin received the post of tutor to the crown prince, afterwards Gustavus III. Queen Louisa Ulrika made him secretary of the Swedish academy of literature, founded by her in 1753. He held the post of tutor to the crown prince until 1756, when he was arrested on suspicion of having taken part in the attempted *coup d'état* of that year, and was tried for his life before the diet. He was exiled from Court, and spent his leisure in preparing the third volume of his great historical work, the *Svea Rikes historia* (History of the Swedish Kingdom), which came down to the death of Charles IX. in 1611. The first two volumes appeared in 1746–50; the third, in two parts, in 1760–62. Dalin had been ennobled in 1751, and made privy councillor in 1753; and in 1761 he once more took his place at court. On Aug. 12, 1763 he died at his house in Drottningholm. In the year 1767 his writings in *belles lettres* were issued in six volumes, edited by J. C. Bökman, his half-brother. During the early part of his life he was universally admitted to be *facile princeps* among the Swedish poets of his time.

See K. Warburg, "Olof von Dalin," in the *Handlingar* (vol. lix., 1884) of the Swedish Academy. A selection of his works was edited by E. V. Lindblad (Örebro, 1872).

DALKEITH, a small burgh, Midlothian, Scotland, between the North and South Esk, 7 mi. S.E. of Edinburgh, by the L.N.E.R. Pop. (1938) 7,658. It is an agricultural centre, and one of the largest grain markets in Scotland. The county is famous for its oatmeal, and Dalkeith is a milling centre. Other industries are brewing, the making of carpets and brushes and brass founding. Near Eskbank, a residential quarter with a railway station, coal mining is carried on. Market gardening, owing to the proximity of the capital, flourishes. The parish church was originally the castle chapel, and was restored in 1852. A park was presented by the duke of Buccleuch in 1909. Dalkeith palace, designed by Sir John Vanbrugh in 1700, has been the residence, during visits to Edinburgh, of George IV., Victoria and Edward VII. The picture gallery, gardens and park are famous. About 1 m. south is Newbattle abbey, seat of the marquess of Lothian, on the site of an abbey founded by David I., the ancient crypt being incorporated in the mansion. Two miles farther south lie Cockpen, immortalized by Baroness Nairne and Dalhousie castle, partly ancient and partly modern. About 6 m. south-east of Dalkeith are Crichton and Borthwick castles, 1 m. apart. The former is in ruins; the latter has been restored—Queen Mary spent three weeks in Borthwick castle after her marriage with Bothwell, and fled from it to Dunbar in the guise of a page. The castle, a double tower, was besieged by Cromwell.

DALKEY, a small port and watering place of Co. Dublin, Eire, 9 mi. southeast of Dublin by rail. It was assimilated, with several other urban districts, into the borough of Dun Laoghaire. It is situated on and about Sorrento point, the southern horn of Dublin bay. The 15th century castle has been restored for use as offices. There are ruins of an old church dedicated to St. Begnet, perhaps a diminutive form of Bega, but the identity is not clear. The harbour was once a landing-place of some importance.

DALLAS, ALEXANDER JAMES (1759–1817), an American lawyer, financier, and statesman who as secretary of the United States Treasury during the difficult years 1814–16 rendered great service in the restoration of a national bank and a national currency and in the formulation of the tariff of 1816, was the son of a Scottish physician of good family and good English connections. The father, Robert Charles Dallas, was resident in Jamaica when the son was born, but returned to Britain for the education of his children. Alexander attended school in Edinburgh and at Kensington in London attracting the attention of Dr. Benjamin Franklin and Dr. Samuel Johnson. The father's untimely death cut short the boy's plans for a legal education in the Temple; and young Alexander James Dallas earned a living in a counting-house for two years. His mother's second marriage enabled him to join the family in Devonshire and resume his studies. In 1780, at the age of 21, he married Arabella Maria, the 16-year-old daughter of Major George Smith, and proceeded with her to Jamaica, whither his mother had gone, and where Major Smith was on military duty. There he became acquainted with Lewis Hallam, who induced him to go to Philadelphia. In this move one may possibly discern the influence of young Dallas' former association with Dr. Benjamin Franklin. Dallas immediately took up the study of law, and gained admission to practice in 1785. With Hallam he indulged his literary and theatrical inclinations, editing the *Columbian Magazine* from 1787 to 1789 and helping Hallam in the establishment of the theatre in Philadelphia.

Possibly during these eventful years, young Dallas developed those abilities and powers which enabled him to render great service to his adopted country in the last two or three years of his life. However this may be, the formation of "a more perfect Union" through the adoption of the Constitution of 1789, and the consequent development of political parties, appear to have stimulated his legal practice and to have drawn his attention to politics and the public service. In 1795 he gained much influence in the Democratic-Republican Party by the publication of an able pamphlet against the Jay Treaty; and when Jefferson became president in 1801, Dallas was appointed United States attorney for the eastern district of Pennsylvania, a position which he held continuously until Madison called him to be secretary of the United States Treasury in 1814. During this quarter century, 1789–1814, at the beginning of which Dallas was about 30 years old, he belonged to the McKean-Gallatin branch of the Republicans and opposed the Leib-Duane combination, but he was not on that account any more acceptable to the Federalist element, who naturally feared the ability of the men of the Gallatin school. Although biography has failed to explain satisfactorily A. J. Dallas's development, it is certain that by 1814 he possessed the constructive abilities and powers which were so much needed in the United States Treasury at that time. Within a fortnight after he had entered upon the duties of that post, he wrote a letter to the committee on ways and means recommending the establishment of a national bank. The resulting bill was amended, however, so that it became unacceptable; and Dallas sent another outline in a letter to John C. Calhoun, chairman of the committee on the currency, who was able to carry a bill embodying Dallas's recommendations. Consequently, the second bank of the United States went into operation in Jan., 1817, and resumption of specie payments followed shortly. Meanwhile, he had made recommendations regarding the tariff and a system of protection which became the basis of the Tariff Act of 1816. He left the Treasury, in March 1816, with a surplus of $20,000,000.

See G. M. Dallas, *Life and Writings of Alexander James Dallas* (1871); *The Nation* (New York), Sept. 14, 1871; and Henry Adams, *History of the United States.*

DALLAS, GEORGE MIFFLIN (1792–1864), an American statesman and diplomat, was United States minister to England (1856–61) on the eve and at the outbreak of the American Civil War, and the immediate predecessor of Charles Francis Adams. He was the son of Alexander James Dallas (*q.v.*). In 1813, just after he was admitted to the bar, he went abroad as the private secretary to Albert Gallatin and brought back from Ghent important despatches from the American peace commissioners. For the next 20 years he played a prominent and fairly successful rôle as a Democrat in Pennsylvania politics and in the United States Senate; and from 1835 to 1839 was United States minister to Russia. When he returned from Russia, he entered upon a long struggle with James Buchanan for the party leadership in Pennsylvania. As candidate for vice-president on the ticket with James K. Polk (*q.v.*), he helped to win the Democratic victory in 1844; but the appointment of Buchanan as secretary of state deprived him of a most important share of party patronage and influence in the Polk administration. Consequently he became the leader of a distinct body of conservative Democrats who were not in all respects in harmony with the administration, but he did not go so far as to oppose territorial expansion. Indeed, he sacrificed his influence with protectionists in Pennsylvania by casting his vote at a critical time in the Senate in favour of the Walker Tariff bill of 1846. He returned to the practice of law in 1849, and became associated with Robert James Walker (*q.v.*), his relative by marriage, in promoting in England the financial interests of the Illinois Central railroad.

In 1853 President Pierce was urged to appoint Dallas minister to England; and in 1856 the President did so, sending him to succeed his old political rival, James Buchanan, who returned to the United States and made a successful campaign for the presidency. Buchanan retained Dallas at the London post throughout the whole of his administration. Dallas's earlier contacts with the friends of the United States in Great Britain, through the promotion of American business interests there, appear to have served him well in the solution of difficulties which faced him from the beginning of his residence as minister. Friction over the various interpretations of the ill-starred Clayton-Bulwer Treaty of 1850 and the serious crisis over British enlistments in the United States during the Crimean War, which was drawing to a close, made war imminent between Great Britain and the United States; but Cobden, Gladstone and others forced their Government to publish papers of a damaging character, while in America the failure of the Cincinnati Convention to nominate President Pierce for a second term had a pacific effect. In Great Britain the nomination of Buchanan was regarded by some as a stiffening of the American attitude. In October, Dallas and Lord Clarendon succeeded in drawing up the project for a treaty which later became the basis of an adjustment. By the close of 1860, official Anglo-American relations were to all appearances composed.

There is no satisfactory biography of George Mifflin Dallas; but *see* his *Letters from London, 1856–1860* (1871); his *Diary* (1892); and J. B. Moore (ed.), *The Works of James Buchanan.* (T. P. MA.)

DALLAS, the largest city of northern Texas, U.S.A., on the Trinity river, 30 mi. E. of Fort Worth and 75 mi. from the Oklahoma state line; the county seat of Dallas county, a port of entry in the Galveston customs district and an important financial and commercial centre. It is on four transcontinental highways (Bankhead, King of Trails, Dallas-Canadian-Denver and Dixie Overland), is served by the Ft. Worth & Denver City, the Frisco, the Missouri-Kansas-Texas, the Rock Island, the St. Louis Southwestern, the Santa Fe, the Southern Pacific and the Texas and Pacific railways, is a commercial aviation centre and has air-mail service.

The land area is 40.6 sq.mi. The population was 158,976 in 1920, of whom 24,023 were Negroes and 8,730 were foreign-born white, and had increased to 294,734 in 1940 by the federal census. There is a Union station (opened 1916) where more than 100 passenger trains arrive and depart daily. Interurban electric lines operate upwards of 250 passenger and freight trains daily from an interurban terminal. The municipal airport, Love field, covers 173 ac. General offices of the Texas and Pacific railway, Texas headquarters of the Missouri-Kansas-Texas lines, southwestern headquarters of the American Railway Express and headquarters of the telegraph and telephone systems of the southwest, are in Dallas.

The freight, express and parcel-post business coming into Dallas over all the above-mentioned lines aggregates 8,000,000,000 lb. in a year.

Since the World War of 1914–18 many skyscraper business buildings, large warehouses and factories, hotels and apartment houses have been erected. The hotels, representing an investment of $40,000,000, furnish accommodations for 20,000 guests. The assessed valuation of property in 1940 was $251,191,475. The water supply from Lake Dallas is sufficient for a population of 1,000,000.

Lake Dallas, covering 10,444 ac., with a shore line of 65 mi., was completed in 1928.

Since 1915 natural gas and fuel oil have been available from fields in the neighbourhood. The municipality has 50 parks, covering 4,134 acres. There are six high and 45 elementary public schools, employing about 1,100 teachers, and 80 private schools of various kinds. Southern Methodist university, established there in 1911 and opened in 1915, has an enrolment of more than 3,000.

Its campus (132 ac.) is in the separately incorporated suburb of University Park, north of the city. The schools of nursing and dentistry of Baylor university (at Waco) are located there. Dallas has a manager-council form of government.

The economic life of Dallas is based on the agricultural and mineral wealth of the surrounding region. It is the largest inland cotton market in the country, and is the southwestern headquarters of large oil companies. Dallas ranks fifteenth in the total amount of its jobbing business, fifth as a distributor of dry goods, third of farm implements and first of cotton-seed products, saddlery and harness. There are 500 wholesale houses in the city.

Wholesale transactions are estimated at $800,000,000 annually; retail business at $250,000,000. The cotton firms handle about 3,000,000 bales a year.

Dallas is the seat of the federal reserve bank of the Eleventh district. In postal receipts it stands high, with a total of $4,597,769 in 1940; as an insurance centre it ranks fifth, containing the home offices of more than 20 companies and the agencies of more than 170 other insurance firms. The approximately 500 establishments situated in Dallas county produce goods valued at $125,000,000 annually. The numerous groups of manufactures are widely diversified. Nearly half the cotton gins used in the world are made in Dallas. There are petroleum refineries and plants making machinery and supplies for the oil fields. Printing and publishing is an important industry. The 72 periodicals issued include three daily newspapers and numerous trade and religious magazines. Other manufactures of importance are aeroplanes, automobile accessories, awnings and tents, bagging, candy, clothing, cement, flour, mixed feed, iron and steel products, textiles, store fixtures and packing-house products.

The bank deposits were (1940) $3,160,201,000; (1930) $2,640,868,000. The postal receipts were (1940) $4,597,769; (1930) $3,797,916. Dallas had 122,786 motor vehicles in 1940 as against 89,101 in 1930.

There were 101,071 telephones in 1940 and 69,732 in 1930. The Texas state fair, the largest annual fair in the United States, drawing an attendance of 1,000,000, has been held at Dallas since 1886.

Fair park contains about 150 ac. and has a stadium seating 40,000.

A log hut built in 1841 on the bank of the Trinity river by John Neely Bryan was the nucleus of a village called Peter's Colony, which in 1845 adopted the name of the newly inaugurated vice-president, George Mifflin Dallas, of Philadelphia. It was incorporated as a city in 1871, when the population was about 5,000. In 1890, with a population of 38,067, it was the largest city in the state; in 1900, with 42,638, it ranked third; and in 1910 and 1920 it stood a very close second to San Antonio. The total area within the corporate limits was increased from 7.5 sq.mi. in 1900 to 41.8 in 1940.

DALLE, a rapid falling over flat smooth rock surfaces in a river bed, especially in rivers flowing between basaltic rocks (Fr. for a flag-stone or flat tile).

The name is common in North America, and came into use through the French employés of the Hudson's Bay Company. Well-known "dalles" are on the St. Louis, St. Croix and Wisconsin rivers.

The "dalles" of the Columbia river are very beautiful, and have given its name to The Dalles (*q.v.*), county-seat of Wasco county, Oregon.

DALLES, THE, a city of northern Oregon, U.S.A., on the Columbia river, 93 mi. E. of Portland; the county seat of Wasco county. It is on the Columbia river highway and is served by the Union Pacific railroad. Pop. (1930) 5,883 (99% native white) and in 1940, 6,266.

A few miles above the city the entire Columbia river plunges over a rocky barrier of basalt in the Celilo falls, and just below the falls it is confined into a narrow chasm 130–200 ft. wide.

An $8\frac{1}{2}$-mi. navigation canal with locks enables inland river craft to pass these obstacles. These craft carry a heavy traffic of petroleum products upstream and agricultural products downstream.

The Dalles is the distributing point for much of the wheat and wool produced on the great plateaus of eastern Oregon. It has fruit-processing plants, a salmon cannery, flour mills, a wood-preserving plant and terminals for ocean carriers now navigating the new seaway. The city was founded in 1847 and incorporated in 1857.

DALLIN, CYRUS EDWIN (1861–1944), U.S. sculptor, was born at Springville, Utah, on Nov. 22, 1861. He was a pupil of Truman H. Bartlett in Boston, of the École des Beaux-Arts, the Académie Julien and the sculptors Henri M. Chapu and Jean Dampt (1858–1945), in Paris, and on his return to America became instructor in modelling in the state normal art school in Boston. He is best known for his plastic representations of the North American Indian—especially for "The Signal of Peace" in Lincoln park, Chicago, "The Medicine Man," in Fairmount park, Philadelphia, and "The Appeal to the Great Spirit" in the Museum of Fine Arts, Boston. His statue of Massasoit, the Indian chief, at Plymouth, Mass., was completed in 1921. As a boy he had lived among the Indians in the far west and had learned their language. His later works include "Pioneer Monument," Salt Lake City; "Sir Isaac Newton," Library of Congress; and "Don Quixote." He won a silver medal at the Paris Exposition, 1900, and in 1906 the first prize in the competition for the soldiers' and sailors' monument at Syracuse, New York. He died Nov. 14, 1944.

DALLING AND BULWER, WILLIAM HENRY LYTTON EARLE BULWER, BARON (1801–1872), known as Sir Henry Bulwer, English diplomatist and author, the son of General William Earle Bulwer and his wife Elizabeth Barbara Lytton was born in London on Feb. 13, 1801. His younger brother Edward Bulwer, Baron Lytton, is separately noticed.

Henry Bulwer was educated at Harrow, under Dr. George Butler, and at Trinity and Downing Colleges, Cambridge. In 1824 he went to the Morea, as emissary of the Greek committee then sitting in London, with £80,000 sterling for the use of Prince Mavrocordato and his colleagues. This he describes in *An Autumn in Greece* (1826). In the meantime he had, on Oct. 19, 1825, been gazetted as a cornet in the 2nd Life Guards, but finally left the army for the diplomatic service (Jan. 1, 1829). His first diplomatic appointment was as attaché in Berlin, and he held later similar posts in Vienna (1830), and The Hague (1831). At the beginning of the Belgian revolution (August to October 1830) Bulwer was despatched to Belgium to watch and report on events, and sent home a series of despatches for which he received the congratulations of the cabinet. Shortly before the carrying of the first Reform Bill Bulwer was returned to parliament for Wilton, and later, in 1831 and 1832 as M.P. for Coventry. After two years' absence he was again returned in 1834 as member for Marylebone, and won considerable distinction as a debater. At this time he published *France—Literary, Social and Political* (2 vols. 1834), a work completed in 1836 by two further volumes entitled *The Monarchy of the Middle Classes.*

While on one of his many visits to Paris from Brussels, he obtained his nomination as secretary of embassy at Constantinople. The first task entrusted to him by Lord Ponsonby was the negotiation of a commercial treaty, which had the double object of removing the intolerable conditions which hampered British trade with Turkey, and of dealing a blow at the power of Mehemet Ali, pasha of Egypt, by shattering the system of monopolies on which it was largely based. In this difficult task Bulwer was helped by the hatred of Sultan Mahmed II. for Mehemet Ali, but the treaty was none the less a remarkable proof of his diplomatic skill. Shortly afterwards Bulwer was nominated secretary of embassy at St. Petersburg, but, before he could take up the appointment, was nominated to Paris in the same capacity (June, 1839).

On Nov. 14, 1843 he was appointed ambassador at the court of the young Spanish queen Isabella II. Upon his arrival at Madrid he was chosen arbitrator between Spain and Morocco, and his mediation led to the signature of the treaty of 1844. In 1846 a much more formidable difficulty arose over the question of the "Spanish Marriages," the dynastic intrigue which led up to the February revolution in Paris. The explosion which took place at Paris was answered a month later at Madrid by a similar outbreak. Marshal Narvaez thereupon assumed the dictatorship and wreaked upon the insurgents a series of reprisals whose excessive severities the British ambassador did his utmost to mitigate. When at last Narvaez summarily suppressed the constitutional guarantees Bulwer sent a formal protest in the name of England. Narvaez's counterstroke was the denunciation of the English ambassador as an accomplice in the conspiracies of the Progressistas, and in spite of Bulwer's diplomatic position he was, on June 12, summarily required to quit Madrid within twenty-four hours. Two days later M. Isturitz, the Spanish ambassador in London returned to Madrid. Diplomatic relations were not restored between the two countries until a formal apology, dictated by Lord Palmerston, had been signed by the prime minister of Queen Isabella. Bulwer was gazetted a K.C.B., and received the formal approbation of the ministry and the thanks of both houses of parliament.

Within a year of his return Sir Henry Bulwer married the Hon. Georgiana Charlotte Mary Wellesley, youngest daughter of the 1st Baron Cowley. On April 27, 1849 he was nominated ambassador at Washington. There his principal success was the compact known as the Clayton-Bulwer Treaty (*q.v.*), ratified in May 1850, pledging the contracting governments to respect the neutrality of the meditated ship canal through Central America. After three years in Washington, Bulwer spent three years (1852–55) as minister plenipotentiary at the court of the grand duke of Tuscany at Florence. From May 1858 to Aug. 1865 he was ambassador extraordinary to the Ottoman Porte at Constantinople. He returned to England in 1865 and retired with a pension.

On Nov. 17, 1868 he was elected M.P. for Tamworth, and retained his seat until he was raised to the peerage on March 21, 1871, with the title of Baron Dalling and Bulwer of Wood Dalling in the country of Norfolk. He died on May 23, 1872.

DALLMEYER, JOHN HENRY (1830–1883), Anglo-German optician, was born on Sept. 6, 1830 at Loxten, Westphalia, the son of a landowner. On leaving school at the age of 16, he was apprenticed to an Osnabrück optician, and in 1851 he came to London, where he obtained work with an optician and later with Andrew Ross, a lens and telescope manufacturer. After a year spent in a commercial post, he was re-engaged by Ross as scientific adviser. He married Ross's second daughter, Hannah, and inherited, at Ross's death (1859), a third of his employer's large fortune and the telescope-manufacturing portion of the business. Turning to the making of photographic lenses (*see* PHOTOGRAPHY), he introduced improvements in both portrait and landscape lenses, in object-glasses for the miscroscope and in condensers for the optical lantern. In connection with celestial photography he constructed photo-heliographs for the Wilna observatory in 1863, for the Harvard college observatory in 1864, and, in 1873, several for the British Government. Dallmeyer's instruments took the highest awards at various international exhibitions, and he received many honours from governments and learned societies. He died on board ship, off the coast of New Zealand, on Dec. 30, 1883.

His second son, THOMAS RUDOLPHUS DALLMEYER (1859–1906), introduced telephotographic lenses into ordinary practice (patented 1891), and wrote a standard book on the subject (*Telephotography,* 1899).

DALL' ONGARO, FRANCESCO (1808–1873), Italian writer, born in Friuli, was educated for the priesthood, but abandoned his orders, and founded the *Favilla* at Trieste in the Liberal interest. In 1848 he enlisted under Garibaldi, and next year was a member of the assembly which proclaimed the republic in Rome, being given by Mazzini the direction of the *Monitore ufficiale.* On the downfall of the republic he fled to Switzerland, then to Belgium and later to France, taking a prominent part in revolutionary journalism. In 1860 he returned to Italy, and was professor of dramatic literature at Florence, and then at Naples, where he died on Jan. 10, 1873. His patriotic poems, *Stornelli,* composed in early life and published in 1863, had a great popular success; and he produced a number of plays, notably *Fornaretto, Bianco Capello, Fasma* and *Il Tesoro.* His collected *Fantasie drammatiche e liriche* were published in his lifetime.

See A. De Gubernatis, *Francesco dall' Ongaro* (1875).

DALMAN, GUSTAF (1855–), German theologian and orientalist, was born at Niesky, Silesia, on June 9, 1855. He became professor at Leipzig in 1895 and at Halle in 1900. From 1902 to 1917 he was director of the German Evangelical Institute for Archaeology in Jerusalem, and for the next five years professor at Greifswald. His chief publications are *Christus im Thalmud* (1891, Eng. trans. 1893); *Grammatik des jüdisch-palästinischen Aramäisch* (1894); *Aramäisch-neuhebräisches Wörterbuch* (1897–1901); *Worte Jesu* (1898, Eng. trans. 1902); *Petra u. seine Felsheiligtümer* (1908); *Orte u. Wege Jesu* (1919); *Jesu-Jeschua, Die Drei Sprachen Jesu,* etc. (1922).

DALMATIA, formerly a kingdom and crownland of the Austro-Hungarian empire, in the north west of the Balkan Peninsula, and on the Adriatic Sea. It comprised an area of 4,923 sq.mi.: was 210 mi. long and in breadth 35 mi. After 1918, however, Dalmatia formed a part of the Serb, Croat and Slovene state. (*See* YUGOSLAVIA and BALKAN PENINSULA.)

Ancient and Mediaeval History.—Dalmatia originally belonged to the Illyrian kingdom, which was conquered in 168 B.C. by the Romans, but it was not till A.D. 12 that Tiberius quelled the last of many insurrections. Its capital Delminium was probably Durno in Hercegovina. Already in the 4th century B.C. Greek colonies were established at Issa (Lissa, Vis), Pharia (Lesina, Hvar), Corcyra Nigra (Curzola, Korčula), etc., and these and other towns became flourishing Roman municipalities. Iadera and Salona were the chief towns. Various Illyrian generals became emperor, notably Diocletian, who on his abdication retired to his native province and built the famous palace which still forms the centre of the town of Spalato (Split). Spalato and Epidaurum (Ragusa) were founded after the annihilation of Salona in 639 by the Avars (*q.v.*). The Avars were soon followed by the Croats and Serbs, who established themselves along the coast during the 7th and 8th centuries. The first Croat dukes (*see* CROATIA-SLAVONIA) resided mainly at Bihač near Traù (Trogir) and at Knin, but the towns preserved their autonomy and Byzantine suzerainty was little more than nominal. In 879 Duke Branimir acknowledged the Pope, and henceforth the Croats held with Rome, the archbishop of Spalato becoming metropolitan of the littoral from the Arsa to Cattaro (Kotor). After two centuries of struggle the Slav liturgy (the so-called Glagolitic rite) was sanctioned by a church council at Spalato in 1076. Dalmatia formed part of the Croatian kingdom till its union with Hungary in 1102, and already was involved in conflicts with the rising power of Venice. King Koloman almost at once conceded special autonomy to the Dalmatian towns, the charter of Traù (1107) serving as a model for others. Between 1115 and 1420 there were 21 wars between Hungary-Croatia and Venice; in that of 1202, the republic diverted the Fourth Crusade to the conquest of Zara (Zadar). During the Mongol invasions King Béla IV. took refuge in Dalmatia, but the crown's hold upon it was by now slight, and power was divided between the Venetians and a few great Croat nobles, such as the counts of Bribir, while south of the Narenta (Neretva) river the Serbian rulers held sway. In 1220 Stephen "the First-crowned," having married a niece of Enrico Dandolo, assumed the style *"Totius Serviae Diocliae Tribuniae Dalmatiae atque Chlumiae Rex coronatus":* and over a century later his descendant Tsar Dušan invaded and held southern Dalmatia (1350–6). His death was followed by a successful war of Louis the Great against Venice, who in 1358 ceded to Hungary the whole coast from the Quarnero to Durazzo, though Ragusa (Dubrovnik) maintained its independence. Louis died in 1382 and in 1390 King Tvrtko of Bosnia (*q.v.*) seized most of the coast towns and took the title of king of Croatia and Dalmatia, but died a year later. The disputed succession in Hungary gave Venice a new opportunity: in 1409 Ladislas of Naples, to finance the campaign against his cousin Mary and her husband Sigismund, sold Dalmatia to Venice for 100,000 ducats: and in 1420 Sigismund had to ratify the cession.

Venetian Rule.—Thus from 1420 to 1797 Venice held the coast from the Zrmanja to the Neretva (including Zara, Sebenico, Traù, Spalato and the North and Central islands) and then again (south of Ragusan territory) Cattaro and the Albanian ports. In 1537 Clissa, near Spalato, was captured by the Turks, who gained a further foothold at the mouth of the Neretva. In the second half of the 16th century the Uzkoks established an almost independent corsair community round Almissa (Omiš) and the Neretva, and gave both Venice and Turkey much trouble. In 1635 Venice obtained from the Turks the cession of the "Nani line," as far as the watershed of the Dinaric Alps: by the Treaty of Karlowitz (1699) she obtained the Nuovo Acquisto (Knin and Sinj) and in 1718 the Nuovissimo Acquisto (district of Imotski). Dalmatia supplied numerous levies to the Venetian fleet and army, but was treated in stepmotherly fashion and regarded as a strategic outpost to protect the Adriatic trade route. Sarpi's advice—"If you want the Dalmatians to be faithful, keep them ignorant"—was closely followed: there were scarcely any schools and the first printing press was erected at Zara in 1796. Taxes were heavy; there was an oppressive salt monopoly; the forests were felled and not replanted. Dalmatia had produced real architectural and artistic masterpieces in the 15th and 16th centuries, but then fell into neglect and isolation. Ragusa alone remained an intellectual centre, and produced a brilliant galaxy of poets and writers, notably Ivan Gundulić in the first half of the 17th century. Later still it produced the mathematician Bošković.

Napoleonic Period.—On the fall of Venice in 1797, Dalmatia was assigned to Austria by the Treaty of Campo Formio. In 1805, however, it was united with Napoleon's vassal Italian kingdom. For a time, combined Russian and Montenegrin forces held the French at bay in the Bocche di Cattaro, but eventually the latter occupied Dalmatia, and suppressed the Ragusan republic and even the tiny peasant republic of Poljica (near Split). In 1808 the Russians evacuated, but the British fleet held Vis (Lissa) and under Hoste inflicted on March 12, 1812, a severe naval defeat upon the French. Several islands remained in British occupation till the end of the war. The rest of Dalmatia formed from 1809 to 1814 part of the French province of Illyria, under Marshal Marmont, whose short rule was marked by the building of roads, schools and public institutions. The Austrians under the Croat general Milutinović captured Ragusa from the French in January 1814 and Cattaro in June. The province was definitely assigned to Austria at the peace of 1815 and reorganized in four districts, one consisting of former Ragusan territory.

Austrian Rule.—For the next generation Dalmatia lived its own life, almost forgotten by the rest of Austria and only accessible by sea. Its population was overwhelmingly Slav, but the small educated class, knowing Italian often better than Croat, formed a useful recruiting ground for the Austrian bureaucracy in Lombardy and Venetia, and there was a very close connection with Padua University, where the Yugoslav poet Orsat Počić (Pozza) was specially active. The greatest Dalmatian of this period was Niccolò Tommaseo, who was in close touch with the Illyrian movement before he became a minister in Manin's revolutionary government at Venice in 1848, and provided a synthesis between Italian and Slav aspirations on the Adriatic. In 1836 a Slav review, and in 1849 a Slav literary society, was founded in Zara; but during the fifties all such tendencies were rigorously repressed. National life first really became vocal in 1861 when Dalmatia, like other Austrian provinces, received a diet. Under the narrow franchise 15,600 Italians elected 26 deputies and 140,000 Serbo-Croats only 15. The struggle lay between the Autonomist Party, with its organ *Il Dalmata,* and the Croat National Party, which desired Dalmatia's union with Croatia. The former found a remarkable leader in Bajamonti, mayor of Split, whose motto was "Slavo sempre, Croato giammai" (Slav ever, Croat never), but his successors gave the party more and more an exclusively Italian character. Vienna steadily promoted discord between Italian and Slav, and also between Croat and Serb. Already in 1870 the Slavs won a majority in the diet, and in the eighties stormed the municipalities one by one, till only Zara remained mainly Italian, while Serbo-Croat asserted itself in administration, justice and education. In 1897 a compromise between the Croats and the Serbs reduced the Italians to such a tiny minority, that they lost all representation in the Vienna *Reichsrat* even before the advent of universal suffrage. The events of 1903 in Croatia caused intense excitement in Dalmatia, whose deputies vainly petitioned Francis Joseph on behalf of their kinsmen. The Dalmatian leaders Trumbić, Supilo and Smodlaka played a leading part in drafting the Resolutions of Fiume and Zara (Oct. 1905), and thus effecting a firm Serb-Croat coalition against Budapest and Vienna. With the coming of universal suffrage for the *Reichsrat* (1907) the Dalmatian deputies became more vocal in Vienna, allied themselves with the Slovenes and Czechs, and by constant interpellations drew attention to the scandalous conditions in Croatia (*q.v.*). During the same period publicity was thrown upon the backward economic conditions of Dalmatia, which owing to political jealousies between Budapest and Vienna remained without railway connections northwards. It was very inadequately supplied with primary schools, and had been injured in its fishing and wine trade by Vienna's customs concessions to Italy. Emigration was high, and though the population was only 635,000 in 1910, no fewer than 67,000 persons had left Dalmatia in the previous thirty years, mostly for South America, the United States and New Zealand. Pop. (1930) 650,139.

In 1912 lively demonstrations in Dalmatia in favour of the Balkan allies led to press confiscations and the dissolution of the municipalities of Split and Šibenik (Sebenico). By 1914 in Croatia and Bosnia also the Yugoslav idea made rapid progress.

On the outbreak of World War I, the leading Yugoslav intellectuals were arrested and interned, and all municipal councils (except Zara, which had an Italian majority) were early dissolved. In the winter of 1917–18 an underground revolutionary movement steadily gained strength.

Union with Yugoslavia.—On Feb. 1, 1918, a mutiny placed the fleet and most of the strategic points in the Bocche di Cattaro for three days at the mercy of a revolutionary committee. The leader, Antun Sesan, flew to Italy for help, but was held in arrest, and Austrian ships from Pola suppressed the movement. Early in October, however, a still wider plot was prepared, and its spokesmen, the Czech Štěpánek and the Croat Giunio, crossed the Adriatic in a sailing boat with instructions to communicate with Marshal Foch and arrange with him the date for an insurrection. Had not they in their turn been held in custody for over three weeks by the Italians, and debarred from all intercourse with the Czech and Yugoslav national committees, the Allied fleets might have been in control of Dalmatia a fortnight before the Italian offensive was actually launched. At the close of October a national committee was formed in Split which recognized the supreme authority of the Yugoslav national council in Zagreb, but made itself responsible for local order in the province and disarmed the Austrian and Hungarian troops as they retired northwards from the Albanian front. A very dangerous situation arose when Italian naval forces occupied northern Dalmatia and the islands, and some of D'Annunzio's followers tried to execute a raid upon Trogir (Traù) and Split. A conflict was averted very largely by the tact of the American admiral. By the Treaty of Rapallo between Italy and Yugoslavia (Nov. 12, 1920) the whole of Dalmatia was assigned to the latter, save for Zara and a small enclave round it. (*See* YUGOSLAVIA.)

After Hitler's invasion and dismemberment of Yugoslavia in April 1941, Mussolini, by an agreement of May 18, was allowed to annex Šušak, Spalato and the Dalmatian coast north to Zara; Cattaro and the Adriatic coast south to Albania; and all but three of the former Yugoslav islands in the Adriatic. In August he occupied the whole Dalmatian territory from Fiume in the north to Montenegro in the south. The resulting Italian province of Dalmatia was placed under the administration of Giuseppe Bastianini, former Italian ambassador to Great Britain. Italy thus obtained the Adriatic territory which she had sought but failed to gain at Paris in 1919.

BIBLIOGRAPHY.—For a general survey of Dalmatian history, art and antiquities *see* Sir T. G. Jackson, *Dalmatia, the Quarnero and Istria* (1887, 3 vols., illust.) and E. A. Freeman, *Subject and Neighbour Lands of Venice* (1881). *See* also Sir J. G. Wilkinson, *Dalmatia and Montenegro* (1840, 2 vols.); A. A. Paton, *Highlands and Islands of the Adriatic* (1849); J. M. Neale, *Notes on Dalmatia,* etc. (1861); Horatio F. Brown, *Dalmatia* (London, 1924). Robert Adam, *The Ruins of the Palace of Diocletian* (1764) and E. Hébrard, *Le Palais de Dioclétien à Spalato* (1911) are masterpieces of architectural history. The standard mediaeval history is G. Lucio, *De Regno Dalmatiae et Croatiae* (Amsterdam, 1666). For recent history *see* G. Prezzolini, *La Dalmazia* (Florence, 1915); G. Salvemini and L. Marinelli, *La Questione dell' Adriatico* (Bari, 1915); C. Vellay, *La Question de L'Adriatique* (1915); vol. IV. of *History of Peace Conference* (ed. H. M. V. Temperley); F. Šišić and others, *Le Littoral Jugoslave* (Zagreb, 1919); Hugo Werk, *Cenni sulla Dalmazia* (Zagreb, 1919), and G. Novak, *Naše More* (Our Sea) (1927). (R. W. S.-W.; X.)

DALMATIC, a liturgical vestment of the western church, proper to deacons, as the tunicle (*tunicella*) is to subdeacons. Dalmatic and tunicle are now, however, practically identical in shape and size; though, strictly, the latter should be somewhat smaller and with narrower arms. In most countries, *e.g.,* England, France, Spain and Germany, dalmatic and tunicle are now no longer tunics, but scapular-like cloaks, with an opening for the head to pass through and square lappets falling from the shoulder over the upper part of the arm; in Italy, on the other hand, though open up the side, they still have regular sleeves and are essentially tunics. The most characteristic ornament of the dalmatic and tunicle is the vertical stripes running from the shoulder to the lower hem, these being connected by a cross-band, the position of which differs in various countries.

The *dalmatica,* which originated (as its name implies) in Dalmatia, came into fashion in the Roman world in the 2nd century A.D. It was a loose tunic with very wide sleeves, and was worn over the *tunica alba,* which was simply a long white shirt, by most of the better class of citizens. According to the *Liber pontificalis* (ed. Duchesne, I. 171) the dalmatic was first introduced as a vestment in public worship by Pope Sylvester I. (314–335), who ordered it to be worn by the deacons; but Braun (*Liturg. Gewandung,* p. 250) thinks that it was probably in use by the Popes themselves as early as the 3rd century, since St. Cyprian (d. 258) is mentioned as wearing it when he went to his death.

If this be so, it was probably given to the Roman deacons to distinguish them from the other clergy and to mark their special relations to the Pope. However this may be, the dalmatic remained for centuries the vestment distinctive of the Pope and his deacons, and (according at least to the view held at Rome) could be worn by other clergy only by special concession of the Pope. The dalmatic was in general use at the beginning of the 9th century, partly as a result of the Carolingian reforms, which established the Roman model in western Europe; but it continued to be granted by the Popes to distinguish ecclesiastics not otherwise entitled to wear it, *e.g.,* to abbots or to the cardinal priests of important cathedrals. Dalmatic and tunicle are never worn by priests, except when officiating as deacons, *e.g.,* as deacon and subdeacon assisting at mass, but both are worn by bishops under the chasuble (never under the cope).

In England at the Reformation the dalmatic or tunicle, though prescribed in the first prayer-book of Edward VI., ultimately shared the fate of the other mass vestments. (*See* VESTMENTS.)

In the eastern churches the only vestment that has any true analogy with the dalmatic is the *sakkos.* This, which, as a liturgical vestment, first appears in the 12th century as peculiar to patriarchs, is now very similar to the modern dalmatic. Its origin is almost certainly the richly embroidered dalmatic that formed part of the consular insignia, which under the name of *sakkos* became a robe of state special to the emperors. Braun suggests that its use was granted to the patriarchs, after the completion of the schism of east and west, in order "in some sort to give them the character, in outward appearance as well, of Popes of the east." Its use is confined to the Greek rite. In the Greek-Melchite churches it is confined to the patriarchs and metropolitans; in the Russian, Ruthenian and Bulgarian churches it is worn by all bishops. Contrary to the practice of the Latin church, it is not worn under, but has replaced, the phelonion (chasuble).

A silk dalmatic forms one (the undermost) of the English coronation robes. Its use seems to have been borrowed, not from the robes of the eastern emperors, but from the church, and to symbolize with the other robes the quasi-sacerdotal character of the kingship (*see* CORONATION). The magnificent so-called dalmatic of Charlemagne, preserved at Rome, is really a Greek *sakkos.*

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DALMELLINGTON, a civil parish, Ayrshire, Scotland, 15 mi. S.E. of Ayr by a branch line, of which it is the terminus, of the L.M.S. railway. Pop. (1931) 6,151. The district is rich in coal, ironstone, sandstone and limestone. Though the place is very old, a Roman road running near it, few remains exist. It was, however, a centre of activity in Covenanting times.

DALOU, JULES (1838–1902), French sculptor, was born in Paris, and died there on April 15, 1902. He was a pupil of Carpeaux and Duret and combined the vivacity and richness of the one with the academic purity and scholarship of the other. He was one of the most brilliant virtuosi of the French school. He first exhibited at the Salon in 1867, but took refuge in England in 1871 and began to teach at South Kensington. A bronze version of his "French Peasant Woman," under the title of "Maternity," was erected outside the Royal Exchange, London. He returned to France in 1879. For the city of Paris he executed his most elaborate and splendid achievement, the vast monument, "The Triumph of the Republic," erected, after twenty years' work, in the Place de la Nation, showing a symbolical figure of the Republic, aloft on her car, drawn by lions led by Liberty, attended by Labour and Justice, and followed by Peace. It is somewhat in the taste of the Louis XIV. period, ornate, but exquisite in every detail. Dalou, who gained the *Grand Prix* of the International exhibition of 1889 and was an officer of the Legion of Honour, was one of the founders of the New Salon (*Société Nationale des Beaux-Arts*) and the first president of the sculpture section.

DALRIADA, the name of two ancient Gaelic kingdoms, one in Ireland and the other in Scotland. Irish Dalriada was the district which now forms the northern part of county Antrim, and from which about A.D. 500 some emigrants crossed over to Scotland, and founded in Argyllshire the Scottish kingdom of Dalriada. For a time Scottish Dalriada appears to have been dependent upon Irish Dalriada, but about 575 King Aidan secured its independence.

One of Aidan's successors, Kenneth, became king of the Picts about 843, and gradually the name Dalriada both in Ireland and Scotland fell into disuse.

See W. F. Skene, *Celtic Scotland* (Edinburgh, 1876–80).

DALRY, mining and manufacturing town and civil parish, Ayrshire, Scotland, on the Garnock, 23¼ mi. S.W. of Glasgow, by the L.M.S.R. (Gaelic, "the field of the king"). Pop. (1931) 6,827.

The industries consist of woollen factories, worsted spinning, brickmaking, dyeing, machine-knitting, and iron and steel works. In the vicinity is a curious stalactite cave, known as Elf House, 30 ft. high and about 200 ft. long, offering some resemblance to a pointed aisle. Blair house, an ancient mansion, has a tower said to date from 1130.

DALRYMPLE, ALEXANDER (1737–1808), British hydrographer, was born on July 24, 1737, at New Hailes, near Edinburgh.

In 1752 he sailed for Madras in the service of the East India company. After a voyage of observation to the Eastern Islands in 1759 he attempted unsuccessfully to open up trade with Sulu and Canton.

His activities during these years are indicated by the titles of his publications: *An Account of the Discoveries in the South Pacific Ocean Before 1764* (1767); *Historical Collection of South Sea Voyages* (2 vols., 1770); *Collection of Charts* (1772); *Historical Relation of the Several Expeditions from Fort Marlborough to the islands off the West Coast of Sumatra* (1775). In 1779 Dalrymple became hydrographer to the East India company, and from 1795 to 1808 held the same office to the admiralty.

He died in London on June 19, 1808.

DALRYMPLE, SIR JAMES: *see* STAIR, JAMES DALRYMPLE, 1ST VISCOUNT.

DAL SEGNO: *see* DA CAPO.

DALTON, JOHN (1766–1844), English chemist and physicist, was born about Sept. 6, 1766, at Eaglesfield, near Cockermouth in Cumberland. His father, Joseph Dalton, was a weaver in poor circumstances, who belonged to the Society of Friends. John received his early education from his father and from John Fletcher, teacher of the Quakers' school at Eaglesfield, on whose retirement in 1778 he himself started teaching. But he earned only about five shillings a week, and after two years he took to farm work.

He received some help in his mathematical studies from a distant relative, Elihu Robinson. In 1781, he left his native village to become assistant to his cousin George Bewley who kept a school at Kendal. There he passed the next 12 years, becoming in 1785, through the retirement of his cousin, joint manager of the school with his elder brother Jonathan. He remained at Kendal till, in the spring of 1793, he moved to Manchester, where he spent the rest of his life. Mainly through John Gough (1757–1825), a blind philosopher who was a good classical and mathematical scholar, he was appointed teacher of mathematics and natural philosophy at the New College in Moseley Street (in 1889 transferred to Manchester College, Oxford), and that position he retained until the removal of the college to York in 1799, when he became a "public and private teacher of mathematics and chemistry."

Encouraged by Gough, Dalton had, while he was at Kendal, contributed solutions of problems and questions on various subjects to the *Gentlemen's* and *Ladies' Diaries,* and in 1787 he began to keep a meteorological diary in which during the succeeding 57 years he entered more than 200,000 observations. He made his own instruments. His first separate publication was *Meteorological Observations and Essays* (1793), which contained the germs of several of his later discoveries; but in spite of the originality of its matter, the book met with only a limited sale. In

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BY COURTESY OF (1, 2, 4) THE DIRECTOR OF THE VICTORIA AND ALBERT MUSEUM; PHOTOGRAPH (3) ALINARI

PERSIAN, SPANISH, FLEMISH AND BYZANTINE DALMATICS

1. Persian dalmatic (sakkos) of brocade in coloured silks and silver-gilt thread, on ground of silver thread. Roses, irises, tulips, narcissi and other flowers, with wisps of cloud, form the design. Fastened by loops and silver buttons. Persian work of late 17th or early 18th century
2. Spanish dalmatic, 15th century, of silk velvet. Apparels and orphreys of 16th century appliqué work, the former bearing shields charged with the Five Wounds
3. Dalmatic of Charlemagne, in the sacristy of St. Peter's, Rome, an example of Byzantine work, originally ascribed to 8th–10th century, but now generally attributed to the 12th century or later. Front shows Christ as judge of the world; the back, shown here, depicts the Transfiguration
4. Flemish dalmatic of late 15th century, in Waterford cathedral, Ireland. Cut green silk velvet with cloth of gold ground; orphreys embroidered with figures of saints in gold and colours

1794 he was elected a member of the Manchester Literary and Philosophical Society, and a few weeks after election he communicated his first paper on "Extraordinary facts relating to the vision of colours," in which he gave the earliest account of the optical peculiarity known as Daltonism or colour-blindness, and summed up its characteristics as observed in himself and others. This paper was followed by many others on diverse topics. In 1803 he published a paper on the "Absorption of gases by water and other liquids"; containing his "Law of partial pressures."

Dalton was a crude experimenter, a good many of his results have since been disproved and none of his investigations compares with those concerned with the Atomic Theory, with which his name is inseparably associated. It is clear from the notes prepared for his lectures that in his long series of meteorological experiments he was feeling his way towards the Atomic Theory. A study of these papers by Roscoe and Harden (*A New View of the Origin of Dalton's Atomic Theory,* 1896) shows that the idea of atomic structure arose in his mind as a purely physical conception, forced upon him by study of the physical properties of the atmosphere and other gases. The first published indications of this idea are to be found at the end of his paper on the "Absorption of gases" (Oct. 21, 1803) published in 1805. Here he says: "Why does not water admit its bulk of every kind of gas alike? This question I have duly considered, and though I am not able to satisfy myself completely I am nearly persuaded that the circumstance depends on the weight and number of the ultimate particles of the several gases." He proceeds to give what has been quoted as his first table of atomic weights, but on p. 248 of his laboratory notebooks for 1802–04, under the date Sept. 6, 1803, there is an earlier one in which he sets forth the relative weights of the ultimate atoms of a number of substances, derived from analysis of water, ammonia, carbon dioxide, etc., by chemists of the time. Confronted with the "problem of ascertaining the relative diameter of the particles of which, he was convinced, all gases were made up, he had recourse to the results of chemical analysis. He thus arrived at the idea that chemical combination takes place between particles of different weights, and this differentiated his theory from the historic speculations of the Greeks. The extension of this idea to substances in general necessarily led him to the law of combination in multiple proportions, and the comparison with experiment brilliantly confirmed the truth of his deduction" (*A New View, etc.,* pp. 50, 51). Dalton communicated his atomic theory to Dr. Thomas Thomson of Glasgow university, who by consent included an outline of it in the third edition of his *System of Chemistry* (1807), and Dalton gave a further account of it in the first part of the first volume (1808) of his *New System of Chemical Philosophy.*

In 1804 Dalton was chosen to give a course of lectures at the Royal Institution, London, where he delivered another course in 1809–10; and in 1822 he became F.R.S. He was a corresponding member of the French Academy of Sciences, and in 1830 he was elected as one of its eight foreign associates in place of Davy. In 1833 Lord Grey's government conferred on him a pension of £150, raised in 1836 to £300. He lived for more than a quarter of a century with his friend the Rev. W. Johns (1771–1845), in George Street, Manchester, where his daily round of laboratory work and tuition was broken only by annual excursions to the Lake district and occasional visits to London, "a surprising place and well worth one's while to see once, but the most disagreeable place on earth for one of a contemplative turn to reside in constantly." In 1822 he paid a short visit to Paris, where he met many of the distinguished men of science then living in the French capital, and he attended several of the earlier meetings of the British Association at York, Oxford, Dublin and Bristol. Into society he rarely went, and his only amusement was a game of bowls on Thursday afternoons. He died in Manchester on July 27, 1844.

See Henry, *Life of Dalton,* Cavendish Society (1854); Angus Smith, *Memoir of John Dalton and History of the Atomic Theory* (1856), which on pp. 253–263 gives a list of Dalton's publications; and Roscoe and Harden, *A New View of the Origin of Dalton's Atomic Theory* (1896); an essay by Sir William A. Tilden in his *Famous Chemists* (1921); also ATOM.

DALTON, a city of north-western Georgia, U.S.A., 34 mi. S.E. of Chattanooga; the county seat of Whitfield county. It is on federal highway 41, and is served by the Nashville, Chattanooga and St. Louis and the Southern railways. The population was 8,160 in 1930 and 10,448 in 1940 by the federal census. It is a shipping point for cotton, cattle, grain and fruit, and has various manufacturing industries, including four textile mills, hosiery mill, chair factory, brick plant and more than 30 chenille bedspread plants. The tufted bedspread industry originated in Whitfield county and has developed into the largest industry in the county in value of product and number of employees. The city was founded about 1844 and was incorporated in 1847. In Nov. 1863, after Gen. Bragg's defeat at Chattanooga, he retreated to Dalton, and this became the headquarters of the Confederate army in northern Georgia through the winter. Three weeks afterwards, Bragg was replaced by General Joseph E. Johnston who, with his force of 54,000, adopted defensive tactics to meet Sherman's invasion of Georgia, with his 99,000 or 100,000 men in the army of the Cumberland (60,000) under General G. H. Thomas, the army of the Tennessee (25,000) under General J. B. McPherson, and the Army of the Ohio (14,000) under General J. M. Schofield. The city was evacuated the following spring during the retreat toward Atlanta before the advance of Sherman's federal forces.

DALTON-IN-FURNESS, urban district and market town of Lancashire, England, 4 mi. N.E. of Barrow-in-Furness. Pop. (est. 1938) 10,440. Area, 12.5 sq.mi. St. Mary's church retains ancient fragments and a font believed to have belonged to Furness abbey, 3 mi. south (*see* FURNESS). Of Dalton castle, where the manorial court of Furness abbey was held, there remains a square tower showing decorated windows. There are iron-ore mines in the parish. A canal 3½ mi. long communicates with the sea.

DALTON'S LAW states that *the total pressure of a mixture of gases is equal to the sum of the partial pressures of the individual constituent gases.* The partial pressure is the pressure which each gas would exert if it alone occupied the same total volume of the mixture at the same temperature. This law is true only for perfect or ideal gases. (*See* KINETIC THEORY OF MATTER.) (J. B. Ps.)

DALTON SYSTEM: *see* EDUCATION: *Educational Experiments.*

D'ALVIELLA, COUNT GOBLET (1846–1925), Belgian legislator and writer, was born on Aug. 10, 1846, at Brussels. He sat in parliament from 1874 to 1878; from 1874 to 1890 he directed the *Revue de Belgique;* from 1892 to 1894 he was Liberal leader in the senate, and then became professor of the history of religion in Brussels. His chief publications were *The Sahara and Lapland* (Eng. trans. 1874); *Inde et Himalaya* (1877); *The Contemporary Evolution of Religious Thought in England, America and India* (Eng. trans. 1885); *The Origin and Growth of the Conception of God* (Hibbert Lectures 1892); *La Migration des Symboles* (1891, Eng. trans. 1894); *La Représentation proportionelle en Belgique* (1900); *Souvenirs des États-Unis* (1906); *Croyances, Rites, Institutions,* 3 vols. (1911).

DALY, AUGUSTIN (1838–1899), American theatrical manager and playwright, was born in Plymouth (N.C.), July 20, 1838. He was dramatic critic for several New York papers from 1859, and he adapted or wrote a number of plays, *Under the Gaslight* (1867) being his first success. In 1869 he was the manager of the Fifth Avenue theatre, and in 1879 he built and opened Daly's theatre in New York, and in 1893, Daly's theatre in London. At the former he gathered a company of players, headed by Miss Ada Rehan, which made for it a high reputation, and for them he adapted plays from foreign sources, and revived Shakespearean comedies in a manner before unknown in America. He took his entire company on tour, visiting England, Germany, and France.

Some of the best actors on the American stage have owed their training and first successes to him; among them Clara Morris, Sara Jewett, John Drew, Fanny Davenport, Maude Adams, and Mrs. Gilbert. Daly was a great book-lover; his valuable library was dispersed by auction after his death, in Paris, June 7, 1899.

Besides plays, original and adapted, he wrote *Woffington: a Tribute to the Actress and the Woman* (1888).

DALYELL (or DALZIELL or DALZELL), **THOMAS** (d. 1685), British soldier, was the son of Thomas Dalyell of Binns, Linlithgowshire. He was present at the battle of Worcester (Sept. 3, 1651), where his men surrendered, and he himself was captured and imprisoned in the Tower. In May he escaped abroad, and in 1654 took part in the Highland rebellion and was excepted from Cromwell's act of grace, a reward of £200 being offered for his capture, dead or alive. The king's cause being now for the time hopeless, Dalyell entered the service of the tsar of Russia, and fought in the wars against the Turks and Tatars. He returned to Charles in 1665, and on July 19, 1666, he was appointed commander-in-chief in Scotland to subdue the Covenanters. He defeated them at Rullion Green and exercised his powers with great cruelty, his name becoming a terror to the peasants. He obtained several of the forfeited estates. On Jan. 3, 1667, he was made a privy councillor, and from 1678 till his death represented Linlithgow in the Scottish parliament. He was incensed by the choice of the duke of Monmouth as commander-in-chief in June 1679, and was confirmed in his original appointment by Charles, but in consequence did not appear at Bothwell Bridge till after the close of the engagement. On Nov. 25, 1681, a commission was issued authorizing him to enrol the regiment afterwards known as the Scots Greys. He was continued in his appointment by James II., but died soon after the latter's accession in Aug. 1685.

DAMAGES, the sum of money claimed or adjudged to be paid in compensation for loss or injury inflicted by a wrongdoer. Compensation first appears in law as a substitute for retaliation. Primitive systems appear universally to have had detailed scales of compensation for each particular form of personal injury, like the ποινή of the *Iliad* and the Anglo-Saxon *wer-gild*. Punishment and compensation were not distinguished. In modern systems criminal and civil remedies are clearly separated, although in France and many foreign countries they are often administered in the same proceeding. In countries following the common law and in Scotland, the proceedings, with few exceptions, are kept separate.

Assessment of Damages.—Courts of common law had no other remedy than damages, and consequently rules had to be evolved for assessing in money losses which often could not be so assessed with any degree of accuracy. Where, as in breaches of contract, the loss could be accurately estimated, the measure of damages was governed by strict rules; in other cases, the jury, or a judge, arbitrator or referee acting as a jury, was left to fix a reasonable sum in view of all the circumstances. In such cases, unless substantial injustice has been caused by the judge's misdirection or by the improper admission or rejection of evidence, a court of appeal will not interfere with the assessment if a jury could reasonably have so fixed the amount. The damages, however, must be assessed once and for all in one lump sum. If unexpected damage occurs after assessment, in the absence of a new cause of action, the plaintiff cannot obtain a reassessment, nor, if possibilities which do not in fact occur induce the jury to award heavy damages, can the defendant, when the event is ascertained, have the assessment reduced. Thus in an action for personal injuries permanently incapacitating the plaintiff, the jury cannot award an annuity, but, with reasonable regard to the probabilities, must award a sum which will stand unaltered whether the plaintiff survive for one year or for 20. If, however, the occurrence of future damage would constitute a new cause of action, damages are assessed up to the time when the assessment takes place, but no account is taken of future damage, however probable.

Courts of equity had, until 1858 (Cairn's Act), no jurisdiction to award damages, but could order specific performance of certain contracts and could interfere by injunction to prevent a threatened wrong. These powers were not exercised if the damages which could be obtained from a court of common law were an adequate remedy, but since 1858 courts of equity have been empowered to award damages, if they deem fit, in lieu of an injunction or a decree of specific performance. This power enables the court to award damages where the injury is only threatened (*Leeds Industrial Co-operative Society, Ltd.*, v. *Slack*, 1924, A.C. 851). Apart from this special case, however, damages can only be awarded by any court when a legal wrong has already been committed. Trade competition, revelation of the true character of an impostor, the making of works authorized by statute and countless other acts may inflict serious injury, yet damages cannot be recovered. A cause of action must be proved. If a cause of action is proved, however, damages will be awarded. The amount will be nominal (from 40 shillings to one shilling or even a farthing) if no proof of actual injury is given; but the award is important as establishing a right and as a "peg on which to hang costs." Such nominal damages are to be distinguished from contemptuous damages, by awarding which the jury express their view that the plaintiff although alleging substantial injury, has not in fact suffered any, and should not have brought an action. The award of contemptuous damages seldom occurs in practice except in actions for defamation and can only occur where there is no settled measure of damages. Such an award is a material fact for the judge to consider if he is asked to deprive a successful plaintiff of costs, but it is not a conclusive fact.

If a plaintiff is entitled to more than nominal damages, the object of the common law is to place him, so far as money can do so, in the same position as if the wrong had not occurred. But that principle does not entitle the plaintiff to compensation which flows from some other cause than the defendant's wrong. The damages must not be too remote; but the rules on remoteness of damage are complicated and the subject of much debate. At one time a single test was applied: Was the damage the natural and probable result of the wrong? But the test was of little value unless supplemented by a mass of case law. Of recent years judges have preferred to ask if the damage is the direct result of the wrong. If so, compensation is recoverable, however improbable was the result (*In re Polemis*, 1921, 3 K.B. 560). But the question remains open when the test is applied, whether the defendant's wrong was the true cause of the damage. Thus where a person entrusted with a libellous letter wrongfully left it where it was seen by others and the writer was thereupon successfully sued for libel, the damage which the writer thus suffered was held not to flow from the wrongful exposure of the letter, but from the writer's own libel (*Weld-Blundell* v. *Stephens*, 1920, A.C. 956). Similarly where a maintained action has been successful, the damages and costs in which the defendant is condemned flow from his own wrong and cannot be recovered in an action for maintenance (*Neville* v. *London Express Newspaper Ltd.*, 1919, A.C. 368). The intervention of another person's act between the wrong and the damage also prevents the damage from being the direct result of the wrong.

Contemplated Result.—Nevertheless, in many cases a wrongdoer is responsible for damage, although the intervention of others has broken the direct chain of causation. If the wrongdoer actually contemplated or ought to have contemplated or was under a duty to guard against the particular kind of damage which followed from his act, he is liable unless, as in the cases above cited, the plaintiff is seeking indemnity from his own wrong. Common illustrations are the republication, in pursuance of a legal or moral duty or by wrongdoer's authority, of defamatory words, and the instinctive acts of persons put in peril by the defendant's wrong. Thus in a famous case (*Scott* v. *Shepherd*, 1773, 2 W.Bl. 892) the plaintiff, injured by the explosion of a lighted squib thrown from hand to hand, was entitled to recover in trespass from the original thrower as if he had directly thrown the squib into his eye. Similarly if a customer draws a cheque with blank spaces which facilitate forgery, he must bear the loss if his bank pays the amount as fraudulently altered (*London Joint Stock Bank Ltd.* v. *Macmillan*, 1918, A.C. 777). The intervening criminal act is an act against which the customer is bound to guard. More difficult questions arise when the intervening acts are of children. Persons who know of the presence or probable presence of children ought to contemplate their getting into mischief and their acts "in the wantonness of infancy" will be mere links in the chain of causation. But if the childish acts are such as would not reasonably be contemplated, the chain of causation will be broken (*McDowall*

v. *Great Western Ry. Co.*, 1903, 2 K.B. 331).

The same principles apply to breaches of contract. Very often damage follows a breach of contract, but the true cause is to be found in circumstances outside the contract. If so damages are only recoverable if the circumstances were or ought to have been in the contemplation of the parties. Mere knowledge is not enough: the circumstances must be in their contemplation as affecting their contractual obligations. In the leading case on the subject (*Hadley* v. *Baxendale*, 1854, 9 Ex. 341), a carrier who negligently delayed a mill shaft sent for repair was held not responsible for the stoppage of the mill owing to there being no spare shaft. The commonest illustration, however, arises where in an action for default in delivering goods claim is made for loss of profit on a resale. If the default makes delivery under the contract of resale impossible the loss of profit will be recoverable if, and only if, resale was in the contemplation of the parties. The same test determines the recovery of damages and costs payable to third parties.

Even when damages are not too remote they may, however, be irrecoverable because the plaintiff has neglected the duty which lies on him to act reasonably in order to mitigate his damages. If, after the cause of action has arisen, the plaintiff can reduce the loss by reasonable steps, he cannot recover compensation for any part of the damage which is due to his neglect to take such steps; and if from the steps he takes he derives a benefit which he would not have secured if the wrong had not been committed, such benefit will be considered in assessing the damages (*British Westinghouse Ltd.* v. *Underground Rys. Ltd.*, 1912, A.C. 673).

Liquidated Damages.—In contracts it is not uncommon to specify the amount to be paid in the event of breach. If the amount, whatever the parties call it, is a penalty, the courts will ignore the provision. If, however, looking at all the circumstances, the court is of opinion that the parties made a genuine attempt to pre-estimate the loss which would result from breach, the amount will be liquidated damages and the court, without independent assessment, will award such amount to the party wronged. Ordinarily he can recover no greater damages; but if he is able to show special damage flowing from circumstances which were entirely outside the contemplation of the parties when the liquidated damages were agreed, and such damage is not too remote, it may be recovered over and beyond the liquidated damages (*Aktieselskabet Reidar* v. *Arcos Ltd.*, 1927, 1 K.B. 352).

If damages are proved in foreign currency, they are converted into legal tender at the rate of exchange prevailing when the cause of action arose, and subsequent fluctuations in the rate of exchange are immaterial.

Interest is only recoverable as damages in exceptional circumstances. (*See* MONEY LENDING.)

Although difficult questions on remoteness often arise, damages for breach of contract can usually be assessed with accuracy since the cost of putting the injured party in the position he would have been in but for the breach can be ascertained by proving the cost of making a contract which will secure to him the like advantages. In some cases by custom or practice of the courts a definite measure of damages which differs, or may differ in result from the application of general principles, has been adopted for convenience of assessment in cases which otherwise would be very complicated. Thus where an insured ship is repaired and the owner derives benefit from the substitution of new materials for old, one-third of the cost of the repairs is deducted for this benefit. Similarly, where a domestic servant is wrongfully dismissed, by custom the damages are a month's wages without any allowance for board and lodging during the month. Sometimes, however, the damage from a breach of contract may be difficult of assessment because of the peculiar character of the plaintiff's loss, as where he is deprived of a chance of losing a prize, or of the enhanced reputation which an actor or actress may gain, in the contemplation of both parties, by appearing in an important part or in a well-known theatre. Difficulty in assessing damages, however, is no reason for refusing to award them or for awarding only nominal damages. The damages for breach of one form of contract—a contract to marry—are peculiarly at large, and the jury may give exemplary damages to mark their disapproval of the defendant's conduct. Generally, however, in contract the common law is concerned only with the loss which the plaintiff has suffered and is uninfluenced by the motive or good faith of the defendant. Roman law, on the other hand, applied quite a different measure of damages when the defendant acted in good faith and when he acted fraudulently. Thus the vendor of a defective article, if he did not know of the defect, was liable only for the difference between the price he received and the price which the buyer would have given if he had known of the defect. If the vendor knew of the defect, however, he would be liable for all injury flowing from the use of the article in its defective condition. Accordingly the Roman and the common law would apply startlingly different measures of damages in cases such as *Pinnock Brothers* v. *Lewis and Peat Ltd.*, 1923, 1 K.B. 690, where copra cake innocently supplied for the manufacture of cattle food contained poisonous castor bean, causing the death of many cattle to which the food was ultimately given. In general, however, the rules governing damages for breach of contract are very similar under all legal systems. Continental systems differ from the common law chiefly in their readiness to enforce an agreed measure of damages, whether or not the stipulated damages are a genuine pre-estimate of the probable loss. Scots law follows English law, as it also does in the sale of goods, the Sale of Goods Act, 1893, forming a common code. The Indian contracts code also adopts, in effect, the English rules.

Exemplary Damages.—In some actions for tort, damages can be calculated with exactness as in contract, *e.g.*, in cases of injury to property. Thus, in conversion, the measure of damages is almost always the value of the article converted at the time of the conversion. Where, however, the injury is to the person or reputation, only actual expenses and loss of income caused by the wrong can be proved with exactitude, and the bulk of the damages are at large and consequently within the reasonable discretion of the jury. Consequently the motives and conduct of the defendant may greatly affect the damages awarded. The chief cases where great latitude is allowed are: (1) in actions for defamation; (2) in actions for malicious prosecution and false imprisonment; (3) in cases of outrageous trespass on land; (4) in seduction and breach of promise of marriage; and (5) for adultery. The divorce court has peculiar powers over the application of damages for adultery, however, and may ensure provision for the maintenance and education of children of the marriage or the maintenance of the guilty wife. In assessing damages the jury are often asked to have regard to the means and position of the adulterer. Whether this was proper was much debated, and the grounds for allowing it, as well as the other principles governing damages for adultery were stated, after a review of the authorities, by Mr. Justice McCardie in *Butterworth* v. *Butterworth*, 1920, p. 126, to which reference should be made.

In cases of collisions at sea where both ships are to blame, the Admiralty rule is to apportion blame and to make the ships bear the total loss in the proportion of their fault. But this rule does not apply to claims for personal injuries brought in the admiralty court.

Although English law gives compensation for physical injury caused by shock, and for pain and suffering, no allowance is made for wounded feelings as a general rule. In Scots law a *solatium* for wounded feeling may be allowed. Probably the greatest difference between the two systems, however, is the recognition in English law, but not in Scots law, of the maxim *actio personalis moritur cum persona*. In English law, as a general rule, a right to recover damages for a tort did not survive the death of either the wrongdoer or his victim, and no right of action could be based on the death of a human being. Limited statutory exceptions to the former principle were made as early as Edward III.'s reign and greatly extended in 1833 (3 and 4 Will. IV., c. 42), but the exceptions only applied where real or personal property was affected by the tort. The rule continues in cases of defamation and other personal torts. By the Fatal Accidents Act, 1846 (Lord Campbell's Act) personal representatives of a person killed or fatally injured by a wrongful act have a statutory right of action, if the deceased would himself have had a cause of action, for the benefit of the husband, wife, parent or legitimate child, grandchild or step-child of the deceased. But the damages recoverable are limited to financial loss from the death, and account must be taken of all benefit resulting from the death (*Carling* v. *Lebbon,* 1927, 2 K.B. 108) such as a widow's or orphan's pension from the Government. By statute passed in 1908, however, sums payable under policies of insurance do not reduce the damages. Regard may be had, moreover, to the reasonable expectation of pecuniary benefit in the future if the deceased had lived, but the courts will ignore a mere speculative possibility (*Barnett* v. *Cohen,* 1921, 2 K.B. 461). Strangers, such as a master deprived by the death of a valuable servant, cannot, however, recover any damages.

In the United States the law of England on damages is generally followed, modified, however, in some particulars by statute. Thus, the law in England that a tenant who commits wilful waste on the premises shall pay thrice the amount of the damages is not the law in all States. Likewise the law in England that a tenant who refuses to quit after due notice shall thereafter pay his landlord double rent is not the law in all jurisdictions in the United States.

See T. Sedgwick, *Treatise on the Measure of Damages* (6th ed., 1874); G. J. Bell, *Principles of Law of Scotland* (10th ed., 1899); J. D. Mayne, *Treatise on Damages* (10th ed. by F. Gahan, 1927). (F. G.)

DAMANHŪR, a town of Lower Egypt, 38 mi. E.S.E. of Alexandria by rail, capital of the richly-cultivated province of Bahera. It is the ancient Timenhōr, "town of Horus," which in Ptolemaic times was capital of a nome and lay on the Canopic branch of the Nile. Its name and other circumstances imply that Horus (Apollo) was worshipped there in the same form as at Edfu, though its Roman name, Hermopolis Parva, should indicate Thoth as the local god. A much frequented fair is held at Damanhūr three times a year, and there are several cotton manufactories. Pop. (1937), 61,962; area 2.3 sq.mi.

DAMAO or **DAMAN,** town, Portuguese India, capital of the settlement of Damão, on the east side of the entrance of the Gulf of Cambay within the Bombay Presidency with a station on the Bombay, Baroda and Central India railway. Pop. (1940) 23,080. The settlement, which has an area of 134 sq.mi. and a population of 63,521, is subject to the Governor General of Goa. It is divided into two parts, Damão proper, and the larger *pargana* of Nagar Havili, the two being separated by a narrow strip of British territory. The soil is fertile though only a small proportion is cultivated for rice, wheat and tobacco. The teak forests are valuable. Weaving is less important than formerly; mats and baskets are made. Deep-sea fishing and shipbuilding are important. There is no foreign trade.

Damão town was sacked and burnt by the Portuguese in 1531. It was subsequently rebuilt, and in 1558 was again taken by the Portuguese, who made a permanent settlement and have held it since. The territory of Damão proper was conquered by the Portuguese in 1559; that of Nagar Havili was ceded to them by the Mahrattas in 1780 in indemnification for piracy.

DAMARALAND, a region of south-western Africa, bounded west by the Atlantic, east by the Kalahari, north by Ovampoland, and south by Great Namaqualand. It forms the central portion of South-West Africa. Damaraland is alternatively known as Hereroland, both names being derived from the tribes inhabiting the region. The so-called Damara consist of two probably distinct peoples. They are known respectively as "the Hill Damara" and "the Cattle Damara," *i.e.,* those who breed cattle in the plains. The Hill Damara are negroes with perhaps some Hottentot blood, and have adopted the Hottentot tongue, while the Cattle Damara are of distinct Bantu-Negro descent and speak a Bantu language. The term Damara ("Two Dama Women") is of Hottentot origin, and is not used by the people, who call themselves Ova-herero, "the Merry People" (*see* HOTTENTOTS and HERERO).

DAMASCENING or **DAMASKEENING,** a term sometimes applied to the production of damask steel, but properly the art of incrusting wire of gold (and sometimes of silver or copper) on the surface of iron, steel or bronze. The surface upon which the pattern is to be traced is finely undercut with a sharp instrument. The gold thread is forced into the minute furrows of the cut surface by hammering and is securely held. This system of ornamentation is peculiarly Oriental, having been much practised by the early goldsmiths of Damascus; it is still eminently characteristic of Persian metal work.

DAMASCENUS, JOHN: *see* JOHN OF DAMASCUS.

DAMASCENUS, NICOLAUS: *see* NICOLAUS DAMASCENUS.

DAMASCIUS, the last of the Neoplatonists, was born in Damascus about A.D. 480. In his early youth he went to Alexandria, where he studied rhetoric, philosophy and science and was a professor of rhetoric. Later on in life he migrated to Athens. He became a close friend of Isidore the dialectician, succeeded him as head of the school in Athens, and wrote his biography, part of which is preserved in the *Bibliotheca* of Photius (*see* appendix to the Didot edition of Diogenes Laërtius and a German translation by R. Asmun of the fragments preserved in vol. cxxv. of Phil. Bibliothek, Leipzig, 1911). In 529 Justinian closed the school, and Damascius, with six of his colleagues, went to the court of Chosroes I., king of Persia. In 533, in a treaty between Justinian and Chosroes, it was provided that they should be allowed to return. The date of his death is not known.

His chief treatise is entitled *Difficulties and Solutions of First Principles* (Ἀπορίαι καὶ χύσεις περὶ τῶν πρώτων ἀρχῶν). It examines into the nature and attributes of God and the human soul. This examination is, in two respects, in striking contrast to that of certain other Neoplatonist writers. It is conspicuously free from Oriental mysticism, and it contains no polemic against Christianity, to the doctrines of which, in fact, there is no allusion. His main result is that God is infinite, and as such incomprehensible; that his attributes of goodness, knowledge and power are credited to him only by inference from their effects; that this inference is logically valid and sufficient for human thought.

Interesting as Damascius is in himself, he is still more interesting as the last in the long succession of Greek philosophers. (*See* NEOPLATONISM.)

His work *Difficulties* was edited in part by J. Kopp (1826), and in full by C. E. Ruelle (1889). French trans. by Chaignet (1898). *See* E. Zeller, *History of Greek Philosophy;* C. E. Ruelle, *Le Philosophe Damascius* (1861); Ch. Levêque, "Damascius" (*Journal des savants,* Feb. 1891); T. Whittaker, *The Neoplatonists* (1901). *See* also works quoted under NEOPLATONISM and ALEXANDRIAN SCHOOL.

END OF VOLUME SIX

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